Cultural legitimacy and innovation journeys : a new perspective applied to Dutch and British nuclear power

CULTURAL LEGITIMACY AND INNOVATION JOURNEYS

A New Perspective Applied To Dutch and British Nuclear Power

Bram Verhees

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PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Technische Universiteit Eindhoven, op gezag van de rector magnificus, prof.dr.ir. C.J. van Duijn, voor een commissie aangewezen door het College voor Promoties in het openbaar te verdedigen op maandag 27 februari 2012 om 16.00 uur

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“The universe is made of stories, not of atoms.”

- Muriel Rukeyser (1968), *The Speed of Darkness*

Acknowledgements

This is a book about journeys. Not the journeys of people per se - though people are of course always the driving force - but those of contested innovations. These journeys are not leisurely tours towards predetermined destinations, but adventurous and open-ended voyages of exploration characterized by uncertainty, twists and turns. In many ways, the writing of this book has been such a journey, as well. And because any journey is a costly affair, I duly thank the *Dutch Knowledge Network for System Innovation and Transitions* (KSI) for financing mine. But where there are costs, there are also benefits. The benefits of journeying, as 12th century Persian poet Saadi already argued, are many:

> "(…) the seeing and hearing of marvelous things, the delight of beholding new cities, the meeting of unknown friends, and the learning of high manners".

The journey of researching and writing this book has certainly yielded these benefits - save perhaps the last. On my journey I indeed saw many marvelous things, not the least of which a multitude of images about nuclear power: sometimes humorous, sometimes gloomy, but always rich and insightful. I diligently collected them and present a few in this book for my readers to view: at the risk of stretching my metaphor, they may be thought of as so many photographs I took 'en route'. And there have been cities, as well. My journey has taken me to such places as Barrow-in-Furness, Milton Keynes and, as I write this, Cleveland. While these may not rival the great cities of the world, my delight in beholding them was no less because of it. And without a hint of sarcasm I can state that the splendid city of Brighton has been a home away from home. But it is to Saadi's 'third benefit' that I wish to devote the remainder of this section. The best part of journeying, it seems to me, is meeting new friends and, the fates permitting, traveling along with them for a while. I had the good fortune of meeting some of the finest companions a lonely traveler could hope for. Some accompanied me for the full duration of my journey, while others did so for stretches of varying lengths. I thank all of them equally, but some deserve special mention.

If my PhD research was a journey, then surely my first supervisor Frank Geels and second supervisor Johan Schot were my indispensable and trusty guides. Instead of leading me by the hand, they encouraged me to explore and make my own discoveries. But if I was in trouble they were there for me and, as good guides do, gently nudged me in a more appropriate direction if ever I strayed too far off course. I greatly respect them, both as scholars and human beings, and am proud to call myself their student.

Special thanks also go out to the PhD students that I embarked on the KSI adventure with: Niels Schoorlemmer, Johanna Ulmanen, and Marloes Dignum. I have fond memories of our conversations about work but still fonder ones of those about different, arguably more important, matters. The same goes for the former PhD students in the *Transnational Infrastructures of Europe* (TIE) project: Irene Anastasiadou, Alec Badenoch, Suzanne Lommers, Vincent Lagendijk and Frank Schipper. Having embarked on their respective journeys somewhat earlier, they have produced a series of dissertations which became shining examples for me - not least because they proved that finishing the damned thing is more than just a theoretical possibility.

On that note, I wish to thank all my colleagues at Eindhoven University of Technology's *School of Innovation Sciences* for providing a stimulating working

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Fortunately my journey took me off the University grounds, as well. I want to thank my 'fellow travelers' Bruno Turnheim and Caetano Penna for making me feel at home on my visits to Brighton. I also wish to thank Martin Forwood, Horace Herring, Leo Jansen, Gordon MacKerron, Richard Mrowicki, Walt Patterson and Jan Willem Storm van Leeuwen for kindly sharing their insights in the British and Dutch nuclear power journeys with me. Special thanks go out to Dirk Bannink at the nuclear power documentation- and research center *Laka* for allowing me access to its truly unparalleled collection on all things nuclear and resistance against these in particular.

Throughout my sometimes stormy journey, my friends and family have always been my safe haven. You know who you are, and I thank you all: I could not have done this without you. Mentioning just a few by name inevitably means overlooking others, but I especially fondly recall the thousands of miles of desert highways with Rogier, the countless hours of *Myst*erysolving with Koos, the late-night philosophizing with Anoek, the Yahtzee therapy sessions with Jos, and the many double espressos with Sergio.

Above all, I am eternally grateful to Anna for her unwavering support. She gracefully put up with my mood during the sometimes excruciating process of completing this dissertation. Over its course, she truly became my dearest friend. If the past four years have been a journey, then she has been my compass. I look forward to the many journeys, both metaphorical and real, that I hope to accompany her on in the future.

And last but by no means least, I thank those who prepared me for this journey long before I ever embarked on it: my family. It is no exaggeration to say that without the love, faith and encouragement of my sister Femke and my parents Peter and Riky, my journey would have ended ahead of time and this book would not have been written. I therefore proudly dedicate it to them.

Cleveland, 1 November 2011

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Chapter 1: Introduction

1.1 Research topic and audience

This dissertation is about *cultural legitimacy* in relation to *innovation journeys*; that is, about longitudinal processes of technological development and their societal embedding. One way to understand these longitudinal processes is offered by the 'technology life cycles' model. Often used in technology management literature, it explains technology development as proceeding along a sigmoid function ('S-curve') over time. Its initial slow growth (e.g. in terms of market shares) is characterized by uncertainty about markets and functions and low technical performance, but growth accelerates as a dominant design emerges. Technical performance improves until a saturation point is reached, which is characterized by decreasing growth rates in terms of market shares and diminishing returns in terms of technical performance improvements (Geels, 2002). However, this approach has been criticized as being overly simplistic and deterministic: by comparing longitudinal case histories of innovation development, organizational scholars have found that innovations rarely (if ever) develop along such stylized and predictable curves (Van de Ven *et al.*, 1989).

So instead, I use the term 'innovation journey' (Van de Ven *et al.*, 2008; Schot and Geels, 2008), because the journey metaphor captures the longitudinal, open-ended and uncertain character of the process and emphasizes agency, twists and turns and dead ends. Van de Ven *et al.* (2008) define 'innovation journey' as

> a nonlinear cycle of divergent and convergent activities that may repeat over time and at different organizational levels if resources are obtained to renew the cycle (Van de Ven, 2008: 16).

In spite of their heterogeneity and complexity, recurring 'patterns of commonality' were found in empirical studies of technological development processes. This observation resulted in a characterization of innovation journeys as proceeding in a non-deterministic fashion through a set of phases characterized by distinctly different entrepreneurial activities (Van de Ven *et al.*, 2008: 23).

Innovation journeys literature provides a useful starting point for this dissertation because of its emphasis on the longitudinal and complex character of the innovation process. However, it has largely focused on the 'business dimension' of innovation processes. Others (e.g. Deuten *et al.*, 1997) have argued that for innovations to become successful, they need to not only function in business environments (where they require integration in relevant industries and markets), but also in regulation environments (where they require integration in laws, regulations, rules and standards) and in wider society (see: figure 1.1.1).

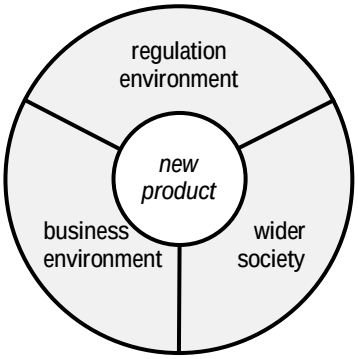

Fig 1.1.1 Relevant environments for innovations. Source: Deuten et al., 1997.

These insights enable a reconceptualization of 'innovation journeys' as long, complex and uncertain processes of embedding innovation in all three environments (e.g. Schot and Geels, 2008). For the functioning of innovations in these other two environments (the regulation environment and wider society) *cultural legitimacy* is an important precondition. Scott (2001) defines legitimacy (in general) as "a condition reflecting perceived consonance with relevant rules and laws, normative support, or alignment with cultural-cognitive frameworks" (Scott, 2001: 59). While the embedding of an innovation in regulation environments requires regulative legitimacy, its embedding in business environments and wider society requires normative and cognitive legitimacy. I follow Suchman (1995) in combining cognitive and normative legitimacy into the broader concept of *cultural* legitimacy: a "generalized perception" that an innovation is "desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs and definitions" (Suchman, 1995: 574). In this view, cultural legitimacy shapes the societal embedding of innovations. For example, Jacobsson and Lauber (2006) link the "exceptionally high degree of legitimacy of renewable energy sources in German society" to the successful diffusion of solar power and wind turbines in Germany. Likewise, Geels *et al*. (2007) suggest that interactions between cultural enthusiasm and concern in society can explain the ups and downs in various generations of psychotropic drugs.

But cultural legitimacy is not only important for the societal embedding of innovations: it also functions as an attractor of resources. Organizational studies have conceptualized cultural legitimacy as a kind of 'intangible resource' that is derived from broader culture (Suchman, 1995) and which can help in overcoming the habitual resistance to innovation that Schumpeter (1934) already acknowledged:

> In the breast of one who wishes to do something new, the forces of habit rise up and bear witness against the embryonic project. (…) In matters economic, this resistance manifests itself (…) in the difficulty in finding the necessary cooperation [and] the difficulty in winning over consumers. (Schumpeter, 1934: 86-87)

An important 'liability of newness' (Stinchcombe, 1965; Singh *et al*., 1986) is the "low level of legitimacy" (Freeman *et al*., 1983: 692) that innovations possess in their early

phases. Organizational, strategic management and innovation studies literatures suggest that overcoming these liabilities by establishing cultural legitimacy is crucial for the success of innovation journeys:

> Among the many problems facing innovating entrepreneurs, their relative lack of legitimacy is especially critical. (Aldrich and Fiol, 1994: 645).

This is because organizations require resources of various kinds and if an organization is new, it has to rely on relative 'strangers' to supply these (Freeman *et al.*, 1983). While decisions to supply resources are usually based on risk-reward trade-offs, these are often difficult to weigh in early phases because of a lack of information about the new organization's capacity to "deliver the goods" (Tilling, 2004: 5; Aldrich and Fiol, 1994). Uncertainties about financial viability, quality, professionalism etc. often preclude the possibility of rational investment decisions:

> No doubt it is important for new ventures (and for all organizations) to be competent in transforming inputs into outputs that its stakeholders need and want. But new ventures need resources from their environment, and, in the end, the motivating factor for external actors to give such resources is their *belief* or *feeling* that the venture is indeed competent, efficient, effective, worthy, appropriate, and/or needed. (Zimmerman and Zeitz, 2002: 416, my italics)

> Legitimation is critical for the emergence of new-to-the-world technologies (…) Trust, or consumer certainty about product quality, is fundamental to the efficient operation of the market institution (…) Creating trust represents a particularly significant entry barrier for product innovations that are costly and technologically sophisticated (Van de Ven *et al*., 2008: 158).

> Legitimacy leads to persistence because audiences are most likely to supply resources to organizations that appear desirable, proper, or appropriate. (Suchman, 1995: 574)

Empirical research in the field of organizational studies corroborates this 'resource-attracting quality' of cultural legitimacy (e.g. Pollock and Rindova, 2003). As both a 'facilitator of societal embedding' and an 'attractor of resources', cultural legitimacy is clearly an important dimension in innovation journeys. This dissertation's main goal is further unpacking the concept of cultural legitimacy in the context of innovation journeys.

Specifically, I am interested in cultural legitimacy in the context of innovation journeys that involve "purchases by government and utilities of expensive capital goods related to defence, energy, communications and transport" (Pavitt, 1984: 370). This 'fifth category' in Pavitt's taxonomy of technological innovation patterns[1] is only briefly

[1] Pavitt (1984) distinguishes 'supplier dominated', 'science based' and 'production intensive' categories, the latter of which is frequently subdivided into 'scale intensive' and 'specialized suppliers'.

discussed in the seminal paper's concluding remarks as a possible addition, which is indicative of the rather limited interest of mainstream innovation studies in these sectors. Arguably, policy plays a substantial role in these sectors. So, for a full understanding of cultural legitimacy in innovation journeys involving governments and utilities, their policy dimension should also be considered. Although the main focus of this dissertation is on cultural legitimacy and innovation journeys, it therefore also pays some attention to interactions with policy. This dissertation, then, primarily addresses an audience of interdisciplinary scholars interested in (1) the longitudinal and (2) the cultural dimensions of innovation journeys. This audience includes scholars from the fields of innovation studies and sociology of technology who have previously conceptualized the cultural dimension of innovation processes in different terms (as will be discussed in Chapter 2).

1.2 Contribution

This dissertation aims to bring together insights about culture and technological innovation in a new way. It does so by articulating (and testing) an analytical perspective on the relation between cultural legitimacy and innovation journeys. This analytical perspective makes two specific contributions:

I. It articulates *mechanisms* of cultural legitimation that integrate cultural structures and cultural agency. 'Cultural structures' represent the constraining dimension of culture: its 'internal structure' which is "consequential for the ways meanings are generated" (Spillman, 2002: 8). Cultural structures exert a relatively autonomous influence on the social sphere in general and the innovation process in particular: as constitutive dimensions "of all social relations, structures, networks and practices" (Goodwin and Jasper, 1999: 48), they operate 'behind the backs' of individuals and *determine* the meaning of, in this case, innovations. Conversely, 'cultural agency' represents the capacity of individuals for strategic cultural action. Cultural agency is about "how interactions constitute meanings and how individuals use them" (Spillman, 2002: 7). It emphasizes how actors can strategically mobilize culture for *shaping* the meaning of innovations. This dissertation aims to bring together these characteristics of culture in single analytical perspective that conceptualizes *how* the cultural legitimacy of innovations is created and contested.

II. It aims to capture the *longitudinal* interrelations between cultural legitimacy and innovation journeys. Although extant literature provides some useful insights into various ways in which cultural legitimacy influences innovation journeys (see: section 1.1), it does not systematically conceptualize its dynamics over time. Process theory argues that this requires:

> a process story about how a sequence of events unfolds to cause an independent (input) variable to exert its influence on a dependent (outcome) variable" (Van de Ven, 2007: 159)

In terms of this dissertation's research interest, this then requires a focus on the *process* of cultural legitimation and how it relates to innovation journeys *over time*. Indeed, Johnson *et al*. (2006) also refer to cultural legitimacy as a general social process and suggest that to understand its influence one must explain the process by which social objects (such as individuals, organizations, practices and technologies) are construed as legitimate in wider society. This dissertation elaborates on their useful suggestion by articulating a sequence of phases that capture the longitudinal interactions between cultural legitimacy and innovation journeys.

In summary, this dissertation seeks to contribute to the debate on innovation journeys by theorizing on how cultural legitimacy, innovation journeys and (to some extent) policy interrelate over time. In the next section, I articulate concrete research questions regarding this problem.

1.3 Research questions

The above sections argued that cultural legitimacy, as a generalized perception of appropriateness of an innovation in terms of broader culture (norms, values, ideas, definitions), is important in the context of innovation journeys:

- Cultural legitimacy is important for the acquisition of resources from other key actors in the highly uncertain early stages of innovation journeys (i.e. actors aim to establish 'local validation' (Johnson *et al.*, 2006) for successful embedding in the business environment);
- Cultural legitimacy is important for the successful functioning of innovations in wider society (i.e. actors aim to establish 'general validation' (Johnson *et al.*, 2006) for successful societal embedding).

I aim to bring together these insights by focusing on the process of *how* cultural legitimacy is constructed and contested over time in the context of innovation journeys. Using these insights, the main research interest (the relation between cultural legitimacy and innovation journeys) can now be transformed into the following guiding question: *What are the mechanisms and dynamics of cultural legitimation in innovation journeys?* To answer this, I articulate the following concrete research questions:

RQ1: What are the specific mechanisms through which cultural legitimacy of innovations is established and contested?

RQ2: How can we conceptualize the longitudinal interactions between cultural legitimation and innovation journeys?

An answer to these research questions will offer a deeper understanding of the cultural legitimation process in innovation journeys, which is where my main research interest lies. Yet, as was mentioned in section 1.1, policy is likely to also play a key role especially in innovation journeys which involve large-scale, highly visible technologies

related to public goods (Pavitt, 1984). This brings me to articulate a third research question:

RQ3: How does cultural legitimacy relate to policy in innovation journeys?

The literature review in the next chapter will thoroughly investigate extant literature on the relation between culture and innovation journeys (section 2.2), and the relation between culture and policy change (section 2.4), with the aim of finding 'building blocks' for a new analytical perspective which can tackle the above research questions.

1.4 Dissertation overview

Chapter 2: Literature review and analytical perspective

The second chapter examines literatures which may contribute to an understanding of the cultural legitimation processes in innovation journeys. It first provides a brief and stylized history of conceptualizations of culture, distinguishes four contemporary analytical approaches to culture across various academic fields, and discusses their utility for answering my research questions. It then articulates an analytical perspective that provides provisional answers to RQ1 and RQ2. A discussion of the perspective's weaknesses reveals its inability to address RQ3, and so the chapter subsequently reviews several policy process and agenda setting theories for insights into the relation between culture and policy.

Chapter 3: Methodological contribution

The third chapter articulates the epistemological and methodological basis of the dissertation, argues for a multiple case study method for answering the research questions, and selects the development of Dutch and British civilian nuclear power as appropriate case studies for testing the analytical perspective. It then identifies relevant data sources for qualitative analysis, and argues for the quantitative methods of word frequency and co-word analysis as complementary tools for building narrative explanations; a combination which constitutes a methodological innovation in the field.

Chapters 4 and 5: Analytic chronologies of Dutch and British nuclear power

The fourth and fifth chapters are analytic narratives of the cultural legitimation process of nuclear power during its innovation journey, respectively, in The Netherlands and in Britain (1945-2010). Applying the analytical perspective articulated in Chapter 2 ensures a focus specifically on cultural legitimation. While such 'zooming in' increases our understanding of the cultural legitimation of nuclear power, it inevitably obscures other processes. As a result, these chapters cannot (and do not) claim to provide new histories of nuclear power in the respective countries.

Chapter 6: Analysis, conclusions and discussion

The sixth chapter draws conclusions about the establishment and contestation of cultural legitimacy in innovation journeys (RQ1) and about how the different phases in the

cultural legitimation process relate to the phases of innovation journeys (RQ2). Based on the analytic narratices in Chapters 4 and 5, it then articulates new hypotheses about the relation between cultural legitimacy and policy (RQ3). It also discusses the external validity of the conclusions, pinpoints underdeveloped themes and issues in the dissertation, and articulates a future research agenda.

Chapter 2: Literature review and analytical perspective

2.1 Introduction

In Chapter 1, I articulated my research interest in cultural legitimation as it pertains to innovation journeys. In this chapter, I will explore literature from a variety of fields for relevant insights into this relationship.

In section 2.2, I critically review four contemporary analytical approaches to culture: cultural production, cultural structures, cultural agency and discourse. Encompassing a broad spectrum of academic fields, all give sophisticated but different conceptualizations of culture as well as how (and to what ends) it should be studied. I conclude the section with my evaluation of how these approaches interrelate.

In section 2.3, I bring together key insights from these approaches and articulate an analytical perspective on the process of cultural legitimation during innovation journeys. This analytical perspective constitutes a preliminary answer to my first two research questions (How is cultural legitimacy constructed? How can this process be characterized over time?). I conclude the section with making the qualification that while the perspective can show the mechanisms and dynamics of cultural legitimation, it does not show how these translate to policy (or not).

Addressing the third research question necessitates an additional literature exploration. Therefore, in section 2.4 I review various theories of the policy process. The section concludes with a set of theoretical insights with regard to how societal issues can shape policy agendas. Although these are not taken up explicitly in this dissertation's analytical perspective (which focuses on cultural legitimation dynamics), the issue is revisited in the concluding chapter.

2.2 Insights for RQ1 and RQ2: analytic approaches to culture

2.2.1 Introduction

This section aims to review extant academic literature about culture in order to find theoretical insights into its relation to innovation journeys. This presents a particular challenge, as 'culture' is a wide-ranging and complex concept with a vast array of (sometimes fundamentally) different connotations. Virtually all disciplines in the social sciences have at some point employed the term culture and have developed their own ideas about what it means, leading to an "inflation" of the term (Roberts, 2002: 2). Various social scientists use it to understand the ways in which some specific segment of the social world that they happen to be interested in, "(…) is constructed through the ideas that people have about it" (Rose, 2007: 1). Because it is academically less interesting what culture *is*, than what its analysts *do* with culture (i.e. which types of problems they address in which ways through it (Spillmann, 2002)), a traditional literature review along disciplinary boundaries is likely not the most informative.

So instead, the literature review in this section deliberately defines culture very loosely as 'processes of meaning-making' and proceeds to make a distinction between four broad, contemporary *analytical approaches* to these processes. It follows Spillman (1995; 2002) in distinguishing cultural production analysis, cultural structures analysis and cultural agency analysis, and adds a fourth approach: discourse analysis. This partitioning should not be interpreted as reductionism: the dissertation acknowledges that in the real world, most cultural research combines these approaches by integrating multiple levels of analysis to explore how processes of meaning-making influence social change (Spillman, 2002). The purpose of this broad review is precisely to avoid such reductionism in this dissertation: I aim to integrate (elements from) the above approaches into a new analytical perspective (see: section 2.3).

One drawback of this cross-disciplinary review is that the contemporary analytical approaches do in fact *originate* in relatively monolithic disciplines. To fully understand the intricacies of some of the arguments within these contemporary approaches, some insight into the history of the concept of culture is required. Therefore, before embarking on the literature review, the next subsection will provide a brief and stylized historical overview of the concept of culture.

2.2.2 A stylized history of culture

From its original Latin meaning as *cultivating, tilling, farming*, *protecting* or even *worshipping,* 'culture' came to refer to intellectual, spiritual and material refinement in the 18th century. In the Enlightenment period, it was synonymous with the manners and morals - the way of life - of the elite (Eagleton, 2000). Later, the concept of culture was appropriated by early Romantics (e.g. Herder) who came to see culture as the way of life of *non*-elite groups of people as well (Baetens and Verstraete, 2002). This allowed 'culture' to become associated with pre-Marxist criticisms of industrialization and imperialism (Eagleton, 2000). In the mid to late 19th century, the idea emerged among scholars (e.g. Bastian, Tylor) that all human societies share the same elementary ideas, of which 'different' cultures are mere local adaptions. This idea revolutionized cultural anthropology, in which the linear model of cultural evolution (from savagery to civilization) had been dominant. Cultural relativism was put in its place, and methods like participant observation became widely practiced. As a topic of academic interest (and controversy), culture blossomed in the early to mid 20th century: in the early 1950s, anthropologists Kroeber and Kluckhohn compiled a list of as many as 164 definitions of culture (Kroeber and Kluckhohn, 1952).

Around the same time, insights from sociology had led to the development of a (structural) functionalist perspective on culture, which saw culture as a separate domain that provides ultimate ends and values (e.g. Parsons, 1951). In this perspective, culture shapes action by defining what people want and regulating social action (figure 2.2.1, left). This conceptualization was later joined by a structuralist perspective on culture, in which culture was seen as a cognitive deep structure that constitutes people's perception

of reality (e.g. Levi-Strauss, 1963) and that provides the frames of meaning within which people act (figure 2.2.1, middle).

Others focused more on the interpretation of the symbols of various cultures (e.g. Geertz, 1973). In the field of symbolic anthropology, 'thick description' became a popular methodology. Advances in this field, along with an increasing emphasis on the relationship between language and thought in the humanities following the 'linguistic turn', were some of the drivers for what has come to be described as a broad 'cultural turn' in the social sciences (Steinmetz, 1999). Increased analytical attention for *meaning* was an important characteristic of the cultural turn: culture came to be seen as a social process in which people make sense of the world, and communicate these meanings to others through symbols. The various interpretive approaches to culture emphasize agency more than structuralist and functionalist approaches do: meaning is seen as arising from interpretation, which is an active process in which actors draw on cognitive deep structures (figure 2.2.1, right).

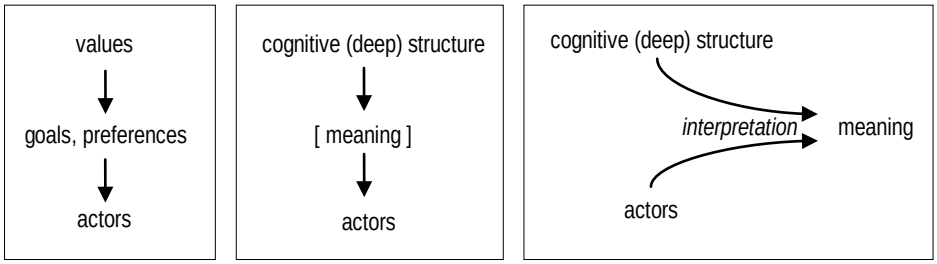

Fig. 2.2.1 Functionalist (left), structuralist (middle) and interpretive (right) perspectives on culture. Source: Geels and Verhees, 2011.

2.2.3 Cultural production analysis

The first broad approach to culture that Spillman distinguishes focuses on the *production of culture* (Spillman, 2002). The production of culture is an important topic in contemporary sociology of culture. Sociology of culture typically uses traditional sociological theory to explain culture as a 'dependent variable', as opposed to cultural structures approaches (see: subsection 2.2.4), which sees culture as a more 'independent variable' that explains *other* social phenomena:

> To speak of the sociology of culture is to suggest that culture itself is something to be explained, by something else entirely separated from the domain of meaning (...) [and] to suggest that explanatory power lies in the study of the 'hard' variables of social structure. (Alexander and Smith, 2002)

In the sociology of culture, culture refers to "a body of artistic and intellectual work of agreed value, along with the institutions which produce, disseminate and regulate it" (Eagleton, 2000). Such research takes cultural products (such as architecture, design, musical styles, the fine arts, but also science) or the institutions that produce them as its units of analysis, and examines how they are produced, disseminated and consumed. It

might, for example, attempt to explain how cultural production works (e.g. publishing houses' decision-making criteria (Wolff, 1999)), or how contingent and historically located social contexts influence such cultural outcomes as styles, trends or genres (e.g. the way the recording technology influence musical styles (Geels, 2007a)).

The production of culture is also an important topic in early Cultural Studies research, albeit in a different way. Two key differences with the aforementioned production-oriented approach in the field of sociology of culture are that it (1) takes 'mass culture' (as opposed to fine arts etc.) as its unit of analysis, and (2) adopts an explicitly normative, critical perspective. Cultural Studies emerged in the 1960s as a critique of capitalist mass culture and its culture industry through which, it argued, the state exercised a form of invisible domination. Culture had a political function: it was a means to produce obedient citizens, primarily through the education system (During, 2003). Through an interpretive analysis of educational material, a cultural analyst could expose its hegemonic effect.

In the early 1980s, the field began to shift its analytical focus away from hegemony and towards to the empowering function of popular culture for marginalized groups within society. It increasingly turned to *popular* cultural products (such as pop art, music, movies and electric appliances) as its units of analysis (Wolff, 1999; During, 2003). A popular framework within contemporary Cultural Studies is a cyclical model called the 'cultural circuit', which distinguishes five major cultural processes - production, consumption, regulation, representation and identity - that can be studied to fathom the cultural dimensions of material culture such as technologies. Such research attempts to understand the way we shape our identities through technology, e.g. how the Walkman was used as a status indicator, and blurred the established notions of 'private' and 'public' (Du Gay *et al.*, 1997). One example is Amundsen (2004), who looks at how TV shows, rock-'n-roll songs, toys, board games and advertisements gave meaning to the government-sponsored 'uranium rush' in the USA during the 1950s (e.g. figure 2.2.2 shows an advertisement for a Geiger counter and calls its audience to *Be a "Forty-Niner in '49*, thereby invoking images of the gold rush a century earlier). Such popular-cultural products, Amundsen argues, simultaneously reflected a government interest in the nuclear industry and contributed to its public disassociation with nuclear warfare repertoires (Amundsen, 2004).

Alternatively, a contemporary Cultural Studies scholar might investigate how representations of a technology shape the meanings attributed to it by analyzing popular, commercial cultural products that prominently feature the technology. For example, one might research how the 1979 thriller *The China Syndrome* about a safety cover-up at a nuclear facility (inspired by a 1970 near-accident in the Dresden II nuclear reactor) shaped the public's interpretation of the Harrisburg nuclear accident which occurred mere days after its theatrical release (figure 2.2.3).

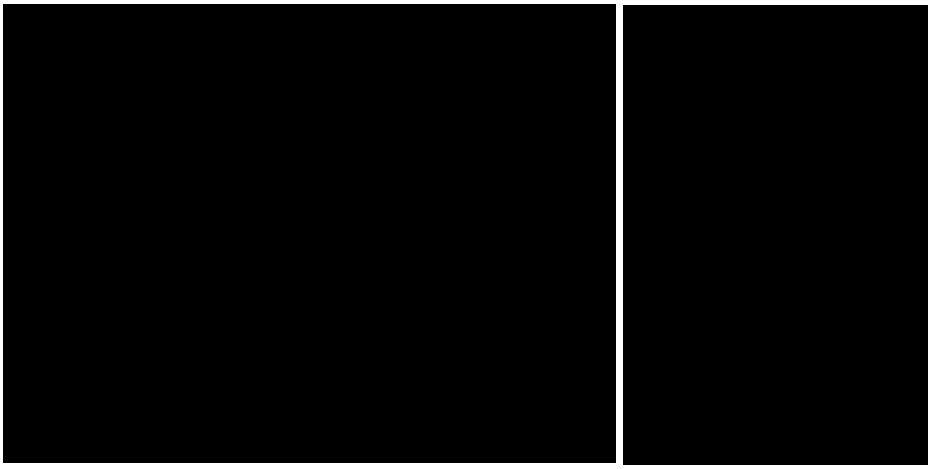

Fig. 2.2.2 American newspaper advertisement (1949) for a Geiger counter during the American 'uranium rush'. Source: http://national-radiation-instrument-catalog.com

Fig. 2.2.3 Film poster for The China Syndrome (1979). Source: http://www.IMPawards.com

2.2.4 Cultural structures analysis

A second broad analytical approach to culture focuses on *cultural structures.* Strands of research that fall in this category broadly focus on "features of culture intrinsic to meaning-making processes themselves" (Spillman, 2002: 8). Culture, like language, is assumed to have its own internal structure which is "consequential for the ways meanings are generated" (Spillman, 2002: 8). These cultural structures, such as symbolic codes, categories or cognitive schemas, are argued to exert a relatively autonomous influence on the social sphere: cultural structures are argued to (partially) explain social structures. In this approach, culture is seen as a

> ubiquitous and constitutive dimension of all social relations, structures, networks, and practices. (Goodwin and Jasper, 1999: 48)

Alexander and Smith (1993) argue that beneath narratives lie *symbolic codes* which are built up from binary oppositions (e.g. sacred vs. profane; clean vs. polluted; nature vs. culture) through the use of analogy and metaphor. These codes constitute the 'raw material' of culture, which is thus seen as "(…) a system of symbolic codes which specify the good and the evil" (Alexander and Smith, 1993). They deconstruct political speeches, in which they discern two basic codes: a democratic code that creates a 'liberty narrative' by specifying characteristics of actors, social relationships and institutions that are appropriate for democracy (e.g. transparent, rational and sane), and a counter-democratic code which creates a 'repression narrative' by specifying inappropriate characteristics (e.g. opaque, irrational and insane). Actors who self-identify as 'good' must make their actions accountable in terms of the liberty narrative. When positioning another actor as 'bad', this must happen in terms of the counter-

democratic repression narrative. As such, two actors can invoke the same (collectively held, deep structural) codes, yet differ strongly in the way they apply them.

Applying this approach to the study of cultural legitimacy in innovation journeys, one might for example attempt to discern similar deep structural codes that differentiate between good and evil in the rhetorics of advocates and opponents of an innovation. One could attempt to discern whether opponents and proponents of an innovation use the same deep structural code (e.g. 'democracy') to different ends, e.g. one camp using it to create narratives about repression and treading the rights of free individuals, while the opposing camp uses it to create narratives about a democratic process thwarted by an irrational minority.

Instead of looking at how actors *reproduce* these deep symbolic structures in their utterances about innovations, one might also focus on how these innovations themselves *challenge* the symbolic order. Not only do innovations often initially display a mismatch with social practices and regulations, they also don't map neatly onto basic dichotomies such as the one between good/evil and natural/unnatural (e.g. Smits, 2002). For example, nuclear power can be seen as a boundary-crossing 'monster'. Because civil nuclear power emerged as a byproduct of the production of the atomic bomb, and because of the dangers of nuclear proliferation associated with enrichment and nuclear waste reprocessing, nuclear technology has always had a dual identity. Because of its inextricable peaceful and warlike potentials, the technology blends the basic categories of good and evil:

> Just as unconditional sovereignty and the atomic bomb cannot safely co-exist, so the peaceful and beneficial effects of atomic energy cannot be divorced from its potential dangers. The world cannot have one without the other; and, having the worse already, there is every reason for it to proceed if it can to develop and enjoy the better. (*The Times*, May 1st, 1947).

It also crosses the boundaries between the categories ‘nature’ and ‘culture’, because radiation can be seen as meddling with natural processes in an artificial, 'unnatural' way:

> It has long been established," the [5th half-yearly USAEC] report says, "that nuclear radiations have the power to cause 'mutations' in the offspring of plants and animals, that is, to interfere with the normal workings of heredity. This fact has tremendous implications, both good and evil, in an atomic age. (*The Times*, February 1st 1949).

Smits’ (2002) 'monster theory' builds upon the work of structuralist social anthropologist Mary Douglas which traces the concepts of 'clean' and 'unclean' among different peoples and through different periods and argues that these categories constitute fundamental social structures (e.g. Douglas, 1966).

Another influential 'cultural structures' approach also builds on work by Douglas. In 1970, Douglas introduced a group-grid theory of social organization, which argued for two fundamental (and orthogonal) dimensions of sociality (Douglas, 1970). The *group* dimension 'measures' the extent to which an individual belongs to a social group, while

the *grid* dimension measures the extent to which an individual's life is restricted by externally imposed rules (Thompson *et al*., 1990). This yields the four ideal-typical combinations of high group/high grid, high group/low grid, low group/low grid and low group/high grid which respectively correspond to *hierarchical, egalitarian, individualistic* and *fatalist* social relations and ways of life (see: figure 2.2.4).

Expanding the group-grid hypothesis and combining it with her earlier work on the fundamental categories of clean and unclean led to a Cultural Theory of risk (Douglas and Wildavsky, 1982). The theory explains individual perception of the risk of a technological innovation through an individual's group-grid position, instead of through rational economic choice (costs/benefits) or social psychology (routines, heuristics). *Conflicts* over risk, then, are struggles between the four basic competing ways-of-life and their associated different conceptualizations of nature (Schwartz and Thompson, 1990).

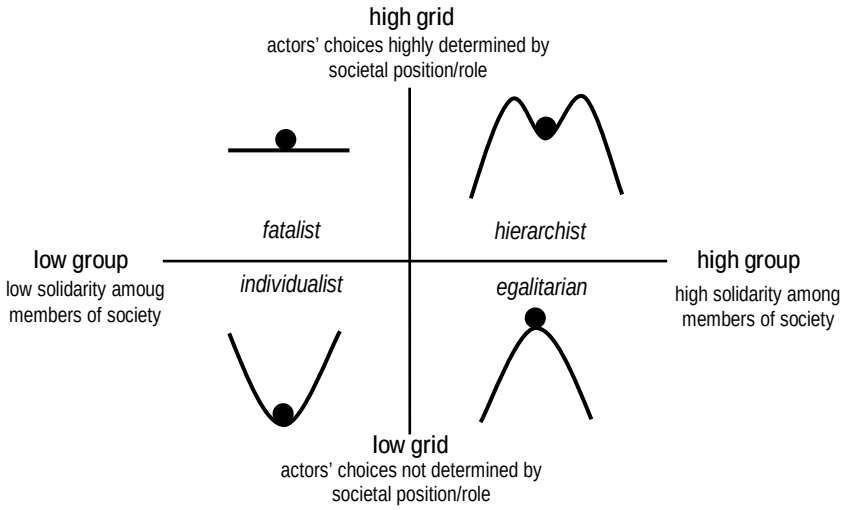

Fig. 2.2.4 Group-grid dimensions, resulting in four ways-of-life. In each quadrant, the black ball (which represents nature) is in an equilibrium. The corresponding way-of-life's attitude towards nature can be inferred from what happens to the equilibrium if the 'nature-ball' is perturbed by human action. Adapted from: Schwarz and Thompson, 1990: 7.

For example, the conflict over the risks of nuclear power in the 1970s is explained as resulting from antagonistic interpretations of nature (Douglas and Wildavsky, 1982):

- The egalitarian, collectivist interpretation of nature as a fragile balance, in which human interference can cause great effects, is dominant in the environmental movement, which renders nuclear power culturally undesirable/inappropriate.
- The individualist interpretation of nature is one of a meta-stable balance which human action cannot permanently disturb. This justifies the construction and operation of nuclear power plants (rendering nuclear power culturally legitimate for

individuals and organizations where individualist social relations are the norm, such as those seeking to commercially exploit nuclear power).

- The hierarchical interpretation of nature is one in which human interference in nature is appropriate and unproblematic up to a certain level, beyond which it could have detrimental effects, which renders nuclear power desirable but also necessitates rules and regulations.

In other words, the different ways of life are cultural structures in which people are embedded and which determine which risks are seen as 'worth' taking (Douglas and Wildavsky, 1982). In terms of methodology, while Douglas' earlier work relied on the reading of rituals, lifestyles and religious texts to uncover fundamental categories, the survey has become the typical method in Cultural Theory for determining people's position in the group-grid matrix. Increasingly, Cultural Theory has found applications beyond the domain of risk perception and has evolved into a more general theory, which argues that within any stable social group (be it a movement, an organization, a sector or a nation) only a limited number of specific *combinations* of grid-group positions are possible (Thompson *et al*., 1990). This way, Cultural Theory became a general 'theory of socio-cultural viability' and came to be used in fields such as policy studies and organization studies (e.g. Swedlow, 2002).

For understanding the relationship between cultural legitimacy and innovation journeys, Cultural Theory offers an explanation of deep, unquestioned repertoires or 'ideographs' (McGee, 1980) such as 'progress'. Moreover, it offers the useful insight that different audiences can hold different norms and values, which has implications for whether or not an innovation is considered appropriate or 'culturally legitimate'. In Cutural Theory, the perceived cultural legitimacy of an innovation is determined by an actor's position on the group/grid matrix: the actor's way of life is the deciding factor in his/her interpretation of the technology. For example, Cultural Theory reframed the 1970s conflict about nuclear power in the 1970s as a conflict between competing ways of life. However, while the emergence of 'counterculture' lifestyles undeniably affected the environmental movement, this reframing does no justice to the diversity of opinions about nuclear power between (and within) environmental movements of the time. Neither does it shed light on the different *ways* in which nuclear power was constructed as a problem. While an actor's group/grid position may determine his/her attitude toward risk in general, it does not determine which risks are perceived as most *important* for any specific technology. This is illustrated by the way today's environmental movements struggle with the meaning of nuclear power, as either a tool in their efforts to conserve the fragile balance of nature (i.e. stop climate change), or a technology which upsets this same fragile balance (i.e. is prone to dangerous accidents, enables proliferation and produces waste).

Generally, the strands of research reviewed in this subsection as cultural structures' approaches offer interesting insights for the study of the cultural legitimation of innovations. The main strength these approaches have in common is that they take

culture seriously as a key dimension of social interactions. Many 'cultural structures' approaches analytically uncouple culture from social structure (Alexander and Smith, 2002: 137). Specific texts and images are not phenomena that need to be explained: instead, they become units of observation for discerning the basic structure of culture. Culture is not something that is *shaped by* material of structural factors, but rather something which *shapes* actions and institutions: it has relative autonomy in shaping social life (Alexander and Smith, 2002; Spillman, 2002). But herein also lies the approaches' main weakness. While they are useful for deconstructing discourses, texts and images to show their underlying 'cultural' structure, they remain vague on exactly *how* this structure shapes actions and institutions. One reason is that the successful deconstruction of such texts requires labor-intensive 'thick descriptions' of each instance. It is prohibitively time-consuming to thoroughly analyze all symbolic objects relevant to an innovation journey (policy statements, speech transcript, brochures, posters, editorials, cartoons etc.) over the long periods of time it takes to play out. Furthermore, the 'cultural structures' approaches typically downplay the issue of the relative importance of specific texts or images. For a text or image to have any significant impact on social life, it requires some degree of exposure: symbolic objects can't shape action if no one sees them. The danger is that 'cultural structures' analyses become unconnected case studies, each one interesting in its own right but contributing little to either the understanding of how influential these specific symbolic objects were in the cultural legitimation of an innovation over time, or in the outcome of an innovation journey.

2.2.5 Cultural agency analysis

A third analytical approach to culture focuses on what I will broadly call *cultural agency*. As a response to the 'deterministic' influence exerted by cultural structures in approaches in the preceding subsection, these analytical approaches emphasize instead the capacity of individuals to act strategically and of their own volition. Strands of research that fall in this category broadly investigate "how interactions constitute meanings and how individuals use them" (Spillman, 2002: 7). They share with symbolic interactionism a focus on meanings as they arise from interactions, but differ from it in that these meanings are not assumed to be necessarily shared or consistent within a group or over time. Similarly, "(…) common norms, values, cognitive frames, and practices are not assumed to be transparent and unambiguous to all. Rather, individuals and social groups may draw fluidly on symbolic repertoires of available meanings" (Spillman, 2002: 7). Culture is thus seen as a kind of toolkit: individuals can actively and strategically mobilize elements from it for meaning-making (Swidler, 1986). Culture is not coherent, monolithic, and structuring, but rather a fragmented, and possibly even contradictory, set of meanings and symbols that actors can mobilize in different ways to pursue different goals (Geels and Verhees, 2011). In sharp contrast to earlier structural-functionalist approaches, culture is argued to shape action "(…) not by providing the ends people seek, but by giving them the vocabulary of meanings (…)

with which they can seek anything at all" (Swidler, 1995). And in contrast to structuralist approaches, which are sometimes criticized for leaning towards cultural determinism because culture operates 'behind the backs of actors', this type of research emphasizes human agency. Actors do not slavishly follow cultural rules but instead actively and strategically create and re-create them (Swidler, 1995).

One strand of research in this category is *social practices* research. Practices are considered 'cultural rules made real' and because they can be observed, practices are a useful unit of analysis. Social practices research often deliberately enlarges the cultural aspects of everyday life, because it considers these aspects to "(…) have been rendered secondary to economic, material, structural factors" (Wolff, 1999: 16). Of particular interest for understanding the relation between cultural legitimacy and innovation journeys is the strand of research which focuses on the role of technological innovations in everyday life. For example, Shove (2003) shows how domestic appliances such as showers, air-conditioning and washing machines have become taken-for-granted by linking up with repertoires about cleanliness, comfort and convenience, and how they simultaneously shaped the meaning of the related practices.

This technological dimension is more explicitly examined in the interdisciplinary field of science, technology and society studies (STS). Whereas the aforementioned cultural agency approaches are interested primarily in the relation between society and culture (which in some cases are argued to be mediated by consumer products), STS is interested primarily in (and has theorized extensively on) the interplay between society and technology. The way in which 'culture' comes into this interplay varies over time and between specific approaches within the field of STS (e.g. Geels, 2004). For example, where STS *explicitly* uses the term culture, it does not always refer to the 'processes of meaning making' central to this dissertation. For example, highly developed societies in which science and technology play a dominant role are referred to as 'technological cultures' (e.g. Bijker, 1995). STS scholars have investigated issues such as the democratic governance of technological cultures e.g. by looking critically at the role of scientific expertise in policy (Bijker *et al*., 2009). Here, the term culture is clearly used in its anthropological sense, to describe a society's 'way of life' (in this case, one in which science and technology are pervasive). But it is where STS uses the term culture *implicitly* that it has produced its most relevant insights with respect to my topic of interest, i.e. the relation between culture (as 'processes of meaning-making') and innovation.

For example, *social construction of technology* (SCOT), a particularly salient perspective within STS, argues that technology is shaped by human action as opposed to the latter being determined by the former. Inspired by constructivist ideas within the sociology of science (e.g. Bloor, 1973), SCOT argues that technological artefacts such as innovations posses 'interpretive flexibility': they can have different meanings for different relevant social groups. Relevant social groups can include the innovation's producers and users, but also less 'obvious' ones such as opposition groups or rejecters

of the innovation (e.g. Wyatt *et al*., 2002). It is through these groups' collective agency that this interpretive flexibility can be reduced and collapsed around a dominant meaning (Pinch and Bijker, 1984). To explain the subsequent (relative) stability of a technology's meaning and associated social groups, SCOT argues that during the social interactions around technologies, 'technological frames' emerge. These consists of elements such actors' goals, strategies, and criteria but also practices and artifacts (Geels, 2002). These heterogeneous frames serve to structure subsequent social interactions around the technology (Bijker, 1995).Yet it also emphasizes that closure is not necessarily permanent: new conflicts over the meaning of an innovation can arise over time as new relevant social groups with new interests (e.g. who are included in different technological frames) assert themselves. SCOT is classified as a 'cultural agency' approach in this dissertation, because of its emphasis on socio-cognitive processes of meaning-making and interpretation of technology (Geels, 2002) and because of the primacy it lends to purposive human action in these processes. SCOT is a radical constructivist theory, rooted in ethnomethodology (Garfinkel, 1984) which emphasizes how actors create meaning through social interaction, but pays less attention to actors drawing on broader cultural structures. In SCOT, cultural legitimation is about purposive attempts to collapse the interpretive flexibility of an innovation around favourable meanings and interpretation, through either rhetorical closure (convincing relevant social groups of the preferred meaning) or through strategically redefining it (Bijker *et al*. 1987: 44).

A strand of 'cultural agency' research which does not concern itself specifically with technology, but further unpacks this intentionality is *social movement studies*. The strategic dimension of culture is especially visible in this field because of the explicitly contentious and goal-oriented nature of social movements. Although the field of social movement studies initially concerned itself predominantly with the role of political opportunities and mobilizing structures in the emergence of social movements, the field has grown increasingly interested in shared meanings and problem definitions that movement actors construct in order to achieve their goals (McAdam *et al*., 2005). Proponents of what has come to be known as the 'cultural framing paradigm' argue that in order for a social movement to emerge, some social group must at least have a shared notion that some aspect of their lives is somehow problematic and that collective action might somehow repair this. To explain this process of coming to a shared problem definition, social movement theorists use the term *cultural framing* (Snow and Benford, 1988; Benford and Snow, 2000). The term was originally coined by Goffman in order to explain how individuals structure their perceptions of society (Goffman, 1974) in an 'automatic' and subconscious cognitive process of meaning-making. But social movement scholars used the term cultural framing to describe the much more purposive act of the "*conscious* and *strategic* efforts by groups of people to fashion shared understandings of the world and of themselves that legitimate and motivate collective action" (McAdam *et al.*, 2005: 6, my italics). Its emphasis on agency in developing (and linking specific issues to) shared meanings makes it a 'cultural agency' approach.

Cultural framing theorists argue that this agency can take three basic forms (Snow and Benford, 1988):

- *Diagnostic framing,* in which actors address the question "what is the problem?" This has an attributional component: placing the blame. However, consensus about a problem's source does not imply consensus regarding its nature: as Benford and Snow (2000) remark, the cause of the nuclear threat may be seen as the defense industry, runaway technology, capitalism, geopolitics etc. For example, figure 2.2.5 (left pair) shows two anti-nuclear movement buttons that establish the problem. The left one frames radiation as a salient problem: it reads *Stop Nuclear Power* and shows a pregnant woman and small child (a reference to the situation that the 'acceptably safe' levels of radiation that the nuclear industry used were calculated for adult males). The right one frames the sea-dumping of radioactive waste as the central problem with civil nuclear power: it reads *Atomic Waste - Carcinogenic Rubbish* and shows two barrels of radioactive waste floating on the waves.

- *Prognostic framing,* in which actors address the question "what should be done?". This involves the articulation of a solution, and often also an undermining of the solutions proposed by one's opponents. Figure 2.2.5 (middle pair) shows two Dutch anti-nuclear movement buttons that establish the solution. The button on the left reads *Refuse Nuclear Power – Home Banker Act Now! – Pay For Your Electricity In Two Parts* (a call for direct action by overloading the utility company's administrative department). The well-known *Nuclear Power? No Thanks!*-button on the right subtly highlights an alternative to nuclear power: the smiling sun can be interpreted as a reference to solar power, a technology supported by some anti-nuclear movement actors of the period.

- *Motivational framing,* in which actors "call to arms". It entails the articulation of 'appropriate vocabularies of motive' which encourage people to act (Benford, 1993). This usually involves stressing the urgency and severity of the problematic situation. Figure 2.2.5 (right pair) shows two Dutch anti-nuclear buttons which engage in motivational framing, The left one depicts a news broadcast of a mushroom cloud and simply reads *When?* – evoking images of a dystopian future that should be prevented. The right one shows a nuclear power plant and reads *No Harrisburg At Sizewell,* motivating action not by warning about the future but by mobilizing the past: it links the (proposed construction of the) British Sellafield nuclear power plant to the 1979 Harrisburg nuclear accident.

Fig 2.2.5 Core framing tasks on anti-nuclear movement buttons: 1-2: diagnostic, 3-4: prognostic, 5-6: motivational. Source: private collection.

Cultural framing sometimes results in shared meanings and influences outcomes, while other times it does not (Snow and Benford, 1992; Derry and Waiker, 2008). The *persuasiveness* of a given cultural framing is argued to depend on its *plausibility* and the *salience* (Benford and Snow, 2000). Their plausibility depends on:

- **frame consistency**: the degree to which there is a perceived contradiction between the claims made; or a contradiction between what the articulators of the frame say and what they effectively do.
- **empirical credibility**: the perceived degree of fit between the claims and the events in the observed world. This is not about whether they are 'true', but rather about the degree to which empirical events lend themselves to being interpreted as supportive.
- **articulator credibility:** the status or perceived expertise of the articulator.

The salience depends on:

- **centrality**: the perceived importance or urgency of the topic to its target audience. Public attention is a scarce commodity: if other issues (that have nothing to do with the topic under investigation) are perceived as being more pressing, the centrality will be lower.
- **experiential commensurability**: the degree to which the claims resonate with their targets audience's everyday experiences and daily lives. The more abstract the framings are, the lower their experiential commensurability will be.
- **cultural fidelity**: the perceived resonance with a target audience's broad cultural repertoires. If the frame fits well within such repertoires, the cultural fidelity will be higher.

But persuasiveness is not the sole arbiter of the success of cultural framing. Alongside a frame's plausibility and salience, its flexibility and inclusivity count, as well. If cultural framing is rigid and exclusive (in the sense that it revolves around only one specific theme or issue) it may only resonate with a very specific group. But if cultural framing efforts incorporate many issues or themes and are articulated in a way which resonates with larger audiences, so-called 'master frames' may emerge:

> Some collective action frames that are quite broad in terms of scope, function as a kind of master algorithm that colors and constrains the orientations and activities of other movements. We have referred to such generic frames as "master frames" in contrast to more common movement-specific collective action frames that may be derivative from master frames (Benford and Snow, 2000: 618-619)

So, while specific frames are voluntaristic (i.e. almost pure manifestations of cultural agency), higher-level master frames also have constraining properties. Because of (1) this partially-constraining-partially-enabling character, (2) their inclusion of multiple specific frames, and (3) their broader scope and wider audience, I will refer to these

master frames as 'discourses (see: subsection 2.2.6). Master frames ('discourses') have the potential to polarize larger audiences, giving them multiple viable frameworks to make sense of broad topics. As a result, antagonistic dichotomies between 'for' or 'against' positions often emerge (e.g. Rip and Talma, 1998). While such conflicts can be seen as conceptual or ideological clashes between competing master frames, the concrete battlegrounds are typically very specific issues or events. They are struggles about the 'correct' way to frame, for example, the sea-dumping of nuclear waste or the accident at Chernobyl; but not about the correct way to frame the broad topic 'nuclear power'. This draws attention to the contentious nature of cultural framing: different people may attach different meanings to any given topic or issue. Reacting to a certain cultural framing of some issue by a social movement, other actors may engage in counter-framing to undermine the movement's framings (see for example: figure 4.3.33). In turn, a social movement may react by reframing, e.g. to limit the impact of counterframing. In cultural framing literature, such struggles are referred to as 'framing contests' (Benford and Snow, 2000) – I will later refer to these as 'discursive struggles'. The back-and-forth dynamics of these cultural framing contests emphasize not only that cultural framing is contentious rather than consensual, but also that it should be analyzed as a process that plays out over time.

An attractive feature of the above 'persuasiveness dimensions' is that they encompass many of the previously mentioned aspects and dimensions of culture. For example, to increase experiential commensurability, actors must frame issues in terms of practices and daily life. To increase cultural fidelity, they must frame issues in terms of broader cognitive structures. Increasing articulator credibility is about constructing identity (specifically, the construction of expertise). And increasing empirical credibility is about interpreting the physical world around us and mobilizing it as proof in a broader argument. The cultural framing literature as reviewed here clearly offers insights into the relation between cultural legitimacy and innovation journeys: it emphasizes human agency and ties this agency to many aspects of the previously reviewed approaches to culture. Yet there are cautions, as well:

- Because of its origins in the field of social movement studies, the cultural framing paradigm is concerned solely with social movements. While this topical focus can hardly be construed as a point of criticism, it obviously has implications for the applicability of their insights outside this realm. An example would be the assumption that cultural framing is *always* a contested process. For cultural framing in relation to social movements, this is likely true: the very existence of a social movement is indicative of certain differences of opinion within society about some topic or issue. However, I should still consider the possibility that in the *absence* of social movements, framing could be a relatively consensual process. For example, strategic framing by product champions with the aim of creating legitimacy might be uncontested in the absence of people that disagree with some aspect of the suggested innovation and/or have conflicting interests. It is only when people *do* disagree, that social movements emerge.

- The cultural framing approaches within social movement studies are primarily concerned with the emergence of social movements and movement-internal dynamics such as mobilization effects. Although some literature exists on mechanisms of frame diffusion (e.g. Jenness and Broad, 1994), this still only addresses the dynamic of frames spreading to other *movements*. The issue of how framing processes affect *other* domains or processes within society - or even how they contribute to the attainment of the movements' goals - remains relatively unaddressed (Benford and Snow, 2000: 632). So while the cultural framing paradigm gives us insight into how cultural framing processes *work* as well as offers clues about how to study them in the context of innovation journeys, it does not provide any clear answers as to how they might *influence* innovation outcomes.
- The broader field of social movement studies is structured by three paradigms that emphasize either political opportunity structures, mobilizing structures, or cultural framing. Social movement scholars in the latter paradigm sought to offer an alternative to the 'determinist' biases in the former two by emphasizing the agency of social movement actors, whom they see as strategic users of culture. But some have argued that in doing so, they artificially separated culture from the other two factors:

  > The distinction between "cultural framings," on the one hand and "political opportunities" and "mobilizing structures," on the other is too often taken to mean that the latter two somehow stand outside of culture, which "mediates" between them. (…) "[F]raming" and "culture" continue to be more or less equated with the self-conscious activities of social movement participants, especially leading activists. All nonstructural factors get rolled into this tiny ball, but the reduction of culture to strategy does justice to neither. (Goodwin and Jasper, 1999: 47)

  Goodwin and Jasper further argue that

  > (…) culture - in such diverse forms as traditions, "common sense," material artifacts, idioms, rituals, news routines, know-how, identities, discourse, and speech genres - also constrains and enables collective action in ways that are not always or even usually intentional or instrumental. (Goodwin and Jasper, 1999: 48)

So, while cultural structures approaches tend to overemphasize the constraining quality of culture, cultural agency approaches tend to do the same for its enabling quality.

2.2.6 Discourse analysis

A fourth analytical approach to culture is discourse analysis. What sets it apart from aforementioned approaches is that it focuses explicitly on *collective* meaning-making around *specific* issues, such as contested innovations (Geels and Verhees, 2011). Commentators note that the concept of discourse, much like culture itself, has "come to be used with a wide range of meanings which cover a wide range of activities" (Brown and Yule, 1983: *viii*), but its roots can be traced back to the field of linguistics. Acknowledging that "language profoundly shapes our view of the world and reality,

instead of being merely a neutral medium mirroring it" (Hajer, 2006: 66), early structuralist linguists turned their analytic attention to language-in-use. Concrete speech acts, such as conversations, were analyzed in an attempt to uncover underlying linguistic structures and gauge their influence on human action (e.g. De Saussure, 1916). This language-in-use was referred to as discourse. But is was mostly the work of structuralist and post-structuralist theorotists such as Lacan, Barthes and Foucault which resulted in increased analytical interest in the concept of discourse among other academic fields (Scott and Marshall, 2005). Foucault defined discourse not as concrete, individual speech acts, but as a

> (…) group of statements which provide a language for talking about – a way of representing the knowledge about – a particular topic at a particular historical moment (…) Discourse is about the production of knowledge through language. But (…) since all social practices entail meaning, and meanings shape and influence what we do – our conduct – all practices have a discursive aspect. (Hall, 1997)

In that case, discourse analysis should thus focus on uncovering historically situated 'ways of thinking and talking', instead of on uncovering general linguistic patterns that structure concrete speech acts (Scott and Marshal, 2005). As a result, attention shifted away from the influence of language (through meaning) *on* practice, and towards the way discourses, as linguistic constructs, are produced and reproduced *through* social practices and give meaning to specific issues in specific historical contexts (Van den Brink and Metze, 2006). In a similar vein, Hajer and Versteeg have defined discourse as

> an ensemble of ideas, concepts, and categories through which meaning is given to social and physical phenomena and which is produced and reproduced through an identifiable set of practices (Hajer and Versteeg, 2005: 175)

Discourses (e.g. the 'acid rain discourse') thus structure discussions about specific issues: discourses are "homogeneous fixations of meaning" (Phillips and Jørgensen, 2002: 144) about specific topics, that exclude other (hypothetical and articulated) meanings of that topic. If large portions of society come to use a specific discourse to give meaning to a specific topic (i.e. 'discourse structuration' (Hajer, 1993)), and if it becomes solidified into institutions and practices ('discourse institutionalization' (Hajer, 1993)), then that discourse can be said to be dominant. However, different meanings (i.e. ones outside the discourse but about the same topic) can coalesce into an alternative discourse: an alternative, relatively coherent way of thinking and talking about the same topic. The two discourses then occupy the same *order of discourse* (Fairclough, 1992), which is

> a social space in which different discourses partly cover the same terrain which they compete to fill with meaning each in their own particular way (Phillips and Jørgensen, 2002: 56).

Different discourses strive to establish themselves in the same order of discourse, i.e. to become the taken-for-granted way of understanding an innovation. Through

antagonism, or "open conflict between the different discourses in a particular order of discourse" (Phillips and Jørgensen, 2002: 56), discourses strive for *hegemony:*

> Hegemony is about constructing alliances, and integrating rather than simply dominating subordinate classes, through concessions or through ideological means, to win their consent. (Fairclough, 1992: 92)

Antagonisms are both creative and destructive, in that they

> attempt to destabilize the 'other' identity but desperately need that very 'other' as a constitutive outside to stabilize their proper identity (Carpentier and De Kleen, 2007: 269).

Especially for the introduction of new technologies in modern society, the rise of antagonistic discourses is typical and anticipated (Rip and Talma, 1998: 301). In the resulting discursive struggles, complex discourses are typically summarized in different ways by individual actors and condensed into simpler *storylines*. These storylines can be used to forge (temporary) *discourse coalitions*, or groups of

> actors that, in the context of an identifiable set of practices, shares the usage of a particular set of storylines over a particular period of time (Hajer, 2006: 70)[2].

Thus, articulating the 'right' storyline is an important source of agency in discourse theory (Hajer, 1995: 56). Discursive struggles occur around specific elements *outside* the discourses (i.e. in the 'field of discursivity') and that are "particularly open to different ascriptions of meaning" (Phillips and Jørgensen, 2002: 28). The articulation of storylines on 'both sides' is aimed at drawing these elements into either discourse by investing them with particular meanings. These elements whose meanings have not (yet) been fixed are sometimes called 'floating signifiers' (Laclau, 1990). For example, in relation to nuclear power, specific industrial accidents can be seen as floating signifiers in the struggle between pro-nuclear and anti-nuclear discourses: they have no fixed meaning when they happen, and might be construed as proof of the superiority of one reactor type over another, or alternatively as proof of the technology's undesirability (thereby transforming the element into a 'moment' or temporarily fixed meanings in, respectively, pro-nuclear and anti-nuclear discourse).

Collective meaning-making is thus an ongoing and contentious process that involves multiple actors interacting and engaging in discussions about specific issues in various arenas. Discourse "is not only what you say (…); it includes to whom you say it, how, why, and where" (Schmidt, 2008: 310). Moreover, meanings that have been produced do not 'go away', but instead provide the background material for subsequent 'rounds' of collective meaning-making processes (see: figure 2.2.6).

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[2] Interestingly, antagonistic actors, who disagree on an issue, can still share a storyline (and thus be part of the same discourse coalition) in this perspective: storylines, not interests, are the 'glue' which holds discourse coalitions together.

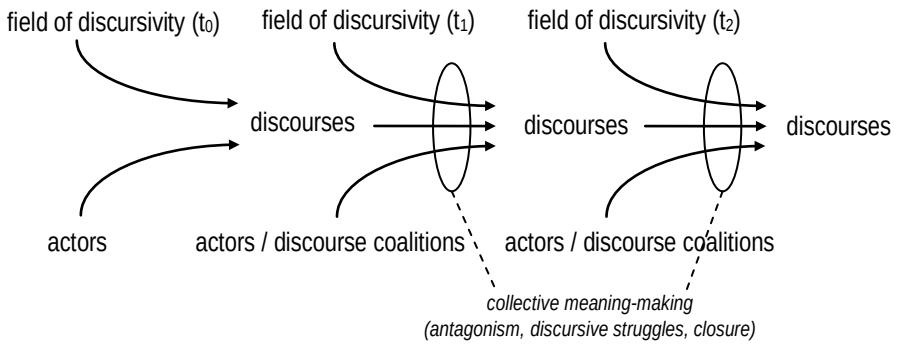


Fig. 2.2.6 Schematic representation of discourse theory. Adapted from: Geels and Verhees, 2011.

For understanding cultural legitimacy in innovation journeys, discourse analysis offers the tools to show the changing meaning of an innovation by analyzing changes in the way actors talk about it. Cultural legitimation could thus be viewed as a discursive practice, in which actors draw on existing discourses which fix meaning in particular ways. These discourses are constantly reproduced (or challenged) in specific articulations or texts. For example, Scrase and Ockwell (2009) have compared the texts of the British government's 2003 Energy White Paper and its 2006 Energy Review report. Although superficially these seem to have a similar message, they display a substantial discursive shift. In the 2003 text, renewable technologies are framed as "major opportunities for our businesses" whereas in the 2006 text, their development suddenly became an "obligation" that cannot single-handedly constitute the "solution to the shortfall we face" (Scrase and Ockwell, 2009: 47). Under the latter framing, nuclear power appears a far more attractive option. Indeed, a storyline is created of an "imperiled island state whose way of life is threatened by the activities of foreign nations: only a domestically controlled energy source such as nuclear power could protect us" (Scrase and Ockwell, 2009: 48). Latching onto that storyline, the nuclear industry talks about a "fleet" of new nuclear power reactors, evoking historical narratives "of Britain defending its shores with mighty ships" (Scrase and Ockwell, 2009: 48). This leads the authors to conclude that "policy influence can be achieved if a discourse is constructed in such a way as to speak to core government imperatives" (Scrase and Ockwell, 2009: 48) such as that of surviving as an independent state.

2.2.7 Intermediate conclusions: different levels of analysis

Comparing and evaluating the above four approaches to culture, I distinguish two broad levels of analysis:

- cultural structures approaches typically operate on a macro-level, examining abstract cognitive and normative structures or networks of signs (e.g. Jacobs, 2002). As a result, they emphasize the *constraining* dimension of culture: the way these 'deep' cultural structures determine meanings and shape individuals' interpretation of the world around them.

- cultural production and cultural agency analysis typically operate on a micro-level, analyzing meanings by examining how they are produced and reproduced in practice. As a result, they emphasize the *enabling* dimension of culture: the strategic use and manipulation of culture to further pre-existing interests (on the part of institutions, other social groups, or individual actors).

I argue that the discourse approach to culture constitutes a middle ground between these, because:

- on one hand, it recognizes that discourses are cultural structures that fix meanings in particular ways and thus determine interpretation. Moreover, some discourses become taken-for-granted 'macro-cultural repertoires' which are relatively resistant to change. These types of discourses function as the 'deep' cultural structures of the cultural structures approaches (e.g. 'ideographs' (McGee, 1980)).
- on the other hand, it acknowledges actors' cultural agency. It argues that discourses are never immutable in the way the fix meaning: change is always possible, because concrete articulations of discourses by actors (strategic or not) always partially reshape the very discourses they reproduce (Phillips and Jørgensen, 2002:29). The creation and performance of storylines thus functions as the strategic cultural action of the cultural agency approaches (e.g. the voluntaristic act of 'cultural framing' in social movement theory).

For the study of the cultural legitimacy of innovations, a discourse analysis approach to culture provides a useful synthesis between cultural structures and cultural agency approaches. The cultural legitimation of an innovation can thus be seen as a process in which focal actors (e.g. innovation champions) enroll audiences into a discourse that signifies the innovation as appropriate or desirable. They do so by creating strategic summaries of that discourse (i.e. ‘storylines’) and performing these: people don't merely tell stories; they enact them in order to provide legitimacy and accountability for their actions (Czarniawska, 1997, 1998). The goal is to persuade their audiences to provide resources (e.g. financial resources), but also facilitate societal acceptance: cultural legitimation is not only about meaning-making by focal actors, but also about influencing the attitudes of other relevant actors on which focal actors depend. If, through persuasive performances of these storylines, large audiences are enrolled into the discourse that signifies an innovation as appropriate, then the innovation can be said to have high cultural legitimacy.

2.3 Analytical perspective

2.3.1 Introduction

Combining relevant insights from section 2.2 yields a preliminary analytical perspective on cultural legitimacy in innovation journeys. The perspective will be applied to concrete empirical cases, in which it enables an analytic focus on the process of cultural

legitimation as it plays out during innovation journeys. In line with methodological insights from process theory, the analytical perspective serves not as a formal conceptual model to be tested, but as a 'narrative plot' which structures the explanatory narrative (see Chapter 3 for further elaboration). The narrative plot forms the 'backbone' of the narrative, drives it forward, and articulates how its main elements relate to one another:

> In narrative methods the plot in the story itself is the generative mechanism (Van de Ven, 2007: 154).

The analytic perspective has two main elements. Subsection 2.3.2 provides a perspective on the *mechanisms* of cultural legitimation (i.e. how it is constructed), while subsection 2.3.3 will describe a perspective on the *phases* of cultural legitimation (i.e. its progression through time). To conclude this section, subsection 2.3.4 will discuss some weaknesses which necessitate the supplementary literature exploration of section 2.4.

2.3.2 Mechanisms of cultural legitimation

The first element of the analytical perspective (i.e. regarding the mechanisms of cultural legitimation) rests on the following assumptions:

- Focal actors, such as technology champions, create storylines that frame an innovation in a certain way (e.g. by emphasizing certain aspects while leaving others out) and link it to cognitive and normative 'deep' structures. These storylines are strategic mobilizations of discourses about the innovation: they simultaneously reproduce and change these discourses. These cognitive and normative 'deep' structures, to which actors link an innovation, are taken-for-granted discourses (macro-cultural repertoires) which constitute people's perception of the world around them. They are not necessarily coherent and monolithic, but form a cultural environment of fragmented and sometimes even contradictory meanings.
- As Schmidt (2008) argues: "[d]iscourse serves not just to express one set of actors' strategic interests or normative values but also to persuade others of the necessity and/or appropriateness of a given course of action" (Schmidt, 2008: 312). Thus, the process is geared towards influencing the beliefs and expectations of *other* relevant actors on whom the innovation depend for financial resources, protection or support. These actors can include investors, but also wider society.
- Actors *perform* these storylines in what can be an openly contentious process: a sequence of discursive struggles between technology champions and 'new' focal actors (with conflicting interests) who perform alternative storylines. As a result, the cultural legitimacy of an innovation can be transient: new challengers may emerge, leading to 'new rounds' of framing struggles, for which the meanings produced in the previous rounds constitute the context.

- "Not all actors have equal opportunities for doing and saying things in new ways and for having their rearticulations accepted" (Phillips and Jørgensen, 2002: 55). Therefore, if an innovation's challengers are individual actors or marginalized groups (e.g. social movement organizations), they will aim to persuade a wider public by seeking out different public stages for performing their storylines (e.g. media, demonstrations, public discussions, etc.).

Focal actors attempt to convince relevant audiences that the innovation is appropriate and desirable by *performing* their storylines on various stages (e.g. media, public debates). Specifically, actors engage in performances that aim to construct:

- *empirical fit*, by mobilizing events in the observed world as proof;
- *credibility*, by mobilizing status or expertise;
- *centrality*, by linking the innovation to issues considered central and/or urgent by the target audience;
- *experiential commensurability*, by linking the innovation to the target audience's everyday experiences and daily lives;
- *macro-cultural resonance*, by linking the innovation to the target audience's broader cultural repertoires.

I omitted the category that Benford and Snow (2000) call 'consistency' (the degree to which the articulators' actions and their storylines are perceived as consonant) because its construction can be conceptualized in terms of the other dimensions. If actors, during the performance of their storylines, mobilize *their own* real-world actions as proof of the veracity of their claims, this can be construed as 'attempting to increasing empirical fit'. Conversely, if other actors point out inconsistencies between their opponents' performances and their real world actions, this can be construed as 'attempting to decrease the opponent's credibility'. The interplay between the different concepts is graphically depicted in the stylized, tentative model of the cultural legitimation process of figure 2.3.1.

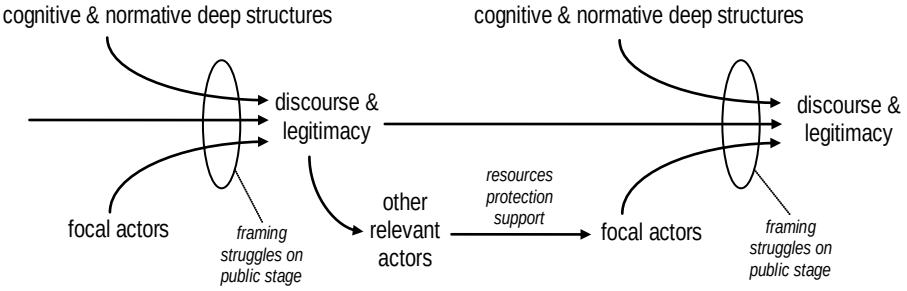


Fig. 2.3.1 Analytical perspective I: proposed cultural legitimation mechanisms. Source: Geels and Verhees, 2011)

2.3.3 Phases of cultural legitimation

The basic mechanisms of cultural legitimation (articulated in subsection 2.3.2) are argued to operate consistently throughout innovation journeys. But because (1) the stages on which storylines are performed and (2) the audiences at which they are directed, shift during innovation journeys, the same mechanisms result in analytically distinct *phases* of cultural legitimation. Phases are central concepts in process theories, because they typically seek to explain development in terms of the order in which things occur and the phase in the process at which they do (Van de Ven, 2007: 154):

> (...) the central focus of developmental process models is on progressions (i.e. the nature, sequence, and order) of activities or events that an (…) entity undergoes as it changes over time. (...) a linear sequence of stages or phases of development is a common form of progression in these process models (Van de Ven, 2007: 199)

The long and complex processes of innovation journeys that innovations go through from concept to implementation are analytically divided up into three ideal-typical periods by Van de Ven *et al*. (2008):

- *Initiation phase*. The predevelopment period typically involves an 'extended gestation period' during which apparent coincidences 'set the phase' for a technological innovation. External 'shocks' then trigger efforts to initiate an innovation. Plans are made and submitted to resource controllers, but these serve more as sales vehicles than as realistic scenarios (Van de Ven *et al*., 2008: 25-34).

- *Development phase*. When the developmental phase begins, divergent development paths (e.g. competing designs) are embarked upon. In this period, unanticipated events result in setbacks and alter the basic assumptions of the innovation, second-order learning occurs, and development paths converge. During (and in support of) innovation development, networks of organizations and institutions (including policymakers) are formed to support the innovation's development (Van de Ven *et al*., 2008: 34-53).

- *Implementation phase*. The implementation phase begins with a take-off during which prototypes of the innovation are produced and implemented as pilot projects. These are geared towards demonstrating its feasibility and learning about the innovation in a protected situation (i.e. with limited consequences). If successful, the innovation diffuses and is adopted and implemented in more settings and on larger scales: implementation accelerates. In these situations, implementation occurs "by linking the "new" with the "old" or by reinventing the innovation to fit the local situation" (Van de Ven *et al*., 2008: 24). Throughout this process, "[e]xternal events and crises frequently occur" (Van de Ven *et al*., 2008: 57).

These empirically validated phases represent internally homogeneous - but mutually heterogeneous - periods of activities, and so provide analytically useful temporal divisions in case studies (Van de Ven, 2007: 214). Because each innovation journey phase is characterized by relatively coherent activities by the actors involved, it is also

characterized by relatively coherent cultural legitimation strategies on their part (both in terms of relevant audiences, and in terms of goals). The innovation journey phases thus provide a useful starting point for understanding the longitudinal interactions between innovation journeys and cultural legitimacy (which addresses RQ2).

Therefore, I reconceptualise Van de Ven's innovation journey phases through a cultural legitimation lens. But because innovation journeys literature pays less attention to what happens *after* successful implementation of an innovation, I also add phases, taking inspiration from organizational sociology studies which have discerned establishment, maintenance, extension and defence phases in firms' environmental accounting strategies (e.g. Tilling, 2004; Ashforth and Gibbs, 1990). I propose the following preliminary model of cultural legitimation phases in innovation journeys:

1. *Construction of cultural legitimacy*. In this phase, cultural legitimacy is established in order to obtain the necessary resources to initiate developmental activities. This occurs during the initiation and development phases of innovation journeys. It is about innovation champions convincing resource controllers of the appropriateness and desirability of an innovation in terms of the latter parties' norms, values and beliefs. This involves framing the innovative idea as a solution to some perceived problem or need. Resource controllers are the main audience at which the legitimating performances are aimed: wider publics are less important in this phase which is about 'local validation' (Johnson *et al*., 2006). Discursive struggles in this phase are about different interpretations of performance criteria, optimal development paths, etc. In SCOT terminology, this is about the social groups that are relevant in this phase of the innovation journey (innovating actors, policy makers, investors etc.) reducing the ambiguity or interpretive flexibility of the innovative idea and constructing a 'technological frame' which structures subsequent social interactions around the technology (Bijker, 1995). During this phase, 'local validation' occurs: an innovation emerges, and the actors involved either justify it *explicitly* by arguing how it addresses some local goal which is important for those on whom they depend for resources, or *implicitly* acquire local consensus by not being challenged (Johnson *et al*., 2006: 60).

2. *Extension of cultural legitimacy*. In this phase, cultural legitimacy is extended to wider society. This occurs early in the implementation ('take off') phase of innovation journeys. It is about convincing wider society of the cultural appropriateness and desirability of the innovation, so as to facilitate its societal embedding. This involves performing storylines on *public* stages such as the media, public debates etc. Civil society is now the main audience of the performances, which are aimed at 'enrolling' the general public into aforementioned technological frame. Both the *number* and the *nature* of relevant social groups increase in this phase. The inclusion of the wider public reintroduces interpretive flexibility by giving rise to new interpretations, which can lead to new discursive struggles. Discursive struggles in this phase are about reducing the innovation's ambiguity:

the innovation's proponents attempt to 'collapse' it around an interpretation of the innovation as generally desirable and appropriate in order to enable its implementation. This phase is about general validation, wherein innovation object diffuses to new contexts and acquires widespread acceptance (Johnson *et al*., 2006: 61).

3. *Stabilization of cultural legitimacy:* In this phase, the innovation's proponents maintain the cultural legitimacy of the innovation as it becomes increasingly applied. This cultural work is aimed at ensuring that wider society *continues* to interpret the innovation as appropriate and desirable. This occurs both throughout and after the implementation phase of innovation journeys (which innovation journeys literature does not explore in-depth). Stabilization of cultural legitimacy involves continuous "(...) symbolic assurances that all is well, and (...) attempts to anticipate and prevent or forestall potential challenges to legitimacy" (Ashforth and Gibbs, 1990: 183). Successful stabilization of cultural legitimacy involves, for example, the signification of setbacks and events in a way that does not detract from the desirability or appropriateness of the innovation, and discursive struggles with actors with different interests.

4. *Destabilization of cultural legitimacy*. The stability of meaning achieved in the previous phase is not necessarily permanent. If new social groups articulate coherent alternative interpretations that signify the innovation as *un*desirable or *in*appropriate, an antagonistic discourse emerges. Organized opposition against the innovation can then be seen as the performance of such antagonistic discourses. Setbacks and other concrete events involving the innovation can become the battlegrounds on which opponents' and proponents' discourses struggle for hegemony by attempting to 'draw in' these ambiguous events by infusing them with specific meanings. In this phase, innovations can lose their cultural legitimacy through (1) the strategic construction of links between the innovation and *new* broad cultural repertoires (that emerge independently of the innovation), or (2) the destruction of earlier links between the innovation and broad cultural repertoires (either because the links are discursively destroyed by opponents, or because the macro-cultural repertoire itself gradually delegitimizes over time) (Deegan *et al*., 2002). In either case, the cultural legitimacy of the innovation is (either rapidly or gradually) lost as its inappropriateness and undesirability becomes the dominant interpretation.

Two important remarks regarding this phase model need to be placed:

- As their descriptions argue, discursive struggles can occur in every phase of the cultural legitimation process. This is in line with insights from discourse theory which argues that while ambiguity of meaning be reduced, it can never be fully or permanently removed:

> There are always other meaning potentials which, when actualized in specific articulations, may challenge (…) the discourse. (…) Hence there is always room for struggles over (…) what discourses should prevail, and how meaning should be ascribed (Phillips and Jørgensen, 2002: 29).

This is corroborated by insights from the social construction of technology, which argues that closure around any interpretation of an innovation is transient: interpretive flexibility can be reintroduced over time as new relevant social groups with new interests cause new rounds of discursive struggles (Pinch and Bijker, 1984). Antagonism has become a salient feature in innovation journeys in modern societies, with introducers of innovation expecting and anticipating opposition (Rip and Talma, 1981). Contestation is thus a ubiquitous dimension of the cultural legitimation process.

- The model does not require that the cultural legitimation process proceeds deterministically through all phases. For example, if no new social groups happen to articulate alternate meanings after the institutionalization phase, the cultural legitimacy of the innovation does not enter a destabilization phase. But also, if innovation champions lose the discursive struggles in any given phase (i.e. if they fail to achieve closure around an interpretation of the innovation as appropriate), this could result in the termination of the innovation journey and the consequent halting of the cultural legitimation process in that particular phase. Moreover, the innovation journey can be terminated at any point in time for *different* reasons than low cultural legitimacy (e.g. resources running out etc.), in which case the cultural legitimation process obviously does not proceed to the next phase, either.

In summary, the proposed phases in the cultural legitimation process during innovation journeys (i.e. the second element of the analytical perspective) are graphically depicted in figure 2.3.2. This phase model will serve as a tentative conceptualization of the longitudinal character of the cultural legitimation process during innovation journeys. The model will be tested in empirical case studies (Chapters 4 and 5), as a result of which it will be refined in Chapter 6.

Fig. 2.3.2 Analytical perspective II: proposed cultural legitimation phases in innovation journeys. Source: own illustration.

2.3.4 Weaknesses of the analytical perspective

The analytical perspective articulated in the above subsections combines insights from various literatures into a coherent view on the process of cultural legitimation which will be tested in Chapters 4 and 5. Yet it is possible to distinguish and discuss some possible weaknesses a priori:

- Although 'deep' cultural structures such as broader, macro-cultural repertoires form a key part of the conceptual perspective (as something that actors draw upon and strategically develop their storylines around), the dynamics of these macro-cultural discourses remain exogenous. For most research, this would not be problematic: the time span during which discursive struggles are analyzed is typically short enough to treat broader narratives as more or less fixed (Tilling, 2004). Yet in the case of innovation journeys, which play out over long periods of time, this assumption is likely invalid, as broader narratives can emerge, change, or fall out of grace during this period. While the conceptual framework as articulated above does *describe* these shifting dynamics, it cannot *account* for them. For example, it cannot explain the rise of the climate change narrative. Of course, one might argue that treating these (changing) broader narratives as exogenous to the process of cultural legitimation is still permitted, because they arise through processes beyond the collective agency of the actors involved in promoting or opposing an innovation. The climate change narrative, for instance, is not created by any one specific (group of) actor(s); instead it is *used* by such actors to legitimize their interests. But in certain instances, the strategic storylines created by innovation champions *do* in fact influence the development of broader narratives, for example when, while reframing the solution, the problem gets reframed as well. E.g. the nuclear industry's storyline about nuclear power as 'emission free electricity', created in an attempt to frame it as a solution for climate change, was so successful that it contributed to a shift in focus in the broader climate change discourse from 'renewable' to 'emission free' (Garud *et al*., 2010). To which degree the discursive struggles around specific innovations shape the broader narratives these struggles draw upon is something which needs to be analyzed separately. However, because my research interest lies not with how broader discourses develop but rather with how they are *used* for the cultural legitimation of innovations, this particular 'blind spot' is arguably acceptable for the time being.
- Focusing on any particular aspect of the social sphere inevitably means a trade-off, in the sense that other aspects are overlooked or downplayed. The analytical perspective directs analytical attention towards the cultural legitimation process in innovation journeys, because the research interest in this dissertation lies with finding general mechanisms and dynamics of *how* the cultural legitimacy of innovations is constructed and contested – a phenomenon not yet systematically investigated in innovation studies. For its clearer view on cultural legitimation, the perspective articulated in section 2.3 sacrifices an analytical focus on the role of policy in innovation journeys. But paradoxically, policy may well play an especially important role in the types of innovation journeys that I'm interested in (see: Chapter 1). Because the policy dimension of innovation journeys is not explicitly taken up into the analytical perspective, it can make no ex ante claims about the relation between cultural legitimacy and policy, or their relative influence

in shaping innovation journeys. This weakness is addressed (although admittedly not fully resolved) in the subsequent section.

2.4 Insights for RQ3: policy process theories

2.4.1 Introduction

As mentioned above, one weakness of my analytical perspective is its myopia with respect to the policy dimension of innovation journeys. So, while the literature review of section 2.2 resulted in an analytical perspective that provides preliminary answers to the first two research questions, the third will require an additional literature exploration. This exploration will be made in this section, and starts with the following open question:

> *How does culture legitimacy (as conceptualized in section 2.3) relate to policy during innovation journeys?*

The types of innovation journeys in which I'm interested typically play out over long periods of time. During these journeys, many events occur which can (through their mobilization into storylines) shape the cultural legitimation process. The discursive struggles over these events (e.g. about whether or not an event is relevant) can turn 'events' into 'issues' in the public sphere. These societal issues form the concrete battlegrounds between proponents' and opponents' discourses. The analytical perspective developed in section 2.3 provides a preliminary explanation of how this occurs. Yet it does *not* deal with how societal issues regarding an innovation shape policy with respect to that innovation (or vice versa). Therefore, my renewed literature exploration focuses on theories about the ways in which societal issues can result in policy outcomes. Although these do not specifically deal with technological innovation, they yield important insights into the broader relation between culture and policy. The section is structured as follows:

- Subsection 2.4.2 reviews issue-attention cycles theory, which proposes a phase model of the rising and falling prominence of issues, and argues that declining public interest does not necessarily reflect the resolution of a societal issue.
- Subsection 2.4.3 reviews the multiple-streams framework, which aims to explain how societal issues can find their way to the policy agenda. It does so through a model that emphasizes the opportune coupling (by policy actors) of independent problem, policy and politics streams.
- Subsection 2.4.4 reviews the punctuated equilibrium theory, which seeks to explain incremental and radical policy change in one model. It emphasizes that cultural action by actors *outside* the policy sphere can affect the policy process, as well, namely through punctuation by cultural constructs referred to as 'policy images'.

- Subsection 2.4.5 concludes this section by assessing the different approaches and articulating preliminary lessons learned.

2.4.2 Issue-attention cycles

The issue-attention cycle (Downs, 1972) starts with the observation that public attention is a scarce commodity, which the wider public needs to ration among a limited number of issues. Downs argues that people's attention usually doesn't stay focused on any specific issue for very long, even if it's a particularly persistent and problematic issue. In the dynamics of environmental concern in the USA, Downs observes a cyclical trend in the way issues jump into prominence and fade away even though the problem remains unsolved. This cycle has five stages:

- The *pre-problem stage.* Some expert groups may be aware of a certain problematic situation, but public attention for the issue is still low.
- *Alarmed discovery & euphoric enthusiasm.* As a result of some dramatic event, the public suddenly becomes aware of the problem. The resulting anxiety is soon followed by an optimistic expectation that the problem can be fixed, "(…) without any fundamental reordering of society" (Downs, 1972: 39). A technological fix is often proposed in this phase.
- *Realizing the cost of progress.* Gradually, the awareness grows that any real solution implies significant costs, because "(…) part of the problem results from arrangements that are providing significant benefits to (…) millions" (Downs, 1972: 40). In other words: the *structural* nature of the problem becomes understood. It is during this phase that new policies and institutions may be created to help solve the problem.
- *Gradual decline of intense interest.* As a reaction on the third phase, the general public (a) becomes discouraged, (b) ignores the problem, or (c) becomes bored with it. Typically, some newer issue will successfully compete with it for attention during this stage (Downs, 1972).
- The *post-problem stage.* In this stage, a problem hardly receives any attention anymore. However, it is not as though the problem never existed: the institutions and policies created during the third phase tend to be more persistent than the problem itself. Additionally, attention for the problem may occasionally resurface.

Theoretically, this should result in a bell-shaped curve of public attention over time for each issue. However, empirical tests of the issue-attention cycle (e.g. using bibliometric methods applied to newspapers as an indicator for public attention) have found that this bell-shaped curve is rarely present. Explanations range from the issue-attention cycle not existing, to newspaper coverage being a bad proxy for public attention. One interesting suggestion is that it might be the result of analyzing public attention at too high a level of aggregation. Newig (2004) suggests that broad, extensive problems serve

as *categories* containing a multitude of specific issues. Environmental pollution, for example, includes more specific issues such as acid rain, ozone depletion, CO_2 emissions etc. For each of these issues, the issue-attention cycle might still hold, but the attention for the category of environmental pollution then appears as a sum of each of these specific cycles (figure 2.3.1).

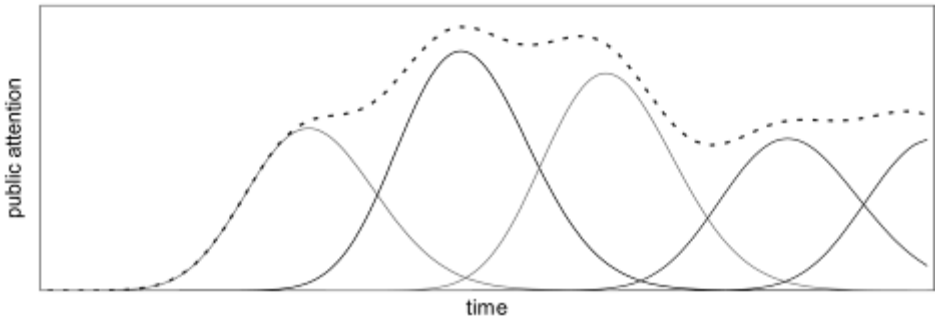


Fig 2.4.1 Public attention to a broad problem area (dotted line) as the sum of various issue-attention cycles (black curves). Source: Newig (2004).

The issue-attention cycle has several interesting features. Firstly, it proposes distinct phases in which different mechanisms operate. Secondly, the idea that attention for broad problems (i.e. categories) may be aggregations of multiple specific issues may go some way in explaining how innovation journeys can remain contested for extended periods of time in spite of 'specific' issues coming and going in relatively short periods. And thirdly, it acknowledges that the

> (…) perception of most "crises" (…) does not reflect changes in real conditions as much as it reflects the operation of a systematic cycle of heightening public interest and then increasing boredom (Downs, 1972: 39).

In other words, attention to specific issues usually does not rise and fall according to 'real world' indicators: attention may fade even though the problem is not solved. For example, in the case of British nuclear power development, the Sizewell B public inquiry into the desirability of constructing a heavily contested pressurized water reactor (1982-1985) became increasingly ignored by the press as well as the general public as time went on, even though the final decision would be taken only in 1987 (Rüdig, 1994: 88).

But the issue-attention cycle has several problematic features, as well. Most prominently, the issue-attention cycle assumes that 'problems' exist independently of actors and can be objectively diagnosed. For example, it holds that during the pre-problem stage (when a problem exists but does not yet receive any attention) experts may already be aware of the problem, and that it is only when 'dramatic events' occur that the wider public becomes aware of it. This downplays the possibility that such groups may in fact be involved in *constructing* the problem, e.g. that such an event is only perceived as being 'dramatic' because of the way it is culturally framed (e.g. as a

'disaster' as opposed to an 'irregularity'). Indeed, Gamson and Modigliani (1989; 1987) adopt a more constructivist approach, suggesting that whether or not events become issues is determined by which *interpretive package* is used to make sense of them. These packages, which contain symbols, metaphors, ideas, have the task of

> (…) constructing meaning over time, incorporating new events into their interpretive frames. (…) The progress package, for example, must be able to deal with the accidents at Three Mile Island (TMI) and Chernobyl, providing them with a meaning that is plausible and consistent with the frame. (Gamson and Modigliani, 1989: 4)

At the core of an interpretive package is a specific *issue frame*, which is

> a central organizing idea or story line that provides meaning to an unfolding strip of events, weaving a connection among them (Gamson and Modigliani, 1987: 143).

As a concept, interpretive packages thus serve the same function as storylines do in discourse theory (see: subsection 2.2.4), and attention for interpretive packages can repair the positivist conceptualization of issues in the issue-attention cycle. But another problematic features of the issue-attention cycle remains. The theory downplays the complicated relationship between public opinion, media, and policy outcomes:

- the issue-attention cycle applies to *public* attention, but it is unclear on whether or not similar cyclical dynamics apply to *media* attention and if so, how the two are related. Although Newig (2004) argues that "[a]ssuming that in today's democracies the mass media constitute by far the most important vehicle for shared attention and political communication, media coverage, then, should best reflect public attention", leaving the role of media out of the picture (i.e. using it only as a proxy) may turn out to be problematic if indeed it not only reflects but also shapes public attention and opinion, as Gamson and Modigliani (1989) have suggested.
- the issue-attention cycle perspective suggests that sustained public attention to any given issue somehow "generate[s] enough political pressure to cause effective change" (Downs, 1972: 38) or that it can "generate sufficient public support to sustain high-level (…) appropriations [i.e. legislative bills that authorize the government to spend money]" (Downs, 1972: 42). However, it remains unclear about the precise mechanisms through which public attention translates into governmental action. This may in some cases be the media (as in Strong and Berridge (1990) who found that media attention in the case of AIDS also acted to generate a growing sense of crisis that politicians were forced to act on), but certainly not always: in many cases, newspaper coverage simply reports aon (and thus follows) the policy process.

In the following subsections, I will review theories which have explored the policy process in more depth and that have, among other things, theorized about how the wider public's perception of an issue as problematic can translate into policy change.

2.4.3 Multiple streams

While useful, the issue-attention cycle, which I treated in the preceding subsection, cannot explain why or how its 'issues' move from the wider public's agenda to that of policy makers (and how they subsequenty do or do not lead to policy outcomes). The Multiple Streams Framework is a perspective which aims to do just that: it attempts to explain why some problems make the agenda while others do not (Zahariadis, 2007). It was first formulated by Kingdon (1995), who built upon the so-called 'Garbage Can Model' of organizational choice by Cohen *et al*. (1972). This model is a departure from the rational choice model, and conceptualizes the process of choice as a garbage can: actors generate numerous solutions which, paradoxically, are 'thrown away' because there are no suitable problems, only to 'root through the garbage can' once problems arise that may fit previously discarded solutions. The Multiple Streams Framework builds on this idea, applying it to the policy process. It argues that the policy process is not rational, because when faced with a problem, policymakers typically neither generate nor systematically compare all (or even many) possible policy alternatives. Instead, it sees policies as the result of the strategic coupling of the three independent processes or 'streams' of *problems*, *policies*, and *politics*. These streams 'flow' through the policy system, each according to its own internal dynamics:

- The *problem stream* consists of situations that policy makers and/or citizens want addressed (i.e. unemployment, pollution, inflation etc.). First, *focusing events* (such as industrial accidents, strikes and terrorist attacks) draw attention to specific situations. Then, for such situations to be translated into policy, they need to be interpreted as *problems* (Kingdon, 1995). Unlike the issue-attention cycle, which simply states that objectively drastic events cause increased public attention, the multiple streams framework argues that such events enter the problem stream if and only if they are framed as problematic. A feeling must exist that the current situation is somehow wrong, and that it can be rectified by human action. Whether or not something is construed as a problem depends on how successfully it is linked to cultural repertoires.

- The *policy stream* at any given point in time contains various ideas or policy solutions. These were typically generated by specialists in policy communities (Zahariadis, 2007), but were (paradoxically) not necessarily formulated to solve actual concrete problems. From this stream, policy solutions are selected which form the basis of new policy proposals.

- The *politics stream* contains elements like 'national mood', but also pressure group campaigns, impending elections, and changes of government. These can heavily influence agendas (Zahariadis, 2007). In this stream, policy proposals tend to be assessed by their political costs and benefits rather than their practical usefulness.

The multiple streams framework attributes agency in the policy process mostly to behind-the-scenes lobbyists which it refers to as *policy entrepreneurs*. They are the

actors who couple the three streams through the manipulation of ambiguity (i.e. the problematic, unclear preferences of politicians). Policy entrepreneurs couple these streams at crucial points in time, referred to as policy windows, attaching problems to their solutions and presenting them to political audiences (Zahariadis, 2007). This increases the chance that their preferred solution will be translated into policy (Kingdon, 1995). The policy windows can be opened up either in the problem stream by the successful construction (i.e. cultural framing) of 'focussing events', or in the political stream as a result of major political events such as elections. In the former case, solutions will typically be developed in response to specific problems in a 'rational' way. In the latter case, however, attention is typically focused on solutions *before* problems become clearly defined: they will be solutions in search of a problem. This is an ideologically informed process: the adoption of the solution matters more that the problem to be solved (Zahariadis, 2007: 76). The UK's privatization policy is an example. From the perspective of the policy entrepreneur, the purpose of his manipulation is self-interest. However, from a systemic perspective, it serves to create *meaning* for policy makers faced with ambiguous situations (Zahariadis, 2007). The policy entrepreneur's coupling of the three streams or political manipulation is thus cultural action.

The multiple streams (MS) framework is based on the assumption that the *order* in which solutions are considered strongly influences the outcome of policy decisions (Zahariadis, 2007: 68). The temporal order, the timing and flow of events, is important. This is a key feature of process theories (Van de Ven and Poole, 2005, Pettigrew, 1997) which do not explain outcomes by looking at variables but by looking at events. Such theories assume that the world is made up of entities (people, organizations, technologies) that participate in events (‘enactment’) and may change their interpretations, preferences and networks over time (Geels and Verhees, 2011). In terms of the typology of change processes by Van de Ven and Poole (1995), the multiple streams perspective conceptualizes policy change as an evolutionary process, in which policy actors provide variation by generating policy solutions in injecting them into the policy stream. This variation is clearly not random, but it is 'blind' in the sense that it is ex ante unknown which 'mutations' will be selected. The strategic actions of policy entrepreneurs, in the context of policy windows in both the problem stream and politics stream, form the selection pressures for politicians. Finally, retention is achieved when certain solution-problem combinations get translated into policy.

It thus theorizes at the systemic level, taking an entire policy system as its unit of analysis. In doing so, it aims to walk the middle ground between 'grand theory' and 'abstracted empiricism': it does not deal with an overly broad and abstract entity such as 'society', postulating elaborate frameworks with little empirical basis, and neither does it focus solely on micro-level empirical data mining aimed at 'uncovering' correlations between variables and providing much information but few insights (Geels, 2007b). Instead, it emphasizes the interaction between theory and empirical research, in this case in the form of qualitative case studies. It is a *middle range theory*, consisting of "a

limited set of interrelated propositions, aimed at understanding limited topics" (Geels, 2007: 628), in this case the policy agenda setting process.

In terms of Spillman (2002), the multiple streams perspective implicitly uses a *cultural agency* approach (see: section 2.2.5). The central concept of problematic preferences, caused by the ambiguity of situations, emphasizes that issues have no fixed meaning. The policy entrepreneurs' creative attempts at manipulating this ambiguity to favor certain meanings (i.e. cultural framing) can be construed as strategic cultural action (Swidler, 1986). But although the perspective takes agency seriously, it really only attributes agency to policy entrepreneurs, who are seen not as mere advocates of specific solutions, but as "manipulators of problematic preferences and unclear technology" (Zahariadis, 2007:74). Their success depends not only on their position in the network and/or access to resources, but also on their experience and skill as users of culture.

The multiple streams framework thus downplays the agency of other actors. Policy solutions are generated by policy communities and coupled to problems exclusively by policy entrepreneurs that have the financial resources and political connections to successfully lobby for their preferred issues. In the model, other actors such as social movement organizations are relegated to the politics stream, where they can perhaps exert some minor influence by attempting to influence 'national mood' or engage in political lobbying. The possibility that external actors such as social movements can contribute to the problem stream (e.g. by engaging in cultural action) or to the policy stream (e.g. by submitting alternative policy proposals or participating in public consultations) is downplayed in the multiple streams framework. Its assumptions that the three streams are (a) independent, (b) proceed according to their own internal logic and rules, and (c) interact only during policy windows as a result of actions of policy entrepreneurs, may be false. Critics (e.g. Bendor *et al.*, 2001; Sabatier, 2007) have argued that the streams are interdependent, allowing for changes in one stream to trigger changes in another, and attributing more agency to other actors in linking streams together.

Although this issue could conceivably be repaired by following these critics' suggestions and explicitly looking at the role of, for example, social movements in contributing to the problem stream and the policy stream, one problematic feature of the multiple streams framework remains: it assumes a 'blank slate' for each policy decision. Politicians select the solution-problem combinations furthered by the most successful policy entrepreneurs at any given point in time without being weighed down by their (or their predecessors'). If this were true, the policy process would be capricious and unstable. But others have shown that the policy process in fact typically consists of relatively long periods of stability and lock-in (issues which the multiple streams framework downplays) which are occasionally interrupted by radical changes (True *et al.*, 2007). For example, nuclear historian R.F. Pocock observes about the 1945-1977 period that "the history of Britain's nuclear industry is a record of periods of vigorous

activity alternating with periods of intensive reappraisal" (Pocock, 1977: 1). Because of the strong ties between nuclear industry and the government, and the high cost of nuclear research and development, it is fair to assume that this 'vigorous activity' by the nuclear industry occurred during periods of relatively stable nuclear policy and political consensus about which way to proceed. If so, the periods of 'intense reappraisal' would have mostly occurred in periods of political uncertainty characterized by what Kingdon (1995) would call 'problematic preferences'. The multiple streams framework cannot simultaneously explain such long periods of stability and brief bursts of change in one model. The next subsection deals with a policy process theory which attempts to simultaneously repair the multiple stream framework's neglect of outside agency, and this inability to symmetrically deal with stability and change.

2.4.4 Punctuated equilibrium

The problem of explaining long periods of stability and incremental change as well as short periods of radical change in a single model (sketched in the preceding subsection) first surfaced in the field of paleontology. According to some, the fossil record shows that most species underwent relatively little evolutionary change throughout most of their history, but that when such change did occur, it did so in relatively rapid events of branching. This observation became known as the *punctuated equilibrium* hypothesis (Eldredge and Gould, 1972). While punctuated equilibrium was thus originally a biological hypothesis, it gradually came to be thought of as a more general change process. The underlying idea that some systems evolve through the alternation of periods of equilibrium (during which underlying structures only permit incremental change) and periods of revolution (during which the underlying structures are fundamentally changed) has been applied on many levels in many domains. Gersick (1991) lists biological species, scientific fields, organizations, groups and individuals as just some of the 'systems' that have been investigated through the lens of punctuated equilibrium models by scholars in various disciplines.

Frank Baumgartner and Bryan Jones applied the punctuated equilibrium (PE) model to the policy process (e.g. Baumgartner and Jones, 1991), aiming to explain the observation that policy processes are generally characterized by stability and incremental change, but sometimes produce dramatic deviations from previous trajectories (True *et al*., 2007). Like the multiple streams framework, punctuated equilibrium is a process theory. It explicitly includes a temporal dimension in its conceptualization of policy change. It does not explain its outcomes as resulting from the interaction between variables, but rather as the result of chains of events, in which the timing of these events is crucial. And like the issue-attention cycle perspective, PE argues that attention is a scarce commodity throughout this process. However, it adds that it is just as scarce for macro-political institutions such as governments as it is for the general public (True *et al*., 2007). Macro-political systems simply cannot deal with all the issues that they are faced with, all the time. Discussion of these issues is thus typically delegated to various issue-specific *policy subsystems* which allow political

systems to engage in *parallel processing* of thousands of issues simultaneously (Jones, 1994). These subsystems tend to be dominated by experts, operate relatively autonomously and opaquely. They are typically robust and conservative, which results in stability and, at most, incremental change. However at times, specific issues may become 'hot', climb to the top of political agendas, and force macro-political institutions (e.g. parliaments) to act by making changes in the aforementioned subsystems. This can then translate into radical policy change (True *et al*., 2007).

Issues can climb the agenda "in an environment of changing issue definitions and heightened attentiveness by the media and broader publics" (Jones, 1994: 185). This attributes agency to outsider actors, in the sense that they can influence the macro-political agenda by increasing 'attentiveness'. Punctuated equilibrium theory explains heightened attentiveness in terms of *policy image*. For example, when the widely accepted image of US civilian nuclear power was supportive of techno-scientific progress and economic benefits, the subsystem that dealt with nuclear policy was essentially unquestioned: it had a policy monopoly. However, once opponents furthered images of danger and pollution, this monopoly started to collapse (Baumgartner and Jones, 1991). Policy punctuations are explained as

> (…) arising from the interactions of *images and institutions*. When an agreed-upon image becomes contested, a policy monopoly is usually under attack, and the likelihood grows of a new mobilization (a wave of either criticism or enthusiasm) advancing the issue onto the macropolitical agenda (True *et al*., 2007: 163, my italics).

Unlike the issue-attention cycle, punctuated equilibrium argues that 'focusing events' (such as accidents) do not autonomously exert influence on policy outcomes. Instead, it argues that events only affect policy outcomes through cultural images in "(…) a mixture of empirical information and emotive appeals" (True *et al*., 2007: 161). Punctuated equilibrium theory thus builds on theories of conflict expansion (e.g. Schattschneider, 1960) that analyze the breakthrough of new ideas propagated by outsiders into established policymaking. Cultural images are not merely the powerless results of the public's interpretation of political action. Instead, they are an integral part of a 'feedback mechanism' which can have the power to punctuate policy equilibria and open windows of opportunity for change. By arguing that this is one of the mechanisms of punctuation, it takes seriously the notion that action by individuals or social groups *outside* the policy sphere can affect the policy process. And moreover, it explicitly hypothesizes a *mechanism* through which they can do so.

But while punctuated equilibrium theory can show us how the interaction between (policy) images and institutional venues can lead to a punctuation of policy equilibria, it neither explains how these images come into existence in the first place, nor why certain images are more dominant than others. Instead, it furthers a simplistic view of images as how things "are discussed in public and the media" and as "beliefs and values concerning a particular policy" (Baumgartner and Jones, 1991: 1045-1046). It differentiates only between "images that are favorable to proponents of a given policy

and those that are detrimental". For example, Baumgartner and Jones suggest that "[f]or nuclear power, these distinctions are simple: positive images are growth, jobs, high-technology solutions; negative images are mushroom clouds, waste, leaks[3]" (Baumgartner and Jones, 1991: 1046). This simplification may stem from examining historical material through the lens of the present-day antagonistic storylines about nuclear power. But while the mushroom cloud has indeed largely been a 'negative image' of nuclear power throughout most of its history, this was not always the case, especially in the United States. There, alongside death and destruction, it also signified mystery and technological superiority, especially in the years immediately after WWII where the US had a monopoly on both the knowledge and the materials to create nuclear weapons. These framings of the mushroom cloud competed for dominance, with the threat of nuclear destruction by the Soviet Union from the early 1950s onward eventually 'helping' the negative image of the mushroom to win. Figures 2.3.2 and 2.3.3 show that positive images of the mushroom cloud were still used well into the 1950s.

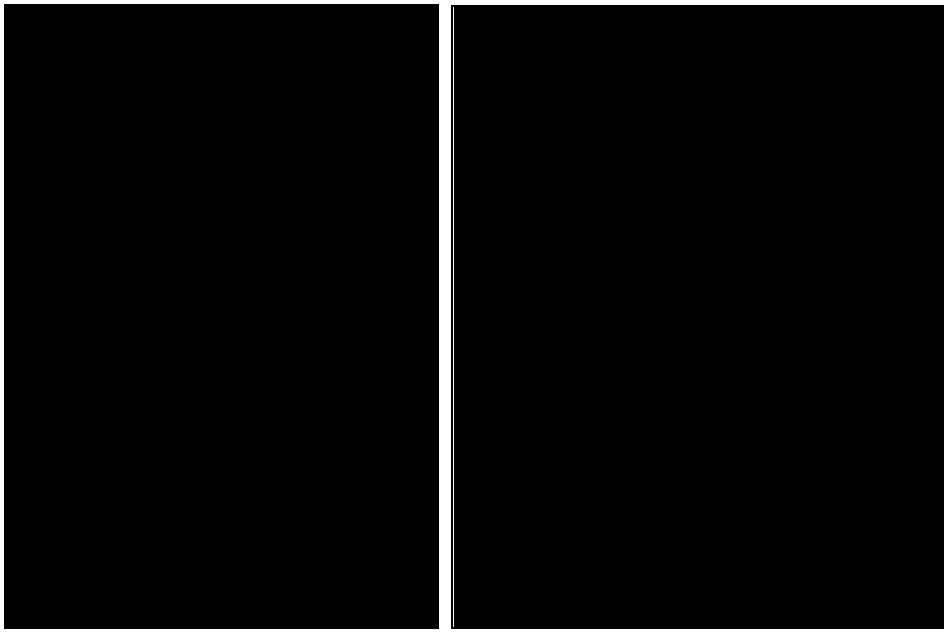


Fig. 2.4.2 Advertisement for Marvel Mystery Oil, an engine lubricant, which prominently features a nuclear 'mushroom cloud'. Source: Mechanix Illustrated, February 1952 (p. 169).

Fig. 2.4.3 Lee Merlin, the last "Miss Atomic Bomb", 24 May 1957. Las Vegas News Bureau (photographer: Donald English). Source: Wikimedia Commons.

[3] The theory was initially developed to explain policy processes in the United States, and as such has been applied primarily to cases involving American policymaking. However, there is a growing evidence base that suggests the underlying processes of punctuation are present in the policy domain for other countries as well (e.g. Timmermans and Scholten, 2006).

Punctuated equilibrium theory sees 'positive image' of a technology as 'ways in which it is discussed in the media and in the public' or 'beliefs or values about a technology' which are favourable to its proponents. This is similar to the concept of cultural legitimacy, which is about (the beneficial effects of) the perceived appropriateness by wider society in terms of widely held beliefs and values, but because does not go into the cultural *construction* of images: it simply assumes the existence of positive and negative ones. What punctuated equilibrium theory does offer, however, is a concrete mechanism through which cultural legitimacy (i.e. the 'image' of a technology) can affect relevant policy. This is relevant for my third research question, because it explicitly theorizes on the relation between cultural legitimation and policy: it articulates a mechanism through which the cultural legitimacy of an innovation can affect relevant policy.

Beyond providing this insight for my third research question, punctuated equilibrium theory also offers some interesting methodological insights. Research into the punctuation of policy equilibria typically uses a combination of quantitative and qualitative methodologies. Quantitative indicators (such as government spending numbers, numbers of congressional hearings or newspaper articles on certain topics) are used to find those critical moments in time where a policy equilibrium was punctuated. Subsequently, qualitative methodologies (e.g. narrative methods) are used to closely examine the period leading up to the punctuation as well as the periods of dramatic deviations from previous trajectories. I revisit this combination of quantitative and qualitative methods in Chapter 3.

2.4.5 Analysis and conclusions

Specific insights

The above theories of the policy process offer partial insights into how openly antagonistic (i.e. public) discursive struggles can lead to societal issues appearing on political agendas and, in some cases, translate into policy change that affects innovation journeys. This subsection summarizes these insights into the relation between cultural legitimacy and policy:

- To become influential, a discursive struggle about a specific innovation will have to capture public attention: it will have to become a 'societal issue'. But public attention is a scarce commodity, and at any given time, different issues in the social sphere compete for it. News media are an important stage for the competition between issues, so that the attention to certain issues in such outlets as newspapers can be used as an indicator for public attention for an innovation.
- But news media are not objective conduits for news: the media have (political) agendas, too. News media both reflect and shape public attention and meaning-making around innovations, which means that they are not perfect indicators of public attention. Yet because of their prevalence in contemporary society, they are

likely the best available indicator for public attention to broad issues over extended periods of time (Newig, 2004).

- The issue-attention cycle argues that societal issues typically emerge as a result of 'alarmed discovery'. For innovations, this means that their cultural legitimacy can become contested when dramatic events create public awareness of some problem. The resulting anxiety is often eased by proposing a technical fix. If the problem turns out to be of a structural nature, the true cost of progress will become evident only later, and can lead either to the establishment of new institutions and policies to solve the problem, or to a return to normal if public attention for the issue fades even though it is not solved.
- The multiple streams framework further articulates the mechanisms by which some 'problems' become 'policy' (and explain why others do not). It argues that at any given time, the sum total of all socially constructed problems can be seen as a 'problem stream'. Similarly, a 'policy stream' at any given moment contains many solutions (some of which do not even address any concrete problem in the problem stream) articulated by experts, while the 'politics stream' contains such elements as national mood and upcoming elections.
- Actors dubbed 'policy entrepreneurs' can strategically couple these streams, attaching problems to their preferred solutions at opportune moments (e.g. in response to 'focussing events') and presenting them to their (political) audiences (Zahariadis, 2007), thereby increasing the chance that their preferred solution will be translated into policy (Kingdon, 1995).
- The *order* in which solutions are considered, influences the outcome of policy decisions (Zahariadis, 2007: 68). The importance of the timing and flow of events is important is a feature of process theories, which assume that the social world is made up of entities (people, organizations, technologies) that participate in sequences of events.
- From the perspective of the policy entrepreneur, the purpose of the coupling of streams is self-interest. But doing so creates meaning for policy makers faced with ambiguous situations: policy entrepreneurs are "manipulators of problematic preferences and unclear technology" (Zahariadis, 2007: 74). In discourse theory terminology, this can be seen as a strategic attempt to enroll policy makers into a particular discourse coalition around an innovation (see: section 2.2.6).
- The multiple streams framework only emphasizes the agency of policy entrepreneurs, conceptualizing the agency of other actors (e.g. social movement organizations) primarily as contributing to the politics stream (e.g. through political lobbying). However, I argue that such actors can also contribute to the problem stream (e.g. by framing situations as problematic and performing their storylines on public stages, creating awareness), to the policy stream (e.g. by contributing to

public consultations), and to linking these streams together (e.g. by arguing for specific solutions to their perceived problems in the media).

- The multiple streams framework assumes that politicians select the solution-problem combinations furthered by the most successful policy entrepreneurs without being weighed down by previous choices. Others have argued, however, that this would lead to capricious and unstable policy processes, while policy processes in fact typically display long periods of stability and lock-in, occasionally interrupted by radical changes (True *et al*., 2007).

- The punctuated equilibrium model of policy change simultaneously explains such long periods of stability and incremental change, and short bursts of radical change. It argues that attention is just as scarce for governments as it is for the wider public, and that as such, issues are routinely delegated to various policy subsystems for parallel processing. Because of the typically opaque, expert-dominated, and conservative (i.e. resistant to change) nature of these subsystems, policy change is typically incremental.

- But at certain points in time, societal issues may generate more (or more intense) discourse than at others. Following Chilton (1978), Gamson and Stuart (1992) and Lehtonen and Martiskainen (2010), I will refer to such periods of increased commentary and debate during an ongoing broader issue as ‘critical discourse moments’.

- It is during critical discourse moments that policy equilibria can be punctuated: when the cultural legitimacy of an innovation becomes openly and vehemently contested, an issue can climb to the top of the political agenda. If this happens, macro-political institutions (e.g. parliaments) feel pressure to act by making changes in aforementioned subsystems, or risk the legitimacy of their authority. This can then result into radical policy change.

- To explain how issues climb the political agenda, punctuated equilibrium theory introduces the concept of 'image', which in the case of an innovation involves *how that innovation is discussed in public and the media*, as well as *the beliefs and values concerning that innovation*. It distinguishes between 'positive images' and 'negative images', which discourse theory might call two antagonistic discourses about an innovation.

- If the image of an innovation is generally positive, the innovation has high cultural legitimacy, which leads to a situation where the policy subsystem which regulates that innovation is essentially unquestioned: a policy monopoly. But if opponents successfully further negative images and the positive image becomes contested, this policy monopoly comes under attack, forcing macro-political institutions to act.

Transcending the insights

The above insights present a heterogeneous and fragmented perspective on the relation between cultural legitimacy and policy. In search of a way to transcend this fragmentation and unite them into a more comprehensive and general perspective on the relation between culture and policy, I now turn towards neo-institutional theory (a sociological theory which concerns itself with how institutions shape and are shaped by society, e.g. DiMaggio and Powell (1991) and Scott (2001)), and more specifically towards *discursive institutionalism.* As a reaction to rational choice institutionalism (which argues that boundedly-rational actors seek to maximize utility through institutions) and historical institutionalism (which emphasizes path-dependency and lock-in), discursive institutionalists emphasize the role of *ideas* and *discourse* in politics (Schmidt, 2008: 1). Discursive institutionalism argues that "institutions consist of discursive elements that shape political and economic perceptions, the definition of actors' interests and, ultimately behaviour" (Campbell, 2001: 6) or more generally, that discourse matters in policy (Schmidt and Radaelli, 2004). Moreover, it argues that to answer the question of the relation between discourse and policy, researchers should "develop a cultural analysis of the meanings attached to particular institutional arrangements" (Campbell, 2001: 131). This 'cultural analysis of meanings' should distinguish between coordinative discourse and communicative discourse (Schmidt, 2008; 2002). Coordinative discourse (which takes place between policy actors) constructs innovation policies, while communicative discourse (which takes place between political actors and civil society) conveys these innovation policies to the general public (Schmidt, 2002). However, communicative discourse consists not only of policy actors attempting to sell specific innovation policies to wider society (i.e. the construction of cultural legitimacy), but also of wider society reacting to this (i.e. the contestation of cultural legitimacy; see: figure 2.4.1).

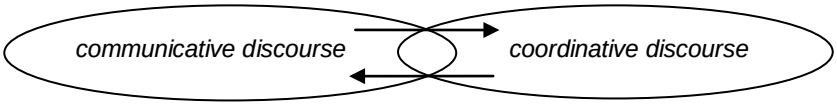


Fig. 2.4.1 Schematic representation of discursive institutionalism. The overlapping area signifies the possibility of actors operating in both spheres. Adapted from: Schmidt (2002: 232).

So, through a discursive institutionalism lens, the question of the relation between cultural legitimacy and policy becomes one of the relation between communicative discourse and coordinative discourse. Unfortunately, discursive institutionalist studies have shown that the degree to which communicative discourses and coordinative discourses are coupled (and the way they are utilized in the policy process) differ between countries to the point of idiosyncrasy:

> [D]iscursive institutionalism (...) views the relation between discourse and institution as historically contingent – as the outcome of specific ways of situating and organizing discursive practices in a society (Campbell, 2001: 227)

This renders it difficult to incorporate the above insights with regard to the relation between cultural legitimacy and policy (i.e. between communicative and coordinative discourse) up into the general analytical perspective that theorizes on the mechanisms and phases of cultural legitimacy. Yet this does not mean that my third research question has to be abandoned completely. Instead, I will use the insights from the above discussion as sensitizing concepts for the empirical research.

Sensitizing concepts

The analytical perspective articulated in section 2.2 is rooted in narrative theory, and uses concepts derived from literature to structure empirical material (i.e. real-world innovation journeys) and subsequently draw conclusions about the mechanisms and dynamics of cultural legitimation in innovation journeys. The analytical perspective thus functions as an interrelated set of (more or less) *definitive concepts* which provide "prescriptions of what to see" (Blumer, 1969: 148). In contrast, the lessons learned in this subsection will function more as a loose collection of analytical heuristics (Geels and Schot, 2010) or *sensitizing concepts*, which provide "a general sense of reference and guidance in approaching empirical instances" (Blumer, 1969: 148). Sensitizing concepts are often used in 'grounded theory' approaches, which rely on inductive data analysis for purposes of theory construction (Glaser and Strauss, 1967). Their purpose is to sensitize a researcher to a particular question (Van den Hoonaard, 1997; Titscher *et al.*, 2000, Charmaz, 2006: 16). With regard to the question about the relation between cultural legitimacy and policy, this dissertation adopts a similar approach: instead of directly answering the third research question, it aims to 'reverse engineer' substantial new hypotheses about that particular question based on the empirical material in Chapters 4 and 5. The issue of the currently elusive relation between cultural legitimacy and policy in innovation journeys is thus revisited in this dissertation' final chapter. Based on the empirical cases of Chapters 4 and 5, that chapter proposes a tentative perspective (rooted in discursive institutionalism) for systematically investigating that relation.

Chapter 3: Epistemological and methodological basis

This chapter elaborates on this dissertation' ontological and epistemological orientation, on the approach it adopts (i.e. its research design and types of sources), and on its methods of analysis. With regard to the latter aspect, the specific combination of qualitative techniques and quantitative techniques (i.e. occurrence and co-occurrence bibliometrics) for construction narrative explanations renders this methodological chapter a contribution to innovation journeys literature unto itself.

3.1 Ontology and epistemology

Burton-Jones *et al*. (2004) argue that "[a]cquiring knowledge about phenomena requires one to assume a particular approach" and that the choice of this approach can be based on one's ontological or epistemological assumptions (Burton-Jones *et al*., 2004:15). Because these assumptions form integral parts of the methodology of any study, the following subsections will address the ontological and epistemological assumptions underpinning this dissertation, and conclude that a process model best fits the ontological and epistemological assumptions underpinning my research questions.

3.1.1 Ontological orientation

Ontological assumptions are assumptions about the 'nature of reality'. They reflect beliefs about what the social phenomenon of interest is 'made of' and how it works (Bennett and Elman, 2006, in: Kern, 2009). For my research interest, the relevant ontological assumptions are thus assumptions about the nature (and workings) of cultural legitimacy.

The key ontological consideration for this dissertation involves the question of whether to view the phenomenon of interest as a constellation of *things* or as a constellation of *processes*[4]. Van de Ven and Poole (2005) illustrate this ontological distinction by showing how in organizational research, these two orientations result in two different kinds of studies: studies into organizations as concrete social actors, and studies into the organizing process. A similar argument holds for cultural legitimacy:

- The (usually firm-level) approaches in organizational, strategic management and innovation studies literatures typically treat cultural legitimacy as a kind of 'intangible resource' that is derived from culture (Suchman, 1995) and that can help in overcoming the 'liability of newness' (Stinchcombe, 1965; Singh *et al*., 1986) by attracting other, more tangible, resources (Zimmerman and Zeitz, 2002, Van de Ven *et al*., 2008). The ontological assumption is one of cultural legitimacy as a 'thing' (albeit an immaterial one) which an organization or innovation can either

[4] Van de Ven and Poole (2005) trace this dichotomy back to the orthogonal philosophies of, respectively, Democritus and Heraclitus).

possess or not. This ontology has resulted in a bias towards questions about the *effects* of an innovation (not) possessing cultural legitimacy (the 'noun').

- Alternatively, as I addressed in Chapter 1, cultural legitimacy can be viewed as a transient (i.e. temporary) condition produced through a socio-cultural process in which actors attempt to render innovations either appropriate or inappropriate. Moving away from a reification of cultural legitimacy, this view argues that cultural legitimacy is not a 'thing', but a condition or state reflecting a process at a particular point in time. For example, Scott (2001) argues that

  > (…) legitimacy is not a commodity to be possessed or exchanged, but a condition reflecting perceived consonance with relevant rules and laws, normative support, or alignment with cultural-cognitive frameworks (Scott, 2001: 59).

  In this view, cultural legitimation (the process) is fundamental and cultural legitimacy (the apparent thing) is derivative, because it arises only as the result of the "varied and fluctuating" (Van de Ven and Poole, 2005: 1378) process of construing

  > (…) an innovation as consonant with and linked to the existing widely accepted cultural framework of beliefs, values and norms" (Johnson *et al*., 2006).

  This ontology results in an analytical focus on cultural *legitimation* (the 'verb') and a bias towards questions about the *production* of cultural legitimacy (the 'noun').

This dissertation in concerned primarily with the process of cultural legitimation and how it is constructed, maintained, and contested. Therefore it adopts a 'process ontology' with respect to cultural legitimation in innovation journeys.

3.1.2 Epistemological orientation

While ontology deals with the 'nature of the social world', epistemology deals with how we can *understand* that social world. Epistemological assumptions, then, are assumptions about 'ways of understanding'. Van de Ven (2007) usefully distinguishes two basic scientific models which rest on fundamentally different epistemologies: a variance model and a process model. The following subsections briefly address these basic models and their corresponding epistemologies, position this dissertation's epistemological assumptions as corresponding to those of the process model, and argue for the identification of mechanisms as the key to understanding cultural legitimation.

3.1.2.1 Variance and process models: different epistemological assumptions

The two basic models are typically used for addressing two very distinct types of research questions: *what* are the consequences of an issue under study, versus *how* does that issue emerge, develop, grow, or terminate over time (Van de Ven, 2007: 147; Van de Ven and Poole, 2005):

- The majority of social science research has traditionally focused on answering questions of the what-type (Van de Ven, 2007: 145), and these 'what-questions'

have typically been addressed with variance models. Variance models depend on variables that represent the key aspects of an issue. They seek out statistically significant relationships between causes (independent variables) and outcomes (dependent variables), often using methods such as experiments and surveys. Explanations take the shape of (generally linear) causal models that incorporate these variables ("X causes Y") and require the presence of co-variation and absence of spurious relations. Poole *et al.* (2000) describe several (usually implicit) epistemological assumptions of variance methods, e.g. that all significant changes in the issue under study can be captured by variables, that chronological order in which independent variables affect dependent variables doesn't matter, and that variables have one and the same meaning throughout the period under study (see also: table 3.1.1). Although variance methods can be powerful tools and form the cornerstone of much social science research, these assumptions limit their applicability to certain kinds of problems and research interests (Van de Ven, 2007: 151).

- Conversely, questions about *how* change processes occur are often addressed with a *process model* instead. It should be noted that the word 'process' here does not refer to 'a method of doing or producing something', such as in 'a manufacturing process'. Instead, it refers to "a narrative describing how things develop and change" (Van de Ven, 1992), e.g. as in the term 'the civilizing process' (Elias, 1939). Process models view the social world as being made of entities that participate in sequences of events[5]. To understand how processes of change unfold,

  > (…) rather than first generalize in terms of variables, researchers should first generalize in terms of a narrative history or a *story* (Van de Ven, 2007: 197).

Variance and process models thus have different epistemological assumptions. Table 3.1.1 summarizes the key epistemological assumptions for these basic models. It is important to note that one's ontological orientation does not determine one's basic model. While a 'process ontology' (of the social world as a constellation of processes) may seem to necessitate a 'process model' (with its related epistemological assumptions), this is not necessarily the case. For example, Van de Ven and Poole (2005) mention dynamic agent-based modeling and chaotic complex adaptive systems as examples of *variance models* with underlying *process ontologies* (i.e. viewing organizations as 'emergent and fluctuating processes of organizing' as opposed to 'collective social actors').

Even so, the process model is ideally suited for answering this dissertation's research questions about cultural legitimation: not just because I view cultural legitimation as a

[5] It should be noted that 'events' in this context do not refer to exogenous occurrences or incidents. Instead, events are what key actors *do* or what happens to them (Van de Ven, 2007).

process, but also because the process model's epistemology 'allows' focal actors to change identity (and events to change in meaning) over time as a result of cultural action by focal actors.

Variance model	Process model
Explanations based on efficient causality	Explanations based on final, formal, and efficient causality
Generality depends on uniformity across cases/contexts	Generality depends on versatility across cases/contexts
Time ordering among independent variables is immaterial	Time ordering of independent events is critical
Emphasis on immediate causation	Explanations are layered and incorporate both immediate and distal causation
Attributes have a single meaning over time	Entities, attributes, events may change in meaning over time

Table 3.1.1 Key epistemological assumptions of variance and process approaches. Source: Van de Ven, 2007: 150.

3.1.2.2 Process epistemology: understanding through mechanisms

In spite of their focus on narratives instead of variables, the objective in process models is explicitly *not* to simply write stories containing sequences of events (i.e. case histories) that describe, in Arnold Toynbee's famous words, 'one damn thing after another'. Instead, the objective is to produce *analytic chronologies* which explicitly attempt to interpret and explain (Pettigrew, 1990) the process under study:

> (…) to describe a process, one needs event sequences. But to *explain* a process one needs to identify the generative structures that enable and constrain it (Pentland, 1999: 722).

Process research thus aims at an "event-driven *explanation* of the temporal order and sequence in which a discrete set of events occur based on a historical narrative" (Van de Ven *et al*., 2008:145). It relies on narrative methods, because these can capture fuzzy, unfolding processes (Abbott, 1992). Van de Ven (2007) argues:

> Explanation requires a *story*, and stories can be understood as process theories (…) [T]he story is an abstract conceptual model; it identifies the generative mechanisms at work (Van de Ven at al., 2007: 223).

The objective for process research, then, is to turn case histories into case studies by telling stories which identify generative mechanisms. Process models are *mechanism-based explanations:* a style of theorizing that has received considerable attention in the past decade in the social sciences (Hedström and Ylikoski, 2010; Norkus, 2005; Machamer *et al.,* 2000). Mechanism-based explanations focus not on statistical explanation but rather on "the cogs and wheels of the causal process through which the

outcome to be explained was brought about" (Hedström and Ylikoski, 2010: 50). Their goal is to turn *possible* social mechanisms into *plausible* social mechanisms by using empirical evidence (usually case studies) to support their assumptions. Like any narrative, a mechanism-based explanation, describes reality selectively:

> It does not aim at an exhaustive account of all details but seeks to capture the crucial elements of the process by abstracting away the irrelevant details (Hedström and Ylikoski, 2010: 53).

The term 'mechanism' sometimes attracts criticism because of its deterministic connotation. The social mechanisms such theories seek to uncover, however, do not necessarily *determine* the outcome of whatever the mechanism is for. Hedström and Ylikoski use the analogy of a roulette wheel to explain:

> [A] standard roulette wheel does not have different mechanisms for distributing the ball to pockets 16 and 17. Rather, the same mechanism produces all 37 outcomes (Hedström and Ylikoski, 2010: 50).

Similarly, Van de Ven argues that

> within the same narrative framework, the particular histories of individual cases may lead them to take different paths to different outcomes. To subsume these differences under a common theory, it is necessary to show how the sequence of events for each case resulted in a unique causal history that caused the narrative to unfold in different ways (Van de Ven, 2007: 157).

Thus, the *same* generative social mechanism can produce *different* outcomes. Because "differences in temporal order can make large differences in outcomes" (Van de Ven, 2007: 157), different exogenous events or even different actor strategies between cases can make the case histories play out very differently, possibly in spite of the same underlying mechanism. A process study may conclude, for example, that a particular process typically proceeds through a specific number of identifiable phases, but that the precise sequence of phases, or the time-span in which the process remains in a certain phase, varies greatly between cases (e.g. Van de Ven *et al.*, 2008; 1989). The underlying *mechanism*, then, is what drives the progression *through* the phases, which themselves represent coherent periods of activities into which specific events were 'parsed' by the process researcher. The various *ways* in which the process can proceed through these phases represent the *dynamics* of the process. If these can be grouped into (a small number of) distinct trajectories, we could speak of *patterns.* To tease out such patterns, a case study approach is often used (Tsoukas, 1989). In the next section about research design, I will elaborate on the case study approach.

3.2 Case study approach

My research questions are of the type *how is cultural legitimacy is created in innovation journeys?* Such 'how' questions deal with operational links over time, instead of mere frequencies or incidence and thus favor the use of case studies over other qualitative methods such as surveys or case histories (Yin, 2009: 9-10). Because I conceptualize

the cultural legitimation process during innovation journey as a relatively long series of contingent, historical events which needs to be traced over time and over which I have no control, the case study approach is preferable (Yin, 2009: 13).

For finding mechanisms and patterns in processes, researchers commonly turn to comparative idiographic explanatory case studies. Idiographic case studies are not geared towards finding general laws that explain objective phenomena (cf. nomothetic), but towards finding relevant patterns and explaining the similarities and differences between cases:

> idiographic explanatory studies shed light on the specific contingent conditions under which the postulated generative mechanisms combine and operate (Tsoukas, 1989: 555)

Similarities between cases are explained by

> the generative mechanisms and the similar type of contingencies that have been responsible for the mechanisms' activation (Tsoukas, 1989: 555)

Conversely, differences between cases are attributed

> either to the operation of different generative mechanisms or to the dissimilar contingencies within which the operation of a similar set of mechanisms has taken place (Tsoukas, 1989, 555)

The overall case study design and the criteria for selecting specific cases are explained in the next subsection.

3.2.1 Case study design and selection criteria

As stated in the previous subsection, my interest in patterns necessitates a comparative case study design. Specifically, I opted for a *multiple-case design* resulting in a *cross-case analysis* (Yin, 2009: 20). Unlike single case research designs, this design allows for the discovery of patterns (Tsoukas, 1989), such as the existence of similar phases in the dynamics of cultural legitimation between cases. Moreover, a multiple-case design negates some of the common criticisms about the generality of conclusions drawn from single case studies[6] (Yin, 2009: 62).

For qualitative methods, sampling is typically strategic rather than random (Gray, 2004). This is not problematic for process research, because unlike for variance research, the goal is not to generalize from these samples to populations (see also: table 3.1.1). Various strategic sampling methods are available for qualitative multiple case design, and their choice depends largely on one's research interest (e.g. Patton, 2002).

[6] It should be noted, however, that process models employ different criteria for generality than variance models do. Conclusions drawn from them should accordingly be judged by their versatility across cases instead of their uniformity across contexts (Van de Ven, 2007, see also: table 3.1.1).

This dissertation explores the cultural legitimation of a technology during its innovation journey (i.e. the long, uncertain and non-linear processes of its embedding in wider society, the market and the regulation environment). For most innovations, the majority of which are incremental in nature, the cultural legitimation process is relatively uncontested to all but perhaps a small group of actors. For this reason, cultural legitimation processes can be expected to be relatively opaque, and therefore difficult to study, for 'typical' or 'representative' cases of innovation journeys.

One way to solve the problem of difficult-to-perceive (but arguably important) mechanisms is to select cases by *extreme case sampling*. Extreme case sampling is a strategic case selection method that entails choosing cases that offer extreme manifestations of the phenomenon of interest:

> When the objective is to achieve the greatest possible amount of information on a given problem or phenomenon, a representative case or a random sample may not be the most appropriate strategy. (…) [E]xtreme cases often reveal more information because they activate more actors and more basic mechanisms in the situation studied. (Flyvbjerg, 2006: 229)

Extreme case sampling involves learning from highly unusual manifestations of the phenomenon of interest, such as outstanding successes versus notable failures, or in terms of an analogy: top-of-the-class students versus drop-outs (Patton, 2002). But while it is a good strategy for finding information on otherwise opaque mechanisms, a major danger of extreme case sampling is generalization from these extreme cases (Gray, 2004: 325). Extreme cases can be so unusual that they provide a distorted portrayal of the phenomenon of interest (Rubin and Babbie, 2010: 150). Extreme case sampling thus compromises the generality criterion for process research of 'versatility across cases/contexts' (see also: table 3.1.1).

The research design aims at a compromise between 'visibility of cultural legitimation processes' and 'versatility across cases' by using the strategic multiple case selection method of *intensity sampling*. This involves selecting information-rich cases that manifest the phenomenon of interest intensely, but are nevertheless more typical than the absolute extremes (Patton, 2002; Gray, 2004). In terms of the above analogy, one would thus choose study above-average versus below-average students (instead of top-of-the-class versus dropouts) to study some hypothesized mechanism of learning. For this dissertation, then, the cases are selected to provide 'intense' manifestations of cultural legitimation in innovation journeys, in order to be able to more clearly discern its underlying generative mechanisms[7].

[7] The selected cases will thus also function to some degree as *critical cases* (Yin, 2009: 48; Flyvbjerg, 2006), in the sense that if the mechanism cannot be demonstrated in innovation journeys where cultural legitimation is 'intensely' present, then they cannot be expected to be present in *any* innovation journeys.

Moreover, because I am also interested in the relation between cultural legitimacy and *policy* in the context of innovation journeys, the selected cases should also provide 'intense' manifestations of interaction between cultural legitimacy and the policy domain. Because policy is an especially important dimension in the type of technological innovation pattern that Pavitt (1984: 370) characterizes as "purchases by government and utilities of expensive capital goods related to defence, energy, communications and transport", the selected innovation journeys should be from one of these sectors.

3.2.2 Case selection: nuclear power in The Netherlands and the UK

The context selected for the specific cases in this dissertation is civilian nuclear power. As is often the case for qualitative methods, this selection was not planned in advance (Gray, 2004: 324), but surfaced as a promising and viable context after some initial empirical work. The nuclear power innovation journey was embarked upon by many countries immediately after WWII, variously being considered a necessity for meeting future electricity demand, an opportunity for building a national industry, and an innovation which would showcase techno-scientific prowess on the world stage. After the first commercial reactor was opened in 1956 in the UK, diffusion slowly took off, and accelerated over the 1970s and early 1980s. From the late 1980s onward, the worldwide total installed capacity leveled off, increasing only marginally ever since (see: figure 3.2.1).

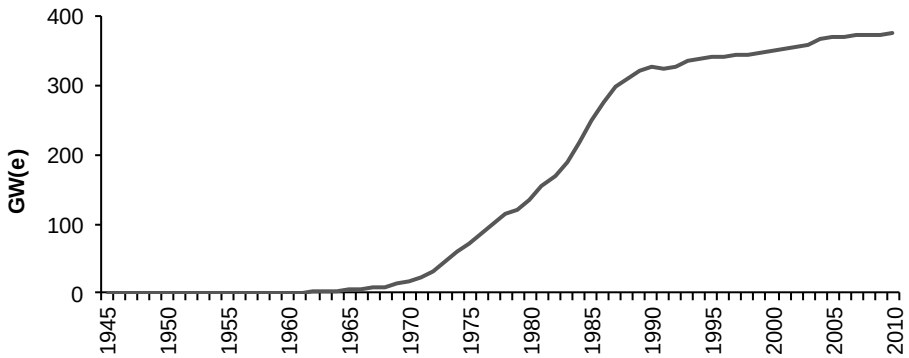


Fig. 3.2.1 Worldwide installed nuclear capacity (in GWe) over time. Compiled by author from different sources: EIA, www.wordwatch.org, www.world-nuclear.org.

Given the complexity and long time-frame of nuclear innovation journeys for specific countries, in combination with the time-consuming nature of processing the large amount of empirical material over that period, doing two in-depth case studies was deemed to be the maximum achievable number for this dissertation. Although additional cases would increase the robustness of the study, any analytic conclusion drawn from two cases which are selected because they offer contrasting situations, already represents a strong start towards replication and vastly strengthens the findings

compared to those from a single case (Yin, 2009: 61). This does however require a meticulous selection of the countries whose nuclear innovation journeys are studied.

In 2005, 31 countries had operational commercial nuclear power plants, which together provided some 15% of the world's electricity (IEA, 2007). Large differences between these countries exist both in their absolute nuclear power generation and in the share of nuclear power relative to the country's total electricity production. In absolute terms, the USA, France and Japan are (respectively) the world's largest nuclear power producers: together they were responsible over 56% of the total nuclear generating capacity in 2005 (IEA, 2007). In relative terms, France has the world's highest penetration of nuclear power: almost 80% of its total electricity production comes from nuclear[8].

If one were to use a two case design based on an *extreme case sampling* logic, one would select the biggest success and contrast it with the largest failure. France presents itself as a candidate on one extreme: it is both the second largest absolute producer (second only to the USA) as well as the largest relative producer of nuclear power (relative to its total domestic electricity production). For this reason, France is popularly hailed as the world's main nuclear success story (e.g. *The Ledger*, 14 August 2008). On the other extreme, a country would then be selected which had concrete nuclear power ambitions, as well as access to the necessary technical, financial and natural resources, but in which a nuclear power program never materialized (e.g. Australia); or a country which had a nuclear power program, but abandoned it (e.g. Italy). But while extreme cases maximize the information obtained about the relation between cultural legitimation and innovation journeys, they risk being exceptional to the point of deviancy. This increases the chance of the cases painting a distorted picture of cultural legitimation in innovation journeys, and endangers the generality of any findings.

As stated in the previous subsection, *intensity sampling* offers a compromise. Cases should then be selected not at the extremes of the spectrum (e.g. 'largest nuclear producers' versus 'no nuclear power program') but rather at more moderate, yet still contrasting, points of the spectrum (e.g. 'above average nuclear producer' versus 'below average nuclear producer'). Ruling out a two-case study that compares any of the top 3 nuclear power producers (USA, France, Japan) with a country that does not currently use nuclear power still leaves many options. For choosing from these, practical considerations come into play, as well. Creating an explanatory narrative about a culturally and politically contested process protracted over more than six decades requires access to a large amount of very heterogeneous empirical material. Subsequently interpreting these materials (such as cartoons, brochures, posters etc.)

[8] Lithuania, the only country with a similarly high percentage of nuclear power in 2005, owes this to a combination of having a single large nuclear power plant and a relatively low total electricity production. This serves to show that it is necessary to look at absolute production as well.

requires proper contextualization and a more than passing familiarity with the culture and language of the case.

Factoring in the above theoretical and practical considerations, I opted for the civilian nuclear power innovation journeys in The Netherlands and the United Kingdom. A comparison of the UK to The Netherlands follows an intensity sampling logic:

- At its peak, the UK produced some 27% of its electricity through nuclear power and by 2005, in spite of the decommissioning of old plants which were not replaced, this figure was still at some 20%. In combination with its early head start (the UK built the world's first commercial nuclear power plant) and its position in the top 10 of worldwide nuclear power producers in absolute terms, this renders the UK an *above average* player in terms of nuclear power.

- Conversely, The Netherlands only ever managed to construct two nuclear power plants, one of which was essentially a test facility which was shut down in 1997. In The Netherlands, the contribution of nuclear power to domestic electricity production was never more than 7% and by 2005 had dropped to some 4% (mostly due to increasing production from other sources). In both absolute and relative terms, The Netherlands rank near the bottom of nuclear power producing nations, making it a *below average* player in terms of nuclear power.

  Even though the cases are not at the extremes in terms of innovation journey outcomes, a preliminary scan (see: Box 3.1) showed that the cases do in fact intensely display the phenomenon of interest (i.e. a very dynamic cultural legitimation process). Both nations articulated very ambitious plans in the 1950s to substitute large portions of the extant electricity generating capacity with nuclear fission reactors. In both cases, nuclear power enjoyed a singularly high cultural legitimacy (i.e. perceived appropriateness in terms of societal norms, values and beliefs) in this period. And in both cases, this cultural legitimacy became contested in the subsequent period. Again in both cases, actual implementation fell far short of expectations and the technology disappeared from the policy agenda from the late 1980s onward, after which it acquired renewed cultural legitimacy in the context of the climate change debate. These heavily fluctuating dynamics of the cultural legitimacy of nuclear power, combined with the very public nature of its contestation, should provide a good view of the basic mechanisms of the cultural legitimation process.

The next subsection will elaborate on the sources used for analyzing these two cases, as well as the methods of analysis.

Box 3.1: A brief case history of Dutch and British nuclear power (1945-2010)

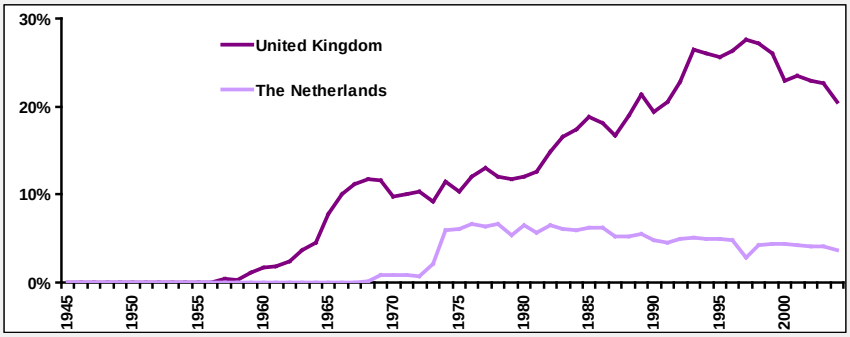


Fig. 3.2.2 Contribution of domestic nuclear power to total electricity production (BERR / CBS)

In the UK, nuclear power was initially developed as a (literal and metaphorical) by-product of the production of nuclear weapons. Because of their involvement in the Manhattan Project, UK scientists had an epistemic advantage to most countries with similar ambitions, but were excluded from cooperation with the USA following the McMahon Act. A postwar coal shortage, exacerbated by the Suez crisis, led to an ambitious and demilitarized nuclear power program. A series of home-grown designs were chosen over American designs, and the UK began implementing civilian nuclear power relatively quickly. Many problems were encountered throughout the process: the plants were riddled with technical and economic problems. Concerns about nuclear power blew over from the USA in the 1970s, but these were effectively channeled into a series of public inquiries about specific (proposed) nuclear power plants, after which any concerns were typically dismissed. While the Chernobyl accident led to societal outrage, it had no discernable effect on nuclear policy. When political developments in the late 1980s and early 1990s necessitated the privatization and liberalization of the electricity sector, the record of the technology's bad economic performance became public. Nuclear power seemed to have run its course, until it was revived in recent years as a means to mitigate the effect of climate change while solving an anticipated future energy gap resulting from the closure of end-of-life existing plants.

In The Netherlands, the ambition to possess nuclear weapons appears never to have been present in the political arena. The scientific community dominated nuclear policymaking in the immediate postwar period. The Suez crisis legitimized an ambitious plan and in spite of the discovery of large domestic fossil fuel reserves, nuclear power continued to be seen as the future in policy circles. A pilot plant was built, but conflicts over responsibilities postponed the construction of a full-size plant, until an electricity sector actor unilaterally decided to construct an American-licensed design. Policy changes were made, aiming to prevent similar situations in the future and nurture a domestic nuclear industry. At the same time, growing concerns about nuclear power safety coalesced into an antinuclear movement after a nationwide levy for financing a Dutch-German-Belgian nuclear joint venture. Because of aforementioned policy change, antinuclear sentiments were able to create a stalemate. Government initiated a broad societal discussion on (nuclear) energy policy, aiming to overcome this stalemate. While its results (condemning new construction) were initially overturned by government, the Chernobyl accident resulted in a postponement of nuclear construction that lasted until the present (2010). Nuclear power thus became a political taboo until recently, when it made a discursive comeback in the context of the climate change debate.

3.2.3 Sources of evidence

This subsection elaborates on the sources used in this dissertation. One principle of data collection for case study research is the use of multiple sources of evidence, which not only allows a researcher to address a broader range of issues, but also increases the robustness of any findings through triangulation and converging lines of inquiry (Yin, 2009:114-115). Yin (2009) lists documents, archival records, interviews, physical artifacts, direct observations and participant observations as possible of sources of evidence for case studies. While the last two are not applicable to historical case studies, the first four can be (and are) used. In this dissertation, archival records (e.g. news articles, newspaper cartoons) and physical artifacts (e.g. protest buttons, stickers, posters) are treated as primary sources. Documents and interviews can serve both as primary sources (e.g. policy documents, interviews with focal actors) and secondary sources (e.g. pre-existing studies about the topic of interest, interviews with scholars).

3.2.3.1 Secondary sources

The first step towards a case study of cultural legitimation of nuclear power is constructing a case *history* of nuclear power developments (i.e. a descriptive chronology of relevant events). For the case histories of Dutch and British nuclear power, this dissertation relies on secondary literature such as academic and non-academic histories of aspects related to the case, such as histories of nuclear power, relevant institutions, and anti-nuclear movements. Key histories include:

- Flam, H. 1994. *States and Anti-nuclear Movements.* Edinburgh: Edinburgh University Press.
- Gowing, M. 1974. *Independence and Deterrence: Britain and Atomic Energy, 1945-52.* Volume 1: Policy Making. London: Macmillan Publishing
- Gowing, M. 1974. *Independence and Deterrence: Britain and Atomic Energy, 1945-52.* Volume 2: Policy Execution. London: Macmillan Publishing
- Hall, T. 1986. *Nuclear Politics: The History of Nuclear Power in Britain.* Bungay, Suffolk: Richard Clay (The Chaucer Press).
- Herring, H. 2005. *From Energy Dreams to Nuclear Nightmares: Lessons from the Anti-Nuclear Power Movement in the 1970s.* Charlbury, England: Jon Carpenter.
- Lagaaij, J.A.C., Verbong, G.P.J.. 1998. *Kerntechniek in Nederland 1945-1974.* Den Haag/Eindhoven
- Molenaar, L. 1994. *'Wij kunnen het niet langer aan de politici overlaten. De geschiedenis van het VWO 1946-1980.*
- Patterson, W.C. 1985. *Going Critical: An Unofficial History of British Nuclear Power.* Paladin Books.

- Pocock, R.F. 1977. *Nuclear Power: Its Developments in the United Kingdom.* Surrey: The Gresham Press
- Schot, J.W. H.W. Lintsen, A. Rip, A.A. Albert de la Bruhèze. 2000. *Techniek in Nederland in de Twintigste Eeuw: Delfstoffen, Energie & Chemie*. Walburg Pers, Zutphen, 2000
- Van Noort, W. 1988. *Bevlogen bewegingen: een vergelijking van de anti-kernenergie, kraak- en milieubeweging*, Uitgeverij Sua, Amsterdam
- Van den Bosch, K. 2006. *De angstreactor: Kalkar, kroniek van een eeuwige belofte*, Uitgeverij SUN, Amsterdam

3.2.3.2 Semi-structured interviews

The case histories constructed through the above secondary (and inevitably biased) sources were followed up by conducting a small number of in-depth, semi-structured interviews to enable *data triangulation* (Patton, 2002). The interviewees were all individuals who are (or had been) relevant stakeholders in the nuclear innovation journey (e.g. industry representatives, social movement actors) or possess some 'privileged' birds-eye view of this journey because of their specialized knowledge (e.g. innovation scholars, historians). The flexibility of the semi-structured interview method allows the researcher to bring up new questions during the interview by reacting to the interviewees' statements (Lindlof and Taylor, 2002). The in-depth interviews served to identify key issues and events that had not come up in the analysis of aforementioned secondary literature, as well as to provide alternatives to my own interpretations of key issues and events extracted from secondary sources. In processing the results, the method of iteration was used, by which a researcher iterates between sources until saturation is reached: a state where further data collection ceases to generate 'new' substantial issues and events (Rowan and Huston, 1997). The interviewees were:

- Mr Walter C. Patterson. Independent analyst, formerly energy campaigner for Friends of the Earth. May 11th 2009
- Mr Richard Mrowicki. Head of strategy and business planning, Nuclear Decommissioning Authority. May 20th 2009.
- Prof Dr Gordon MacKerron. Director of SPRU, University of Sussex; specialized in the economics and policy issues of nuclear power. Former chairman of UK government committee on waste management. May 5th 2009
- Mr Martin Forwood. Campaign coordinator & founding member of CORE - Cumbrians Opposed to a Radioactive Environment. May 19th 2009.
- Dr Horace Herring. Research fellow in Energy & Environment Research Unit, The Open University; specialized in environmental history. May 21st, 2009.

- Prof Leo Jansen. Member of Steering Group of the Broad Societal Discussion (BSD) on Energy Policy, 1981-1984. July 3rd, 2008.
- Mr Jan Willem Storm van Leeuwen. Senior consultant at the Center for Energy Conservation and Sustainable Technology and co-author of scenarios used in the BSD. June 11th, 2008.
- Mr Dirk Bannink. Anti-nuclear activist and member of the action group Break the Atomic Chain Netherlands, 1977-1982. May 14th, 2008.

3.2.3.3 Primary sources

To ensure an analytical focus on the cultural legitimation of nuclear power, this dissertation relies on empirical material from a broad and heterogeneous range of primary sources. Because my research interest lies with the diverse meanings that have been given to nuclear power over time and the ways in which these have been mobilized, I selected materials which explicitly or implicitly *frame* nuclear technology in a certain way. Such materials include:

- content of newspaper articles: those articles which are incorporated in the bibliometric graphs, as well as the newspaper articles from different publications which did not meet the requirements for inclusion in the quantitative part (see subsection 3.3.3.3).
- political and/or topical cartoons about and/or prominently featuring nuclear power symbology, technology, or relevant actors/instutions, both from newspapers and from other publications such as trade journals and magazines;
- 'grey' literature, e.g. official and unofficial reports about nuclear power produced by government, industry, scientific and social movements;
- transcripts of political debates;
- non-academic books about nuclear power, e.g. popular-scientific books and works of fiction;
- educational material, e.g. slideshows, nuclear power exhibition guides and photos;
- video material, e.g. documentaries about nuclear power or anti-nuclear demonstrations, news clips;
- material culture which prominently features nuclear imagery, e.g. consumer products decorated with atomic imagery;
- material culture produced by social movements, e.g. posters, leaflets, brochures, comic books, campaign buttons;

In line with my conceptual framework, these heterogeneous sources of primary evidence are viewed as *performances* which enact various storylines about nuclear power. Combining these cultural performances with other sources of evidence

(secondary sources, interviews, co-occurrence bibliometrics) enables the reconstruction of of the process of the cultural legitimation of nuclear power.

3.3 Methods of analysis

Process research utilizes any method that can help make sense of change and development processes. This prominently includes qualitative methods (Van de Ven *et al*., 2008: 154), but does not reject quantitative ones. Accordingly, this dissertation uses a mixed method strategy, which "(…) mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (Johnson and Onwuegbuzie, 2004: 17). I do so because this allows me to "(…) address more complicated research questions and collect a richer and stronger array of evidence than can be accomplished by any single method alone" (Yin, 2009: 63). The following subsections will discuss the various methods used in this mixed methods strategy.

3.3.1 Discourse analysis

This dissertation argues that a key mechanism of cultural legitimation is the strategic articulation and performance of storylines that favor certain meanings over others. Understanding this mechanism thus means focusing on the various *meanings* these performances attribute to nuclear power. Thus, an analytic technique is required that focuses on meaning. Because meanings cannot be observed directly, "(…) the realm of meaning has to be approached through reflection and interpretive analysis" (Fischer, 2003: 130, in: Kern, 2009). Various methods for interpretive analysis of meaning are available, e.g. hermeneutical analysis, discourse analysis, semiotics, content analysis, frame analysis, narrative analysis. Of these, only discourse analysis meets the criteria of being able to:

- Process large numbers of very heterogeneous performances;
- Deal with meanings that are not fixed and can change over time.

Whereas other interpretive methods "(…) work to understand or interpret social reality as it exists, discourse analysis tries to uncover the way that reality is produced" (Hardy *et al*., 2004: 19). Similarly, I am less interested in understanding cultural legitimacy 'as it exists' as in uncovering the way cultural legitimacy is produced, i.e. finding the mechanisms of cultural legitimation.

Discourse analysis thus seems a promising method for doing so. But it is important to realize that discourse analysis is more than merely a technique for text analysis: it is a full-fledged methodology in the sense that it is 'theory plus method' (Phillips and Jørgensen, 2002; Hardy *et al*., 2004). In the constructionist tradition to which discourse analysis belongs, observation is theory-laden and consequently, theory and methodology are intertwined.

Moreover, discourse analysis is not monolithic: researchers using discourse analysis can have different (and even conflicting) interpretations of what discourse is, draw on

different literatures, and use different methods for studying empirical material (Laffey and Weldes, 2004: 28). Phillips and Jørgensen (2002) usefully distinguish three broad approaches in discourse analysis: discursive psychology (e.g. Potter, 1996), critical discourse analysis (e.g. Fairclough, 1989), and discourse theory (e.g. Laclau and Mouffe, 1985):

- Discursive psychology looks at everyday discourse: it is concerned with the way discourses are concretely (re)produced in everyday discursive practices. To this end, it empirically investigates conversations, and 'mediatized' speeches and interviews, emphasizing transcription and coding (Phillips and Jørgensen, 2002).
- Critical discourse analysis, rooted in critical theory, is concerned with how socio-political domination is reproduced in talk and text. It focuses on power and ideology in discourse. To uncover these, it uses systematic linguistic analysis: strategically selected texts are analyzed with a high level of detail and according to strict methodological rules (Phillips and Jørgensen, 2002).
- Discourse theory looks at abstract discourse: it seeks to uncover the way the social world is constructed by different overarching discourses which offer different meanings. To this end, it searches for general patterns in discourses and engages in abstract mapping of the various discourses within some societal domain by analyzing large volumes of heterogeneous texts (Phillips and Jørgensen, 2002).

This dissertation draws on the latter approach (discourse theory) for two reasons:

- its focus on discursive struggle as an important mechanism facilitates an understanding of the interaction between pro-nuclear versus anti-discourse as different systems of meaning;
- its particular strength when it comes to group formation and collective identity (Phillips and Jørgensen, 2002) facilitates an understanding of the role of anti-nuclear movement organizations.

This approach to discourse analysis is sometimes criticized for 'depersonalizing' discourses and losing sight of the actors. Yet in the abstract discourses of discourse theory, the creation and maintenance by actors through everyday discursive practices (such as the ones of interest to discursive psychology) is not denied but rather implied (Phillips and Jørgensen, 2002). Discourse theory is rooted in the ideas that (1) discourses are socially contracted meaning-systems "that could have been different", which are (2) maintained and transformed through discursive practices, and (3) represent particular ways-of-talking about and/or understanding (some aspect of) the social world (Phillips and Jørgensen, 2002: 12). Because discourses shape our view of the social world, they are more than just talk. They are performative in the sense that they have effects on the social world:

> Within a particular worldview, some forms of action become natural, others unthinkable. Different social understandings of the world lead to different social

> actions, and therefore the social construction of knowledge and truth has social consequences (Burr, 1995:5, in: Phillips and Jørgensen, 2004)

Another criticism of this approach to discourse analysis is that it risks reifying discourses. But in line with its constructionist ontology, discourse theory actually acknowledges that a discourse is not a 'thing' which a researcher discovers in the real world, but rather an analytical construct:

> that is, as an entity that the researcher projects onto reality in order to create a framework for study. (…) For instance, if the researcher is interested in investigating the clash between established medicine and alternative treatment discursively, it makes sense to treat them each as discourses – that is, as homogeneous fixations of meaning (Phillips and Jørgensen: 144)

Of course, a researcher has to render such a division into different discourses plausible. This can be achieved by taking a pre-existing categorization found in (or a tentative categorization based on) secondary sources as a point of departure, and subsequently keeping an open mind about primary sources which may contradict this categorization into two (or more) discourses. In this dissertation, the chosen 'order of discourse' is civil nuclear power production, and the two main discourses which are assumed to populate this space (and whose interaction will be analyzed) are a 'pro-nuclear' and an 'anti-nuclear' discourse. This ex ante delimitation makes theoretical sense because this antagonistic pattern can be expected for the introduction of new technologies in contemporary society (e.g. Rip and Talma, 1998), as well as empirical sense because it has previously been distinguished for several countries in relation to nuclear power (e.g. Nelkin and Pollak, 1981; Gamson and Modigliani, 1989; Flam, 1994).

In terms of concrete analytical tools (i.e. a 'recipe' for discourse analysis), the discursive psychology and critical discourse analysis approaches both specify clear techniques for the systematic and meticulous linguistic analysis of texts. However, the consequently small number of texts which can be taken on board in the context of a research project which is delimited in time and resources, rule out a thorough psychological or critical analysis of the relevant discourses during multiple, very long innovation journeys.

So also in this respect, the discourse theory approach to discourse analysis is a better fit. But unfortunately, while such studies often work with large numbers of texts, they articulate very few concrete tools for analysis (Phillips and Jørgensen, 2002:147). Instead, they rely more on the interpretive expertise of the analyst (Wood and Kroger, 2000), who

> (…) has a perspective on what is investigated and (…) goes beyond what is directly said to work out structures and relations of meaning not immediately apparent in a text. This requires (…) recontextualizing what is said in a specific conceptual context (Kvale, 1996: 201, in: Kern, 2009)

In this dissertation, the conceptual framework articulated in Chapter 2 serves as such a vehicle for recontextualizing. Interpreting the various performances in terms of the way

they construct (1) centrality, (2) credibility, (3) empirical fit, (4) experiential commensurability, and (5) macro-cultural resonance ensures an analytical focus on the mechanism of (strategic) cultural legitimation. However, one has to take care not to treat these concepts as rigid, immutable analytical categories to which data are allocated (such as in content analysis; see: table 3.3.3):

- The relative importance in (nuclear) discourse of each of the (five) analytic concepts may vary over time and between cases;
- The *meaning* of these concepts (e.g. what the standards for credibility are, what constitutes 'proof') may change over time;

In discourse analysis, researchers should thus apply their concepts whilst not being overly constrained by them (Wood and Kroger, 2000: 99). Analytical concepts, such as in this case the five dimensions, should not be used as 'taken for granted' categories to which data are mechanistically allocated, but as structuring devices that allow the researcher to explore how concrete performances actively *construct* these categories (Hardy *et al*., 2004). Accordingly, the five dimensions will be used to structure the narrative explanations in Chapters 4 and 5 and guide interpretation of the empirical material. Because this empirical material prominently includes *images*, a relatively uncommon data source for innovation studies, the next subsection will elaborate on image analysis methods in general, and the method adopted in this dissertation in particular (which is essentially a form of visual discourse analysis).

3.3.2 Image analysis

Because image analysis is not a well-known methodology in the field of innovation studies, and because this dissertation uses a large amount of images as primary empirical material, this subsection will elaborate on the use of images as units of analysis for scholarly research. I provide a brief and stylized literature review here as opposed to in Chapter 2 because it directly pertains to the methodology instead of the construction of the conceptual framework.

In the move from structuralism to poststructuralism, all forms of representation, including images, have come to be thought of as text in the broadest sense of the word (Ali, 2004: 266 in: Seale, 2004). While images have always been units of analysis in art history etc., they have become empirical material for a variety of other fields and disciplines ever since that move. The interest in images from fields like cultural studies and sociology stems from the argument that we are constantly confronted with images of various kinds, rendering 'seeing' our main tool for interpreting the world and giving meaning to reality (Fyfe and Law, 1988; Jay, 1993). The methodologies for analyzing images within and across the various fields vary widely and depend on the questions a researcher seeks to address, and on the type and availability of images. Rose (2007) constructed a typology of image analysis based on three 'image sites' where meaning is produced, and three 'modalities' of meaning in images. The three modalities of visual meaning are:

- *technological* (e.g. how an image is enabled by the technologies of production, display and dissemination)
- *compositional* (e.g. the content, symbology, color and special arrangement of elements of the image)
- *social* (e.g. how the economic, social, and political web of relations, institutions and practices in which an image is suspended constrain and enable the interpretation and use of the image)

The three sites of visual meaning production are:

- site of *production* (e.g. how the circumstances of the production of an image, such as technique, genre and rules of the institution in which it is conceived, shape its effect);
- site of the *image itself* (e.g. how the various components of an image, such as its material, composition, symbols or implied social relations, shape its interpretation);
- site of *audiencing* (e.g. how the different modes of watching images, such as looking at reproductions in newspapers vs. in internet, shape meaning-making, reinterpretation or rejection, or how images are mobilized to effectuate social change).

These sites and modalities are graphically summarized in the circular diagram of figure 3.3.1. The different methodologies for analyzing images are scattered over the diagram. This underscores that there is no single method for analyzing all aspects of an image, and that research interests shape (the choice of) visual methodologies. Because the sites and modalities of image analysis are fairly abstract concepts, I provide in table 3.3.2 a concrete (but stylized) example of what the elements of the above typology might look like when applied to an image related to the cultural legitimation of nuclear power: the iconic 'smiling sun' image of figure 3.3.2.

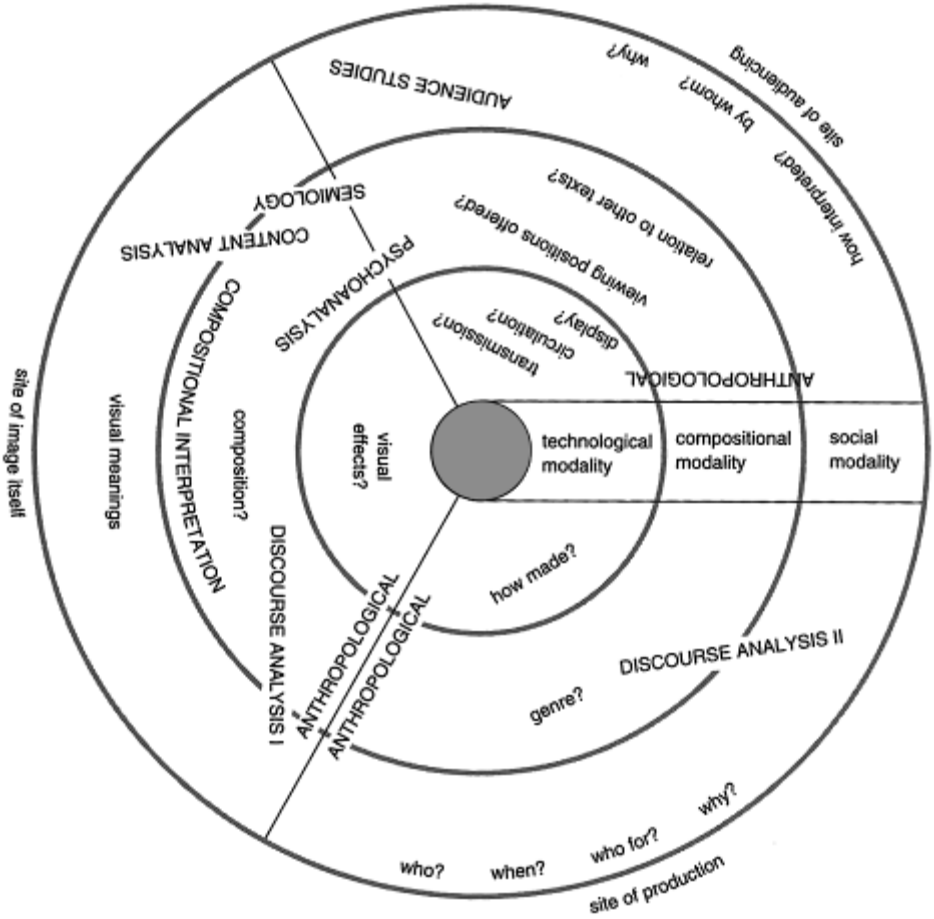


Fig. 3.3.1 Sites and modalities for interpreting visual materials. Source: Rose (2007: 30).

Types of images	Common methods
TV programs	audience studies (focus groups)
Fine art paintings	compositional interpretation (art history)
Advertising	semiology (signs, referents)
Movies	psychoanalysis (archetypes)
Photographs, fine art objects	anthropology (materiality, recontextualization)
Museums, art galleries	discourse analysis II (focus on institutions, practices)
Various images (e.g. illustrations, maps, photos, cartoons)	discourse analysis I (focus on texts, discursive formations)
Many of one specific type of image ((e.g. over time)	content analysis (coding of symbols, enumeration)

Table 3.3.1 Image types and corresponding methods of analysis. Adapted from: Rose (2007: 31).

	technology	composition	social
production	Developments in offset printing processes enabled cheap and fast reproduction of large amounts of images in the 1970s. The most common material form on which this particular image commonly appeared was a tinplate brooch or button (~20-30 million); others were T-shirts and posters.	The image fits with the 'genre' of the protest image: highly symbolic and simple imagery that can be reproduced quickly on various material forms, and that diagnose a perceived problem ('diagnostic framing'), suggest a solution ('prognostic framing') and/or call to action ('motivational framing').	Designed in 1975 by Anne Lund as a logo for the Danish anti-nuiclear group OOA, the text was translated into 45 languages. Objects featuring the image (buttons, T-shirts, posters etc.) were sold to anti-nuclear campaign groups around the world as a fundraising tool. Revenues were used to start up and partially finance WISE (World Information Service on Energy).
image itself	Cheap, high-volume printing put constraints on the image itself: the limited color scheme necessitated the use of bright contrasting colors, instantly recognizable symbolism, and a short and to-the-point slogan. These visual effect contributed to the 'quick & dirty' communication of a framing of the undesirable situation (i.e. nuclear power).	The image contains three 'semiotic' messages: 1. linguistic: a question ('atomic energy?') and a polite reply ('no, thank you'). 2. denoted image: a radiant red sun, on which a happy face appears (closed eyes, nose and smiling mouth) 3. connoted message: warmth, friendliness, politeness, happiness.	The friendly, open-minded face was intended to call for a particular social practice in relation to anti-nuclear protesting: communication about the issue of nuclear power through dialogue, as opposed to antagonism and violence.
audience	The products the image appeared on were bought by decentralized anti-nuclear movement groups and distributed among their members. The mode of displaying the image varied with the material form it was printed on: fastening it to clothing (buttons), wearing it (T-shirts) and gluing to picket signs or walls (posters). In all cases, social movement actors took the image out into the streets where it could be viewed (voluntarily or not!) by onlookers and passers-by during their protest actions. Currently, the image is also displayed in various museums, usually arranged with other social movement imagery as part of exhibitions on social history.	The image was used in conjunction with others texts (information brochures, different images) to enact the peaceful opposition to nuclear power. The 'smiling sun' image became iconic of the world-wide anti-nuclear movement. Yet while the image suggests a 'preferred' interpretation, it does not determine one. Audiences can reinterpret: to some, the sun image may suggest an alternative to nuclear power (solar PV). Audiences can also reject the interpretation and produce counter-images: fig. 3.3.3 rejects the non-violence message through a smiling sun with a closed fist (well-known symbol of resistance). Fig. 3.3.4 rejects the linguistic message through a smiling Rutherford model (atomic symbol).	The 'wearing' of protest imagery became a recognizable socio-cultural practice in 70s-80s counterculture. Not only was wearing the image a means to display and disseminate it: wearing the images also created social cohesion, differentiated between 'insiders' and 'outsiders', and expressed (an 'alternative') social identity.

Table 3.3.2. Stylized example using the Rose (2007) typology of 3 sites and 3 modalities for image analysis. Highlighted cells indicate main areas of interest for 'visual discourse analysis I' as suggested in Rose (2007). Sources: International Institute of Social History, Organisationen til Oplysning om Atomkraft website (www.smilingsun.org), and Bannink (2011).

Fig. 3.3.2 'Smiling sun' image. Source: private collection.

Fig. 3.3.3 Counter image calling for direct action. Source: private collection.

Fig. 3.3.4 Counter image calling for nuclear power. Source: www.nuclearpoweryesplease.org.

In theory, images can be studied with regard to all three sites and modalities. However, this is often both analytically redundant (e.g. because of the specific research purpose the image is interrogated with) and practically unfeasible (e.g. because data for the audiencing site is unavailable, or because insufficient images of a specific type can be accessed for content analysis).

Because images have only relatively recently come to be seen as 'serious' potential sources of data for social scientists, and because (social movement) organizations only rarely collect the images they produced (Bannink, 2011: 9), systematic archives of images are sparse. I therefore rely on a broad and eclectic variety of sources and types of images:

- political and topical cartoons published in newspapers;
- illustrations from pro- and antinuclear books, brochures and websites;
- photographs / stills from educational material (e.g. slideshows, documentaries);
- images of consumer products featuring nuclear symbology;
- protest images appearing on social movement material culture such as posters, t-shirts and campaign buttons.

Rose (2007) describes ‘visual discourse analysis-I’ as a type of image analysis that focuses on texts and discursive formations, rather than on institutions and practices. This a suitable method for analyzing large numbers of heterogeneous images, especially when studied in conjunction with other (e.g. linguistic) texts for triangulation. The method concerns itself primarily with the site of the image itself, and is particularly strong at exploring the effects on the compositional and social modalities of images in relation to the construction of social difference (Rose, 2007: 170), which is relevant for contested innovations. In the example of table 3.3.2, this corresponds to the type of interpretations in the highlighted box. Some drawbacks of the method are that it necessarily relies heavily on a researcher's interpretation, and that it reveals relatively

little about the practices and institutions through which such constructions are disseminated (Rose, 2007: 171). Nevertheless, for image analysis in this dissertation I will primarily use this particular visual discourse analysis method with its corresponding sites and modalities for the following reasons:

- For addressing questions about the meaning given to innovations through images, the site of production (left column in table 3.3.2) and the modality of technology (top row in table 3.3.2) are less interesting;
- Although the site of audiencing (bottom row in table 3.3.2), and especially the compositional and social modalities, *would* be of interest for my research questions because they pertain to how images are appropriated, mobilized, and contested by focal actors, the relevant data for making claims about these phenomena is absent for most images;
- Its philosophical, theoretical and methodological synergy with the discourse analysis approach chosen in the previous subsection means that it can be seamlessly integrated into a multiperspectival but still methodologically coherent framework (Phillips and Jørgensen, 2002:4)

Accordingly, for the (large number of) images in Chapters 4 and 5, I provide information on the *denoted image* (by explaining what is literally depicted), the *connoted image* (by suggesting what the image implies in terms of signs and referents), and its *socio-cultural context* (by inferring which cultural repertoires and/or practices it reproduces and/or links nuclear power to). When available and relevant, anecdotal accounts pertaining to an image's audiencing site will also be provided.

3.3.3 Content analysis

As stated earlier, process research utilizes any method that can help make sense of change processes, qualitative or quantitative. In this dissertation, the qualitative (visual) discourse analysis methods described in subsections 3.3.1 and 3.3.2 are supplemented by (specific techniques from) content analysis. As a method for text analysis, content analysis is distinctly different from discourse analysis:

> Where discourse analysis highlights the precarious nature of meaning and focuses on exploring its shifting and contested nature, content analysis assumes a consistency of meaning that allows for occurrences of words (or other, larger units of text) to be assumed equivalent and counted (Hardy *et al.*, 2004: 19).

Some other key differences between discourse analysis and content analysis in table 3.3.3 shed more light on their different assumptions, methods and conventions.

	Discourse Analysis	Content Analysis
Ontology[9]	social constructionist	positivist
Epistemology	meaning is fluid and constructs reality in ways that can be posited through the use of interpretive methods	meaning is fixed and reflects reality in ways that can be ascertained through the use of scientific methods
Data source	textual meaning, usually in relation to other texts, as well as practices of production, dissemination and consumption	textual content in comparison to other texts, for example over time
Method	qualitative	quantitative
Categories	exploration of how participants actively construct categories	analytical categories taken for granted and data allocated to them
Reasoning	inductive	deductive
Point of view	subjective	objective
Context	can only understand texts in discursive context	does not necessarily link text to context
Reliability	formal measures of reliability are not a factor; differences in interpretation are not a problem (and may be a source of data)	formal measures of intercoder reliability are crucial for measurement purposes; differences in interpretation are problematic and risk nullifying any results
Validity	validity in the form of performativity: demonstrating a plausible case that patterns in the meaning of texts are constitutive of reality in some way	validity in the form of accuracy and precision: demonstrating that patterns in the content of texts are accurately measured and reflect reality
Reflexivity	necessarily high – author is part of the process whereby meaning is constructed	not necessarily high – author simply reports on objective findings

Table 3.3.3 Various differences between discourse analysis and content analysis. Adapted from: Hardy et al., 2004.

Like discourse analysis, content analysis combines method and theory into a methodology. Because of the different ontological and epistemological assumptions underpinning these two methodologies, they cannot straightforwardly be combined without serious reflection on these issues. It is for this reason that this dissertation does not use content analysis as a whole, but rather borrows a specific technique often used in content analysis: media bibliometrics. Such integration is encouraged:

[9] Hardy *et al.* (2004) list *realist* (objective ontology, subjective epistemology; Van de Ven, 2007) as the ontology for content analysis in their table, whereas the additional information provided seems to indicate a position which in this dissertation has previously been referred to as *positivist* (objective ontology, objective epistemology; Van de Ven, 2007). Accordingly, I altered the table to reflect this.

> (…) while the content of the package should form an integrated whole, it is possible to create one's own package by combining elements from different discourse analytical perspectives and, if appropriate, non-discourse analytical perspectives. Such multiperspectival work is not only permitted but positively valued in most forms of discourse analysis (Phillips and Jørgensen, 2002: 4)

Media bibliometrics is a commonly used quantitative technique in content analysis. It is based on the assumption that the words which occur most frequently in any given body of texts are those which reflect its key issues. Thus, the frequency with which words relating to nuclear power appear in the media outlets of the two countries under study 'says something' about the public attention for the subject. Specifically, the reasons for including a bibliometric analysis in this dissertation are:

- A bibliometric graph can be construed as an indicator for the level of public attention of the issue of nuclear power. While a quantitative media analysis such as a newspaper count is only a rough indicator of public attention, it is likely the best one available for the investigation of specific issues over long time-scales. Newig (2004) suggests that

  > [a]ssuming that in today's democracies the mass media constitute by far the most important vehicle for shared attention and political communication, media coverage, then, should best reflect public attention. (Newig, 2004: 159)

- Any distinct patterns observed in the quantitative data may serve as a first step towards dividing the innovation journey into phases in the cultural legitimation process;

- Quantitative analysis of media coverage can also shed light on the emergence and disappearance of certain specific *themes* within nuclear discourse (see: subsection 3.3.3.3).

The next subsection will elaborate on the two specific quantitative techniques this dissertation borrows from content analysis.

3.3.3.1 Word frequency and co-word plots

Because of the relatively large timeframe over which the nuclear innovation journey played out (1945-2010), a bibliometric analysis requires media outlets which:

- have published or broadcast more or less consistently throughout this period;
- have digitized their publications or broadcasts of the period;
- have made such a digital archive publicly available;
- allow for relatively sophisticated search options (such as Boolean queries).

The latter requirement is important because, to ensure that a specific query returns predominantly relevant results, I require some degree of control over the search terms. The digital archive's search engine needs to allow wildcard operators (to find plural

forms, conjugations or compounds of the word of interest) as well as the logical "or" operator (to compensate for semantic shifts in indicating a concept, such as the substitution of 'atomic energy' by 'nuclear energy').

The records found in such archives typically consist of a mix of news articles, opinion pieces, correspondence items, advertisements and official announcements. While some digital archives allow users to refine their search by selecting only articles of a certain type, the underlying classification is typically performed automatically and, upon closer inspection, often quite poorly. Moreover, not all sources offer the option to refine searches this way. So to facilitate inter-source (and inter-case) comparison, the various types of utterances are lumped together. The datasets generated this way are used for two purposes:

- *Occurrence (or word frequency) bibliometrics.* For each year during the period under analysis, the records returned were added up and graphically plotted as time-series. Of course, any such occurrence analysis will suffer from several biases. Firstly, there will be articles which would have been relevant, but are excluded from the query's search results ('false negatives'). I minimized this bias through iteration between results and search strings: I took a random sample of articles in the returned results, scanned them for different words that refer to the same subject, added these words to the original search term, and repeated this process to the point where adding new search terms no longer significantly impacts the total number of articles returned. Unfortunately, broadening the search this way inevitably exacerbated the second bias, which is the inclusion of irrelevant articles in the results returned ('false positives'). While the obvious solution to this problem is a close reading of all articles returned, this was impractical because of their large number. Hence, it is unlikely that the graphs exclusively and exhaustively contain relevant articles. Finally, the requirements listed in subsection 5.3.1 imply that relatively few archives can be used, which in itself introduces a bias (e.g. the political ‘color’ or target audience of the publication). However, it should be noted that these graphs are not the final result of my research effort, but rather served as a starting point. Differences as well as similarities between cases are explored in Chapters 4 and 5. In both cases, this weakness will be offset by this dissertation's primary focus on interpretative, qualitative methods.

- *Co-coccurence (or co-word) bibliometrics.* While occurrence bibliometrics say something about the frequency of use of a specific word, they say nothing about which other words appear frequently in these articles. The co-occurrence of words is interesting, because it can be indicative of *themes*. If, in any given period, a word occurs frequently in articles together with another word, the two can be said to be semantically linked. If a researcher chooses these words with care, and if there are apparent patterns in this linking over time, he may be on the trail of a theme which emerges or disappears in the context of nuclear power. Co-word analyses can thus serve as a first order approximation of the dynamics over time of themes in nuclear

discourse. For co-occurrence analyses, I counted (for each year) the articles in which 'nuclear power' occurred together with other words of interest, which were derived from both secondary histories of nuclear power and a close reading of relevant news articles. In each case I plotted the results as a fraction of the number of articles containing 'nuclear power'. This similarity measure is referred to as an *inclusion index* (Van Eck and Waltman, 2009) and uses Equation 1:

$$S(c_{ij}, s_i) = \frac{c_{ij}}{s_i} \qquad \text{(Eq.1)}$$

…in which c_{ij} here stands for the number of articles containing both 'nuclear power' and the co-word of interest, and s_i stands for the number of articles containing the base term 'nuclear power'. Such time-series graphs serve as qualitative corroboration of the emergence and disappearance of certain themes in the context of nuclear power (e.g. because of the emergence of the environmental movement in the 1970s, articles containing the word 'nuclear power' increasingly contained the word 'pollution' from that point in time onward).

The results of my occurrence bibliometrics (frequency graphs) are presented in subsection 3.3.3.5 of this chapter, because they serve as a starting point for the explanatory narratives of Chapters 4 and 5 (and are consequently frequently referred to in these chapters). The results of the co-occurrence bibliometrics (co-word graphs) appear it relevant points in the explanatory narratives of Chapters 4 and 5, because they serve as quantitative corroboration of themes in nuclear discourse.

3.3.3.3 Sources

Of the various types of media outlets, typically only newspapers meet most of the requirements articulated in subsection 3.3.3.1. For the Dutch case, the one exception is the Dutch national news agency ANP, which has digitized (and made available) the transcripts of all its radio bulletins over the 1945-1984 period. Currently, the major Dutch national newspapers do not offer digitally searchable databases going back before 1990. For the occurrence bibliometrics in the 'early' period, I therefore resorted to other sources:

- *Leeuwarder Courant* is the oldest Dutch newspaper still operating under its original name (since 1752), the largest newspaper in Friesland, and the 10th largest regional newspaper. It provides news coverage and editorials about regional, national and international events and issues. All 258 volumes (some 800,000 pages) have been made available digitally. However, from 2006 onward, many articles are published in multiple local editions (*Leeuwarder Courant Noord*, *Zuid* etc.), so that one and the same article can appear in the search results as (up to) five 'unique records'. Because this renders the bibliometrics from 2006 onward incomparable with those before 2006, the database is used from 1945 up to and including 2005. Unless stated otherwise, I have used the *Leeuwarder Courant* as the source for the co-word

analysis because a) it covers the largest period, and b) it offers the most flexibility in terms of constructing appropriate queries.[10]

- *Algemeen Nederlands Persbureau* (ANP) is the largest Dutch press agency. Established in 1934, it supplies news to newspapers, broadcasting corporations and magazines and It has a digitally searchable online archive of approximately 1,800,000 pages containing transcripts of its radio bulletins broadcast between 1937 and 1984 (Koedijk, 1996)

For the period after 1990, digital archives for several major Dutch national newspapers are available:

- *NRC Handelsblad* is the result of a 1970 merger between *Algemeen Handelsblad* (1828) and *Nieuwe Rotterdamsche Courant* (1844). It is currently the 4th largest (paid) national newspaper in terms of circulation and claims a liberal character. Its digital archive is searchable from 1990 up to the present.

- *Trouw* is a Dutch national newspaper published since 1942. It is currently the 5th largest (paid) national newspaper in terms of circulation. Originally a protestant-christian publication, it still focuses strongly on matters of religion and philosophy. Its digital archive is searchable from 1992 up to the present.

- *De Volkskrant* has been published since 1919. It is currently the 3rd largest (paid) national newspaper in terms of circulation. Originally a roman-catholic labour movement weekly, it acquired a politically center-left character from the 1960s onwards. Its digital archive is searchable from 1995 up to the present.

For the UK case, only *The Times* and *The Guardian* meet the criteria in subsection 3.3.3.1 for constructing occurrence bibliometrics for (most of) the period under study:

- *The Times* is a daily national newspaper which has been published in the United Kingdom since 1785. It is commonly seen as a quality newspaper (as opposed to sensationalist tabloids) with a moderate conservative (center-right) signature. Its digital archive runs from 1785 to the present[11]. However, as the result of an industrial dispute, the newspaper was not published for almost a year (between 1 December 1978 and 12 November 1979), which results in a lack of data for 1979.

[10] I mentioned earlier the *Leeuwarder Courant* archive's drawback of returning multiple copies of the same article for queries after 2005 (because of multiple local editions of the newspaper after that year). However for my co-word analysis, this is not problematic because I plot the *relative* number of articles (i.e. the number of articles in which 'kernenergie' and some other word occur, as a percentage of the total number of articles containing 'kernenergie' for each year)

[11] The website http://archive.timesonline.co.uk/tol/archive/ offers a digital archive of *The Times* from January 1st 1785 to December 31st 1985. The website http://www.newstext.com.au/ offers a digital archive of *The Times* from July 1st 1985 to the present. I use their respective results as a continuous time-series, because the results in the overlapping six months in 1985 were identical.

Unless stated otherwise, I have used The Times as the source for the co-occurrence analysis because it offers the most flexibility in terms of constructing appropriate queries.

- *The Guardian* is a daily national newspaper which has been published in the United Kingdom since 1821. It is commonly seen as a quality newspaper with a moderate progressive (center-left) signature. Its digital archive runs from 1821 to the present[12].

3.3.3.4 Search terms

Compiling a graph which aims to paint a meaningful picture of public attention to 'nuclear matters' over such a long period presents a challenge, because the words which to refer to this category change over time (e.g. from 'atomic' to 'nuclear'), and the content of the category changes as well (e.g. the emergence of the main application of nuclear energy as a means of civilian power production). The issue of changing meanings would not be problematic for a qualitative discourse analysis of the articles, but can seriously compromise the results of a quantitative content analysis (which assumes meanings to be fixed). To compensate, multiple search terms were derived from the close-reading of a sample of news articles in different periods. In the Dutch case, this revealed the following:

- Initially, the concept of the potentially useful energy locked away in the cores of the basic unit of matter was referred to using the compound noun 'atoomenergie' (atomic energy). The popular use of 'atoom-' in this context gradually decreased in favor of the word 'kern-' (nuclear), necessitating my inclusion of both 'atoomenergie' and 'kernenergie' as search strings. Simply using the noun 'kern' as a search string is impractical, because it results in a great number of 'false positives' since it has multiple connotations far outside the scope of the technology I'm interested in. The connotation of the noun-noun compound 'kernenergie' is at least limited to the physical characteristic of energy within the atomic nucleus.
- At some point, the main practical application of this type of energy emerges: a self-sustaining fission reaction (releasing the 'nuclear energy'), typically taking place in pressure vessels (~'nuclear reactors'), with the aim of producing heat to power steam turbines that generate electricity which is fed into the grid ('nuclear power'). This process takes place in industrial facilities commonly referred to as 'nuclear power plants'. In English, a search for the term 'nuclear power' would obviously also return articles containing 'nuclear power plant'. In Dutch, however, this is not

[12] The website http://archive.guardian.co.uk/ offers a digital archive of *The Guardian* from 1821-2000. The website http://www.guardian.co.uk/search offers a digital archive of *The Guardian* from 2000 to the present. I use the results as a continuous time-series, because the results in the overlapping year of 2000 differed by less than 2.3%.

the case. Because of the propensity of the Dutch language for concatenated noun-noun compounds, these facilities are typically referred to as 'kerncentrales' (i.e. without spaces, and without the word 'energy'). Because (1) I had previously ruled out the use of the word 'kern' as a search term, and (2) the use of the search term 'kernenergie' doesn't return articles about nuclear power plants (unless they happen to specifically mention the word 'kernenergie' as well), I had to include the words 'kerncentrale' and 'atoomcentrale'.[13]

- In the early period, the word 'atoom' is sometimes also used as part of the compound noun 'atoomkracht', which translates as 'atomic force'. There is a parallel between this and the word 'stoomkracht' ('steam force'), which was commonly used to connote the mechanical work produced by steam engines. As a result, 'atoomkracht' primarily appears in the context of the transportation domain (i.e. nuclear engines for ships etc.). This may partially explain why the term falls out of use as it becomes clear over time that nuclear propulsion is a non-option for The Netherlands. Although its counterpart, the word 'kernkracht' ('nuclear force'), does appear occasionally in press, I have opted not no include it as a search term. It is almost exclusively used to refer to two of the four fundamental interactions of nature ('sterke' and 'zwakke' kernkracht, meaning 'strong' and 'weak' nuclear force) in popular-scientific articles about theoretical physic(ist)s which do not relate directly to nuclear technology.

In the UK case, a close-reading of a sample of articles published throughout the period of interest also yielded different terms used for referring to nuclear matters:

- Initially, the compound term 'atomic energy' was commonly used to describe the abstract phenomenon of vast amounts of energy locked away within the atom, regardless of its application domain. From the mid-1950s onward, the new term 'nuclear energy' came to describe this same physical phenomenon as the general public came to understand that these vast amounts of energy were the result of chain reactions in which the *nuclei* of atoms are split into smaller parts (whereas at the atomic level, 'traditional' chemical reactions take place). A contemporary observer commented on this terminology shift in *The Times* in 1953:

  > The oft-used term atomic energy is a misnomer in this connexion. (…) The energy obtained from burning coal would be more properly called atomic energy because it derives from the combination of atoms in a chemical process, whereas the potential energy of the future, with which we are concerned here, reposes within the nucleus of the atom and is enormously greater. The total effect of the successful development of

[13] Specifically, I used the search term *kerncentra** where the wildcard operator * is a placeholder for any nonzero number of letters. This was done to include into the results the plural form (*kerncentrales*) and compound words (*kerncentralebouwer*, *kerncentraleplannen*), while excluding words like *kerncentrum*.

> industrial nuclear power is not likely to make electricity any cheaper than it is today, but in quantity it could be almost unlimited, which is more important to industry and the well-being of mankind. (*The Times*, 26 January 1953, 'Industrial Power From Nuclear Energy')

- Even so, 'atomic energy' remained present in newspaper coverage, both because of continued popular use of the term in spite of it being a 'misnomer' for a physical phenomenon, and because the term was preserved in the names of key institutions such as the United Kingdom Atomic Energy Authority (UKAEA) as well as the International Atomic Energy Agency (IAEA) and the United States Atomic Energy Commission.
- When the press speaks of concrete applications of atomic/nuclear energy, the word 'power' often replaces the word 'energy', so as to connote the rate at which work is performed or energy is converted. 'Power' in this context either appears in reference to *mechanical* power (i.e. for the propulsion of vehicles using fission as a source of energy) or as *electrical* power (i.e. for the production of electricity using fission as a source of energy). Because vehicle propulsion was considered a promising application domain only in the early period (in which the term 'atomic energy' was the dominant word for describing the physical property) the term 'atomic power' appeared mostly in the early period and in reference to mobility or transportation domains. Because electricity production came into focus as the main practical application domain over the 1950s (at which time the physical property was already commonly called 'nuclear energy' instead) the term 'nuclear power' appeared mostly from the mid 1950s onward and in reference to (civilian) electricity generation[14].
- Unlike in the Dutch situation, the use of the above search terms ('atomic energy', 'nuclear power') actually captures nearly all articles about concrete power production facilities using fission as a source of energy, as well. As mentioned earlier, the Dutch propensity for constructing compound terms without the use of spaces and by dropping parts of the original term leads to the use of 'kerncentrale' (nuclear power plant). Articles containing this word are obviously not returned when searching for 'kernenergie' (nuclear energy or nuclear power). In English, this is not a problem: the power generating facilities are usually referred to as 'nuclear power plant' or 'nuclear power station', both of which are returned when searching for the more general compound term 'nuclear power'.

[14] The situation is complicated somewhat by the popular use of the compound term 'nuclear power' to connote something altogether different, as well: a nation-state which possesses nuclear weapons is sometimes referred to as a 'nuclear power'.

3.3.3.5 Results: Dutch and British media graphs

For the Dutch case, a Boolean search query was entered in the above media outlet archives for articles containing any of the words 'atoomenergie', 'kernenergie', 'atoomcentrale', 'kerncentrale' or 'atoomkracht'. Wildcard operators (*) were used to allow the inclusion of plural forms, conjugations or compounds of the search terms (e.g. 'kerncentralestoring', 'atoomenergiecongres'). For the UK case, a Boolean search was made for articles containing any of the words 'atomic energy' or 'nuclear power'[15]. The numbers of unique records for each media outlet are listed in table 3.3.4.

The Netherlands			**The United Kingdom**		
media outlet	*period*	*number*	*media outlet*	*period*	*number*
Leeuwarder Courant	1945-2007	9,536	The Times	1945-1985	18,077
ANP radio bulletins	1945-1884	6,920	The Times	1986-2008	6,799
NRC	1990-2010	4,374	The Guardian	1945-2000	20,385
Trouw	1992-2010	3,052	The Guardian	2001-2010	3,692
Volkskrant	1995-2010	2,504			

Table 3.3.4 Used media outlets with number of records containing selected keywords.

The corresponding time-series are plotted in figure 3.3.4 (The Netherlands) and figure 3.3.5 (the United Kingdom). The time-series serve as a first approximation of the dynamics of public attention to matters of nuclear energy in the Dutch and British public spheres. In the Dutch case (figure 3.3.4), while there are some marked differences between the various media outlets, the overall dynamics are remarkably similar:

- From virtually nil in 1945, attention rises gradually until it speeds up around 1953 and reaches a first peak around 1955-1957.
- It subsequently declines, at first sharply in the late 1950s and then more gradually throughout the 1960s.
- In the early 1970s, it rises sharply until 1977, briefly falls back, and continues its rise to a second, far higher peak in the 1979-1981 period.

[15] The *The Times* search engine only allows users to construct logical AND queries (i.e. the instances of articles containing "atomic energy" *and* "nuclear power"). To construct a logical OR query, I performed separate queries for both of the compound terms, and added up the results. I then performed an AND query to find articles that include both terms, and subtracted the resulting number of articles from the previous total. This yields the logical equivalent of an OR query for 2 search terms. This protocol was repeated for each year, so that a time-series could be constructed.

- It then falls abruptly (reaching a local minimum around 1984), picks up again and reaches third peak in 1986.
- It then declines again sharply until 1990, when attention briefly picks up again until around 1994.
- Thereafter, it falls sharply to a local minimum around 1996, and gradually increases a little up to the present.

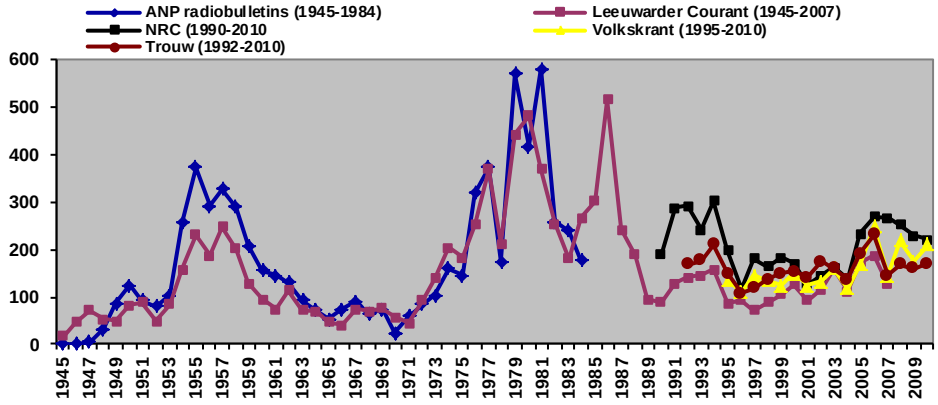


Fig. 3.3.4 Occurrence bibliometrics for selected keywords in Dutch media outlets (absolute).

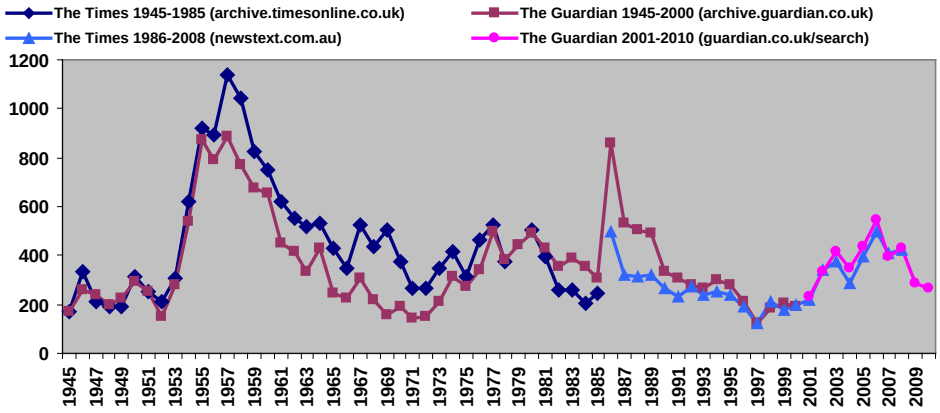


Fig. 3.3.5 Occurrence bibliometrics for selected keywords in UK media outlets (absolute).

In the British case (figure 3.3.5), the differences between the various media outlets are even smaller, and the overall dynamics are also remarkably similar:

- Nuclear matters are already steadily present in British press in 1945, where they were largely absent in the Dutch press at that point in time. Attention for nuclear matters remains relatively constant up to and including 1953. It then shoots up in 1954 and 1955 and reaches a peak in 1956-1957.

- It subsequently declines sharply, up to and including 1972. A minor difference between the two datasets is that in *The Guardian*, the decline is more or less constant, while in *The Time*s a minor and temporary upsurge appears between 1967-1969 period.
- Both time-series rise in 1973 but level off around 1977 at a much lower leven than was the case in the late 1950s (and also much lower than the Dutch graph in the same period). Attention to nuclear power remains relatively constant up to and including 1980 (although for *The Times*, the 1979 data is missing). It then declines from 1981 onward (although noticeably more sharply in *The Times* than in *The Guardian*).
- In both time-series, the downward trend is punctuated by a brief peak of attention in 1986 following the Chernobyl disaster, although this peak is much more pronounced in The Guardian than it is in *The Times*. In both cases, public attention to nuclear power drops steadily afterward, reaching an all-time low in 1997 for both time-series.
- For both time-series, public attention to nuclear matters gradually increases from 1998 to the present, reaching a level higher than that of the peak in the late 1970s, but still much lower that that of the mid to late 1950s. Two interesting peaks appear for both datasets in 2003 and 2006.

Comparing the Dutch graph to the British graph, a few things are immediately evident:

- While there was some sustained media attention for nuclear power immediately after WWII in the British case, it started from zero in the Dutch case.
- Two 'long wave' peaks occur around the same time in both cases:
    - the first one beginning in 1953, reaching a maximum in the late 1950s, and decreasing afterwards ('enthusiasm')
    - the second one beginning in the early 1970s, peaking in the early 1980s and decreasing afterward ('opposition')
- Both cases display a narrow-but-high peak in 1986, the year of the Chernobyl accident.
- The two major peaks differ substantially in relative size: in the British case the early peak is far larger than the later peak, while in the Dutch case, the later peak is far larger than the early one.

These characteristics, similarities and differences will be contextualized (and referred to) in the explanatory narratives of Chapters 4 and 5.

Chapter 4: The Cultural legitimation of Dutch nuclear power

4.1 Introduction to the chapter

In this chapter, I lay out a chronology of civilian nuclear power in The Netherlands. By using the five dimensions of centrality, actor credibility, empiricat fit, experiential commensurability and macro-cultural resonance to structure the subsections, I ensure an analytic focus on the process of cultural legitimation. The chapter is divided into three sections:

- Section 4.2 deals with the cultural legitimation process between 1945 and 1970. It concludes that over this period, the cultural legitimacy of nuclear power was successfully constructed, enabling the practical implementation of nuclear power in The Netherlands.
- Section 4.3 deals with the cultural legitimation process between 1971 and 2001. It concludes that over this period, the cultural legitimacy of nuclear power became contested, resulting in the abandonment of expansion plans and the disappearance of nuclear power from the policy agenda.
- Section 4.4 details the cultural legitimation process between 2003 and 2010 and concludes that attempts were made at reconstructing the cultural legitimacy of nuclear power by linking it to climate change, enabling nuclear expansion plans to re-enter the policy agenda.

Throughout the chapter, numerous pictures appear which frame nuclear power in a variety of ways and which have been mobilized as vehicles to communicate these framings to the public. I contextualize and interpret these framings in the body text. In each image's caption I provide the source of its original publication (when relevant) as well the archive I located it in. For reasons of brevity, the caption contains only these archives' names: in the references section the reader may find a list of consulted archives containing full details.

Moreover, a number of co-word graphs, based on quantitative newspaper bibliometrics, appear throughout the text as a means to triangualate on themes in nuclear discourse. The methodology underpinning these co-word graphs has been explained in-depth in subsection 3.3.3.1 of the methodology chapter: in this chapter, only the resulting graphs are presented.

The chapter's text frequently refers to a bibliometric occurrence graph that is used as an indicator for public attention. Although this graph also appears in the methodology chapter, it is reproduced here for easy reference (see: figure 4.4.1). As a final note, all translations into English of (excerpts from) Dutch-language newspaper articles, policy documents etc. are mine, unless indicated otherwise.

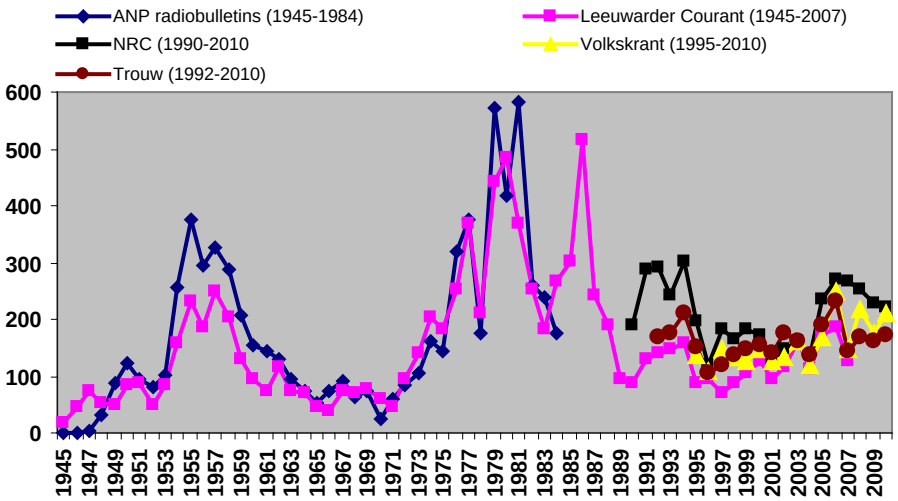


Fig. 4.1.1 Number of articles or bulletins mentioning 'kernenergie' OR 'kerncentrale' OR 'atoomenergie' OR 'atoomcentrale' for selected publications (see legend).

4.2 Constructing and extending legitimacy: 1945-1970

4.2.1 Prologue: breaking free of the bomb

In early 1939, Dutch Prime Minister Colijn was informed by physics professor De Haas about the possible consequences of German chemists Hahn and Strassman's discovery (in late 1938) that uranium could be split into lighter elements by bombarding it with neutrons. On his advise, the government purchased two hundred barrels of sodium urinate (yellow uranium oxide) from a mine in former Belgian Congo (Lagaaij and Verbong, 1998). Because uranium was commonly used in the late 19th and early 20th centuries to give a fluorescent green color to glass for tableware and other household items, a glass producer was used as an intermediary in order to cover up the true purpose of the acquisition, which was atomic research. Dutch news media coverage of such research was sparse before WWII, and those articles which did cover the matter were usually reports of public lectures by physicists. An article in *Leeuwarder Courant* reported on a certain Professor Coster's lecture and ominously concluded:

> "All mass is energy and all energy is weight, so Einstein taught us. Well, if one were to succeed in creating just 4 grams of helium atoms from hydrogen atoms and electrons, one would net an amount of energy that would produce as much heat as would be released from the combustion of 80 tons of coal. Fortunately, this has not succeeded yet – although one could then hold a winter's domestic heat supply in one's vest pocket – and we don't know if it ever will. But in the event that it should, professor Coster concluded, we should fear for our lives!" (*Leeuwarder Courant*, 19 February 1939)

During WWII, press coverage of atomic research in German-occupied The Netherlands continued to be sparse. But much like the article above, the few articles that *did* appear, invariably linked the promise of energy to the possibility of destruction:

> It is principally in the following direction that the thoughts of current-day atomic physicists proceed: how will humanity, which requires awesome quantities of energy each year and sees her resources shrink each year as well (how long will our coal and oil reserves last?), firstly tame immeasurable amounts and secondly utilize them practically? (…) A mouth-watering prospect for technicians. But the main difficulty is that the potential release of this energy-accumulation would be accompanied by such destructive forces that total annihilation would ensue. So the question remains: how will man subjugate this force of nature as well? The question is far from answered, and yet, a surprising new future already dawns on the horizon". (*Leeuwarder Courant*, 7 December 1940, 'The philosopher's Stone Then And Now')

In March of 1941 *Leeuwarder Courant* published an article on announcement by a certain Jean Thibaud, named as a professor of physics at the University of Paris. Alongside a fairly accurate prediction concerning nuclear weapons, it also contained a truly dystopian image of the resulting (literally!) universal destruction:

> Prof. Jean Thibaud (…) predicted (…) in relation to his latest research into the pulverization of atoms that science will succeed within two or three years in establishing this process artificially. He added the warning that, if one were to use atomic bombs as weapons of war, there is a chance that the whole world would be destroyed. "Atomic bombs as weapons of war", said Thibaud, "are certainly conceivable, but they would be as dangerous to those who use them as they are to their targets. No one yet knows how to stop the decomposition of matter (…) No one can say if the destruction thus initiated won't skip over to the universe. (…) Scientists hesitate to undertake large-scale experiments with shattering atoms for fear that the destruction will be unstoppable." (*Leeuwarder Courant,* 12 March 1941, 'Gevaarlijke energie')

In the same article, this dystopia was once again coupled to a utopian promise of limitless amounts of energy:

> "Thibaud added that within ten years, millions of volts of energy can be harvested through the controlled release of energy accumulated within a grain of sand. Through the shattering of atoms one will be able to illuminate and heat cities, power factories and irrigate farmland. The professor concluded his lecture with the words: "I only hope that humanity will utilize this limitless source of power for the benefit of the world – and not as a horrible means to complete annihilation." (*Leeuwarder Courant, 12-3-1941, 'Gevaarlijke energie')*

Before and during WWII, there was no coherent 'nuclear discourse' in The Netherlands. Although the sparse popular articles on atomic research reproduced the 'sacred versus profane' binary (e.g. Alexander, 1993) and the macro-cultural repertoire about the subjugation of nature by man, the centrality of the topic of atomic energy was very low, as were its empirical fit and experiential commensurability, resulting in low cultural legitimacy. This would all change with the atomic bombardment of Hiroshima and Nagasaki in 1945, which dramatically demonstrated to the world the American success in establishing nuclear chain reactions and realizing a 'practical' application of atomic energy.

Occurring some three months after the liberation of The Netherlands by Allied forces, it cast a shadow over the general joy about the ending of the war (Van Lente, 2006). The public clearly had doubts about the consequences of the supposed peace-bringer. Soon after the bombings, the difficult relation between peace and the atomic bomb became the subject of various performances in the news media. *Metro* published a political cartoon depicting a demonic-looking angel labeled *pax* (peace) ready to shatter the earth with a sphere labeled *atoom-bom* (atomic bomb), while a white dove carrying an olive branch (a common symbol for peace) flies away (figure 4.2.1). A cartoon in *De Groene Amsterdammer* parodied Rembrandt's famous 'The Anatomy Lesson of Dr. Nicolaes Tulp' by showing US President Harry Truman performing an anatomy on a corpse labeled *vrede* (peace), extracting an *atoombom*, and saying *"And this, gentlemen, is the heart"* to an audience depicting various world leaders (figure 4.2.2)

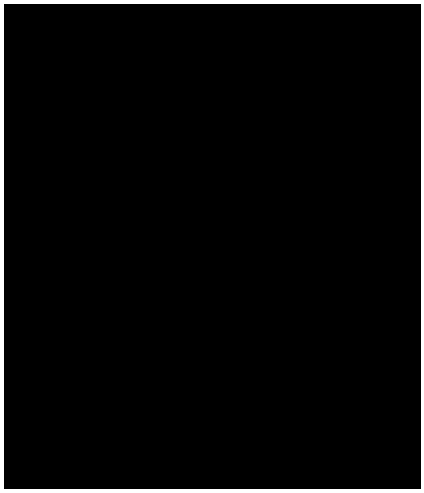


Fig. 4.2.1 Metro, 24 August 1945 (Artist: M. Toonder). Source: Van Lente (2006).

Fig 4.2.2 De Groene Amsterdammer, 3 November 1945 (Artist: L.J. Jordaan). Source: Het Geheugen van Nederland.

Figure 4.2.2 also illustrates that it was clear to the Dutch public that it would only be a matter of time before other governments would possess the atomic bomb. The American reluctance to share 'the secret of the atom bomb' - and the question if this was for reasons of international safety or rather for commercial reasons – became dominant topics in the Dutch media. Figure 4.2.3 is a political cartoon depicting US president Truman, confidently presenting a pile of conventional weapons of war while hiding a small bomb labeled *atom* behind his back. The caption read: *"I will give you everything, but that one thing"* - a reference to a popular German song at the time. Another major theme was the question if Russia also possessed the atomic bomb – and speculation about the consequences when it was made public in 1949 that it did. Figure 4.2.4 is a political cartoon that at first glance appears to depict an erupting volcano, but in reality shows Stalin exhaling a jet of fire labeled *atom*. The caption read: *'The Stalin Works'*.

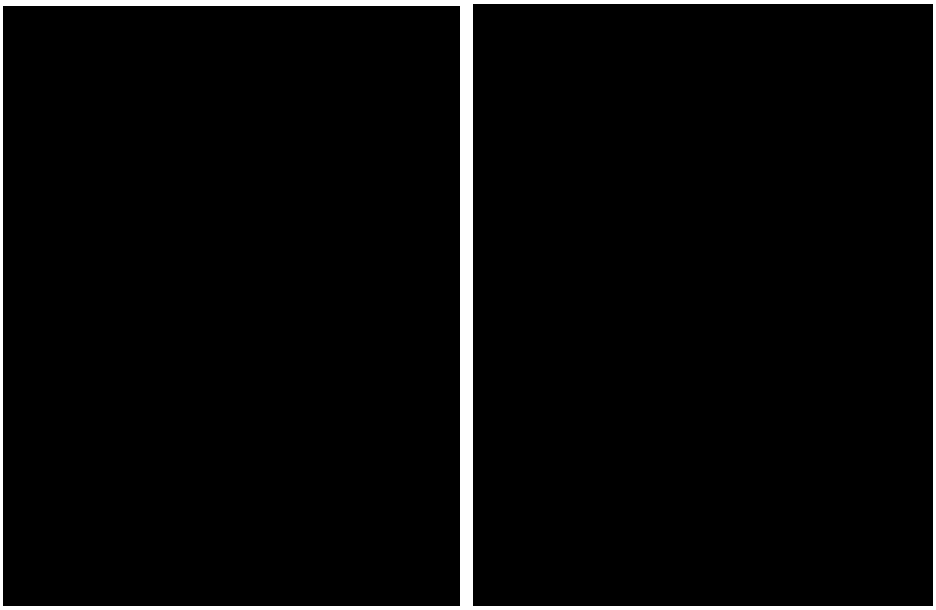


Fig. 4.2.3 Vrij Nederland, 30 July 1949 (Artist: L.J. Jordaan). Source: Het Geheugen van Nederland.

Fig 4.2.4 Vrij Nederland, 1 October 1949 (Artist: L.J. Jordaan). Source: Het Geheugen van Nederland.

Other key themes in the Dutch press relating to nuclear technology in the late 1940s and early 1950s were:

- the USA's call for international supervision of nuclear energy and the establishment of an independent Atomic Development Authority;
- the disagreement between the USA and Russia about disarmament resulting from the USA's refusal to discuss it until said international supervision has been implemented;
- the failure of attempts to establish said international supervision and the calls for a 'world government' and global disarmament as the only alternative to annihilation.
- atomic espionage, continuing atomic bomb tests, and the development by both the USA and Russia of the thermonuclear (hydrogen) bomb.

But throughout these developments, Dutch scientists had labored to reconnect with international developments in the area of nuclear physics. Already in 1945, scientists had advised the government to create a new organization for the promotion of atomic research, and a year later, the Foundation for Fundamental Research of Matter (FOM) was thus established. After restarting the research efforts that had begun before WWII with the acquisition of the uranium oxide, FOM concluded in 1949 that The Netherlands needed to have "a finger in the pie", both in terms of fundamental and

applied research into atomic energy. The government agreed: it was felt that atomic energy would eventually be crucial for the economy of the impoverished and war-ravished nation (Lagaaij and Verbong, 1998). The development of potential *civilian* applications of atomic energy thus required an 'uncoupling' of the strong association that existed in the public sphere between atomic energy and the threat of war, destruction, suffering, and death. As such, the Dutch government, like many Western governments at the time, initiated a 'propaganda offensive' for the development of peaceful applications of atomic energy (Van Lente, 2006). While in some countries, the purpose of this offensive was at least in part to cover up the (further) development of nuclear weapons, this appears not to have been an ambition in The Netherlands. The creation of cultural legitimacy required the articulation of a 'positive' storyline about atomic energy, as well as its performance on public stages. These performances were geared towards rendering the storyline both plausible and salient to its audience (the general public) can thus be analysed in terms of the five dimensions of empirical fit, credibility, centrality, experiential commensurability and macro-cultural resonance.

4.2.2 Macro-cultural resonance: reconstruction & industrialization

Reconstruction and the restoration of national pride became important macro-cultural repertoires in the war-ravaged Netherlands after WWII. Figure 4.2.5 illustrates this by showing a couple and a young child accompanied by the words in the colors of the national flag reading 'restore The Netherlands through labor'. One way to restore prosperity would be the process of industrialization. This macro-cultural repertoire is performed in figure 4.2.6, which shows a poster commissioned by the government information service. It reads 'a necessity for wealth: industrialization' while showing The Netherlands as a cogwheel powered by a transmission belt in the national colors.

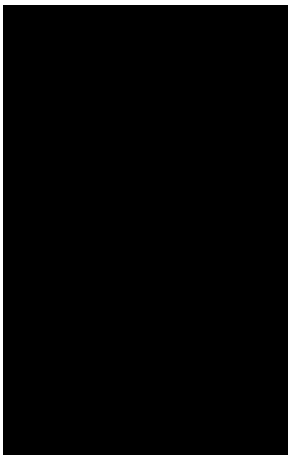


Fig. 4.2.5 Associated Advertising Artists, 1947-1948 (Artist: W. Brusse). Source: Het Geheugen van Nederland.

Fig. 4.2.6 Rijksvoorlichtingsdients poster, 1945-1950 (Artist: Studio Flem). Source: Het Geheugen van Nederland.

Atomic energy was linked to the repertoires of industrialization and technical progress. In 1950, FOM presented a plan to the government which entailed the construction of a nuclear reactor in a joint-venture with Norway, the construction of a small domestic test-reactor, and eventually the construction of a large industrial reactor. Dutch industry was to have a large share in this. The document submitted to the Ministry of Education, Arts and Sciences (OKW) read:

> "The [FOM] Board of Directors feels that no expense should be spared to ensure that, when applying new technologies, The Netherlands can build, operate and maintain them with its own people. A repetition of the sad state of affairs in late 19th century industrial development, when the hulls of Dutch-built ships had to be towed to England to be outfitted with boilers and engines, should be prevented in this new domain." (Source: Lagaaij and Verbong, 1998: 22)

Scientists expressed similar sentiments towards the press. Atomic energy was linked to the technical progress repertoire, by stating that The Netherlands simply couldn't afford to lag behind. In 1951, *Leeuwarder Courant* published an article in which physics professor Milatz (later: director of Dutch Reactor Center RCN) was quoted as saying:

> "When we find that one gram of uranium is equal to 25 tons of carbon as an energy source, when we see that England hopes to power an aircraft carrier with atomic energy by 1954, that the United States have a project to equip a submarine with atomic energy already before 1953 and than plans are being executed for the atopmic propulsion of bombers, then it speaks for itself that a forward-looking people cannot stay on the sidelines of research into atomic nuclear energy." (*Leeuwarder Courant*, 13 July 1951, 'Toekomst aan atoomenergie').

Educational material such as slide shows and brochures, supplied by the United States Information Service (USIS) and translated into Dutch, were used to position atomic energy at the center of technical progress in all domains of society. Figure 4.2.7 shows two consecutive slides from an educational slide show called 'Man and the Atom'. The left slide links atomic energy to industrialization by showing a nuclear reactor (depicted as an industrial building decorated with the Rutherford atomic model) amid key technical inventions of the past. The accompanying text reads:

> All this is no exaggeration. For the discovery of the forces and possibilities that hide inside the atom are of far greater importance to humanity even than the invention of the steam engine, the internal combustion engine and the microscope.

The story continues in the right slide, which shows the same nuclear reactor, this time at the center of a circle made up out of a bundle of wheat, a microscope, a cow, a man, and a pair of cogwheels which symbolize the societal domains which atomic energy would revolutionize (respectively, agriculture, research, animal husbandry, health care and industry). It also prominently shows an atomic bomb crossed out with a big X. The accompanying text, which follows up on the previous slide's caption, reads:

> Provided that those forces aren't used to destroy the Earth, but for the benefit of mankind, to combat disease and to promote hygiene. And in the interest of animal

husbandry, agriculture, industry and science. For in these domains, the possibilities are enormous.

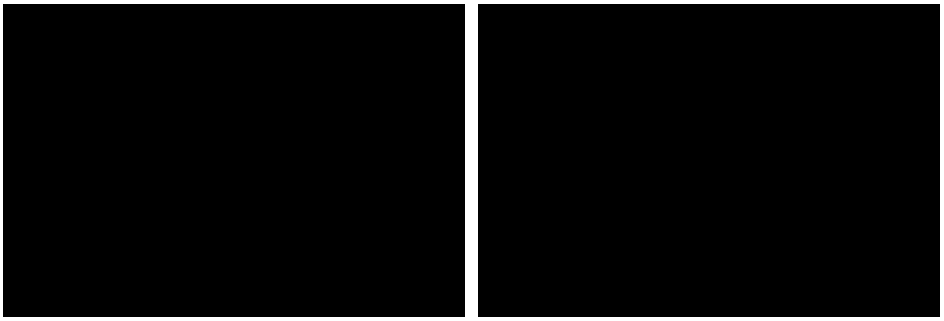


Figure 4.2.7 Two consecutive slides from Man and the Atom. Fibo Beeldonderwijs, Zeist, early 1950s (compiled by: A. Timmermans). Source: www.laka.org/dias.html.

Another strategy to link atomic energy to the macro-cultural repertoire of technical progress was to place atomic energy in a historical context and frame it as a logical and inevitable next step in the subjugation of nature by mankind in general and the Dutch in particular. In their series of educational books, Elsevier published *Het Atoom* (De Vries, 1957). One of the chapters is entitled 'From muscle power to atomic power' and narrates 2,000 years of utilization of energy sources by mankind, concluding with mankind finally, and "just in time", discovering the ultimate source of energy. Figure 4.2.8 shows the accompanying illustration, which positions a nuclear power plant at the end of a line of energy conversion technologies which starts with a sailing ship and a wind mill; both strong symbols of The Netherlands which invoke images of an illustrious past.

Fig. 4.2.8 Illustration depicting issustrious Dutch energy conversion technologies from past to present (Artist: Peter van Straaten). Source: De Vries (1957: 114).

4.2.3 Actor credibility: high status of scientists

Beyond instilling a sense of fear among the wider public in The Netherlands, the reality of the atomic bomb also highlighted the relationship between science and politics. Within science, the dominant view had previously been that the two domains should be disconnected: that science should stand free from society. Yet the atomic bomb was seen as proof that this was no longer viable (Molenaar, 1994: 39). In late 1945 the Royal Academy of Arts and Sciences (KNAW) drafted a resolution. Directed towards the government, it observed that "as a fruit of the natural sciences, atomic energy has because an energy source accessible to society" and that this had "opened up far-reaching possibilities for a better world economy". It further stated that although "this discovery has initially led to the atomic bomb, which holds terrifying potential for destruction", "the world of science, which has unlocked this potential, is aware of the responsibility it bears for this" (Molenaar, 1994: 31). The resolution therefore argued that in the future, "secrecy about the results of scientific research would be unacceptable for the development of science and the interrelated development of public wealth and health". The political cartoon in figure 4.2.9illustrates this view. It shows a scientist as a David battling Goliath, a symbol of mankind's warlike side. In his hand the scientist holds a rock that, in the legend the image refers to, will fell the giant, and the rock is labeled 'OPENBAARHEID' (disclosure). The cartoon's caption read: *"David and Goliath: the freedom struggle of science"*.

KNAW argued that the only way to ensure that science would be used exclusively for the good of society was for scientists and governments to work together. To this end, 'men of science' would be involved in the decision-making process. It was a call for technocracy, and Dutch Prime Minister Schermerhorn answered. Experts of various kinds were already heavily represented in his postwar cabinet: of the 15 ministers, 6 held PhD's, 5 were engineers and 4 were professors (Molenaar, 1994: 29). They felt that scientific research was key to the postwar reconstruction efforts and industrialization. The government had a societal mandate to restructure society, and established such institutions as the Foundation for Fundamental Research of Matter with a minimum of bureaucratic fuss (Molenaar, 1994: 30). This happened on the advice of physicists, who saw themselves as the de facto representatives of atomic energy (Lagaaij and Verbong, 1998).

Because the support of public opinion in societal restructuring was considered crucial (Molenaar, 1994: 32), science and politics together embarked on a "propaganda campaign" (Dick Van Lente, 2006) for the promotion of scientific research in general, and the beneficial use of atomic energy in particular. Prominent Dutch physicists played an important role in this engagement with (and education of) the general public (Molenaar, 1994: 31). Physics professor G.J. Sizoo, for example, wrote a popular-scientific book on atomic energy aimed at educating the public both about the physics behind it and the importance of developing peaceful applications (figure 4.2.10).

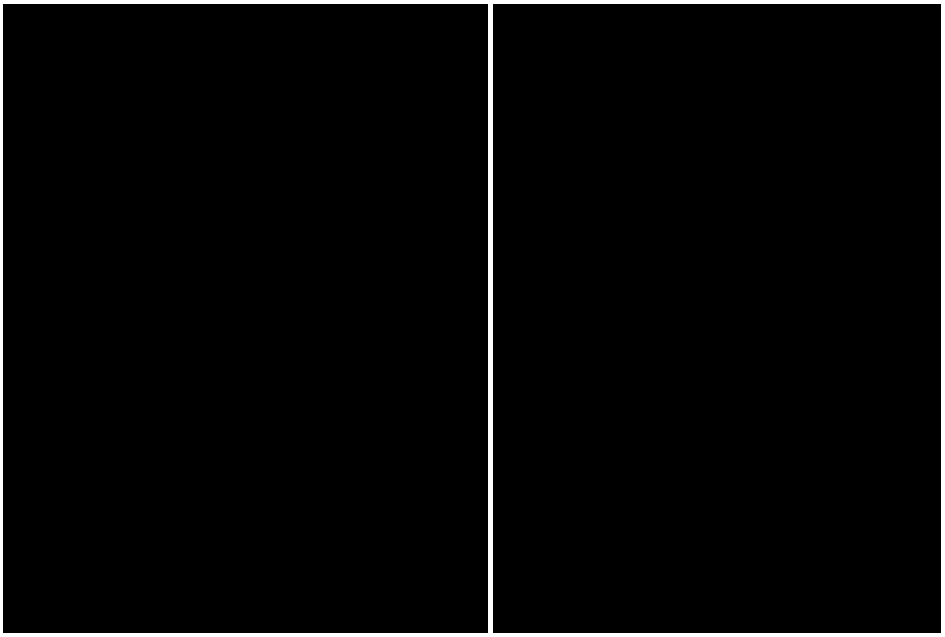


Fig. 4.2.9 De Groene Amsterdammer, 2 November 1946 (Artist: J.L. Jordaan.). Source: Het Geheugen van Nederland.

Fig. 4.2.10 Cover of G.J. Sizoo's popular-scientific book Atoomemergie (1946).

Such performances by prominent and well-known physicists increased the credibility of the atomic energy storyline. Scientists in general were well-respected, trusted and believed. Instead of being seen as perpetrators (who had brought the atomic bomb into the world), scientists were seen more as victims, who had been forced by the horrors of war to apply their knowledge for destructive purposes. Their atonement was perceived as genuine, as indicated by the following newspaper quote from *Zierikzeesche Nieuwsbode* (7 August 1945);

> Day and night, scientists rack their brains for ways to rid themselves of the specter of the atomic bomb. When they point out its lethal dangers, it is only to instill a "healthy fear" into the people. They seek to guard the world of a dull apathy with the regard to the atomic bomb by stressing that there will always be desperados who would reach for this diabolic weapon in an ill-fated moment (*Zierikzeesche Nieuwsbode*, 7 August 1945)

The establishment of the Association of Scientific Researchers (VWO) in 1946 reinforced this perception. Convinced of the responsibility of science to promote peace, they initially argued for the necessity of international control of atomic weapons (Molenaar, 1994: 86) and from the mid 1950s onward, they took an increasingly active role in the emerging movement to ban atomic weapons (Molenaar, 1994: 168). Over this period, the association between atomic energy and the atomic bomb decreased in the public mind. The co-word graph in Figure 4.2.11 illustrates that the atomic bomb storyline and the atomic energy storyline became increasingly separated. In the decade

after the end of WWII, atomic energy for consumption gradually became just as 'good' as the atomic bomb was 'evil' (Molenaar, 1994: 169): it was the birth of an Atomic Age.

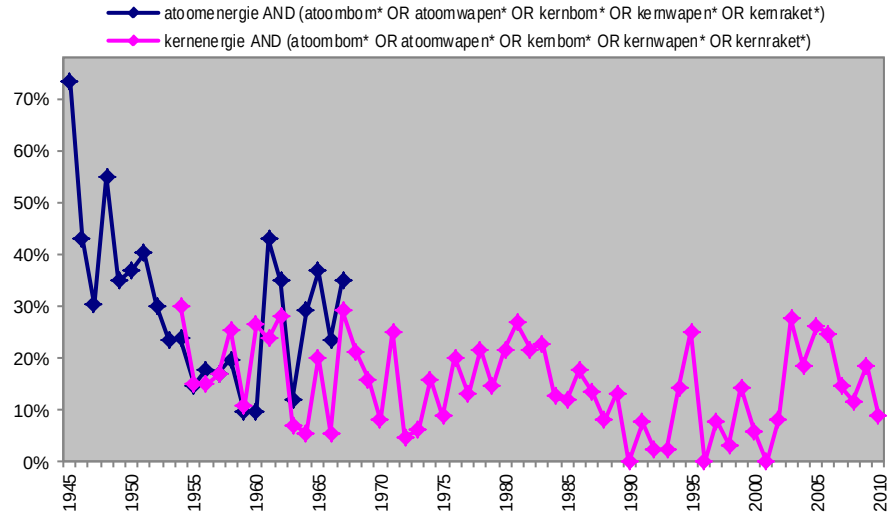


Fig. 4.2.11 Co-word plot for words in legend. Absolute occurrence of 'kernenergie' before 1953 and of 'atoomenergie' after 1967 is so low that co-occurrence with other words is rendered meaningless and therefor not plotted. Source: Leeuwarder Courant.

4.2.4 Experiential commensurability: atoms for everything

The vision of an Atomic Age emerged when newspaper articles, educational material and popular scientific books also linked atomic energy to concrete, future transformations in people's daily lives and everyday practices. Between 1954 and 1957, daily newspaper *De Tijd* ran a recurring section entitled 'Living With Atoms' in which the benign effects of the atom on people's lives were discussed. For about a year, this section also featured on the radio in weekly installments, and in 1957 it culminated in a popular scientific book of the same title by H.C.M. Edelman (Edelman, 1957). The book told of the potential of radioactive isotopes in curing diseases, killing insects, finding leaks in pipes, making perfectly homogeneous paints, measuring the cleanness of laundry, and even preserving fresh and canned foods. This latter application is illustrated in figure 4.2.12, which features two excerpts from another US Information Service-supplied educational slideshow, this one called 'Blessings of the Atom'. The caption for the left slide read:

> Potatoes which have been exposed to radioactive irradiation can be kept at room temperature for two years without sprouting. On the right: an irradiated potato, on the left: a potato from the same harvest that was not irradiated.

The caption for the right slight read:

They're also experimenting with tinned foodstuffs, which are being irradiated with radioactive cobalt in order to keep them from going bad.

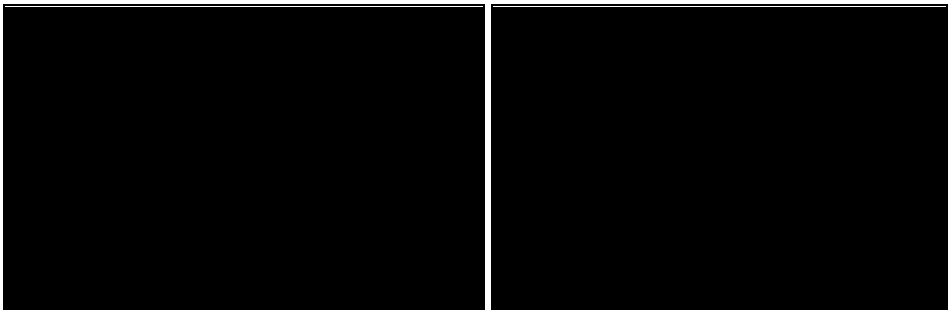


Fig. 4.2.12 Two slides from Blessings of the Atom. Fibo Beeldonderwijs, Zeist, early 1950s (compiled by: A. Timmermans). Source: www.laka.org/dias.html.

Atomic energy would revolutionize people's mobility, as well: nuclear reactors would soon provide new power sources for the various modes of transportation. Nuclear-powered submarines had already become a reality with the launch of the American *USS Nautilus* in 1955 and the Soviet ice-breaker *Lenin* in 1957. Various programs were underway for nuclear merchant ships and even airplanes. Even in The Netherlands, studies were made into the possibility of building a nuclear reactor for ship propulsion (Lagaaij and Verbong, 1998). Such developments were mobilized in educational material. The popular scientific book 'The Atom' (De Vries, 1957) for example imagined the arrival of nuclear-powered airplanes and cruise ships (see: fig. 4.2.13).

Fig. 4.2.13 Illustration of various modes of transport that were thought to be powered by nuclear reactors in the near future (Artist: Peter van Straaten). Source: De Vries (1957: 120-121).

In the mobility domain, the link to daily life even occurred through promises of nuclear powered automobiles. The Ford Motor Company created a (nonfunctional) concept car with an interchangeable nuclear reactor in the back. It was unveiled at the Detroit Motor Show of 1958 and reported in the magazine of the Dutch motorist club ANWB (see: figure 4.2.14). The accompanying text read:

> No indeed: atom cars do not yet exist but…they can certainly come. Ford USA sent us a sketch of the future (…) We too are convinced that atom cars *will* arrive within a relatively short time. Then, this picture will prove of historical significance!

Fig 4.2.14 Image adapted by Autokampioen illustrator Jusling from sketch supplied by Ford USA. Source: Autokampioen, 8 March 1958.

These and similar performances of atomic energy as a central part of people's future daily lives aimed to make atomic energy less abstract, strange and distant. This contributed in the mid to late 1950s to a perception that people were living in an 'atomic age' – a perception that was capitalized upon by various business to sell their (often completely unrelated) products. Figure 4.2.15 shows a life insurance advertisement, which paints a picture of a future in which people's daily lives are permeated by technological innovations, among which 'atomic heating':

> See-through walls, roof and doors…television, atomic heating, radio power…the house of the future. Of 1967? 1983? 1976? We don't know. What we *do* know is that you'll need money for the education of your children, your pension, and your next of kin (…)

Figure 4.2.16 is an advertisement enticing the Dutch to reap the expected financial benefits of the atomic age by investing in the American nuclear industry:

> Investing in the atomic Age. Atomic Development Mutual Fund, an American investment fund which covers all facets of the atomic nuclear industry aims to pay its shareholders the largest possible dividends through the development of nuclear energy.

Dutch certificates of 10 shares ATOMIC FUND are traded at the Amsterdam stock exchange (…).

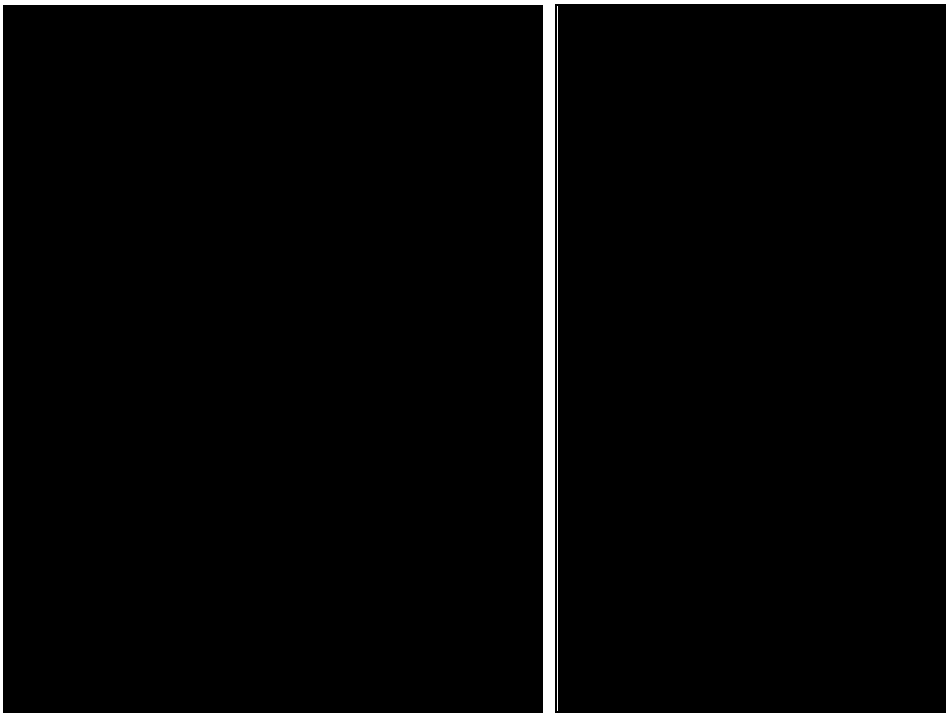


Fig. 4.2.15: Advertisement for life insurance. Source: Leeuwarder Courant, 6 September 1956.

Fig 4.2.16: Advertisement for Atomic Development Mutual Fund inc. Leeuwarder Courant, 7 September 1957.

4.2.5 Centrality: the solution to squandering

The 1956 Suez crisis increased the public awareness of the vulnerability associated with dependence on fossil fuels. This created an opportunity to frame atomic energy as a solution to a central social problem. Edelman's popular-scientific book (1957) for example argued that:

> For Western Europe, the Suez crisis has been an omen (…). It is clear that it could be of the utmost importance for the independence of Western European energy supply of a larger share of the required energy would come from indigenous sources. From nuclear power plants, in other words. (Edelman, 1957: 17).

Similarly, the popular-scientific book by De Vries (1957) argues that:

> Mankind has discovered – just in time – a new source of energy. (…) [W]e have seen to what extent the wealth of nations depends on the availability of energy and what disastrous consequences the depletion of coal and oil supplies would have. (…) [T]his

> would result in the greatest disaster of all time, the starvation of millions and the downfall of our entire modern, industrial society – were it not for the fact that a new, incredibly rich source of energy was discovered in the cores of atoms. (De Vries, 1957: 124-125)

The book emphasized humanity's "potvertering" (i.e. squandering of natural resources). To reinforce the appropriateness of atomic energy as a solution to the unreliable and diminishing fossil fuel supply, this and many other performances emphasized the high energy density of uranium compared to fossil fuels. For example, the educational slide show 'Blessings of the Atom' contains four consecutive slides which perform a storyline of nuclear energy as a virtually limitless energy source to replace fossil fuel (figure 4.2.17). The captions read:

> 2. Some 90% of all energy required comes from coal and oil. But because in the last forty years, mankind has used more coal and oil than in all the preceding centuries combined, the stocks are depleting so quickly that they will most likely be radically depleted within the next 100 years.
>
> 3. Fortunately, another source of power has been discovered. Uranium. A kilogram of uranium – a quantity about the size of two match boxes – contains as much energy as…
>
> 4. …130 railroad carriages of coal of twenty tons each.
>
> 5. This energy would be sufficient to let a train circle the Earth three times.

Fig. 4.2.17 Four consecutive educational slides from Blessings of the Atom. Fibo Beeldonderwijs, Zeist, early 1950s (compiled by: A. Timmermans). Source: www.laka.org/dias.html.

As a result, the possible peaceful applications of atomic energy focused more and more on its use for the production of electricity in large, centralized power plants. Thus, in the mid to late 1950s, the relatively heterogeneous atomic energy discourse developed into a more homogeneous nuclear power discourse (see also: the co-word graph in figure 4.2.18).

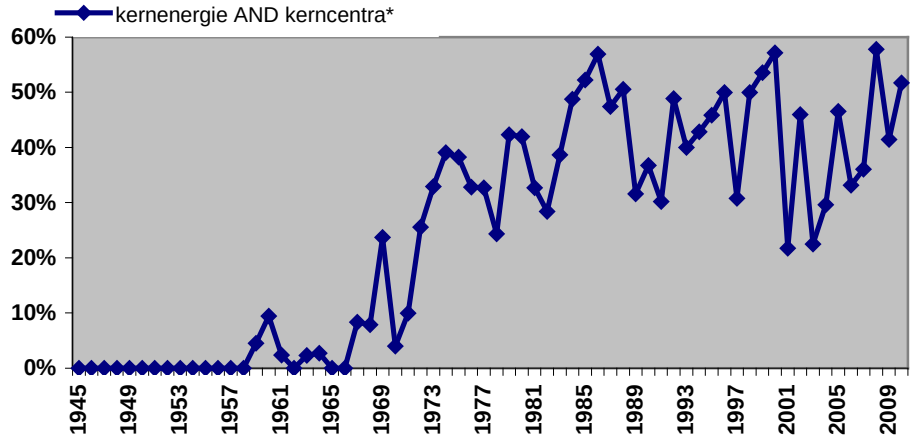


Fig. 4.2.18 Co-word plot 'nuclear energy' and 'nuclear power plant'. Source: Leeuwarder Courant.

4.2.6 Empirical fit: the first reactor

In 1957, a large-scale exhibition called 'Het Atoom' was organized. The exhibition was aimed at educating the Dutch on the peaceful applications of atomic energy with the aim of providing them with the "mental foundation" to be prepared for the coming of the atomic age (Verbong and Lagaaij, 2000: 239). Its location at Schiphol Airport allowed the organizers to link the rapid progress in aviation to the expected rapid progress in nuclear power. The visitor's guide explained:

> The world of tomorrow is near! In 1903 the American Wright brothers made their first flight with a flying machine. No one gave it much thought, because at the time no one could believe in the significance of aviation. Now, barely fifty years later, the whole world is covered by a dense grid of air routes. Just look outside! See Schiphol, see the gigantic airplanes of today! The dream of 1903 was no foolish fantasy! In *one* generation the world made this leap. It is to us, the generation if 1957, to determine the future of tomorrow's world. Our future: atomic energy! (Tentoonstelling Het Atoom, 1957)

To further link atomic energy to modernity, the exhibition also showcased a number of other new technologies, among which an IBM-calculator and a modern kitchen (Oldenziel and Zachmann, 2009). The exhibition's 250,000th visitor was even presented with a refrigerator; a fairly rare appliance in Dutch households at the time (figure 4.2.19).

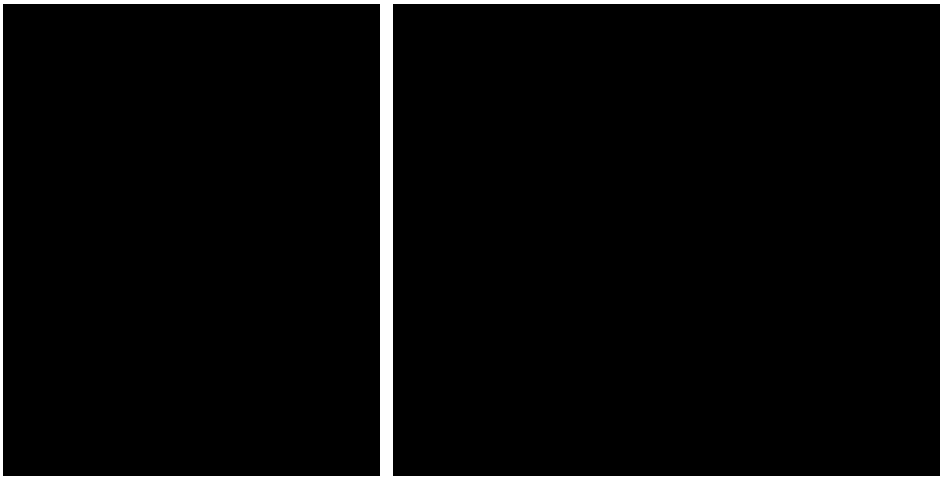


Fig. 4.2.19 Photograph of the 250,000th visitor of 'Het Atoom' being given a refrigerator, 3 August 1957. Source: Het Geheugen van Nederland.

Fig. 4.2.20 Photograph of a group of nurses looking at the pool reactor at the exhibition 'Het Atoom', 1957. Source: Schot et al. (2000: 238).

The largest effect of the exhibition, however, was on the dimension of empirical fit. By 1957, and in spite of 'high scores' on the dimensions in the previous subsections, the empirical fit of the Dutch nuclear power storyline (i.e. the extent to which real-word events could be mobilized as empirical proof) was low at the time. While the USA and the UK could pride themselves on, respectively, the launch of the nuclear submarine *Nautilus* and the grid-connection of the world's first commercial nuclear power plants *Calder Hall*, The Netherlands couldn't yet claim any domestic successes. Previously, to increase the empirical fit, various performances (such as educational slideshows and popular-scientific books) had pointed to these concrete foreign successes in the application of nuclear power.

But with the 1957 exhibition, the first functioning nuclear reactor came to The Netherlands. A small, open-ended 'swimming pool reactor' had been purchased by the Ministry of OKW for the exhibition. It was activated and operated by the Dutch reactor center RCN and the Delft Polytechnic High School, and displayed for the public to see (figure 4.2.20). In an altogether very successful exhibition - it drew some 750,000 people (Verbong and Lagaaij, 2000) - the swimming pool reactor was the main attraction. Although the relatively simple reactor produced only 10 kW of power and was intended more for materials research purposes than for electricity production, it was the first nuclear reactor on Dutch soil. People would wait in line for hours just for a glance of the "mysterious blue glow" (Visitor's Guide, 1957) of the Cherenkov radiation from the scaffolding that was erected over the pool in which the reactor was located. Although the reactor was designed by the American Machine & Foundry Company in New York, the visitor's guide to the exhibition proudly claims that:

> We the Dutch can rejoice that this company has had such faith in our Dutch industry, that it has agreed to, under their supervision, let Comprimo in Amsterdam and Philips in Eindhoven manufacture the reactor right here in our own country. (Visitor's guide, 1957)

This way, the reactor was mobilized as real-world proof of the Dutch ability to construct and operate a nuclear reactor, thereby increasing the empirical fit of the nuclear power storyline.

4.2.7 Epilogue: high cultural legitimacy in late 1950s

By 1957, the various performances targeting the dimensions in the above subsections had resulted in a strong atomic energy storyline that was both plausible and salient. At the height of public attention to atomic energy (see also: bibliometric graph of figure 4.1.1), Minister of Economic Affairs Zijlstra published a Memorandum on Nuclear Energy which expressed strong ambitions for the construction of nuclear power plants.

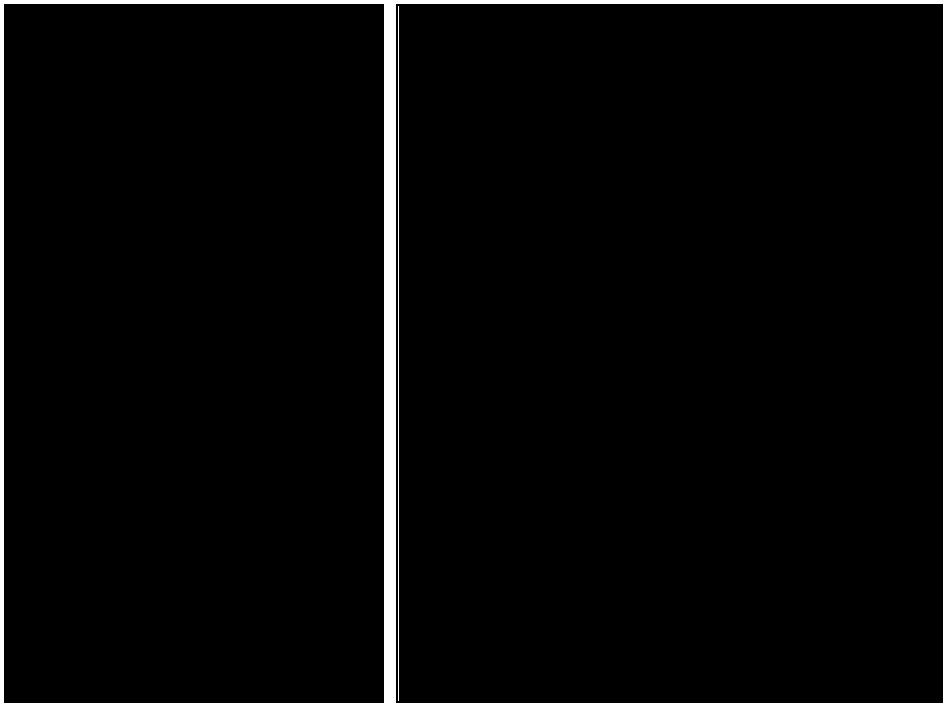


Fig. 4.2.21 Advertisment for 'Het Atoom'. Source: Zierikzeesche Nieuwsbode, July 1957.

Fig. 4.2.22 Political cartoon parodying the advertisment for exhibition 'Het Atoom'. Vrij Nederland, 13 July 1957. Source: Het Geheugen van Nederland

By 1975, 3000 MW of the expected 8650 MW of electricity production capacity should consist of nuclear power plants. Moreover, after 1975, all new power plants should be nuclear, and already by 1962 should the first nuclear power plant (a small 100 MW station comparable in design to the British *Calder Hall*) come online (Ministerie van

Economische Zaken, 1957). The Memorandum makes no mention of other uses of atomic energy: the technology had claimed the domain of power production. The graph of Figure 4.2.18 corroborates this: power plants emerge as an important topic in the context of nuclear power.The price of the required restructuring of the electricity sector would be an estimated 9 billion Dutch guilders. These costs were the only aspect of the plan that drew criticism: some felt that 9 billion guilders was a high price to pay to enter the Atomic Age. The political cartoon in figure 4.2.22, for example, is a parody of an advertisement for the aforementioned exhibition 'Het Atoom' (figure 4.2.21). Zijlstra is depicted as the seductive young lady in the advertisement, and the cartoon reads: "A glance into the future. Entry price: 9 billion".

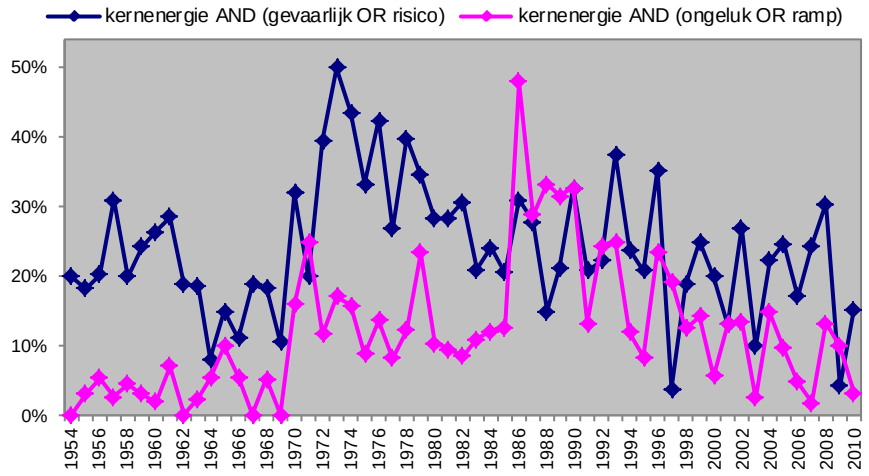


Fig. 4.2.23 Co-word plot: 'nuclear power' and ('danger' or 'risk') versus 'nuclear power' and ('accident' or 'disaster'). Source: Leeuwarder Courant.

Although the possible dangers of atomic energy were acknowledged early on and even discussed in the media (see: co-word graph of Figure 4.2.23), any concrete occurrences were regarded as reminders to exercise caution and intensify research efforts, instead of as incentives to abandon atomic energy:

- In September of 1957, a number of apparently mutated frogs were found in a ditch downstream of the Institute for Nuclear Physics Research (IKO) in Amsterdam (see: figure 4.2.24). An article in *Vrij Nederland* made the connection to IKO's routine discharges of radioactive fluids in said ditch. A biologist's claim of a causal connection was refuted by both the Institute's director and a renowed nuclear physicist: "After all, these people know nothing about nuclear physics and radiation theories" (*Vrij Nederland*, 14 September 1957, 'Wanstaltige kikkers in Amsterdamse sloot'). They dismissed the situation as "toeval" (coincidence) and a "doodgewone afwijking" (a commonplace anomaly).

- A month later, in October of 1957, a fire in the graphite core of one the *Windscale* plutonium production piles in the UK caused substantial radioactive contamination of the surrounding area. A cloud of radio-active iodine blew eastward, and increased levels of radioactivity were even measured in The Netherlands. Even so, Dutch newspapers reported only sparsely on the event, referring to it as an "onregelmatigheid" (irregularity) with consequences no more severe than several nearby farmers having to flush their milk supplies (figure 4.2.25).
- Three months later, in January of 1958, a small piece of a radium needle inadvertently broke off in the nose of a young girl from Putten during treatment in a Utrecht hospital. This went undetected and when the girl arrived at her home, she began vomiting. Upon detection, it was found that both the stove that was used to incinerate the vomit and the garden in which the ashes had been deposited, were radio-active (*Leeuwarder Courant*, 20 January 1958). As a precaution, the family was admitted to a hospital and their home was quarantined (figure 4.2.26). The situation was somewhat neutrally labeled in the press as a "vergissing" (mistake; Leeuwarder Courant, 20 Jauary 1958) and an "omstandigheid" (circumstance; *Leeuwarder Courant*, 22 July 1958).

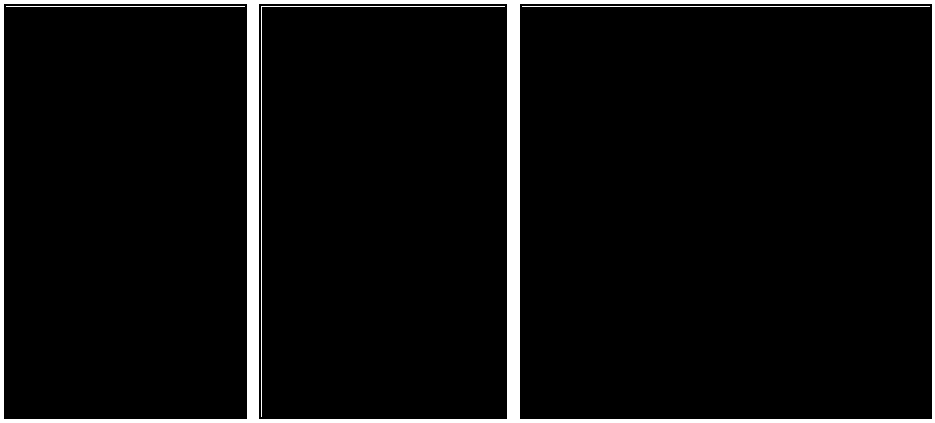


Fig 4.2.24 Photo of mutated frog reproduced in radiation booklet. Source: Van Duinen (1958: 15).

Fig. 4.2.25 Photograph of contaminated milk being flushed in Cumbria, UK. Source: Zierkikzeesche Nieuwsbode, 18 October 1957.

Fig 4.2.26 Photo of police officer guarding radio-active home. Sign reads: "perilous – do not enter". Source: Van Duinen, (1958: 1).

In the context of a positive nuclear power discourse, these and similar occurrences could only be interpreted as 'irregularities', not as indications that nuclear power was undesirable. For example, an educational brochure about the dangers of radioactivity written by physician A.T. van Duinen calls these occurrences "the result of the incorrect application of the necessary precautions, or the insufficient number of such precautions"

(Van Duinen, 1958). They are mobilized to argue for a speedy adoption of a regulatory framework, instead of a halt to atomic research. The brochure concludes with:

> Of course, many scientists are laboring to deflect such dangers. (…) Through intensive research, they try to reduce the dangers to a minimum. Recently, there have been a few successes in this area (…). Dutch scientists (…) have succeeded in largely curing radiation disease. [Members of the] French commission for nuclear power (…) have announced that they have in all likelihood found a medicine that can protect humanity from radioactivity (…) Concluding, we can safely say that the problem of ionizing radiation is currently still posing many difficult and confusing questions, but that for the utilization of nuclear power – regulated through international agreement and based on regulations derived from extensive experimentation – the future dangers may be smaller than expected. (Van Duinen, 1958)

It would be unfair to state that such statements were naïve or even intentionally misleading. In the absence of an 'anti-nuclear' discourse, these events simply could not be easily interpreted as reasons to stop pursuing nuclear development. By tweaking the various storylines about nuclear power to emphasize the need for further research, these events could be resolved *within* the extant nuclear power discourse.

Once the cultural legitimacy for nuclear power had been established, attention shifted towards practical implementation. In 1957, the government announced that the first Dutch nuclear power plant would be operational by 1962 in Geertruidenberg, followed by one in Harderwijk in 1964. The utilities, however, were hesitant about the economic feasibility of a commercial nuclear power reactor, in part because of the abundance of cheap oil after the Suez crisis and the newly discovered and very large domestic natural gas supplies, which formed feasible alternatives for electricity generation (Lagaaij and Verbong, 1998). In late 1959, the utilities decided not to order a nuclear power plant, much to the disappointment of the Ministry of Economic Affairs and the industry. So high was the legitimacy of nuclear power that the government believed that the economic value of the domestic natural gas would plummet as nuclear power would become more widespread. It therefore preferred a policy of quickly selling off natural gas (Lagaaij and Verbong, 1998). But in 1961, the Ministry of Economic Affairs published a (second) Memorandum on nuclear energy which acknowledges that the earlier (1957) one had been too optimistic on cost. Even so, in order to gain the necessary expertise, it proposed the construction of a plant big enough to learn from, but small enough not to result in large economic losses. In 1962, the utilities agreed to order such a plant, a General Electric 55 MW boiling water reactor, on the condition that the Ministry of Economic Affairs and Euratom share in its cost. Construction of the *Dodewaard* plant began in 1964. Because the Nuclear Energy Act of 1963 was not yet completely in effect, the only possible barrier was the municipal application for a license under the Nuisance Act, but no objections were made locally.

Additionally, in the mid 1960s, the Dutch government began negotiations with Germany and Belgium about the construction of a prototype fast breeder reactor. Research into this technology had been heavily invested in previously, and it was

widely considered to be the future of nuclear power. But in order to stimulate the build-up of a domestic nuclear industry, the government also continued to push for a second, larger commercial nuclear power plant to supplement Dodewaard (Lagaaij and Verbong, 1998). So in the mid 1960s, 'off-stage' negotiations took place between the utilities and industry about this government ambition. In 1968, the provincial electric utility company PZEM issued tenders for a 450 MW nuclear power plant. Seven were received, among which one by a Dutch-American joint venture. In 1969, the year in which the smaller Dodewaard station was connected to the grid, PZEM announced that would definitively order a nuclear power plant, because the establishment of an electricity-intensive aluminium plant (Pechiney) in Borssele would provide a guaranteed market for the generated electricity. It accepted a German proposal by Siemens for an American-designed pressurized water reactor (PWR) (Lagaaij and Verbong, 1998). Industry and government were not amused: a small regional electric utility company had unilaterally frustrated the build-up of a domestic nuclear industry. However, the government had no legal means to contest this decision. Construction of the Borssele plant was initiated that same year. In 1972, the Dutch government furthermore definitively decided to participate in the (previously mentioned) joint-venture with Germany and Belgium for the construction of an experimental fast breeder reactor in the German town of Kalkar. In the same year, the government published a new Memorandum on Nuclear Power, which discussed the participation in the Kalkar project and also contained the ambition of having 35,000 MW of nuclear electricity generating capacity by the year 2000. This latter figure represented some 50% of the total capacity which was at the time thought to be required by the end of the century. It would necessitate the construction of some thirty-five new nuclear power plants. In the early 1970s, the future for nuclear power in The Netherlands was arguably looking bright.

4.3 Stabilizing and destabilizing legitimacy: 1971-2001

4.3.1 Prologue: emerging doubts

During the 1960s, Dutch industry and politics turned towards the various aspects of the practical implementation of nuclear power, which had emerged as the dominant application of atomic energy in The Netherlands. Public attention to atomic energy and nuclear power decreased over this period: rapidly in the late 1950s and early 1960s, and more slowly later in the decade (see: figure 4.1.1). As regulatory frameworks emerged and nuclear power plants were constructed and operated, the nuclear power discourse gradually became institutionalized. Nuclear power received less media attention than it had previously, but the tone of the coverage was still predominantly positive. Over the 1960s, articles about nuclear power more frequently mentioned nuclear power plants (see: figure 4.3.1) as concrete plans and locations for their construction were announced, and spoke more often about practical aspects such costs and electricity production (see: figure 4.3.2).

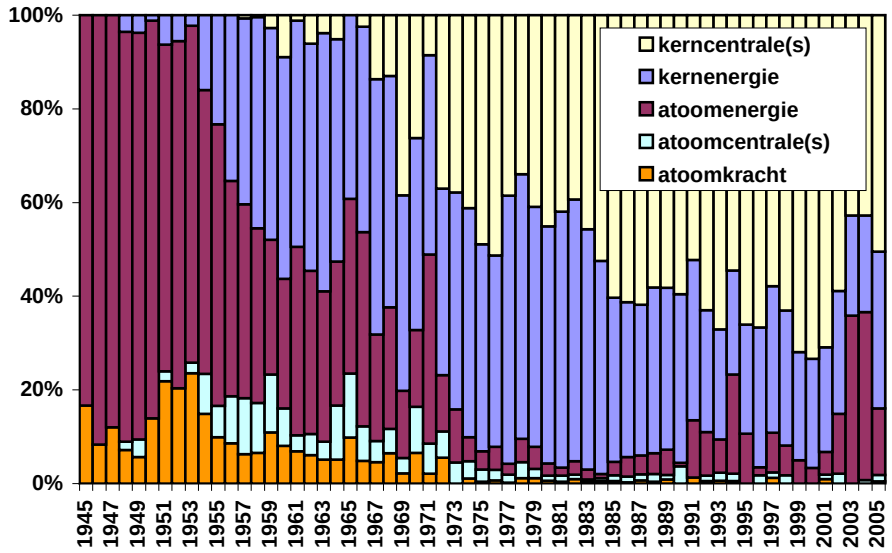


Fig. 4.3.1 Relative occurrence of 'nuclear plant', 'nuclear energy', 'nuclear energy', 'atomic energy', 'atomic plant', 'atomic power'. Source: Leeuwarder Courant.

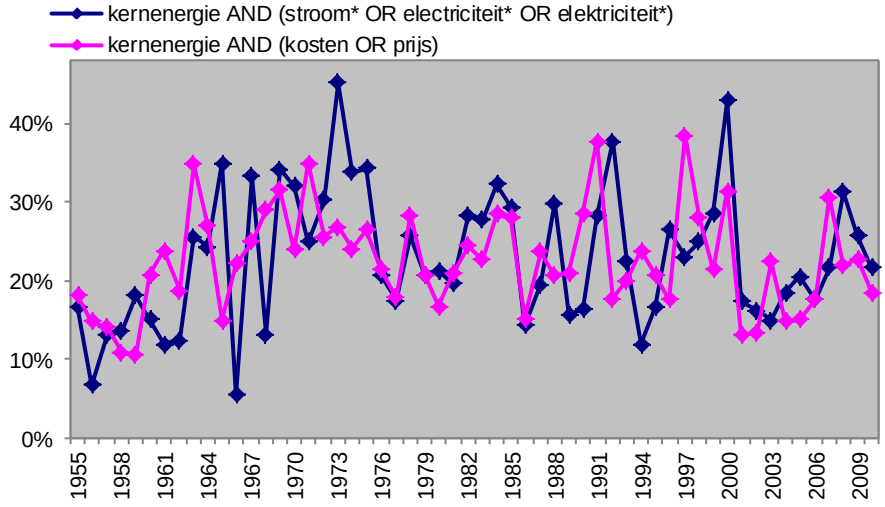


Fig. 4.3.2 Co-word plot: 'nuclear power' and 'electricity' versus 'nuclear power' and ('cost' or 'price'). Source: Leeuwarder Courant.

Only very rarely did criticism to the concrete plans emerge, such as the following ironical quote from newspaper *De Gelderlander*:

> Atomic energy has the demonic property of bewitching certain minds, thereby seducing them to downplay its dangers towards laypersons. In a democracy, this is most undesirable (*De Gelderlander*, 10 July 1964. From: www.kernenergieinnederland.nl)

However, such expressions of doubt regarding commercial nuclear power were few and far between in The Netherlands during the 1960s. This was somewhat different in the USA. Controversies about nuclear power in the USA can be traced back to 1958, when locals opposed the siting of a nuclear power plant in Bodega Bay, California (Wellock, 1998). During the subsequent growth of the USA's nuclear industry grew, a (broader) environmental movement emerged (Walker, 2004). While the new environmentalists were somewhat positive about nuclear power because it reduced air pollution, three issues emerged in the late 1960s that led environmentalists to oppose nuclear power:

- *Thermal pollution.* Nuclear power plants' waste heat was typically released into the environment through the discharge of high-temperature cooling water into nearby bodies of water. The detrimental effects of this practice on aquatic life and water quality became a major concern in the late 1960s (Walker, 2004)
- *Health effects*. Research in the late 1960s by biologists John Gofman and Arthur Tamplin had suggested that large-scale application of nuclear power would result in thousands of extra deaths from cancer and leukemia. It culminated in a best-selling book entitled *Poisoned Power* (Gofman and Tamplin, 1971) and led to calls for (much) more stringent radiation standards.
- *Reactor accidents.* A number of minor accidents with small experimental nuclear reactors over the 1960s, combined with the large number of nuclear power plants ordered and commissioned over the same decade, led some to worry about the consequences of an accident with a large commercial power reactors. In the early 1970s it led to a highly publicized debate over the safety of the emergency core cooling systems in American light water reactors (Rüdig, 1990).

At that time, any Dutch opposition against nuclear power was still very local. The main concern was pollution by the Péchiney aluminum factory which the Borssele nuclear power plant would enable. In 1970, several locals had organized themselves in the Borssele Committee (CB) and teamed up with the Zeeland Environmental Hygiene Association (VMZ), which in 1970 formally objected to the granting of an establishment license for the nuclear power plant. But the concern about the aluminum factory pollution was soon supplemented with concerns about nuclear power itself.

Through various channels, the American concerns anout nuclear power had found their way to The Netherlands in the early 1970s. Notably, Dutch school teacher Jannie Möller found a brochure outlining some of these concerns while spending the summer of 1970 at a German biological nursery garden (De Vries, 2008). Over 1971, she established Werkgroep Atoom (WA) which was quickly embraced by counterculture movement Provo. Soon after, the group teamed up with the Raad voor Milieudefensie, an organization of concerned scientists established in 1971 following the Club of Rome's

warnings about the effects of unrestrained population increase. Under the new name Werkgroep Kernenergie the group labored to raise public awareness of the dangers of nuclear power. The Raad voor Milieudefensie, which had been called Stichting Milieudefensie since 1972 and was an official partner of Friends of the Earth, joined with VMZ in filing thousands of petitions to object to PZEM's 1972 request for an operating license for Borssele (Van Noort, 1988). It was unsuccessful: the Borssele nuclear power plant was connected to the grid in mid 1973.

Around that time, many local groups emerged which opposed nuclear power for a variety of reasons and with a variety of goals. Over the 1970s, they expanded their constituency to political parties, unions and churches, and their actions became increasingly coordinated. Gradually, an anti-nuclear movement (albeit a heterogeneous one) emerged. Its fragmented concerns, framings and storylines coalesced into an *anti*-nuclear discourse. Within the loosely-connected ensemble of ideas, concepts, and categories that made up the field of discursivity about nuclear power, anti-nuclear discourse emerged as a second, and antagonistic, internally coherent interpretive framework for giving meaning to nuclear power over the 1970s.

In the subsequent subsections, I will show how cultural performances of various storylines by opponents of nuclear power managed to increase this anti-nuclear discourse's plausibility and salience, eventually resulting in the extreme polarization of opinions on nuclear power of the late 1970s. As in the previous sections, I will do this by constructing an analytical chronology in which the five dimensions of empirical fit, credibility, centrality, experiential commensurability and macro-cultural resonance form the narrative plot.

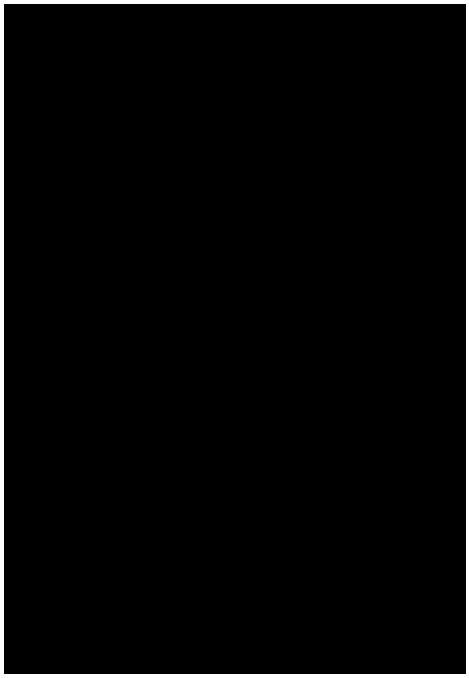
4.3.2 Actor credibility: an alliance with science

Because the initial anti-nuclear performances were by inhabitants of the region surrounding the Dutch nuclear power plants and addressed local issues, they had a 'not-in-my-back-yard' (NIMBY) character. Nuclear proponents could easily disqualify the performers as emotional or irrational non-experts (interview, Storm van Leeuwen). This strategy became less feasible when 'laypeople' who were concerned about the effects of nuclear power forged coalitions with concerned scientists. When *Werkgroep Atoom* began coordinating concerned scientists (at the request of Club of Rome member and Raad van Milieudefensie co-founder Wouter van Dieren), it acquired the necessary technical and scientific expertise to question pro-nuclear power arguments on quality of data, theoretical assumptions etc. Under its new name *Werkgroep Kernenergie* (WKE) it quickly evolved into a dedicated anti-nuclear lobby group.

When in 1972, the Ministry of Economic Affairs (EZ) published a Memorandum on Nuclear Power Policy, the Werkgroep's scientists and engineers, some of whom worked in the nuclear industry, wrote an alternative Memorandum on Nuclear Power in response which was published by the Raad voor Milieudefensie (Werkgroep Kernenergie, 1972). The EZ memorandum, sometimes referred to as the 'nota-Langman'

contained the expectation that the necessary electricity generation capacity in the year 2000 would be some 70,000 MW (almost eight times the capacity in 1970). Because of the expected increase in oil prices, half of this generating capacity would have to be nuclear, which amounted to 35 new nuclear power plants of 1,000 MWe each, to be commissioned in the next thirty years (Langman, 1972).

The *Werkgroep's* alternative Memorandum (figure 4.3.3) used scientific methods to argue that that the assumptions of ever increasing electricity demand in the Langman memorandum were false, and emphasized that many technical and scientific issues regarding nuclear power remained unaddressed (Werkgroep Kernenergie, 1972). Its first page prominenty listed its authors' occupations, which included (nuclear) physicists, chemists, radiation experts, electrical and mechanical engineers and laywers (figure 4.3.4). This increased credibility and transformed the framing struggle from one of 'rational versus emotional arguments' to one of 'conflicting rational arguments'.



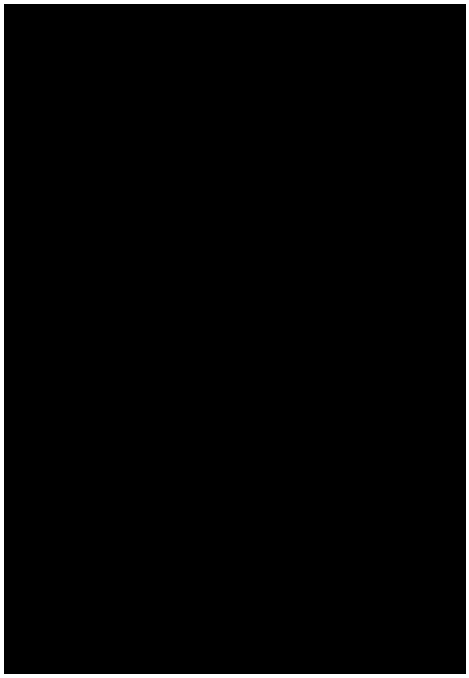


Fig. 4.3.3 Cover of Kernenergienota. Source: Werkgroep Kernenergie (1972).

Fig. 4.3.4 Copyright page of Kernenergienota. Source: Werkgroep Kernenergie (1972).

4.3.3 Centrality: the oil crisis and limits to growth

The oil crisis of 1973 and the publication of the Club of Rome's Limits to Growth had emphasized the dangers of dependence on fossil fuels. The energy question became a central issue on the societal agenda (Lagaaij and Verbong, 1998). In policy circles, the

issue was perceived as so central that in 1973, the Ministry of Economic Affairs (EZ) initiated a campaign to urge the public to conserve energy. Figure 4.3.5 is a poster from this campaign which clearly illustrated the perceived centrality of the problem of depletion by showing the earth as a candle which was burning up. Nuclear power was perceived by EZ as a good solution for this central problem. In spite of the calls for caution by concerned scientists, the Ministry of Economic Affairs published a Memorandum on Energy in 1974 which proposed new nuclear construction. The Memorandum also announced a change of course in nuclear policy. Previously, the government's only real responsibility in nuclear matters had been its safety aspects. But from now on, it wanted to increase its control: it desired a decisive say in all relevant policy aspects (Lagaaij and Verbong, 1998). One reason was the desire to increase the involvement of Dutch industry in the construction of new plants and prevent a repetition of the Borssele situation (wherein the electricity sector had sidelined government and industry). An unforeseen effect, however, would be that this increased democratic control would enable societal organizations to block nuclear expansion (Lagaaij and Verbong, 1998). Although the Memorandum mitigated the plans of its the 1972 predecessor, it still planned to increase the Dutch nuclear generating capacity by 3,000 MW in 1985. This would imply the construction of 3 new nuclear power plants (Ministerie van Economische Zaken, 1974).

In response, concerned scientists once again formulated a scientifically substantiated alternative memorandum. The *Bezinningsnota Kernenergie* (reflection memorandum on nuclear power) was written by the *Bezinningsgroep Energie* (energy reflection group). This organization, which had close ties to the Werkgroep, consisted of concerned scientists, engineers and politicians. It argued that a decision on the future of nuclear power in The Netherlands should only be made when more was known about its safety issues and economic performance. Thus, it called for more research and a conducted during a five-year moratorium on any decision about the future of new nuclear power (Bezinningsgroep Energiebeleid, 1974). This call was repeated in a full-page advertisement in several national newspapers in early 1976. The advertisement with the caption "Members of Parliament, Give Us The Benefit Of The Doubt" was placed by Bezinningsgroep and signed by some 1,200 scholars from various fields and disciplines (lower right hand corner of Figure 4.3.6). It offered calculations that argued that new nuclear construction to be unnecessary because electricity demand could be met with existing power plants; that it would be unlikely to stimulate domestic industry; and that it would be too expensive because of increasing uranium prices. While it was not an outright rejection of nuclear power, it did directly address members of parliament and called for a postponement in the definitive decision to approve new nuclear power plants. It attempted to counter the framing of nuclear power as an urgent solution to this central problem of depletion by arguing that "the [projected increase in energy] demand can be met by existing construction plans for regular power plants" and by labeling "the suggestion that saying no to nuclear power means saying no to a good energy supply system" as "a dangerous myth".

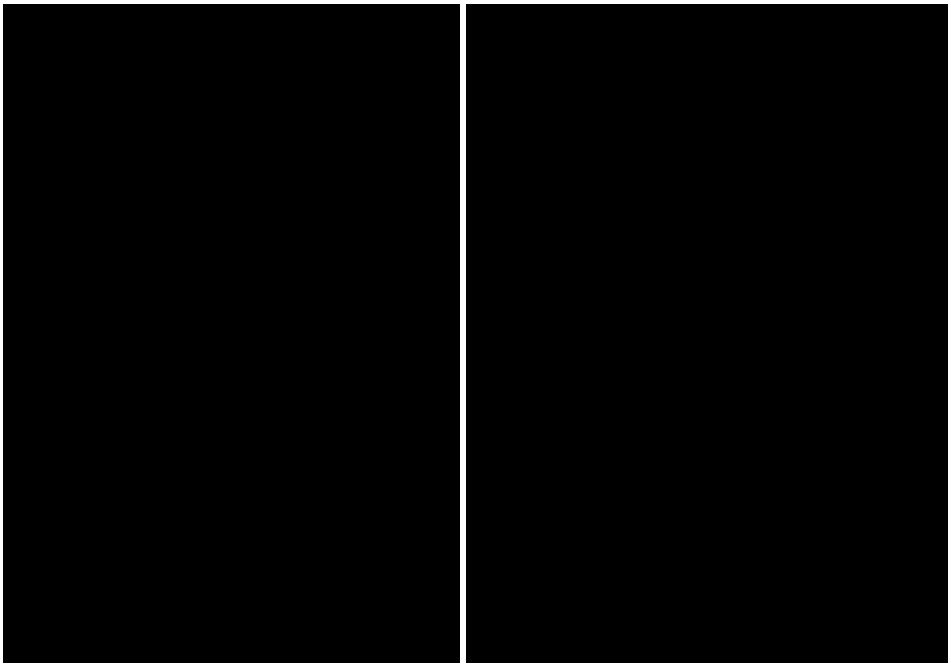


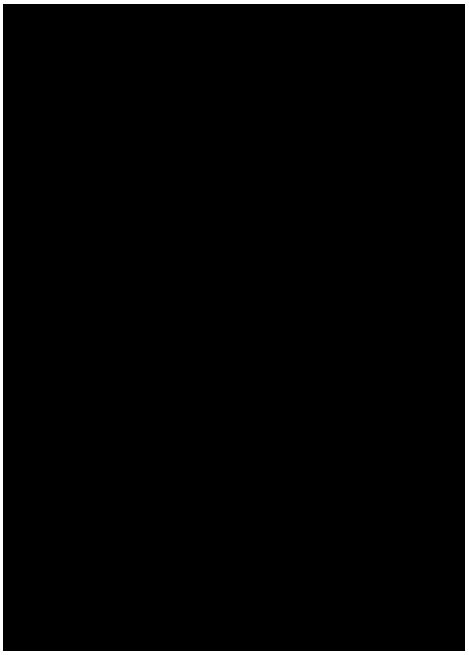
Fig. 4.3.5 Ministry of Economic Affairs poster advocating energy conservation, 1973. Source: Het Geheugen Van Nederland.

Fig 4.3.6 Full page newspaper advertisment by Bezinningsgroep Energie, 1976. Source: NRC Handelsblad, 31 January 1976.

4.3.4 Experiential commensurability: the era of protest

Despite the promises of positive effects of nuclear power on people's everyday experiences that had been articulated in the 1950s, the first noticeable effect on Dutch citizens' daily lives was a 3% increase in their electricity bills. In 1972, the Dutch government had decided to go ahead with a Belgian-German-Dutch joint venture to construct an experimental fast breeder reactor in the German town of Kalkar. Fast breeder reactors were commonly considered to be the future of nuclear power, as they consumed much less fuel (essentially by 'breeding' new fuel while it produced power). In order to finance this project, the decision was made in 1973 to put a 3% levy on electricity consumers' power bills. This increase, which came to be popularly referred to as the 'Kalkar levy', led to societal outrage and resulted in the emergence of many small local groups that either opposed the levy or the project. Some of their performances attempted to convince people to refuse to pay the levy (e.g. figure 4.3.7) and thus called for civil disobedience. Many people who for this reason defaulted on their payments, were disconnected by the utilities, which caused much media attention (Van Noort, 1988). The Kalkar levy was also the direct cause for the first large-scale anti-nuclear power protest in September of 1974 (Van den Bosch, 2006). Although the march took place in Germany at the Kalkar site, most of the 10,000 participants were Dutch, since

the German anti-nuclear movement was not yet focusing on the fast breeder reactor. Posters aimed at mobilizing people for the protest march (e.g. figure 4.3.8) called for the cancellation of the law that enabled the levy, a Dutch withdrawal from the joint venture, and the cancellation of the project. At the rally, speeches were held by representatives from Dutch left-wing political parties which had joined in the *Anti-Kalkar Komitee* (AKK). The media exposure of the protest march had a mobilizing effect: a month later, 155,000 signatures were offered to Parliament, calling for the end of the Kalkar project.



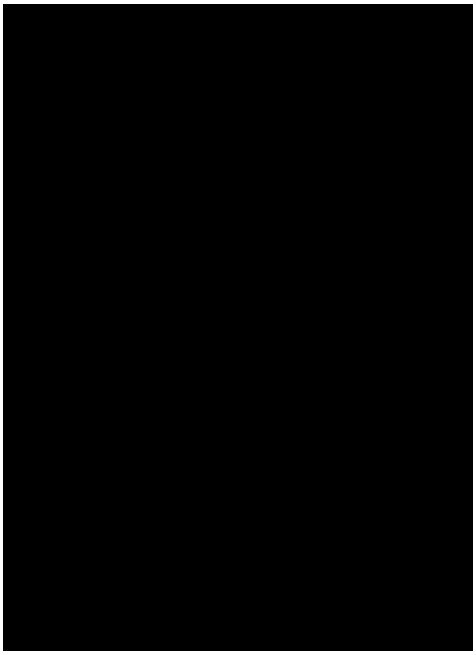


Fig. 4.3.7 Poster calling people to refuse to pay Kalkar levy, 1974. Source: Stichting Laka (2008).

Fig. 4.3.8 Poster calling for participation in protest march, 1974. Source: Stichting Laka (2008).

The public increasingly experienced nuclear energy as a contested issue which was discussed in talk shows on radio and TV, and performed on the evening news through the coverage of protest marches. Many such protest marches, rallies and demonstrations were organized in the mid- and late 1970s, and attendance numbers kept growing. The largest protest march, with about 50,000 people attending, occurred in 1978 in Almelo response to expansion plans of Urenco's uranium-enrichment facility (Stichting Laka, 2008; figure 4.3.9). While images of the large crowd gathering in Almelo and petitions offered to officials (figure 4.3.10) received much media attention, the protest itself had little effect, because political parties largely supported the expansion plans in parliament.

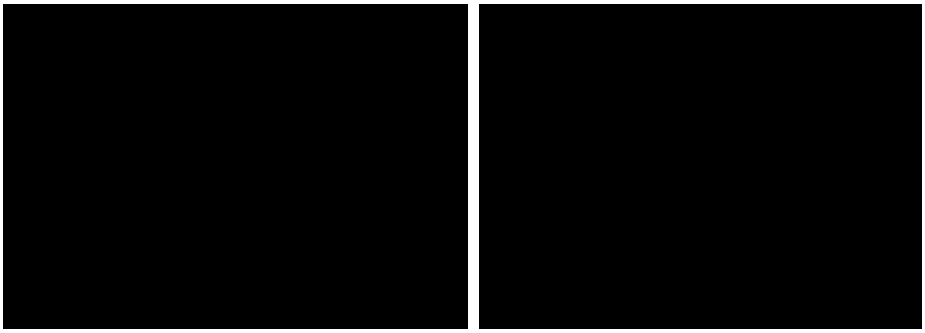


Fig. 4.3.9 Aerial photograph of Almelo demonstration,4-3-1978. Source: Stichting LAKA (2008).

Fig 4.3.10 Photograph of protesters presenting signatures, 22 October 1974. Source: Dutch national news agency ANP.

Some members within the anti-nuclear movement became increasingly frustrated at the apparent ineffectiveness of petitions and protest gatherings seemed ineffective. They started adopting 'direct action' strategies instead, which included such activities as chaining themselves to fences, occupying grounds owned by the nuclear industry, and obstructing transport of nuclear fuel and waste. The adoption of direct action strategies became evident not only in the concrete cultural actions, but also in the material culture produced by the anti-nuclear movement. In the late 1970s, the Dutch anti-nuclear movement (like those of many other countries) adopted a logo featuring a smiling sun accompanied by the words "Nuclear Power? No Thanks!" which had been designed by organizers of the Danish anti-nuclear campaign in 1975 (see also: table 3.3.2). It was printed on buttons, t-shirts, stickers, posters and picket signs at demonstrations (see: figure 4.3.11). When direct action was adopted as a strategy by the anti-nuclear movement organization *Dodewaard Gaat Dicht (DGD)*, the smiling sun logo was altered to include a clenched fist: a symbol commonly associated with defiance of authority and empowerment.

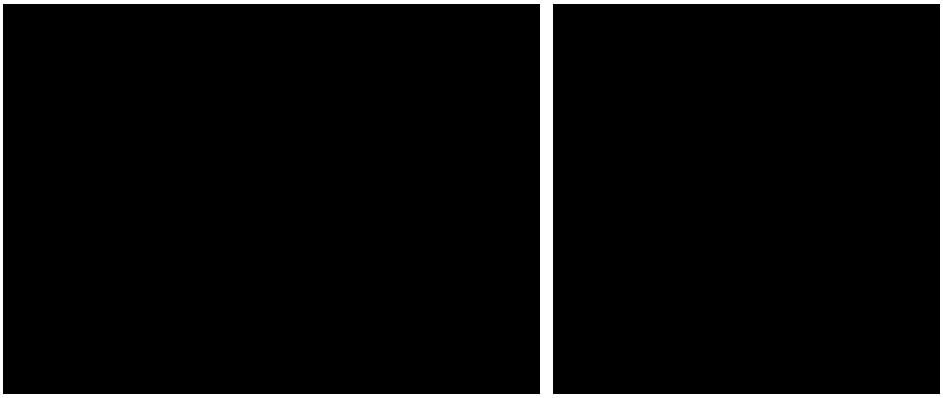


Fig 4.3.11 April 1979 protest in Borssele, after Harrisburg. Source: Stichting Laka (2008).

Fig 4.3.12 Various protest buttons. Source: www.laka.org/cultuur.html.

Figure 4.3.12 shows some DGD campaign buttons that use the image in this way. The bottom left button doesn't feature the altered smiling sun logo, but rather shows a closed fist inside an open hand, possibly signaling a change of strategy from 'urging to stop' to 'actively doing something about it'. The adoption of direct action methods were a first sign of an emerging schism within the anti-nuclear movement and the creation of a radical wing.

4.3.5 Macro-cultural resonance: counterculture repertoire

Although the postwar macro-repertoires of modernization and techno-scientific progress persisted, they were joined by 'counterculture' repertoires over the 1960s and 1970s. These repertoires embodied norms and values that deviated from (and were in part a reaction to) the societal mainstream. They came to be carried by an educated and relatively wealthy generation that had sufficient leisure time to devote attention to social issues. As respect for and obedience to authorities weakened, attitudes towards 'the establishment' became more critical. Material culture such as campaign buttons and posters became popular ways for many individuals that identified with these new repertoires to display their beliefs and visually portray the counterculture themes. The counterculture repertoire included themes such as:

1. 'the environment' and a related concern for environmental problems. Whereas pollution, if it was considered in those terms at all, was seen earlier as an inevitable byproduct of industrial development, it was now increasingly framed as a problem.
2. 'technology out of control', which linked concerns about negative social side-effects to views of unstoppable technology;
3. 'technocracy' (i.e. a governing elite of technical experts) and related demands for democratization and participation in decision-making processes;
4. peace and (nuclear) disarmament;
5. anti-establishmentarianism (i.e. the notion of the state as exploitive, corrupt, or repressive)

At various points in time throughout the 1970s, anti-nuclear protesters linked nuclear power to these new macro-repertoires.

Ad 1: Environmental issues

Anti-nuclear protesters linked nuclear power to the environment theme through highlighting the environmental problems associated with radioactive waste, such as the routine dumping of nuclear waste into the sea. Figure 4.3.13 shows four campaign buttons of the period which succinctly frame the issue by showing barrels decorated with the international radiation symbol ('trefoil') floating on the waves. The texts read (clockwise from the top left) "atomic waste: carcinogenic rubbish", "atomic waste in the sea? no!", and "a radiant future". Figure 4.3.14 is a Greenpeace poster showing a dead

fish, a barrel of nuclear waste, and the Rutherford atomic model and read "No nuclear waste into the sea".

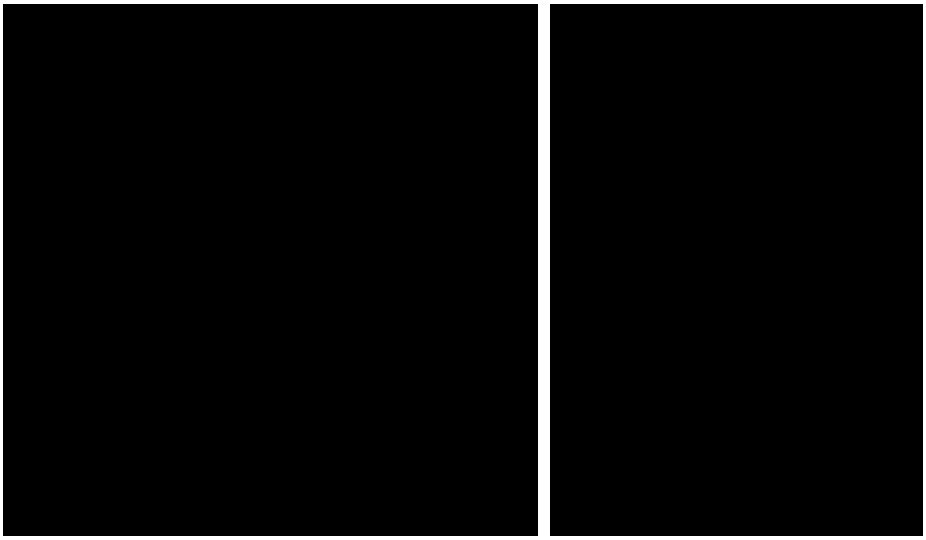


Fig 4.3.13 Various protest buttons. Source: http://www.laka.org/cultuur.html.

Fig 4.3.14 Greenpeace poster against nuclear waste sea dumping, 1980-1982. Source: Het Geheugen Van Nederland.

Ad 2: Technology out-of-control

Anti-nuclear protesters linked nuclear power to the technology-out-of-control theme through emphasizing the risks and uncertainties with regard to radiation, such as its effects on health. Various cultural performances highlighted (the lack of adequate knowledge about) the negative side-effects of radiation. Figure 4.3.15 is a photograph of a home-made traffic sign at the Borssele plant. The sign is meant to convey (through its analogy to a prohibition sign) that the area is “illegal for pregnant women and children”. It was placed by anti-nuclear activists in 1974 to call attention to the fact that extant radiation norms had been drafted to apply to healthy men who are less susceptible to the effects of radiation. Figure 4.3.16 is a poster which reads “Love from Kalkar” and portrays what appears to be a horribly disfigured child, alluding to radiation-induced genetic mutation. Figure 4.3.17 shows four campaign buttons which read (clockwise from the top left) "refuse atomic power", "atomic energy deathly certain", and "death roams…but not for long!" (the latter being a pun on the name Dodewaard, the first Dutch nuclear power plant). All link nuclear power to death through the use of symbols such as crosses, skulls that appear as light bulbs and nuclear reactors, or the Grim Reaper.

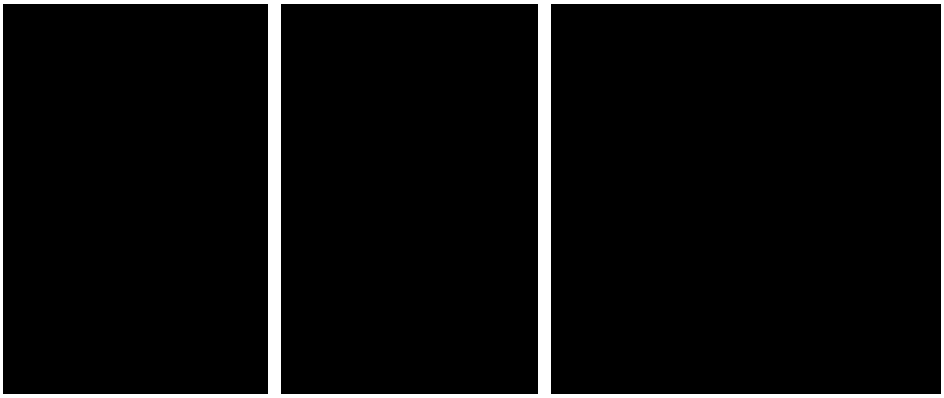


Fig 4.3.15 Protest sign at Borssele. Source: Utrechts Nieuwsblad, 27 August 1979.

Fig 4.3.16 Poster commissioned byAktiegroep Stop Kalkar (Oss), 1974-1975 (Artist: A. Schalken). Source: Het Geheugen Van Nederland.

Fig 4.3.17 Various prorest buttons. Source: www.laka.org/cultuur.html.

Ad 3: Technocracy

Anti-nuclear protesters linked nuclear power to the technocracy theme by inciting people to be suspicious of 'establishment' experts and accusing these of hiding risks and uncertainties. The implication was that experts and authorities could not be trusted to tell the truth, because they were influenced by political and industrial interests.

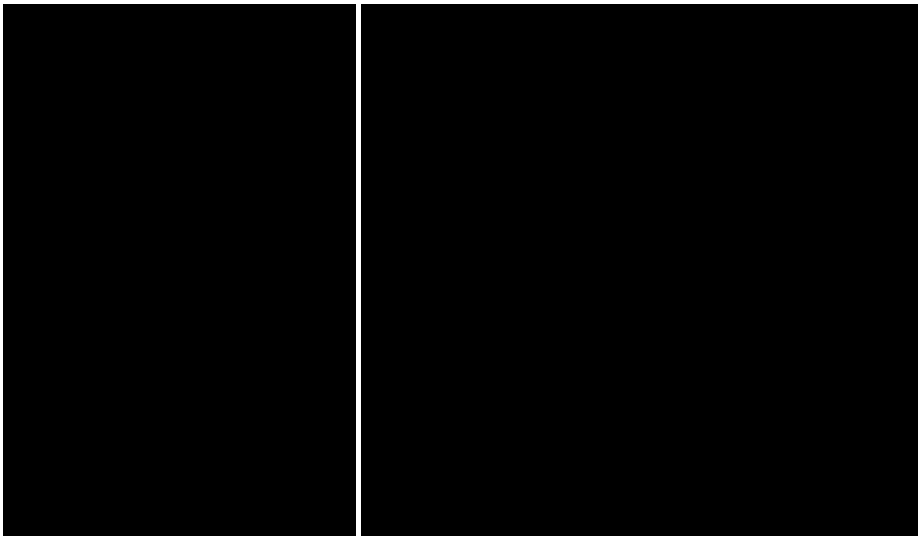


Fig 4.3.18 Wetenschap & Samenleving, Oktober 1978 (Artist: unknown).

Fig 4.3.19 De Groene Amsterdammer, 22 Augustus 1979(Artist: unknown).

Figure 4.3.18, for example, is a political cartoon showing a scientist telling the public: “Really people, believe me, the odds of a serious accident are zero”, while a huge radioactive die (a symbol of random chance) with the words “radioactive – do not approach” hangs over them like the proverbial sword of Damocles. Figure 4.3.19 is another political cartoon showing a technician in a nuclear power plant sweeping a stray atom under the rug – a reference to minor plant incidents that the nuclear industry had attempted to cover up.

Ad 4: Peace and disarmament

Anti-nuclear protesters linked nuclear power to the peace and disarmament themes through emphasizing the danger of the proliferation of plutonium (an inevitable by-product of nuclear power plants) and nuclear weapons. The four campaign buttons in figure 4.3.20 link nuclear power to nuclear weapons in various ways. The top left one shows a flower growing from an up-side-down military helmet and reads "atomic energy and atomic weapons – no!". The top right one shows a nuclear power plant devouring a white pigeon (a common symbol of peace) and read "nuclear power plants threaten peace". The bottom left one shows a crying white pigeon flying above the UEC's Dutch uranium enrichment facility and reads "no peace with nuclear energy". The poster in figure 4.3.21 invites people to attend a rally entitled "women's culture against nuclear energy and nuclear weapons", also specifically linking the two themes.

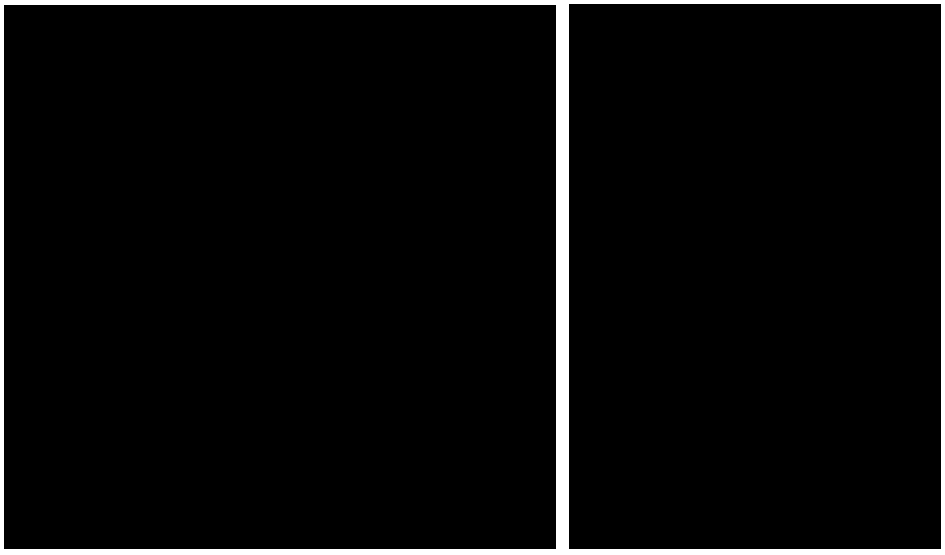


Fig 4.3.20 Various protest buttons. Source: www.laka.org/cultuur.html.

Fig 4.3.21 Poster for meeting organized by Rosa Vrouwenkultuurgroep, 13 November 1981. Source: Het Geheugen Van Nederland.

Ad 5: Anti-establishmentarianism

In the late 1970s, political activists with a broader opposition agenda started joining the anti-nuclear movement. These activists were less interested in environmental or risk issues, but saw the nuclear issue as an arena for their radical agenda (Bannink interview, 2008). For these individuals, nuclear power was not a focal point: it was simply one front in a broader struggle against the state. They linked nuclear power to anti-establishmentarianism through framing nuclear power as a 'repressive technology' that necessitated (and legitimated) heavy policing. The fact that some of these anti-nuclear protesters didn't in principle rule out violence as a strategy (unlike most of those favoring the use of other direct action strategies), exacerbated the schism in the anti-nuclear movements towards the end of the 1970s.

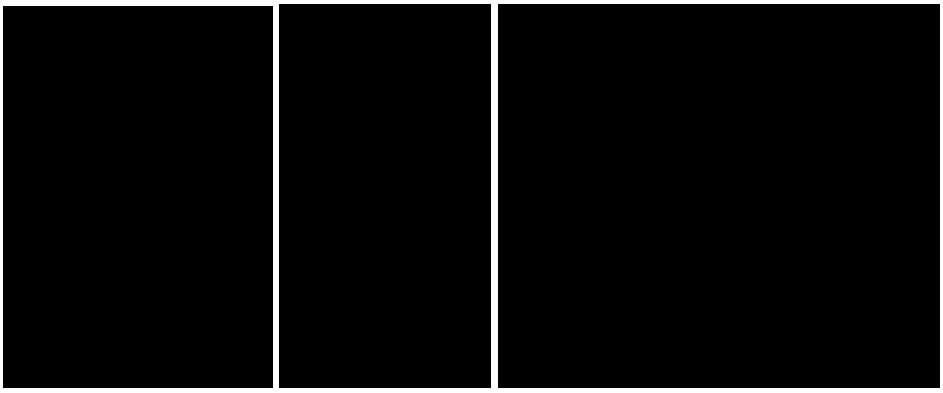


Fig. 4.3.22 Poster by Stroomgroep Den Bosch, 1980-1981 (Artist: C. Deleuran). Source: Het Geheugen Van Nederland.

Fig. 4.3.23 Protest buttons. Source: www.laka.org/cultuur.html (bottom), private collection (top).

Fig. 4.3.24 Groene Amsterdammer, 25 April 1979 (Artist: unknown).

Figure 4.3.22 is a poster reading *nuclear power leads to a police state* which shows a nuclear transported under heavy guard by military police. The two campaign buttons in figure 4.3.23 also show military police, whose shields are decorated with the radiation trefoil. The top one reads *parliamentary democracy* and shows the police officer smashing the word democracy with his baton, while the bottom one reads *the other side doesn't discuss about violence, they simply pour it into laws and execute it*. Figure 4.3.24 is a more lighthearted cartoon that nevertheless performs the same storyline. It shows a nuclear power plant guarded by hundreds of soldiers and two scientists saying *"atomic power is relatively cheap, but guarding it turns out to be rather expensive"*.

4.3.6 Empirical fit: from nuclear successes to Harrisburg

Not everyone subscribed to these counterculture repertoires. Many policy makers, scientists, business managers, and citizens continued to subscribe to the macro-repertoires of inevitable technological progress. And in the 1970s, pro-nuclear discourse

still resonated with this repertoire. Advocates of nuclear power were also able to point to the successful domestic construction and operation of two nuclear plants: Dodewaard and Borssele. Educational brochures that explained the general process of nuclear power and popular-scientific books thus prominently featured photographs of the nuclear power plant at Borssele on their covers (figures 4.3.25 and 4.3.26)

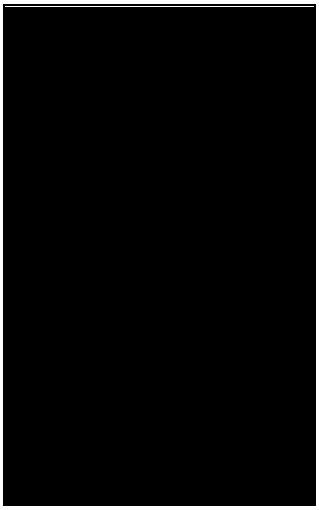


Fig. 4.3.25 Cover of educational bookled about the Borssele plant. Source: Heuckelbach (1974).

Fig. 4.3.26 Cover of book on nuclear power in The Netherlands. Source: Goedkoop (1975).

These and similar performances of the success story of Borssele enhanced the empirical fit of pro-nuclear discourse. The opponents of nuclear power, on the other hand, were not able to mobilize real-world accomplishments or events to frame as proof of their views about risks and dangers. The empirical fit of anti-nuclear discourse was therefore low, which enabled nuclear proponents to downplay anti-nuclear sentiments.

Then, in 1979, a major accident occurred in the Three Mile Island nuclear power plant in Harrisburg, USA. Unlike the 1957 Windscale accident, an anti-nuclear discourse was now in place which allowed the accident to be interpreted as empirical evidence for the risks associated with nuclear power. Because Borssele was a pressurized water reactor like the Three Mile Island station, the Harrisburg accident was framed by anti-nuclear protesters as real-world proof that nuclear power in general, and Borssele in particular, were dangerous. This framing enhanced the empirical fit of anti-nuclear discourse. The theme "Harrisburg is everywhere" was immediately taken up into anti-nuclear performances such as large protest marches outside the Borssele nuclear power plant (figure 4.3.27a and 4.3.27b; see also: figure 4.3.11).

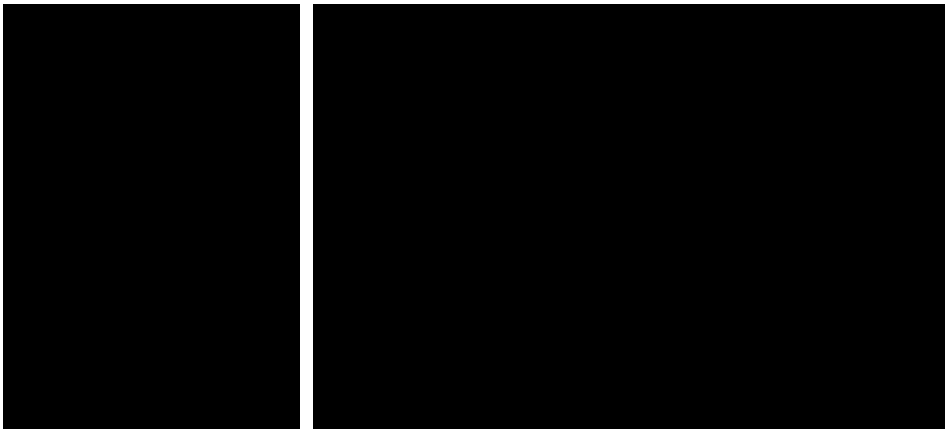


Fig. 4.3.27a Poster calling for protest following Harrisburg, 1979. Source: Gebeugen Van Nederland.

Fig. 4.3.27b Protest at Borssele after Harrisburg, 1979. Source: Dutch national press agency ANP.

The accident turned the tables in the sense that nuclear proponents now had to prove that nuclear energy *was* safe. The nuclear industry employed various rhetorical strategies to this end:

- One was highlighting design differences, for instance in safety systems. The chairman of the Dutch committee of reactor safety claimed that "both our country's nuclear power plants differ in construction from the Harrisburg plant and hence, the chances of a similar accident occurring here are significantly smaller." *(Leeuwarder Courant*, 2 April 1979)
- Another was to blame human error, so that the technology was not the problem. A spokesperson for the American Nuclear regulatory Commission was cited in Dutch press as saying that the accident "probably occurred because the automatic cooling systems could not tolerate human intervention" (*Leeuwarder Courant,* 5 April 1979)
- A third strategy was to argue that Harrisburg had been a *partial* meltdown, thereby suggesting that reactor failures are ultimately controllable (Storm van Leeuwen interview, 2008).

The salience of anti-nuclear discourse had already been at least as high as that of its pro-nuclear counterpart, but with the mobilization of the Harrisburg accident as empirical proof, its plausibility suddenly increased as well. In the field of discursivity about nuclear power, now two internally consistent, plausible and salient, discourses existed that catered to different audiences for giving meaning to the increasingly central issue of nuclear power. Because these discourses were at odds with each other, opinions became strongly polarized. And because the policy changes following the 1974 Memorandum

had increased parliamentary control over the decision-making process, it ground to a halt as a result. Several societal organizations called for a broad societal discussion on the subject. The General Energy Council (AER), an advisory body to the government, supported this initiative, hoping that such a discussion would finally overcome the disagreements and provide solid grounds for final decision-making. In their advice to the government, they stated that

> After the (...) discussion, there should be no more grounds for the view that insufficient opportunity for the formation of opinions has existed.

It also hoped that such a discussion would make a

> clear-cut distinction (...) between hard facts (...) and uncertainties and value judgments (Voorlopige Algemene Energieraad, 1978).

In 1980, the government decided to proceed with what would be a broad Societal Discussion on Energy Policy (BSD). An independent Steering Group was appointed to organize, moderate and summarize the discussion. The BSD was seen both a tool to overcome the stalemate and as a democratic experiment for dealing with controversial issues. According to an informational brochure published by the Steering Group in early 1983 (print run: 1,000,000 copies):

> LOCKED-UP DECISION-MAKING NECESSITATED BSD. In 1977 it had become clear that the decision-making process on energy had come to a stop. Concerns about the environment, fear for the possible consequences of nuclear power and the feeling of being dependent on oil-supplying countries had come to play a large role. Ever more people and organizations engaged with the energy question. This led to frictions between societal groups of differing opinions. There was no real exchange of ideas; differences in opinion were simply too large. *(Energiekrant BMD, jan 1983, p2).*

4.3.7 Experiential commensurability & centrality: radicalization

Meanwhile, tensions grew within the anti-nuclear movement. Two key developments can be discerned. Firstly, frustration grew over the apparent ineffectiveness of their performances in terms of their immediate goals (among which the closure of the existing nuclear power plants). Secondly, the adoption by some of its members of direct action methods and an extremely decentralized organizational structure of autonomous 'base groups' had already initiated a schism, which had been exacerbated by the participation in anti-nuclear performances of ‘anti-establishmentarians’ pursuing a broader political agenda. The announcement of a broad societal discussion further divided the anti-nuclear movement. Some anti-nuclear protesters believed it would be the only stage left for them to perform their storylines (after the perceived failure of the protesting strategy) and were eager to participate. Others were less enthusiastic. Some believed it to be an attempt at the neutralization of a minority by the state through assimilating it into a decision-making process whose outcome had in reality been

predetermined (Hontelez, 1983; Schöne, 1983) and thus refused to participate[16]. The cartoon in figure 4.3.28 exemplified this view. Its caption read "meaningless involvement a.k.a. repressive tolerance?". Others believed that, instead of an actual discussion, a BSD would inevitably amount to an (expensive) opinion poll. The political cartoon of figure 4.3.29 illustrates this sentiment by symbolizing the BSD as a cake, divided in three equal parts labeled "Yes", "No" and "No opinion", with a price tag of 35,000,000 guilders: the funds requested by the Steering Group for its organization.

Fig. 4.3.28 Intermediair, 12 January 1979 (Artist: unknown).

Fig. 4.3.29. Het Parool, 15 januari 1982 (Artist: Peter van Straaten). Source: Het Geheugen Van Nederland.

One effect of these two developments was the emergence of a radical wing within the anti-nuclear movement. One such radical group, calling themselves *Verzetsfront Willie Wortel en de Lampjes* (Resistance Front Gyro Gearloose and the Light Bulbs) published a brochure entitled *Sabotage in your leisure time* (figure 4.3.20). It described in a detailed fashion how to cause, using household items, short circuits in power transmission lines, which were described as the "weak link" in the electricity system, and subsequently evade arrest (Stichting Laka, 2008). At the DGD blockade of 1981, briefly after the publication of the brochure, violent confrontations erupted between protesters and military police. This escalation received widespread media attention and was mobilized by DGD. For example, a photograph of military police beating a protester at the blockade was used in one of their publications to illustrate claims of police brutality (figure 4.3.31). The next year, a group of radical anti-nuclear protesters broke into the offices of a shipping company that owned a nuclear waste dumping ship and destroyed the inventory. A press statement released by the group stated:

[16] Ironically, in their lack of enthusiasm to participate these more radical exponents of the anti-nuclear movement were joined by many proponents of nuclear power. The latter actors felt it was unnecessary and did not see the value of the BSD's stated goal of "treating emotionally determined statements equal to rationally substantiated ones" (Stuurgroep Maatschappelijke Discussie Energiebeleid, 1984). In the end, and unlike the more radical exponents of the anti-nucler movement, the nuclear industry nevertheless participated because it hoped for a 'rationalization of arguments' and for recouping some of public support that had dwindled over the 1970s (Hontelez, 1983).

Inflicting damage, destruction and sabotage have become tools in the battle against nuclear power. No foul, no harm! Companies that build bunkers for temporary storage on land or place drilling rigs at salt domes can count on our love of destruction. And you betcha it's fun to destroy! (Source: Stichting Laka, 2008)

Fig. 4.3.30 Brochure cover, 1981. Source: Stichting Laka (2008).

Fig. 4.3.31 Photograph of military policy in action at Dodewaard Gaat Dicht demonstration, 1981. Source: Banning et al., (1981).

These and similar radical performances had counteracting effects on the legitimacy of anti-nuclear discourse. On one hand, they undermined the credibility of anti-nuclear movement actors and the experiential commensurability of their discourse: the general public simply could not identify with such radical views and violent actions. Although carried only by the anti-nuclear movement's (minority) radical wing, these performances alienated the general public from the entire anti-nuclear movement and gave nuclear proponents the opportunity to frame the anti-nuclear protesters as anarchist troublemakers. The radical protest actions therefore lowered the credibility and experiential commensurability of anti-nuclear discourse. On the other hand, the radical actions received widespread media attention and in doing to, increased the centrality of nuclear energy in public opinion and political debate. Public attention to nuclear power reached an all-time high in this period (see also: figure 4.1.1).

4.3.8 Centrality & experiential commensurability: the BSD

Initially conceived as a means to overcome the polarization of opinion about nuclear power and deal with its controversial decision-making process, the BSD's scope had been negotiated during its preparations to include the entirety of Dutch energy policy as a discussion topic. In an attempt to break free from the dilemma 'coal or nuclear power', it included various scenario's which were used as a basis for discussion (one of which had a strong focus on energy savings and investments in renewable energy sources). It intended to bring energy decision-making closer to the people by allowing them to express their views. During the 'information phase', which was to result in an overview

of societal opinions on energy policy, the Steering Group communicated directly with the public. In late 1981, a full-page 'bulletin' was published in virtually all large newspapers, which asked the general public for opinions on matters of energy. The bulletin headed:

> Which energy sources do you want in the future and which don't you want? That's what they want to know in The Hague. (*Nieuwsblad van het Noorden,* 17 October 1981, 'Bulletin 1: Brede Maatschappelijke Discussie over Energie')

It went on to state that for such a vital affair as energy supply, it was understandable that many points-of-view existed and collided, but that a decicion was vital:

> Even so, were have to chose now. Otherwise, we won't be able to cook, clean, drive, shave, iron, watch TV and heat our homes the way we would want. You couldn't. Your children and grandchildren couldn't. Indeed, so important is this choice that government and parliament don't want to make it without your involvement. (*Nieuwsblad van het Noorden,* 17 October 1981, 'Bulletin 1: Brede Maatschappelijke Discussie over Energie').

Through such publications, the Steering Group thus emphasize the experiential commensurability of the energy question in general by linking it to daily practices. It also attempted to increase the perceived centrality of the general energy issue, e.g. through cultural performances like the posters in figure 4.3.32a (*ENERGY - Why do the experts disagree?*) and the logo in figure 4.3.32b (*ENERGY -Too important to leave just to the experts*).

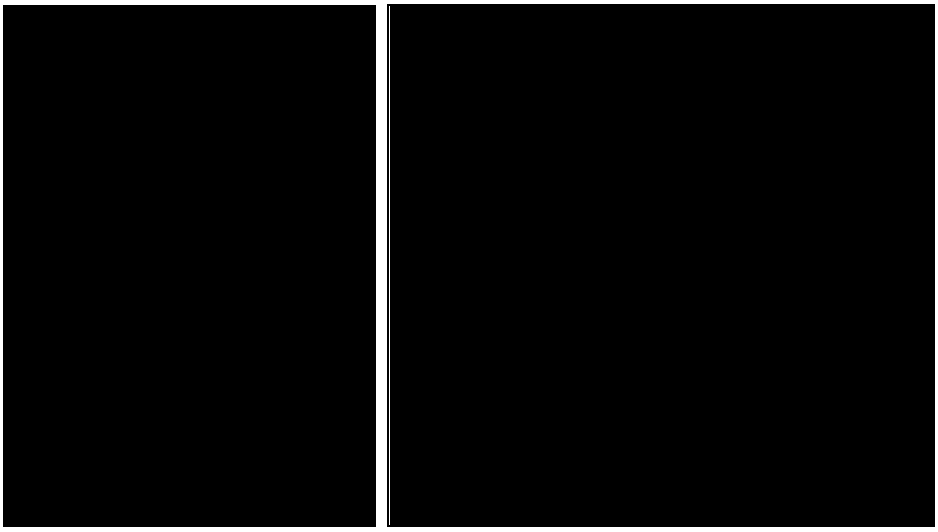


Fig. 4.3.32a Poster announcing BSD controversy hearing. Source: Het Geheugen Van Nederland.

Fig. 4.3.32b Logo appearing on multiple official publications for the Broad Societal Discussion. Source: Stuurgroep Maatschappelijke Discussie Energiebeleid (1984).

In the run-up to the BSD, both pro- and anti-nuclear actors struggled to sway public opinion - sometimes reacting on each other's performances. For example, the pro-

nuclear image in figure 4.3.33 (left) performed the storyline that nuclear power was necessary to 'keep the lights on' through depicting a lightbulb accompanied by a play-on-words: 'allicht' means 'of course, but also contains the Dutch word for 'light'. It was responded to by an antinuclear image (right) which copied the design but rejected the message both textually and visually in an effort to counter the former's attempt at increasing the experiential commensurability of the pro-nuclear storyline.

Fig. 4.3.33 Left: pro-nuclear image by Stichting Kernenergie Allicht *on sticker, approx. 1981. Right: anti-nuclear reframing of that image (on a button). Source: private collection.*

But by the time the (hundreds of) moderated discussions started in 1982 and 1983, public attention to nuclear power had plummeted (see: figure 4.1.1). The centrality of the energy question in general, and the issue of nuclear power in particular, had decreased as other issues, such as the economic recession, rapidly increasing unemployment and the stationing of cruise missiles on Dutch soil[17], became more central in the public sphere (Turkenburg, 1984). As a result, turnouts at the discussion meetings were lower than expected. Although the Steering Group had hoped for 35,000-50,000 participants, only some 19,000 people attended the information meetings, the discussion meetings or both (Stuurgroep Maatschappelijke Discussie Energiebeleid, 1984). Furthermore, the BSD fell short of its goal of an exchange of ideas. It functioned more as performance stage than as debating forum: actors simply expressed their existing views and virtually no one changed their mind (Jansen interview, 2008).

[17] In 1983, the controversy about the placement of cruise missiles led *Komitee Kruisraketten Nee* to organize a demonstration. It would be the largest demonstration ever held in The Netherlands with some 550,000 participants, or more than ten times the turnout of the largest demonstration against nuclear power.

In 1984, the Steering Group summarized the findings in a report. It showed that, while opinions on closing the existing nuclear power plants were split down the middle, the majority of its participants opposed the construction of new ones. The Steering Group therefore concluded that it would not be "obvious" for the government to decide on new nuclear construction at this time. The end report also stated:

> Never before has Parliament been able to take its decisions armed with the knowledge of opinions by so many, regarding so many aspects of one complex problem. (Stuurgroep Maatschappelijke Discussie Energiebeleid, 1984).

4.3.9 Macro-cultural resonance: technology rules

Environmental organizations were largely pleased with the final report (*De Waarheid*, 23 January 1984; Turkenburg, 1984). But because the government had emphasized throughout the discussion that it would not be a legally binding advice, some believed that the costly discussion with its voluminous reports would prove futile. Minister of Economic Affairs Van Aardenne's initial reaction seemed to corroborate this. In a *Trouw* article, he was quoted as saying that ultimately "it is a matter to be decided by government and parliament" (*Trouw*, 24 January 1984, 'Van Aardenne wijst op beperking energierapport'). A cartoon accompanying the article shows Van Aardenne warming himself by a fire which is kept going by burning BSD paperwork (figure 4.3.34). Another comment on these remarks can be seen in a cartoon from *Wetenschap & Samenleving* (figure 4.3.35). It shows Van Aardenne wearing trefoil-decorated sunglasses against a backdrop of anti-nuclear protesters being brutally beaten by military police while a mushroom cloud hangs over them. Its title *The BMD After* is an allusion to the film poster for *The Day After*, a popular American film about nuclear war. Its caption reads "a co-production by GKN, VVD and CDA", alluding to the idea that nuclear development had already been decided upon by the nuclear industry in unison with the (pro-nuclear) coalition parties.

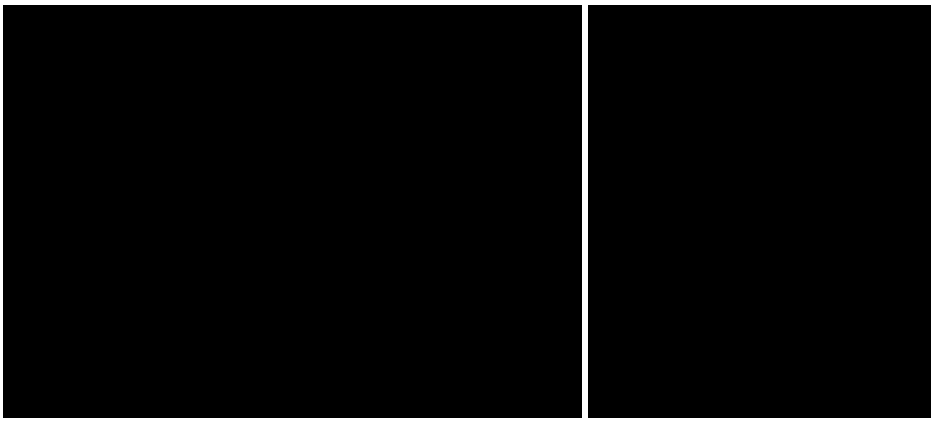


Fig 4.3.34 Trouw, 24 January 1984 (Artist: unknown).

Fig 4.3.35 Wetenschap & Samenleving, March 1984 (Artist: unknown).

As many had feared, the BSD's advice was indeed dismissed by political powers. First, the AER rejected its conclusions, advising the government that the use of nuclear power should be considered as part of energy diversification policy. Following this advice, the government officially rejected the BSD conclusions in early 1985 in a letter to parliament, where it was backed by a political majority. The government proposed the construction of two new nuclear power plants, citing international engagements, energy diversification, and cheap electricity as the main reasons. A parliamentary majority agreed and in January of 1986 the government designated three locations as potential construction sites for the new plants (Van Noort, 1988). Many participants of the Broad Societal Discussion were outraged. A contribution to the *Leeuwarder Courant* commented that the decision marked:

> (...) a sad day for the credibility of politics. (...) A slap in the face of tens of thousands of citizens who have seriously participated in the discussion and hundreds of thousands who have seriously believed in its social use and political weight. (...) Minister Van Aardenne acknowledged that the discussion served a different purpose than its participants thought. Its goal was to calm down heated temperaments. (...) A thirty-million-guilders-costing charade was enacted, a state-sponsored exorcism to incapacitate the demons of ignorant folk beliefs and to expel them using their own weapon: participation. (...) It is not exaggerated to speak of the arrogance or hubris of power. It is now openly admitted that citizens have been used for other purposes than they thought. (*Leeuwarder Courant*, 5 July 1985, 'Een zwarte dag')

Similarly, an article in *Intermediair* stated that:

> Prompted by economic stagnation, the striving for legitimacy based on loyalty of the masses has made way for searching for a form of political hegemony which is based exclusively on the strategically important parts of society. At the center of this are those groups which, in the cabinet's vision, will realize economic recovery (…) The combination of the economization of arguments and the reduction of the group on whose support policy is based, gives the government an increasingly authoritarian character (*Intermediair*, 19 July 1985).

Regardless, the government's decision neither revitalized the antinuclear movement nor led to major protests. But the framing of nuclear power as having been 'pushed through' by policy makers against the will of the people *did* link up with the 'technocracy' theme within anti-nuclear discourse, thereby enhanced its macro-cultural resonance.

4.3.10 Performances on all dimensions: Chernobyl

On April 26th of 1986, Reactor 4 of the Chernobyl nuclear power plant in Ukraine suffered a meltdown. The resulting fire sent a plume of radioactive fallout into the atmosphere and over an extensive area. The Chernobyl disaster had strong effects on nearly all dimensions of anti-nuclear discourse. Firstly, it increased its *empirical fit*, because it was framed as real-word proof of the claim that nuclear power was inherently dangerous and that reactor accidents were less unlikely than its proponents had argued. Secondly, it increased its *credibility*, as anti-nuclear movement actors could now claim

to have been right all along. Thirdly, it enhanced its *macro-cultural resonance* by linking the disaster to the technocracy theme through the government's disregard of the broad societal discussion's outcome. For example, a submitted letter to the *Leeuwarder Courant* read:

> The so-called Broad Societal Discussion [showed that] two thirds of the Dutch population does not want (...) new nuclear power plants. The current CDA/VVD coalition did not let this influence them. The atomic lobby – headed by Gijs van Aardenne – has simply swept the BSD report under the table. If those new plants are not constructed, it will be thanks to the Chernobyl disaster, but let's not claim that the Western peoples were meaningfully involved in the process." (*Leeuwarder Courant*, 10 May 1986, 'Tsjernobyl-syndroom').

Fourthly, it enhanced its *experiential commensurability*. Because the radioactive cloud reached The Netherlands on May 2nd, bans were placed on the sale of recently-harvested leaf vegetables, and on putting cattle out to pasture to prevent the radioactive contamination of milk. Figures 4.3.36 and 4.3.37 are two cartoons in reaction to this news. Both depict Winsemius, the Minister responsible for the environment. In the left one, published briefly after it had been announced that a radioactive cloud drifted over The Netherlands, he appears on TV saying: *"...it is recommended that you hold your breath over the following days..."*. The right one, published a week later, depicts him against a backdrop of nuclear power plants while telling the public *"you may now eat everything again"*.

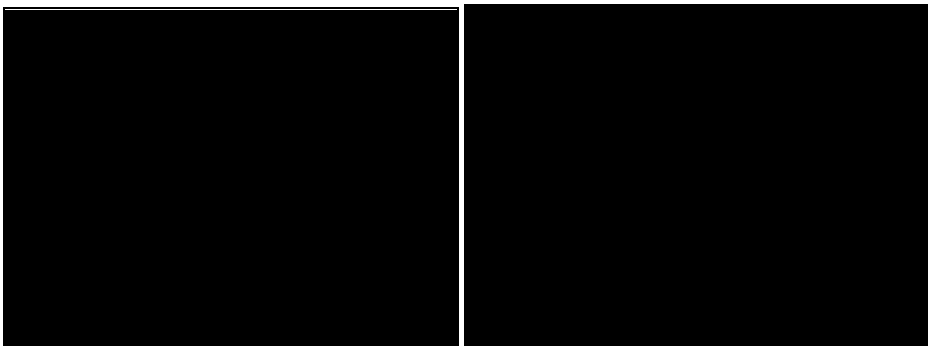


Fig. 4.3.36 Het Parool, 5 May 1986 (Artist: Peter van Straaten). Source: Het Geheugen Van Nederland.

Fig. 4.3.37 Het Parool, 13 May 1986 (Artist: Peter van Straaten). Source: Het Geheugen Van Nederland.

This theme was mobilized by the (remainders of) the anti-nuclear movement to enhance the experiential commensurability of anti-nuclear discourse. For example, in a performance on a market in Dodewaard (figure 4.3.38), anti-nuclear protesters peddled overpriced, rotting vegetables from a delivery bicycle under the motto *"Je moet de groe(n)te uit Dodewaard hebben"* (Stichting Laka, 2008). Another example is the poster in figure 4.3.39, which read: *"Remember the spring of 1986? Cows confined to their*

stables, ban on spinach, run on canned foods, contaminated milk power. Chernobyl never again!" 'Chernobyl never again' subsequently became a persistent theme in anti-nuclear performances.

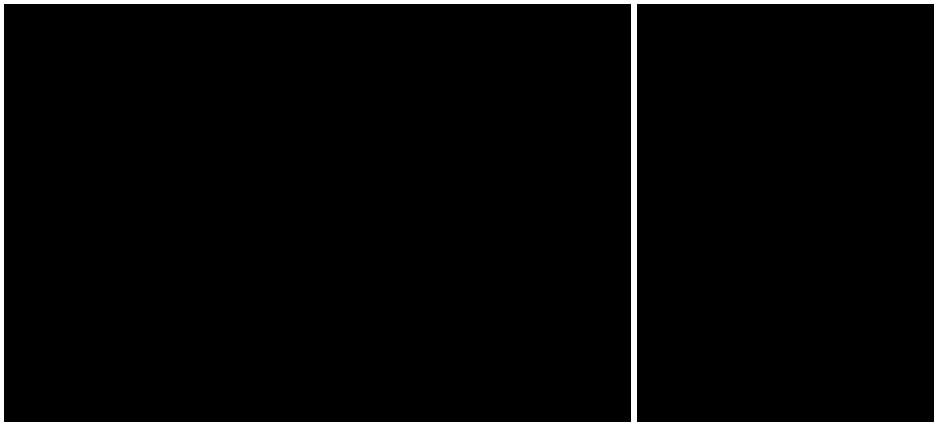


Fig. 4.3.38 Photo of demonstration in Dodewaard, May 1986. Source: Stichting Laka (2008).

Fig. 4.3.39 Anti-nuclear poster mobilizing Chernobyl, April 1987. Source: Stichting Laka (2008).

And finally, it also enhanced the *centrality* of anti-nuclear discourse. As it was the worst nuclear accident in history, the media coverage was extensive. As a result, the public attention to nuclear power that had plummeted in the early 1980s suddenly shot back up (see: figure 4.1.1). The perceived centrality of the safety issue increased, and with it, so did the centrality of anti-nuclear discourse, in which the problematic safety issue had been an important storyline. Previously a non-issue, nuclear power suddenly dominated the campaigns for the parliamentary elections scheduled for May 21st 1986. The anti-nuclear movement initiated a campaign aimed at urging the public to "vote against nuclear power" (figure 4.3.40) by voting against the incumbent Christian-democrats (CDA) and conservative liberals (VVD), who had been the motors behind the recent plans for new nuclear construction.

The political cartoon in Figure 4.3.41 depicts CDA party leader and Prime Minister Ruud Lubbers and VVD party leader Ed Nijpels standing in the rain, saying "Thanks a lot, Russians!". The caption read: "Radioactive election downpour". Fearing political defeat, these parties felt forced to abandon their strong pro-nuclear stance in favor of a more cautious one: postponing definitive decisions pending the outcome of investigations into the causes of the Chernobyl accident and the safety of the Dutch reactors.

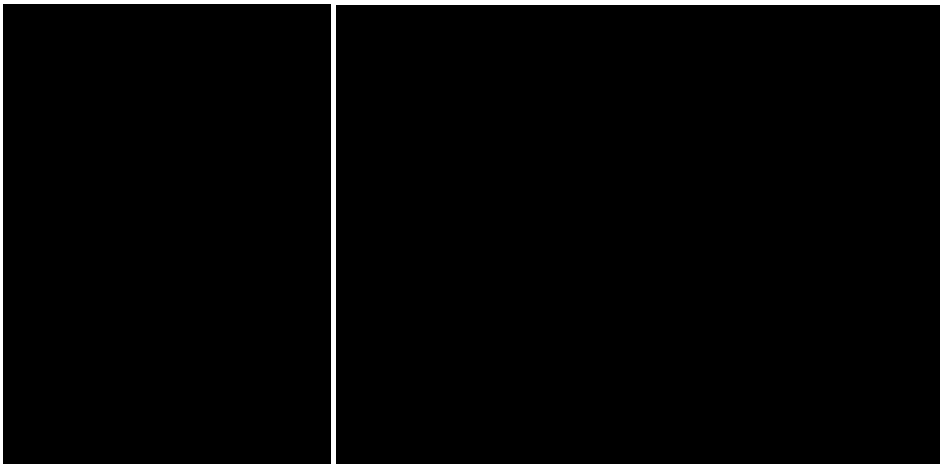


Fig. 4.3.40 Poster calling to vote against nuclear power, April 1986) Source: Internationaal Instituut voor Sociale Geschiedenis.

Fig. 4.3.41 Het Parool, 9 May 1986 (Artist: Peter van Straaten). Source: Het Geheugen Van Nederland.

This strategy proved successful: while VVD lost 9 seats in parliament, CDA gained 9. After a short formation process, a new coalition agreement was reached between the two parties that had previously been the strongest supporters of nuclear construction. Regardless, in the context of a highly plausible and salient anti-nuclear discourse, Chernobyl had come to be interpreted as a decisive reason to halt nuclear expansion. As a result, nuclear power became a politically taboo topic after the 1986 elections.

4.3.11 Epilogue: low cultural legitimacy in the 1990s

After the 1986 elections, the number of cultural actions that performed the various pro- and anti-nuclear storylines dropped and with it, public attention to nuclear power decreased as well (see: figure 4.1.1). A parliamentary majority now favoured an exploration of a future energy system without nuclear power. Decisions about the future of nuclear power were postponed multiple times, and a discussion about the future of the existing plants was delayed pending the outcome of research efforts. In 1987, the report about the safety of Borssele (produced by the International Atomic Energy Agency 's operational safety review team) suggested that it could safely remain open until 2004 with minor improvements.

But even through new nuclear construction was unlikely, the issue of what to do with already-produced nuclear waste (‘legacy waste’) and the future waste produced by the existing nuclear power plants remained. The organisation responsible for such waste was COVRA (Central Organization for Radioactive Waste), which had been established in 1982 by the operators of the two Dutch nuclear power plants (PZEM and GKN) and the Energy Research Centre of the Netherlands (ECN). In 1986, COVRA articulated plans to store the waste in a to-be-constructed, above-ground shelter near the Borssele

nuclear power plant. It would remain there for a period of 50 to 100 years, pending the outcome of research into a more permanent solution, such as underground storage in depleted salt domes. The government supported this initiative by launching a campaign in 1987 aimed at educating the general public about radioactive waste and radiation. An accompanying 8-part booklet (see: figure 4.3.42 for the cover of the synopsis booklet) was fairly comprehensive in terms of information, but much like the government itself, took no position on the desirability of new nuclear construction.

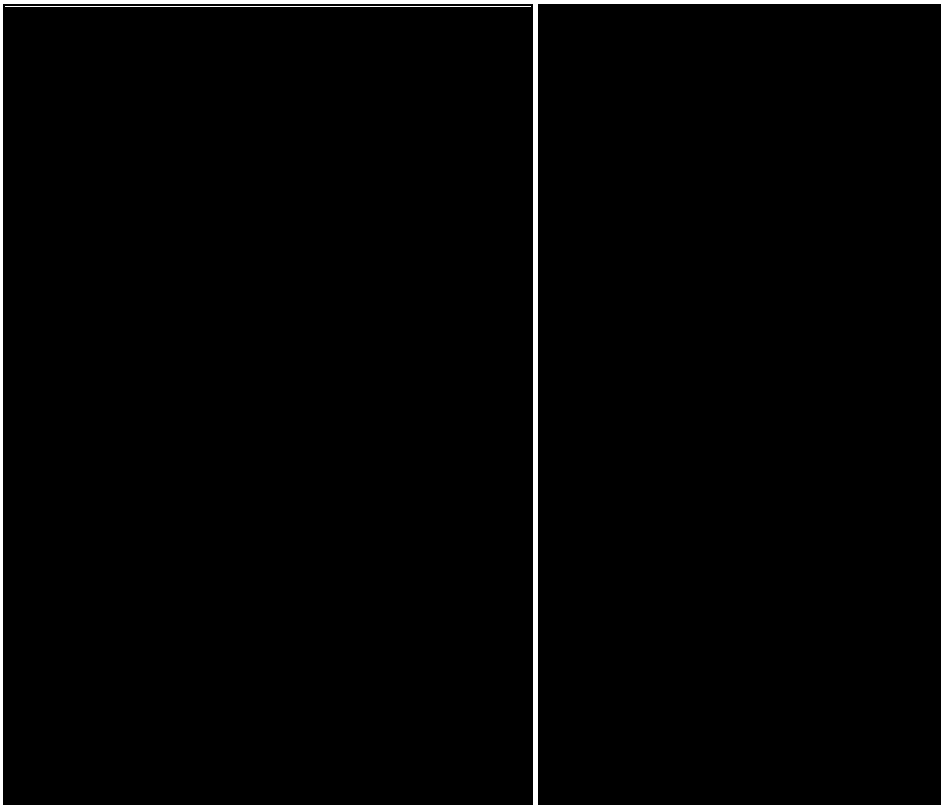


Fig 4.3.42 Cover of government-issued booklet about radiation. Subtitle makes distinction between facts ('feiten') and opinions ('meningen') about radiation. Source: Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer (1987).

Fig 4.3.43 Poster calling for participation in protest march against storage of nuclear waste in salt domes, April 1988. Source: www.kernenergieinnederland.nl.

Because new nuclear construction was now perceived as unlikely, those contentious performances that *did* occur revolved around the issue of radioactive waste. Local protests were held at the site of COVRA's proposed interim storage facility. The environmental movement took issue with its proposed capacity, which they saw as enabling future nuclear construction. A protest march against the proposed permanent storage in underground salt domes (figure 4.3.43) drew some 3,500 people. Although

more than the turnout at many other anti-nuclear protests of the time which averaged a few dozen people, this was still much less than the protest marches a decade earlier. It can be seen as indicative of a relatively low public interest in nuclear power and its related issues.

The salt dome issue was more or less defused by the publication of a report with the findings of aforementioned research into underground storage in 1989. It concluded that there was little incentive for this option because of the future availability of COVRA's long-term interim storage facility at Borssele, and therefore saw no need for the government to adopt an official position on the matter. The 1989 elections resulted in a coalition of Christian democrats (CDA) and Labour (PvdA). The former party, formerly strong nuclear proponents, continued the cautious attitude towards nuclear power brought about by the 1986 elections and the latter party favoured the expedient closure of even the existing plants. Regardless, the earlier public planning decision to disallow any construction on sites previously earmarked for new nuclear power plants remained in effect. Additionally, subsidies were granted for a project aimed at retaining nuclear engineering knowledge (PINC).

While not favouring it as an option for the immediate future, the government *did* keep the door ajar for the possibility of new nuclear construction. This impression is strengthened by the 1993 'Dossier on Nuclear Power' co-published by several Ministries. Its goal was to "enable the next cabinet, if it so chooses, to speak on the nuclear power question" (Ministerie van Economische Zaken, 1993: 47). It concluded that new nuclear power plants designs were sufficiently safe, that proliferation was not an issue for The Netherlands, and that the waste problem was sufficiently addressed by the future COVRA site. The main advisory board to the government on energy matters (AER) reacted to the dossier by stating that an expedient decision on new construction was unnecessary due to the expected over-capacity by 2010.

Thus, *new* nuclear construction was not a central topic in the early 1990s in either the policy or the civil sphere. But in the same period, the *existing* nuclear capacity would briefly revive public attention to nuclear power (see: figure 4.1.1). The joint utilities (SEP) shareholders had agreed to making the safety modifications to the Borssele plant which were suggested by the IAEA's 1987 report, and which were required to retain the operating licence. But in 1993, the estimated costs had risen to 476 million Dutch guilders, prompting SEP to claim that the nuclear power plant would have to remain open at least until 2007 in order to recoup the investment. In 1994, the new government (a coalition of labour (PvdA), conservative liberals (VVD) and progressive liberals (D66)) proposed a compromise. It would pay for part of the modifications if SEP agreed to stick to the original timetable and close the plant before 2004.

The decision further emphasized that the government saw no future for nuclear power in the Netherlands. The Ministry of Economic Affairs' *Third Memorandum on Energy 1996* exemplified this view. It articulated two desired developments for the future of the electricity sector: *liberalization and privatization* on one hand, and *sustainability* on the

other. In both these contexts, nuclear power would have no place. According to the Memorandum,

> nuclear power currently has several disadvantages: limited societal support because of the (perception) of risks, radioactive waste, the proliferation issue and a poor competitive position. (Ministerie van Economische Zaken, 1995)

Although it recognized benefits, such as a reasonably stable price and large uranium supplies, it stated that, especially given the capacity surplus, weighing the pros and cons resulted in a decision against new construction in the foreseeable future. This was not to be a definitive decision: the report announced a 'no regret' policy in which nuclear knowledge is kept up-to-date so as to keep open the possibility of "jumping on the train" (Ministerie van Economische Zaken, 1995: 67) in the next century.

Since the brief increase in public attention for the technology in the 1991-1994 period over the Borssele closure and the definitive ending of the Kalkar project, public attention had decreased again to a minimum in 1996 (see: figure 4.1.1). In that year, and in response to government publications speaking out against nuclear power in the immediate future, the joint utilities (SEP) unexpectedly announced the closure of the Dodewaard nuclear power plant. Instead of in 2004, it would now close already in 1997. The press release stated that

> (...) developments in the government's energy policy make this decision inescapable. (...) Several recent government memoranda and decisions clearly signal a further decline in the positive attitude towards nuclear power. For example, in the Third Memorandum on Energy, decision-making about new nuclear capacity was postponed indefinitely. (*Press release*, 3 October 1996. From: www.kernenergieinnederland.nl)

The 1999 Energy Report (which had been announced in the 1995 Memorandum) reiterated the government's earlier decision against nuclear power. It concluded its section on nuclear power with the words:

> With [the closure of Dodewaard and intended closure of Borssele by 2004, *ed.*], the chapter of electricity generation through nuclear power within the Dutch context seems to be closed (Ministerie van Economische Zaken, 1999: 49).

Various elements from anti-nuclear discourse had become institutionalized. The controversies around nuclear power had rendered it societally undesirable as an option for electricity production, and this lack of societal support was seen by the government as rendering it politically infeasible. There were now two 'mainstream', co-existing discourses about nuclear power. Because pro-nuclear discourse lacked salience and plausibility, anti-nuclear discourse had become dominant even in the policy arena. The technology's disadvantages (i.e. those arguments that had formed the core of various anti-nuclear storylines) were now interpreted by the government as outweighing its advantages: it had lost its cultural legitimacy. Public attention for nuclear power had been low in the preceding decade, and following the publication of the 1999 Energy

Report, themes such as 'environment', 'waste' and 'health' became less prominent in nuclear discourse (see: figures 4.3.44 and 4.3.45).

Nuclear power in The Netherlands was seen as having run its course. This view was reiterated in 2000, when the Raad van State (a government advisory body) nullified the government's 1994 decision to close Borssele before 2004 on procedural grounds of insufficient motivation. EPZ, the then owner of Borssele plant, had wanted to keep it open in order to be able to recoup more of their investments in the plant's modifications. EPZ didn't feel bound by any previous agreements made between the government and its own predecessor (the joint utilities) because these had been abolished as part of the process of privatization and liberalization of the electricity sector. But because a parliamentary majority still favored closure, the government reacted by initiating a lawsuit against EPZ, fully expecting to be able to enforce the original agreement that way. During preparations for the lawsuit, the government published the Fourth National Environmental Policy Plan, entitled 'One World and One Will: Working on Sustainability', which again reinforced its commitment to phasing out nuclear power:

> As long as the problems of waste and safety are not resolved, nuclear power will not be able to contribute to a sustainable energy system in the Dutch situation (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 2001: 156)

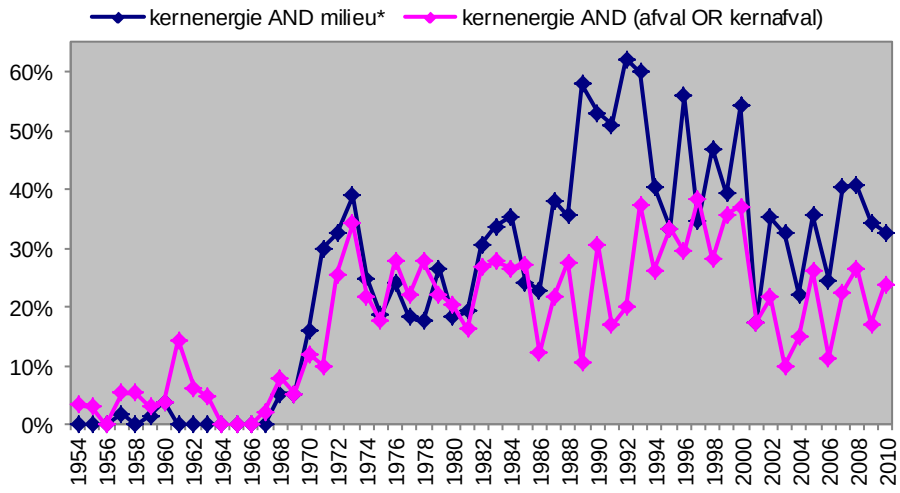


Fig. 4.3.44 Co-word plot: 'nuclear power' and 'environment' vs. 'nuclear power' and 'waste'. Source: Leeuwarder Courant.

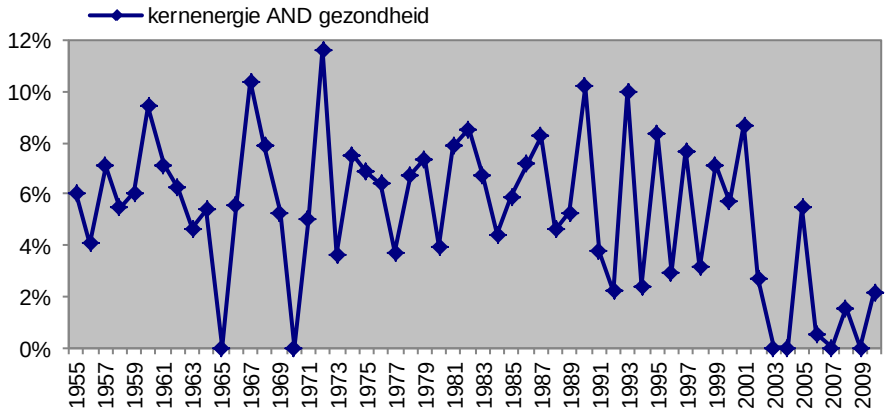


Fig. 4.3.45 Co-word plot: 'nuclear power' and 'health'. Source: Leeuwarder Courant.

4.4 Reconstructing legitimacy: 2003-2010

4.4.1 Prologue: nuclear power and the greenhouse effect

Over the 1980s and 1990s, a new macro-cultural repertoire emerged. The apparent rise of global annual mean temperatures over the 1980s had led to a theory on anthropogenic global warming which came to be colloquially known as the *greenhouse effect*. By the late 1980s, environmental organizations had picked up on this and had begun to advocate measures to prevent further global warming. The Dutch press picked up on the greenhouse effect as well: after the establishment of an Intergovernmental Panel on Climate Change (IPCC) in 1988, the number of articles containing 'broeikaseffect' grew exponentially (see: the columns in figure 4.4.1).

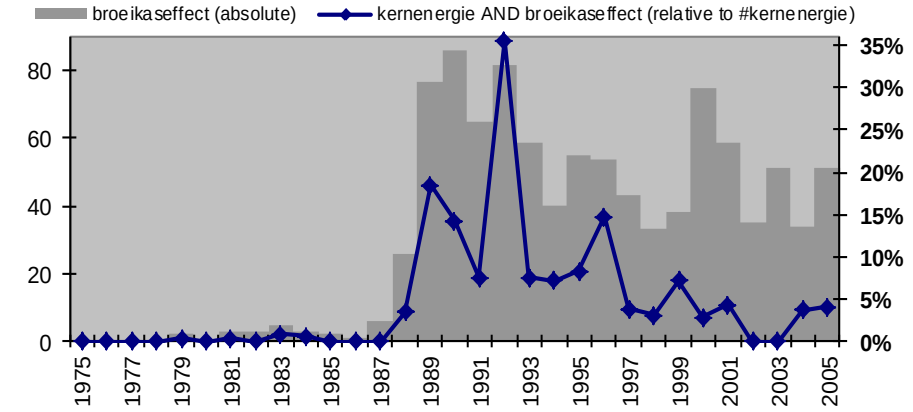


Fig. 4.4.1 Right axis: co-word plot 'nuclear power' and 'greenhouse effect'. Left axis: frequency plot 'greenhouse effect'. Source: Leeuwarder Courant

From then on, nuclear power was occasionally mentioned as energy technology which doesn't emit the greenhouse gas CO_2. But the greenhouse effect was not a major theme in nuclear discourse until the Earth Summit in 1992 (see: the line in figure 4.4.1). In that year, the United Nations organized a Conference on Environment and Development in Rio de Janeiro. A key topic was the search for alternative sources of energy to replace the use of fossil fuels which were linked to global warming phenomenon. An important outcome of the conference was the 'Framework Convention on Climate Change', which was an environmental treaty aimed at stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the global climate. This (non-binding) treaty formed the basis for the (binding) 'Kyoto Protocol', which would be drafted in 1997. These events had an effect on nuclear discourse. For example, the 1993 'Dossier on Nuclear Power' published by the government already noted

> the significant contribution nuclear power can make to limit the greenhouse effect (Ministerie van Economische Zaken, 1993: 48).

But because the dossier dismissed nuclear power as an option because of the unsolved safely and waste issues (see: previous subsection), the greenhouse effect did not remain a prominent theme in nuclear discourse for long. Global warming re-emerged briefly as a theme when the Third Memorandum on Energy (published in December of 1995) mentioned the technology's lack of CO_2-emissions as a benefit and argued that

> without nuclear power, the total global emission of CO_2 would be 8% higher. (Ministerie van Economische Zaken, 1995: 65)

But again, because it ruled out new nuclear build as an option for the immediate future, the theme of global warming did not linger in nuclear discourse in spite of the nuclear industry's attempts to link up with the theme. For example, the SEP's press release about the premature closure of Dodewaard mentioned that

> (...) in the recently published Continuation Memorandum on Climate Change, nuclear power is declared to be not an option. This in spite of this memorandum's observation that a climate problem exists and in spite of naming nuclear power as one of the possible solutions. (...) Regardless, SEP remains of the opinion that nuclear power is and will remain a good and reliable way to produce electricity, certainly now that emissions of substances harmful to the environment and the climate are to be reduced *(SEP press release*, 3 October 1996. From: www.kernenergieinnederland.nl)

4.4.2 Macro-cultural resonance: climate change goals and Borssele

Not only would there not be new nuclear build: the one remaining nuclear power plant at Borssele would have to be closed, as well, in spite of the government's acknowledgment that it reduced Dutch CO_2-emissions. The 1999 Energy Report (announced in the 1995 Memorandum) stated that

> In weighing the pros and cons, the cons, and mainly the waste issue, were the deciding factor in the decision to close the Borssele nuclear power plant ahead of schedule. The

> discussion regarding climate policy has not altered this. (Ministerie van Economische Zaken, 1999: 60)

This was reiterated in the Fourth National Environmental Policy Plan (NMP4) of 2001.When in 2000 the Raad van State had nullified the government's decision to close Borssele on procedural grounds, the government fully expected to win the consecutive lawsuit against EPZ (see: previous subsection). But it didn't. In late 2002, the court ruled in favor of EPZ and decided that the government had no legal means to enforce the closure of Borssele. While the decision itself mostly had obvious consequences for the regulative legitimacy of nuclear power, from a cultural legitimacy perspective the more interesting observation is the fact that the decision was not appealed by the government. What had happened?

Firstly, the storyline about the anthropogenic effects on worldwide temperature, (which was by then talked about increasingly in terms of 'climate change' instead of greenhouse effect) was gaining momentum in the political arena. In early 2002, The Netherlands had ratified the Kyoto protocol, legally binding the country to a reduction in CO2-emissions. Secondly, the political balance of power had shifted with the 2002 parliamentary elections. The new center-right cabinet Balkenende-I had replaced the broad-spectrum cabinet Kok-II. It consisted of the two parties that had traditionally been strongly in favor of nuclear power (the Christian democrats CDA and conservative liberals VVD), plus a new right-wing populist party LPF. The CDA's election program had been in favor of keeping Borssele open so as to be able to realize the Kyoto obligations in time, and VVD had stated that it wanted to keep nuclear power as an option.

Suddenly, a parliamentary majority was now in favor of leaving Borssele open. The new government's 2002 coalition agreement stated that given the desired

> (…) transition to a sustainable energy supply and given the Kyoto-obligations, it does not make sense to close the Borssele nuclear plant prematurely. The cabinet should confer with the producer/owner about leaving open the plant in relation to its economic and safe life span, and reach agreements on this. (Regeerakkoord Balkenende I, 2002).

In spite of the quick collapse of the new cabinet, these sentiments about nuclear power held up after the 2003 elections. Initially, negotiations made between CDA and PvdA (which was opposed to keeping Borssele open), but these negotiations failed and eventually the Balkenende-II cabinet was formed with CDA, VVD and progressive liberals D66. Their 2003 coalition agreement stated:

> The Netherlands will honor its Kyoto-obligations in the most cost-efficient way and will argue for compliance with the Kyoto Accords in EU-context. The nuclear power plant Borssele will be closed when it reaches its technical end-of-life in late 2013" (Regeerakoord Balkenende II, 2003: 15).

These coalition agreements furthered the storyline about the Borssele nuclear power plant as a cost-efficient weapon in the Dutch struggle against climate change. In spite of

a relative lack of public attention to the topic, the government thus explicitly linked the technology to the broader climate change repertoire.

4.4.3 Empirical fit: the waste issue

As stated in the 1999 Energy Report, the main objection to keeping Borssele open had been the waste issue. The responsible organization (COVRA)'s intermediate solution, a storage facility near Borssele for low-, medium- and high-level nuclear waste which had been planned and developed since the late 1980s, had encountered resistance on the local level (figure 4.4.2). But in 2003, a year after the government acquired full ownership of COVRA, the interim storage facility was nevertheless opened and would allow the government to frame the waste issue as having been solved. Its festive opening by the Her Majesty the Queen can be seen as a performance that principally targeted the empirical fit dimension: it was 'real-world proof' that the nuclear waste issue was not a problem anymore. All legacy wastes as well as any future waste that Borssele would produce until 2013 could now be stored a flood-, earthquake- and planecrash-proof structure until it naturally became less dangerous. The brightly colored building was announced to be painted in a lighter shade every 20 years to symbolize the process of decay by which the waste gradually becomes less radioactive (Wentzel, 2005). Greenpeace took issue with the facility and targeted the opening ceremony in newspaper advertisement showing a barrel of radioactive waste surrounded by confetti (fig. 4.4.3).

Fig. 4.4.2. Poster calling for demonstration against nuclear waste storage in Borssele. Source: Stichting Laka (2008).

Fig 4.4.3 Ad by Greenpeace, 30 September 2003. Source: www.kernenergieinnederland.nl.

The advertisement's text read:

> CONGRATULATIONS, MANY HAPPY RETURNS! Today, Queen Beatrix festively opens the transit warehouse for radioactive waste in Borssele, Zeeland. The waste will remain dangerous for 240,000 years. The new warehouse offers a solution for only 100 years. Greenpeace believes that a festive opening ceremony with the Queen is incomprehensible. A new building offers the appearance of a solution, while many generations will be burdened by nuclear waste. That's no reason for a party. (*Greenpeace ad*, 30 September 2003. From: www.kernenergieinnederland.nl)

In doing so, the Greenpeace performance attacked the new government's framing of the storage facility as empirical proof of the resolution of the waste issue, by stressing how it only offered the *appearance* of a solution.

4.4.4 Centrality: nuclear power as a bridge to sustainability

After 2003, the 'climate change' repertoire became ever more prominent in the public sphere and came to bee seen as a central and urgent problem. Figure 4.4.4, a time-series of the (absolute number of) articles in various newspapers that include the word 'klimaatverandering', provides some insight into the public attention to climate change over time[18].

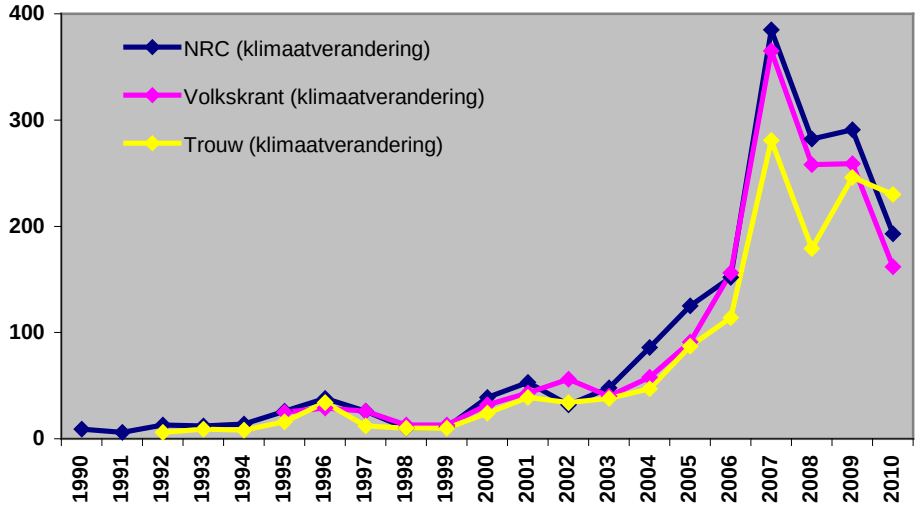


Fig. 4.4.4 Frequency plot: number of articles containing 'climate change' in various newspapers (see legend) over time.

Although The Netherlands (as an EU member state) had ratified the Kyoto Protocol in 2002, it only went into force in early 2005 when Russia's ratification satisfied the condition that its signatories together accounted for 55% of the total carbon dioxide emissions in 1990 (the baseline-year). Realizing the CO_2 targets now thus became politically increasingly important and as such, the government saw no way around nuclear power. A few months after the Kyoto Protocol came into effect, an Energy

[18] I was not able to use the *Leeuwarder Courant* archive for this graph because the absolute number of articles becomes unreliable after 2005 (see also: subsection 3.3.3.3 and footnote 10). But because climate change has become an issue only recently, I was able to use the archives of national newspapers *NRC Handelsblad*, *De Volkskrant* and *Trouw*. The total number of articles for the period through which they were available were 1,851 for *NRC Handelsblad*, 1,626 for *De Volkskrant* and 1,424 for *Trouw*.

Report entitled Nu Voor Later ('now for later') was published by the Ministry of Economic Affairs. On nuclear power it stated:

> In Europe, alongside coal, nuclear power is of lasting significance as a bridge to a sustainable energy system. (…) The use of nuclear power reduces dependence on countries outside the European Union and results in a decrease in CO_2-emissions. Hence, it is *difficult to imagine* how Europe could abolish nuclear power without grave consequences for security of supply, the climate or an economically efficient energy supply (Ministerie voor Economische Zaken, 2005. My italics).

Nuclear power was thus linked to an issue which was increasingly perceived by the public as being central and urgent. This was done not by framing it as a final solution to the problem, but instead as an *inevitable intermediate measure*. It was framed not a part of a sustainable energy system itself, but rather a *bridge* to such a system: a stopgap measure that would enable The Netherlands to meet its Kyoto obligations in the short term, while working on a 'real' solution for the long term. Under this storyline, not only did it make no sense to 'prematurely' close the one nuclear power plant The Netherlands had left, but it also for the first since 1986 time opened up the possibility of *new* nuclear construction.

Taken this as an opportunity, the nuclear industry intensified its performances aimed at enhancing the link between nuclear power and the central issue of climate change. To this end, various organizations were established. Among these were pro-nuclear initiave Stichting KernVisie ('nuclear vision'), which had been established in 2001 with the goal of "supplying solid, objective information and education to create societal support and stimulate an open attitude toward nuclear technology" (source: www.kernvisie.com), and *NucleairNederland*, a joint venture between EPZ, Urenco, NRG, Reactor Instituut Delft and COVRA. Such organizations embraced the Internet as a new stage for the performance of the centrality of their pro-nuclear storyline. In 2007, the *NucleairNederland* website argued that

> Nuclear energy is again receiving much attention because of the changing climate and the depletion of fossil fuels. Nuclear power plants produce energy in an environmentally friendly way, they do not emit greenhouse gasses. A nuclear power plant's fuel is uranium. Its worldwide availability is sufficient to supply us with energy for the coming centuries. (*www.nucleairnederland.nl* website as it appeared on July 2007. Source: www.archive.org)

The website's state claim was to offset a perceived bias in the available information:

> The participating companies and their staff are enthusiastic about the possibilities of 'nuclear technology' for energy supply, the environment and health care. But opponents of nuclear power and other applications of nuclear technology also exist. That's why on the Internet you will encounter a lot of information about the disadvantages of radioactivity and radiation. With our brochures and supplementary information on www.nucleairnederland we aim to nuance this sometimes fairly negative image and also highlight the advantages. (*www.nucleairnederland.nl* website as it appeared on july 2007. Source: www.archive.org)

Environmental organizations that opposed nuclear power such as Greenpeace could not very well argue that climate change was not a central problem: the perception of the urgency of the climate change issue had been one of their major victories. Therefore, they resorted to different strategies. Two can be discerned:

- Firstly, environmental organizations framed nuclear power as *unnecessary*: they argued that *other* options were available for addressing the central issue if climate change. A Greenpeace brochures, for example, read:

  > The climate is changing even faster then scientists feared. The cause is mostly CO2 which is released by the combustion of coal, gas and oil. If we want to stop global warming, then we need to start using other sources of energy. Does this mean that nuclear power is necessary? No, because there are plenty of clean alternatives and nuclear power is dirty, unsafe and expensive (Greenpeace, 2008)

  In the same brochure, Greenpeace presented an "Energy Revolution Scenario" that was aimed at proving that "smarter energy use" and large-scale deployment of wind turbines, solar cells and clear biofuels can "save the climate". It argued that by 2050, 57% of The Netherlands' total electricity consumption could be met through "green electricity". An accompanying photograph showed an array of photovoltaic panels in a familiar agrarian setting (figure 4.4.5).

- Secondly, environmental organizations framed nuclear power as *obstructing a real solution to the central issue*. It was an attempt to *re*frame nuclear power from a bridge to a sustainability society to a blockade on the road to a sustainable society. The illustration in figure 4.4.6 shows a typically Dutch landscape, featuring wind turbines and photovoltaic panels. A dirty-looking nuclear reactor and cooling tower are dropped on the landscape, threatening to crush the turbines and PV panels. The textual message read: *Nuclear power and coal obstruct a sustainable energy supply!*

Figure 4.4.5 Photo accompanying Greenpeace article. Source: Greenpeace (2008).

Figure 4.4.6 Image framing nuclear power as barrier to sustainability. Source: www.laka.org.

In early 2006, a conflict between Russia and Ukraine about gas prices led Russia to shut down its delivery of natural gas for two days. Because Ukraine was a gas transport hub to Europe (to which some 80% of its Russian gas was routed), several European nations

faced temporary reductions in the amount of gas delivered (*BBC News*, 2 January 2006, 'Ukraine 'stealing Europe's gas''). Because The Netherlands imported very little gas from Russia and still possessed a substantial domestic supply, the direct effect on the Dutch gas supply was minimal. Regardless, in political circles it emphasized once again the dangers of any nation's dependence on foreign fossil fuels. A storyline emerged around the need for *security of supply* and, in much the same way it had been following the Suez crisis, linked to pro-nuclear discourse by emphasizing how nuclear power only required uranium.

Framing nuclear power as a solution to the urgent issue of dependence on foreign states (by negating the need to import oil and gas) *and* as a solution to the urgent issue of climate change (by mitigating CO_2 emissions) greatly enhanced the centrality of pro-nuclear discourse. As such, in 2006, the government struck a deal with EPZ for keeping Borssele open. Coalition partner D66, which had called nuclear power "unacceptable" in their 2003 electoral program (D66, 2003) and had demanded the closure of Borssele, now agreed to let EPZ keep operating the plant until 2033 in exchange for a €250 million investment in renewable technologies and energy saving. Borssele would provide a bridge to a permanent solution for a central problem. The extension of its life span, first from 2003 to 2013 and now even to 2033, opened up the door to for the possibility of new nuclear construction even further.

4.4.5 Experiential commensurability: making nuclear power concrete

The year 2006 saw the widely-publicized release of the documentary film *An Inconvenient Truth*, in which environmental advocate Al Gore showed, among other things, the concrete effects that climate change and the squandering of fossil fuels had supposedly already had on the world around us and the daily lives of many people. The film was partially responsible for a large increase in public attention to the issue of climate change in 2006 and 2007 (see also: figure 4.4.4). Framing nuclear power as a tool to help mitigate such effects on people's daily lives increased the experiential commensurability of pro-nuclear discourse. For example, in 2007 *NucleairNederland* published and distributed an educational brochure aimed at adolescents (NucleairNederland, 2007). Instead of focusing solely on the climate change issue, it attempted to broaden the scope of the pro-nuclear storyline by highlighting the various uses of nuclear technology other that only electricity generation: health care, mobility ("from nuclear submarine to space ships") and even the production of drinking water (through the desalination of sea water). In a way reminiscent of half a century earlier, such performances aimed at the experiential commensurability dimension.

Another strategy to link nuclear power to people's daily lives was to show the relatively small amount of radioactive waste produced to meet an average individual's daily electricity requirements. This provided a contrast to many of Greenpeace's recent performances which had featured hundreds of large barrels to confront the public with the total amount of radioactive waste produced (e.g. figures 4.4.7 and 4.4.8).

Fig. 4.4.7 Photo of Greenpeace action: dumping mock nuclear waste barrels in House of Parliament canal, 2005. Source: Stichting Laka (2008).

Fig. 4.4.8 Greenpeace photo of array of mock nuclear waste barrens outside Borssele to emphasize quantity of waste, 2005. Source: Stichting Laka (2008).

Instead, the aforementioned educational brochure showed a picture of a tennis ball (figure 4.4.9). The caption read:

> If someone would only use electricity from a nuclear power plant their whole life, it would give a quantity of highly radioactive waste the size of a tennis bal. If one nuclear power plant would produce electricity for thirty years without interruptions, then all the waste would fit into one living room (Nuclear Nederland, 2007)

The pro-nuclear initiative Stichting KernVisie ('nuclear vision'), which had been established in 2001 with the goal of "supplying solid, objective information and education to create societal support and stimulate an open attitude toward nuclear technology" (Source: www.kernvisie.com), published similar imagery in the December 2008 issue of its monthly publication. Above an article about a new electricity supplier that aimed to supply exclusively nuclear electricity to its customers, it showed a picture of a small keychain-sized barrel of nuclear waste (fig. 4.4.10) which the firm gave out to its new subscribers. The image's caption read:

> Yearly production of shortlived and longlived radioactive waste by an average Dutch family powered by 100% atomic electricity (10 grams). (Stichting Kernvisie, 2008)

By visualizing the waste as small household objects, these peformances aimed to increase the experiential commensurability of pro-nuclear discourse.

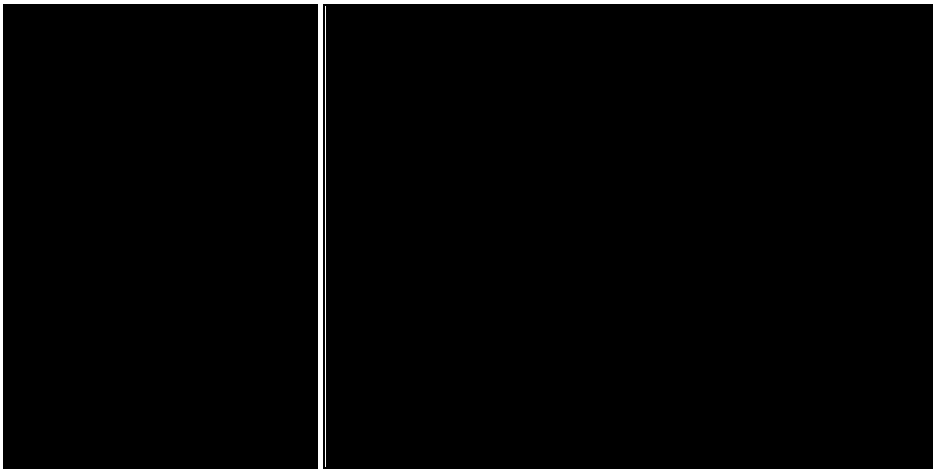


Fig 4.4.9 Image from nuclear power brochure. Tennis ball represents volume of high-level waste produced to cover one person's lifetime energy use. Source: NucleairNederland (2007).

Fig. 4.4.10 Keychain represents volume of low- and high-level waste produced to cover one Dutch family's annual energy use. Source: Stichting Kernvisie (2008).

In 2008, electricity producer Delta (which had a 50% stake in EPZ which in turn owns the Borssele plant) announced its plans to construct a second nuclear power plant. A year later, it initiated the procedure for obtaining the necessary permits for the construction of a 2,500 MW nuclear power plant of a type later to be determined but to be located in Borssele. These new and very concrete plans for the construction of a new nuclear power plant in Borssele were mobilized by those opposed to the plans to emphasize the experiential commensurability of their anti-nuclear storyline. In early 2010, Greenpeace initiated a campaign aimed at influencing the outcome of the upcoming local elections (in which some parties were against Delta's plans).

Figure 4.4.11 Greenpeace e-cards as protest againt second nuclear power plant in Borssele. Source: www.greenpeace.nl.

An enormous greeting card was hung outside the Middelburg city hall and people were given the option to send the design as electronic cards to their friends over the internet.

The various designs all featured people relaxing in familiar settings such lying on the beach, riding a bicycle through the fields, or playing badminton on a camping ground. All designs juxtaposed this serene imagery with a nuclear reactor and a pair of ominous cooling towers (e.g. fig. 4.4.11).

The cards all read "Greetings from radiant Zeeland" and were a direct reference to the popularity of the province of Zeeland (in which Borssele is located) as a holiday spot. The power plants were thus made less abstract, and were visualized in the context of familiar, every-day settings. By suggesting the construction of a new nuclear power plant would ruin many popular holiday activities, the campaign was aimed at increasing the experiential commensurability of anti-nuclear discourse.

4.4.6 Macro-cultural resonance: linking to other storylines

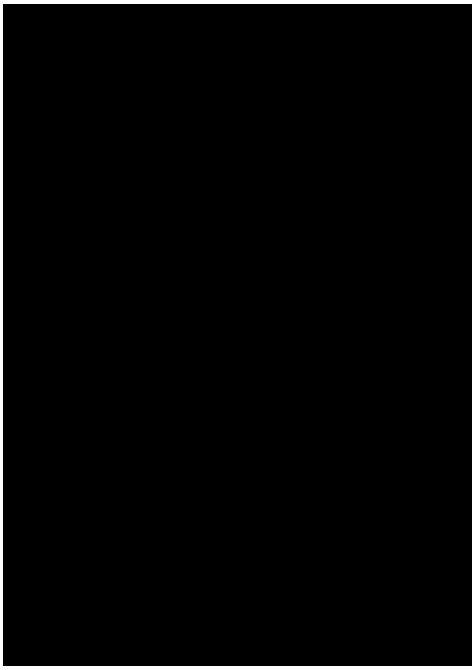
After a long formation period, the 2010 parliamentary elections resulted in a minority coalition between the Christian democrats CDA and conservative liberal VVD, which was supported by the new nationalist opposition party PVV. All three parties had previously expressed their support of nuclear power, and the coalition agreement thus read:

> To realize CO_2-reduction and achieve a less dependent energy supply, more nuclear power is required. Applications for permits for the construction of one or more new nuclear power plants that meet the requirements, will be granted. Storage of CO_2 can take place underground given stringent safety requirements and local support. Such storage will only be considered after granting the license for a new nuclear power plant. (Regeerakkoord VVD-CDA, 2010: 12-13)

New nuclear construction was now no longer merely an option: it was a requirement and a priority. It was now strongly linked to both climate change and security-of-supply. In response, environmental organizations and political parties opposed to new nuclear construction intensified their performances targeting the dimension of macro-cultural resonance, as well. Because the aforementioned linkages were so persuasive, they attempted to forge *different* linkages instead, on both local and national levels:

- On the *local* level, the concrete plans for constructing a new nuclear power plant in Borssele had provided a new impulse for local action groups. The *Zeeuws Comité Borssele II Nee* was established in 2010 by the regional chapter of the Socialist Party (and supported by local chapters of other political parties opposing new nuclear build such as PvdA, PvdD, D66 and GroenLinks). A poster by the Comité (figure 4.4.12) showed an angry-looking young farmer couple in the traditional attire of the region in the foreground, a crossed-out nuclear power plant in the background, and the text *"We're still not happy with nuclear power"* in local dialect. The poster can be interpreted as a performance of traditional, local norms and values being at odds with nuclear power.
- On the *national* level, anti-nuclear movement organizations attempted to emphasize those aspects that they felt were left out in the framings of nuclear power as

'mitigating CO2- emissions' and 'assuring security of supply'. WISE and Stichting Laka produced a poster (figure 4.4.13) which showed images of a mushroom cloud, a bulldozer dumping barrels of waste, a strip mine, the exploded Chernobyl reactor, Iranian president Mahmoud Ahmadinejad, men in radiation suits, and a deformed infant. The text read *"This is nuclear power, as well"*. The poster attempted to enhance the macro-cultural resonance of anti-nuclear discourse by linking the technology to storylines about the proliferation of nuclear weapons, the problematic storage of nuclear waste, the finite availability of uranium, the low-probability-high-impact nature of reactor accidents, geopolitical instability, and the health risks of radiation. It essentially reframes nuclear power, not by arguing that the link to climate change is false, but rather by linking it to a plethora of *other* issues which were argued to collectively discredit nuclear power as a legitimate option.



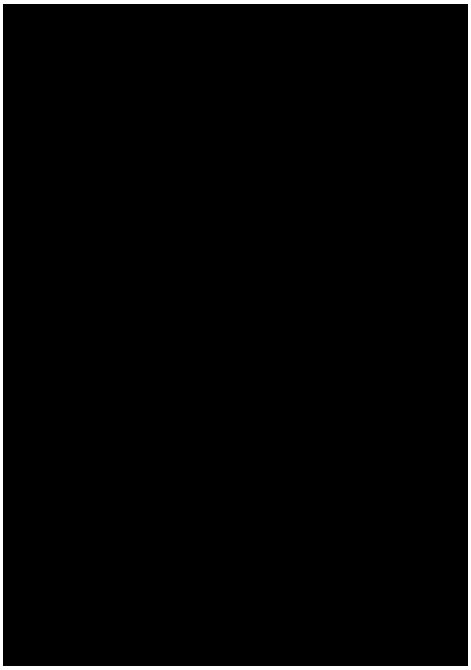


Fig. 4.4.12 Poster against second nuclear power plant at Borssele by Zeeuws Comité Borssele II Nee, 2010. Source: www.borssele2nee.eu.

Fig. 4.4.13 Poster arguing against nuclear power by Stichting Laka and WISE, 2010. Source: www.stopkernenergie.nl.

4.4.7 Epilogue: renewed legitimacy for nuclear power

But in spite of these - and similar - performances by both pro- and antinuclear discourse coalition actors, public attention to the issue of nuclear power has not increased significantly since 1995, when nuclear power was announced by the government to have run its course in The Netherlands. Although figure 4.1.1 shows a very slight rise since about 2005, figure 4.4.14 shows that this rise is in large part due to press attention

for nuclear programs in Iran and North Korea. In the absence of compelling performances that emphasize the credibility of anti-nuclear actors, mobilize new accidents as empirical proof their claims, or show how the various issues affect Dutch peoples' daily lives, the persuasiveness of anti-nuclear discourse is lower than that of its pro-nuclear alternative. The pro-nuclear storyline is structuring nuclear discourse: for a large part of the Dutch public, it is becoming a relatively uncontested framework for the interpretation of nuclear power. Renewed polarization, large-scale protests or intense public discussions such those of the 1970s and 1980s seem unlikely. In terms of figure 2.4.1, coordinative discourse is currently dominating the decision-making process around Borssele-II. Barring a renewed attention to nuclear power in the public sphere and an intensifying *communicative* discourse about nuclear power, the future of Dutch nuclear power will likely be decided along the familiar logics of coordinative discourse and thus hinge on factors such as economic viability.

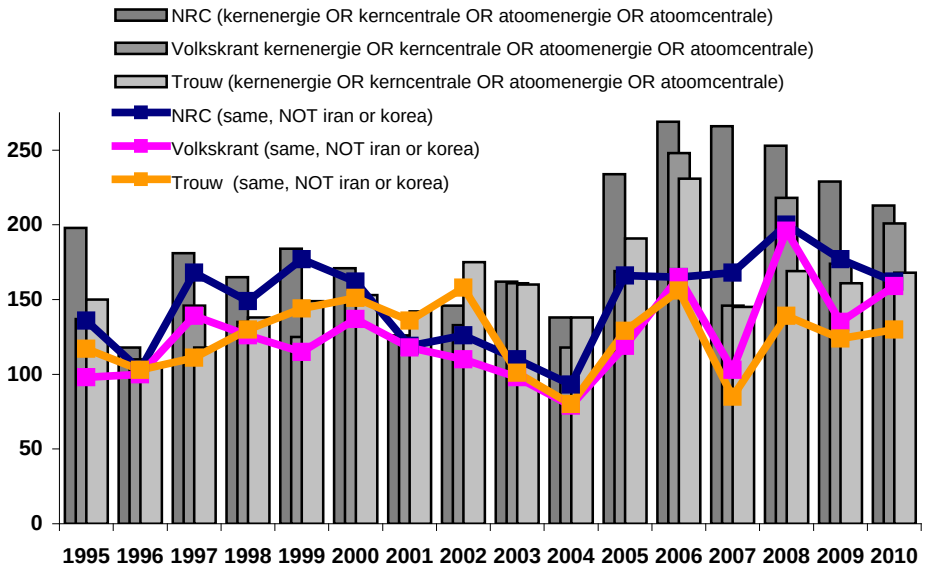


Fig. 4.4.14 Articles in various publications over time which include selected keywords (columns) and selected keywords but excluding 'Iran' and 'Korea' (lines). Source: LexisNexis.

Chapter 5: The cultural legitimation of British nuclear power

5.1 Introduction

In this chapter, I lay out a chronology of civilian nuclear power in Britain. By using the five dimensions of centrality, actor credibility, empirical fit, experiential commensurability and macro-cultural resonance as 'narrative plots' to structure the subsections, I ensure an analytic focus on the process of cultural legitimation. The chapter is divided in into three sections:

- Section 4.2 details the cultural legitimation process between 1945 and 1970 and concludes that over the late 1940s and early 1950s, the cultural legitimacy of nuclear power was successfully constructed by linking up with a pre-existing storyline about the beneficial uses of atomic energy, which yielded societal support for the construction of nuclear reactors in spite of their immediate application for the production of weapons-grade plutonium. But after the nuclear project refocused on electricity production by the mid 1950s and a first program of power reactors was implemented, the cultural legitimacy of nuclear power eroded. Throughout the 1960s the technical and financial troubles associated with the first program were criticized, and early contestation took the form of opposition by the coal miners union, who felt threatened in their livelihoods.

- Section 4.3 details the cultural legitimation process between 1973 and 2003 and concludes that the criticisms that had emerged over the 1960s were joined in the 1970s by safety criticisms from the environmental movement that were targeted at specific aspects of the nuclear industry. Such criticisms were typically addressed through conventional channels such as public inquiries and largely dismissed by the government. Nuclear expansion continued to be pursued with a second and third nuclear power program, but continued controversies over health issues, technical problems and the bad economic performance that came to light as the result of attempts at privatizing nuclear power plants severely undermined the cultural legitimacy of nuclear power in the 1980s and 1990s, to the point where it disappeared from the policy agenda in the early 2000s.

- Section 4.4 details the cultural legitimation process between 2005 and 2010 and concludes that attempts were made at *re*constructing the cultural legitimacy of nuclear power by linking it to climate change and energy security, which enabled nuclear expansion plans to re-enter the policy agenda.

Throughout the chapter, numerous images appear which frame nuclear power in a variety of ways and which constituted vehicles to communicate these framings to the public. I contextualize and interpret these framings in the body text. In each image's caption I provide the source of its original publication (when relevant) as well the archive I located it in. For reasons of brevity, the caption contains only these archives'

names: in the references section the reader may find a list of consulted archives containing full details.

Moreover, a number of co-word graphs, based on quantitative newspaper bibliometrics, appear throughout the text as a means to triangualate on themes in nuclear discourse. The methodology underpinning these co-word graphs has been explained in-depth in subsection 3.3.3.1 of the methodology chapter: in this chapter, only the resulting graphs are presented. Finally, the text frequently refers to a bibliometric occurrence graph that is used as an indicator for public attention. Although this graph also appears in the methodology chapter, it is reproduced here for easy reference (see: figure 5.1.1).

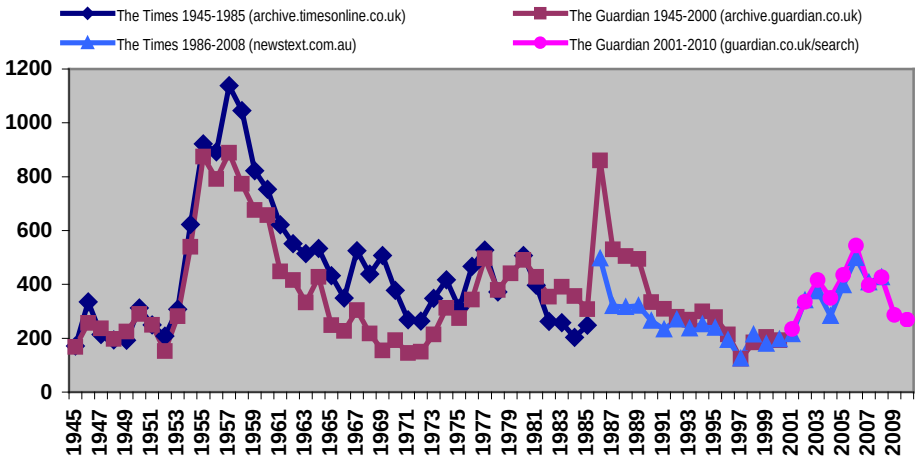


Fig. 5.1.1 Number of articles per year that mention "nuclear power" or "atomic energy" for selected publications. Sources: see legend.

5.2 Constructing and extending legitimacy: 1945-1970

5.2.1 Prologue

In the late 19th and early 20th centuries, a series of discoveries in the fields of chemistry and physics had uprooted many commonly accepted insights. The discovery of X-rays by Röntgen in 1895 indirectly led to the discovery of radioactivity by Becquerel in 1896, although its cause was still unknown at the time. Two years later, Marie Curie, who had coined the term radioactivity, discovered the element radium. It was British scientists Rutherford and Soddy who subsequently realized that the radioactivity of this substance was the result of its spontaneous decay into other elements. Soddy himself contributed to popularizing these discoveries. In 1909 he wrote in his popular-scientific book *The Interpretation of Radium*:

> [T]he work of M. and Mme. Curie, by their discovery of radium, made the world familiar with an element over a million times as radioactive as uranium. In this case the energy evolved is great enough to produce effects which are obvious to all and which cannot be explained away. In a strictly scientific sense there is no difference of principle between the radioactivity of radium and that of uranium. The difference is one of degree

> only, but it is so great that radium, though, as we shall come to see, not so wonderful in reality as uranium, rapidly acquired a monopoly of public interest and attention. (Soddy, 1909: 15)

Radium had indeed sparked the British public's curiosity. British newspapers and books published extensively on radium, framing it as a scientific miracle with any number of beneficial health effects, including curing cancer. Figure 5.2.1 shows the occurrence of the word 'radium' as a ratio of the total number of words in the Google Books collection of UK books[19], as well as the percentage of those books in which the word radium occurs at least once (source: Google Books Ngram Viewer datasets[20]).

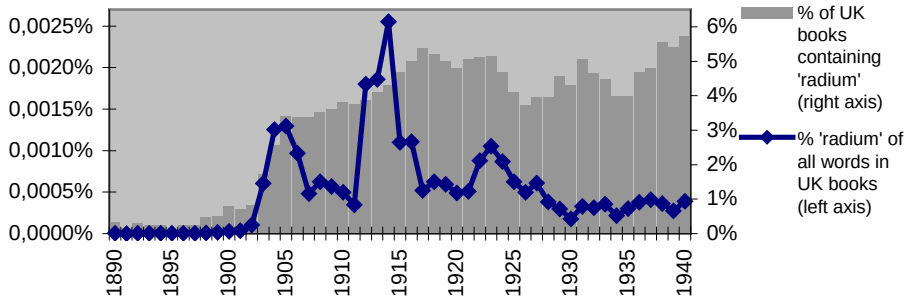


Fig. 5.2.1 The word 'radium' in British-English corpus of Google Books (Smoothing=1). Source: ngrams.googlelabs.com/datasets.

Several scholars (Herring, 2005; Hilgartner *et al*., 1982) link this 'radium craze' to the rise of scientism, an ideology which held that the natural sciences offer the only correct view of the world. But already then, some members of the British public looked beyond the immediate applications of radium and guessed at the broader potential of the enormous amounts of energy locked away inside atoms that Soddy had hinted at. In 1914, on the eve of WWI, popular British science-fiction author H.G. Wells published *The World Set Free*, a book he based upon (and dedicated to) Soddy's *The Interpretation of Radium.* In this novel, set in the 21st century, Wells imagined the future harnessing of atomic energy for purposes of electricity supply, which one of his characters described as:

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[19] Of the 5.2 million books digitized as part of the Google Books project (some 4% of all books ever published (Michel *et al.*, 2011)) 422,797 are classified as having been published in the UK.

[20] Raw data from http://ngrams.googlelabs.com/datasets. On both series, a moving average is applied so that the value for each year is equal to the average of the 'raw' values for that year, the previous year, and the subsequent year. This is done in other to facilitate the discovery of trends instead of mere peaks (Michel *et al.*, 2011).

> (…) a change in human conditions that I can only compare to the discovery of fire (…) I see the desert continents transformed, the poles no longer wildernesses of ice, the whole world once more Eden. (Wells, 1914: 26)

In the book, mankind eventually learns to utilize this energy for destructive purposes, as well. Almost prophetically, Wells calls the resulting weapon an 'atomic bomb'. In his story, a great war eventually breaks out in which atomic bombs are used. The devastation this causes, however, turns out to outweigh any underlying conflict between nations:

> The atomic bombs had dwarfed the international issues to complete insignificance. When our minds wandered from the preoccupations of our immediate needs, we speculated upon the possibility of stopping the use of these frightful explosives before the world was utterly destroyed. (Wells, 1914: 146)

Wells eventually resolves the situation by creating a world government of highly educated rulers - a global technocracy - to replace the outdated national governments which had caused the Last War in the first place:

> Certainly it seems now that nothing could have been more obvious to the people of the earlier twentieth century than the rapidity with which war was becoming impossible. And as certainly they did not see it. They did not see it until the atomic bombs burst in their fumbling hands. (…) [I]t was a matter of common knowledge that a man could carry about in a handbag an amount of latent energy sufficient to wreck half a city. (…) And yet the world still (…) 'fooled around' with the paraphernalia and pretensions of war. It is only by realising this profound, this fantastic divorce between the scientific and intellectual movement on the one hand, and the world of the lawyer-politician on the other, that the men of a later time can hope to understand this preposterous state of affairs. (Wells, 1914: 118)

Around the time of publication of Wells' book, the actual scientific community worked feverishly at understanding the structure of the atom. It was the discovery of the atomic nucleus by Rutherford, Geiger and Marsden in 1909 that led to the formulation of the 'planetary model' of the atom: a positively charged nuclear orbited by electrons. As many scientists in the forefront of these developments were British, newspapers like *The Times* enthusiastically published such discoveries. Many such articles were reports on meetings by the *British Association for the Advancement of Science*, a learned society with the object of promoting public engagement in science. Most articles about the atom published in *The Times* during this period attempted to convey the scientific importance of these discoveries to the general public, but some speculated on its possible practical applications much like H.G. Wells had done. For example, a 1919 editorial in *The Times* reminded its readers of just how quickly new scientific insights had been turned into practical devices during WWI, which had only recently ended:

> The new knowledge of radio-activity that has been growing since the discovery of X-rays and of radium, has revealed the atom as a tremendous storehouse of energy. (…) At present we do not know how to liberate this power. We know of its existence only from the spontaneous disintegration of radio-active substances. But knowledge comes

> quickly. During the war, radiant energy was applied to the amplifiers of wireless telegraphy and telephony, an application of abstract scientific research as unexpected as that may be which will lead to the utilization of atomic energy. (*The Times*, December 11th 1919, 'New Sources of Energy').

Another example is a cartoon by David Low published by *The Evening Standard*'s first issue of the year 1928 (figure 5.2.2). It showed a small child wearing a sash labeled *1928* peering behind a curtain labeled *Secrets of the Future*. Among the many things the boy sees (*Silent motors? Cancer cure? Synthetic life? Weather control? The final poison gas? Television? Teletouch? Teletaste? Universal telephony? The final explosive?*) is a mysterious machine labeled *The Harnassed Atom?*

Fig. 5.2.2 Evening Standard, 2 January 1928 (Artist: D. Low). Source: British Cartoon Archive.

Clearly, the atom had captured the imagination of the public, albeit in an abstract sense: although its exact implications were still unknown, the expectation was that 'the atom' would be 'harnessed' in the near future. But even though new discoveries were continuously made by British scientists (e.g. the crucial discovery of the neutron by Chadwick in 1932), not all scientists were convinced that any practical applications would be forthcoming. A transcript of a speech by Rutherford in *The Times* states:

> (…) [O]n the average we could not expect to obtain energy in this way. It was a very poor and inefficient way of producing energy, and anyone who looked for a source of power in the transformation of the atoms was talking moonshine. But the subject was scientifically interesting because it gave insight into the atoms. (*The Times*, 12 September 1933, 'The British Association - Breaking Down The Atom - The Transformation of Elements')

It was this article which prompted Hungarian physicist Szilard, who disagreed with Rutherford, to conceive of the theoretical possibility of a nuclear chain reaction (Szilard and Weart, 1980; Rhodes, 1986). He filed for a patent in 1934 and assigned it to the

British Admiralty in 1936 to prevent it from becoming public: his reading of Wells' *The World Set Free* had left him fearful that the Germans might attempt to use it as a weapon (Wolpert, 1989). At that time, however, no element was known to posses the properties required to sustain such a reaction. But in late 1938, German chemists Hahn and Strassman, building on earlier research by Italian physicist Fermi, demonstrated that uranium could be split into lighter elements by bombarding it with neutrons. Austrian physicists Meitner and Frisch interpreted their results as being the result of nuclear fission (a term coined by Frisch). In early 1939, Bohr carried this news to the USA and informed Fermi, by then working at Columbia University. Later that year, French physicist Frédéric Joliot-Curie proved that during nuclear fission *additional* neutrons were liberated, thus enabling a nuclear chain reaction much like Szilard had theorized in 1933. When Szilard learned in 1939 that uranium had the right properties to be used for a chain reaction, he wrote a famous letter to President Roosevelt, but had Einstein sign it because of the latter's reputation. The letter brought the possible applications of nuclear chain reactions to the attention of the US government:

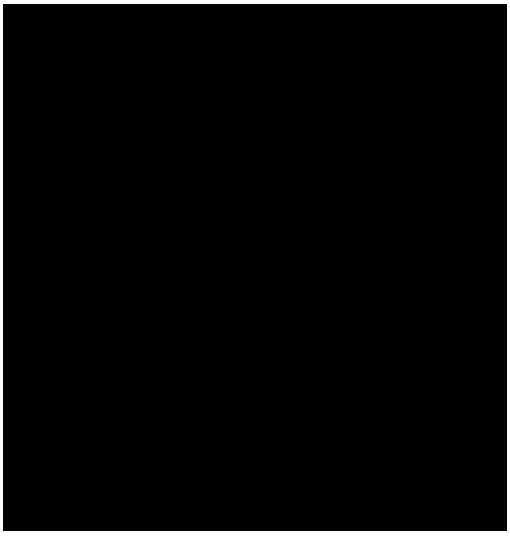
> Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. (…) This new phenomenon would also lead to the construction of bombs, and it is conceivable - though much less certain - that extremely powerful bombs of a new type may thus be constructed. (Einstein, 1939).

Much like Wells' book, the letter hints at the 'two faces' of the atom by making the distinction between its peaceful and warlike applications; a distinction that would become an important rhetorical device in later years. The letter, which articulated the possibility that the Germans might attempt to construct an atomic bomb, was one of the catalysts for the Manhattan Project (Goodchild, 2004). The Uranium Committee, assembled by Roosevelt as a direct consequence of the letter, funded Fermi and Szilard's research into what would become the world's first nuclear reactor: the Chicago Pile-1. The reactor successfully reached criticality in late 1942. The project, as well as the Uranium Committee, became integrated into the Manhattan Project, which culminated in the production and detonation of the first atomic bomb over the New Mexico desert on July 16th 1945. Less than a month later, two more atomic bombs were detonated over Hiroshima and Nagasaki, followed by the surrender of Japan.

5.2.2 Actor credibility: who tames the atom? ('45-'49)

The successes of British scientists in the field of physics in prewar years had already increased the status of scientists in the eyes of the British public, and the success of the Manhattan project made it seem that nothing was impossible for men of science. Science itself was seen as an objective, value-free enterprise. A cartoon by Illingworth published in the Daily Mail following the atomic bombing of Hiroshima, illustrates this (figure 5.2.3). A man labeled 'humanity' is peering through a microscope labeled 'science' at a specimen labeled 'atomic energy'. He is about to flick away a miniature Japanese samurai (a caricature of Emperor Hirohito) who is climbing onto his

microscope obstructing his view. The message the cartoon seems to convey it that science itself is an objective instrument, which humanity is using to understand the secrets of the atom. Armed (literally) with this new knowledge, warlike aggressors are now little more than a nuisance that can be removed almost as an afterthought, but the responsibility for such an action lies not with science (a disinterested tool, after all) but with humanity. Scientists were seen as having privileged access to this value-free realm. In popular press, they were framed as intermediaries between humanity and science similar to how the heroes of Greek mythology mediated between humanity and the gods. Scientists were the heroes of the Atomic Age. This is illustrated by a cartoon in the Evening News (figure 5.2.4) in which a diminutive scientist explains the basics of nuclear chain reactions to an audience of mesmerized girls, who have apparently lost all interest in a group of muscular boys demonstrating their physical prowess.



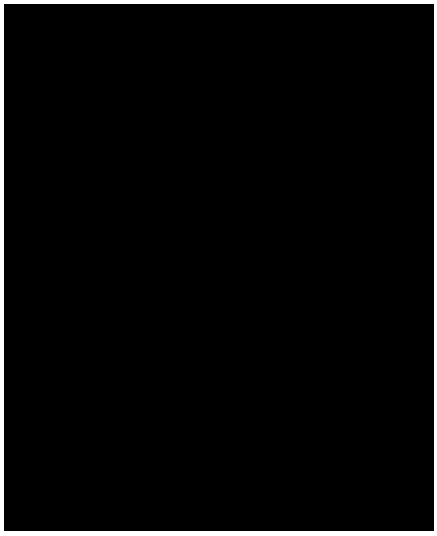


Fig. 5.2.3 Daily Mail, 9 August 1945 (Artist: L. Illingworth). Source: British Cartoon Archive.

Fig. 5.2.4 Evening News, 10 August 1945 (Artist: J. Lee). Source: British Cartoon Archive.

The atomic bombs on Japan had demonstrated the near-omnipotence of science to the British public. Any storylines articulated by scientists thus possessed a high degree of credibility. But there was also a fear that that scientists had given humanity a power which it was not ready to yield. Two days after the day after the bombing of Hiroshima, the *Daily Mail* published a cartoon by Illingworth, and a day later, the Evening Standard ran a cartoon by Low using different symbolism but containing a similar framing (figures 5.2.5 and 5.2.6). Figure 5.2.5 shows a tall woman labeled *science* (the classic personification of wisdom) holding up a radiant vase labeled *atomic energy*. At her feet a number of men clad in various uniforms labeled *the world's militarists* are bickering like children, shouting *'Me! Me! Me!'* as if attempting to persuade the woman to hand over the vase. Figure 5.2.6 shows a stereotypical scientist, with a book labeled *the atom*

in his lab coat pocket, presenting a tiny marble to a crawling infant labeled *humanity*. The marble signifies the atom and is accompanied by the text "life or death".

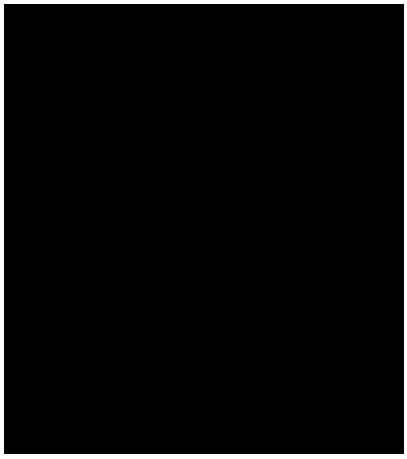


Fig. 5.2.5 Daily Mail, 8 August 1945 (Artist: L. Illingworth). Source: British Cartoon Archive.

Fig. 5.2.6 Evening Standard, 9 August 1945 (Artist: D. Low). Source: British Cartoon Archive.

But this dangerous situation, it was argued, could be mended by a close collaboration between science and politics geared towards taming the atom. Figure 5.2.7 employs the metaphor of a wild horse for conveying the raw power locked away in the atom[21]. Two men, whose coats are labeled *politics* and *science*, are holding reigns and a saddle, waiting for the opportune moment to tame the defiant steed. By politicians and scientists working together, the wild and capricious atom could be domesticated into a benign force ready to do humanity's bidding: figure 5.2.8 shows three Brits dragging a faceless, docile giant labeled 'the mighty atom' around London by the ankle.

[21] Other examples of a wild horse being used for this purpose include a cartoon by Sidney Strube in the November 12th, 1945 edition of the Daily Express (UK) in which Stalin, Truman and Attlee appear as cowboys taming the atom horse with a saddle reading "world peace" and "prosperity", and the cover of the August 4th, 1947 edition of Time Magazine (USA) which features a portrait of David Lilienthal (chairman of the US Atomic Energy Commission) against a backdrop illustration of a rearing, fiery horse held down at the reigns by a pair of strong arms.

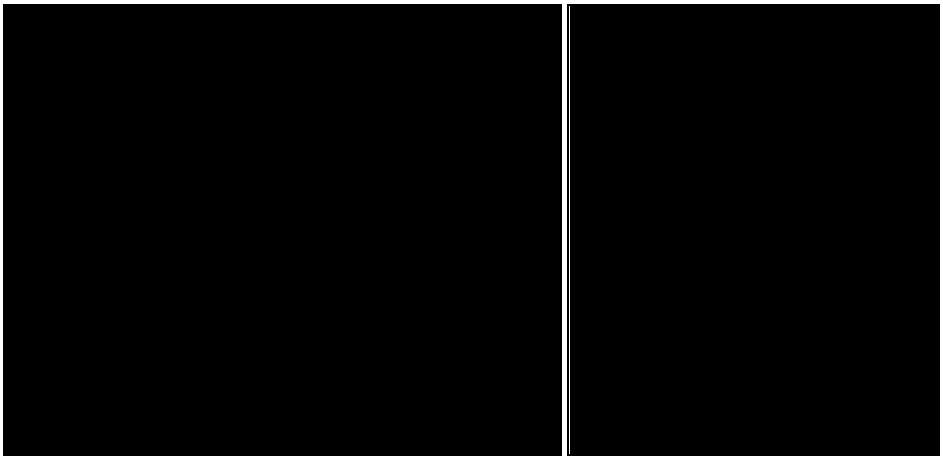


Fig. 5.2.7 Evening Standard, 4 June 1946 (Artist: D. Low). Source: British Cartoon Archive.

Fig. 5.2.8 Daily Mail, 29 April 1946 (Artist: L. Illingworth). Source: British Cartoon Archive.

It was widely known in the UK that British scientists had been instrumental in the success of the Manhattan Project. Soon after WWII however, the US Atomic Energy Act of 1946 (or 'McMahon Act'), which among other things established the United States Atomic Energy Commission (AEC), effectively prevented cooperation between the USA and Britain on nuclear research. The cartoon in figure 5.2.9 shows Prime Minister Attlee and his Canadian colleague St. Laurent sulking in their *branch office*-labeled doghouse outside the heavily guarded American *Atomic Know-How HQ*. This situation was a source of frustration for the British government, which subsequently embarked on its own nuclear weapons program. Trust in British scientists was so great that there was little doubt with the public that they could develop nuclear technology independently. The cartoon in figure 5.2.10 shows a British schoolboy causing a small nuclear explosion and telling his teacher, who is walking away for advice, *"Please Sir, I don't think there's any need to bother the American atomic experts for the know-how"*.

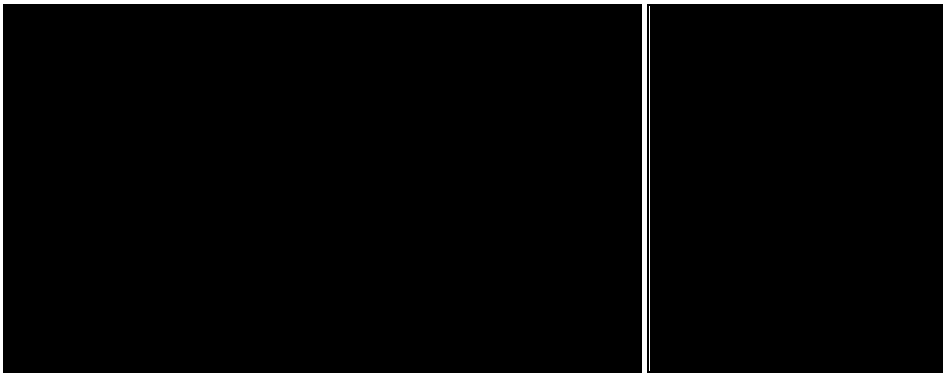


Fig. 5.2.9 Evening Standard, 29 July 1949 (Artist: D. Low). Source: British Cartoon Archive.

Fig. 5.2.10 Daily Express, 21 July 1949 (Artist: M. Cummings). Source: British Cartoon Archive.

5.2.3 Macro-cultural resonance: peace and progress ('45-'54)

A prominent issue in the British press in the months after the bombings was that it had now been demonstrated empirically to all nations of the world that atomic energy was practicable, if only for the time being as a weapon. This had to be signified with some way or another. Regardless of whom had let the atomic cat out of the bag (and whether they should be praised or chastised for it), the cat was out and it was not going back in. An image of atomic energy as a genie in a bottle[22] is used in figure 5.2.11 to illustrate this sentiment. Two children flee from a boogeyman labeled 'sadism' towards a woman labeled *humanity*. As a last resort, the woman has taken the lid off a vase labeled *atomic energy*, out of which a jinn (wielding a lighting rod) emerges, ready to do humanity's bidding. The jinn can be seen to represent both the power and the mystery of the atom.

Fig. 5.2.11 Daily Mail, 14 August 1945 (Artist: L. Illingworth). Source: British Cartoon Archive.

Fig. 5.2.12 Evening Standard, 16 October 1945 (Artist: D. Low). Source: British Cartoon Archive.

But in reality, a surprisingly large amount information about the basic physics behind nuclear chain reactions and the process leading up to the construction of the atomic bomb was available to the public (and even found in newspapers) already very soon after WWII. The only real 'atomic secret' the USA was keeping from the world, the press argued, was the concrete and practical engineering knowledge required to actually create an atomic bomb – not so much the physics behind it. Even though its technological lead would ensure the USA sole possession of the bomb for almost five years, this was already perceived in the press as an essentially untenable position. Figure 5.2.12 shows US President Truman attempting to hide a machine labeled *atom splitter* with a far-too-small cloth, while being ridiculed by a group of men labeled

[22] The genie-in-a-lamp became an often-used metaphor for nuclear power in later years because of its magical ability to grant wishes to the lamps owner alone (see for example figure 5.3.26).

world's scientists. An excerpt from an editorial in *The Times* summarizes these sentiments:

> The secret cannot be kept. All the world now knows that the problem of releasing atomic energy can be solved; the physicists of all nations know the general lines of research along which the solution can be reached. They cannot be held back from reaching it. (…) Here is a source of power that can and will revolutionize human life and livelihood and, by promoting a parity of standards of living throughout the world, eventually modify one of the deepest causes of instability and war. (The Times, October 9th 1945, *Peace And The Atom*)

So paradoxically, one strategy to increase the macro-cultural resonance of the nuclear storyline was to link it to the macro-cultural repertoire about pacifism. The resulting storyline amounted to a call for the development of peaceful applications as a means to avert nuclear destruction by removing the incentives for war. This linking of nuclear technology to peace occurred frequently in British press. For example, J.D. Bernal, vice-president of the Association of Scientific Workers (a trade union for scientists), sent a letter to *The Times* stating:

> The atomic bomb is but the first instance of the use of atomic energy; it marks the opening of a new era of man's conquest of his physical environment. (…) The most hopeful as well as the most effective means of averting the evils implicit in the atomic bomb is to encourage not only the existing teams of scientists but the whole of international scientific effort towards working out the direct and indirect ways of beneficial utilization of atomic energy and thus towards removing the economic causes of the tensions leading to war. (The Times, 5 September 1945, *Atomic Energy*)

The domestic development of applications of nuclear technology was also legitimized by linking atomic energy to macro-cultural repertoires about modernity and techno-scientific progress. The resulting storyline held that the development of nuclear technology was part of a general trend of technological progress which should not be interfered with. The cartoon in figure 5.2.13 illustrates this storyline. The caption read *March of progress* and the cartoon shows a fatigued horse drawing a carriage transporting sacks of coal and a pair of passengers marked "gas" and "oil". A modern-looking racecar labeled "atomic power" apparently wants to overtake the carriage, but is obstructed by a man holding a flag and a child, labeled "future", ringing a bell. This cartoon is an obvious reference to the 1865 Locomotive Act, which required any motorized vehicle to be preceded by a man with a red flag who would enforce a walking pace. This law, which was repealed only in 1896, was the result of special interest group (such as railroad lobby) opposition to the automobile under the guise of safety concerns. The cartoonist here attempted to convey a similar message about the development of atomic power, simultaneously depicting fossil fuels as outmoded and ridiculing attempts to stop the development of nuclear technology.

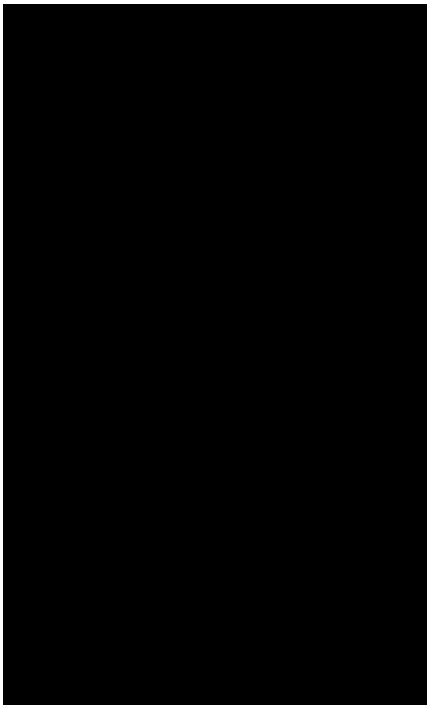
Fig. 5.2.13 Manchester Guardian, 13 July 1954 (Artist: D. Low). Source: British Cartoon Archive.

5.2.4 Centrality: coal shortages and the Suez crisis ('47-'57)

The development of an independent nuclear deterrent had been successful. In 1946, a disused poison gas factory at Springfields had been converted into a uranium metal plant and had started producing uranium fuel elements from raw ore two years later. To produce the necessary plutonium, a pair of reactors had been constructed on the site of a wartime TNT factory at Sellafield which was later renamed Windscale. The reactors, at that time usually referred to as 'piles', were of a relatively simple design: graphite cores cooled by air at atmospheric pressure and were designed solely to produce plutonium. Christopher Hinton, the Deputy Controller of Atomic Energy charged with the production of fissile materials, had proposed one reactor of that type and a second, more advanced, reactor which would produce both plutonium and electricity. However, this plan was shelved because the military would not accept any delays in reaching full plutonium output (Pocock, 1977: 13). The first of the two piles, whose construction had begun in 1946, reached criticality in 1950. They were a success: on October 3rd 1952, Britain detonated its first nuclear bomb on the Montebello Islands off the coast of Western Australia. By this time, government's defense advisors were asking for an increase in the output of fissile materials (Pocock, 1977: 18).

The requirement for more plutonium coincided with a domestic energy crisis, which was perceived by the British public as a central issue. The postwar years had been hard on British households. The large majority of British energy needs were traditionally met through coal, but by the late 1940s demand began to exceeded supply. A very harsh winter in 1947-1948 had led to a fuel crisis for which the press blamed the (Labour)

government. Figure 5.2.14 shows a bobsleigh labeled *planned Britain*, piloted by several Labour politicians, which flies off the track at a bend labeled *European crisis* after already having passed two earlier bends labeled *coal crisis*, and *food crisis*. Figure 5.2.15 shows two luxury cars labeled *Min of Fuel* and *Min of Trade* speeding past a man standing in the pouring rain next to his stranded car begging for some fuel. The caption reads: *"…but not a drop to spare?"*.



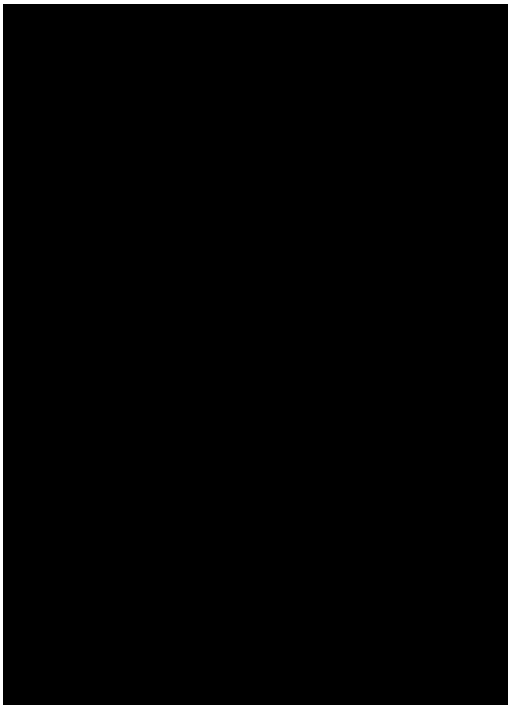


Fig. 5.2.14 Daily Mail, 19 January 1948 (Artist: L. Illingworth). Source: British Cartoon Archive.

Fig. 5.2.15 Daily Mail, 13 December 1947 (Artist: L. Illingworth). Source: British Cartoon Archive.

In the light of the need for plutonium as well as alternative energy sources, the Atomic Energy Council now opted for Hinton's earlier suggestion, rather than constructing a third Windscale pile. A plant would now be built that would not only produce plutonium more efficiently than the Windscale piles, but would also reduce the cost of this plutonium by producing a useful, saleable byproduct: electricity generated from the reactor's waste heat (Mrowicki interview, 2009). Civilian nuclear power technology in Britain emerged, quite literally, as a byproduct of military nuclear weapons production, and enabled the positioning of nuclear technology to a central social issue. Atomic energy was legitimated by framing it as a supplementary source of electricity, and subsequently linking it to the problem of postwar coal shortages. On January 26th of 1953, Minister of Supply Duncan Sandys stated publicly that

> [t]he successful tests at Monte Bello completed an important phase in the Government's programme of atomic research and opened up a widening horizon for further scientific activity. Likewise, the progress made in the studies of the peaceful applications of this dreadful force had justified an expansion of the development programme in that field. (*The Times*, 27 January 1953, 'Parliament')

Regarding those peaceful applications, he announced that if

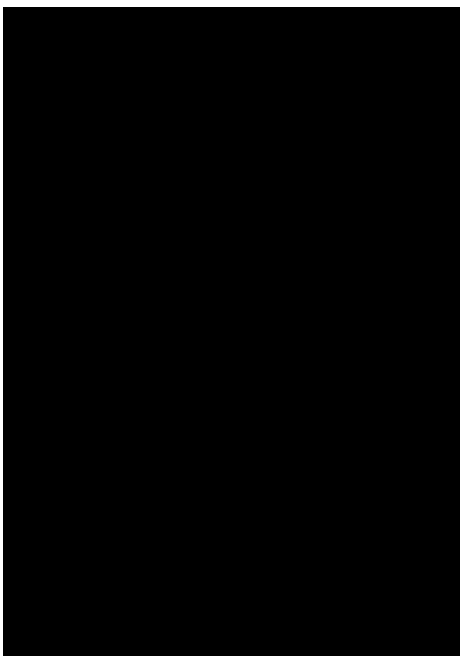
> (…) as was hoped, the technical problems were successfully solved and the new methods proved economical there was no reason why nuclear reactors should not before very long provide a useful additional source of industrial power. (…) if the prospects proved favourable the Ministry would consider constructing an experimental atomic power station of this kind (*The Times*, 27 January 1953, 'Nuclear energy in industry')

Construction of the Calder Hall station began later that year. The abstract idea of peaceful applications of atomic energy had been transformed into the concrete goal of electricity production. Atomic energy 'became' nuclear power and was often framed in reference to coal, whose short supply and high prices were a pressing issue in the public mind at the time. In 1954, the responsibility for the British nuclear project (nuclear weapons as well as power production) was transferred from the Ministry of Supply to an independent civilian institution: the newly established United Kingdom Atomic Energy Authority (UKAEA). In the same year, the Ministry of Fuel and Power spoke out in favor of the development of nuclear power in the House of Commons. *The Times* reported that

> [f]or many years the industries would have to depend on coal for the overwhelming proportion of their production, but it was desirable, if possible, to lighten the load on the coal industry. Among alternatives, pride of place must go to atomic energy. (…) [I]f atomic development progressed as quickly as there were grounds for hoping, the design and, it might be, the construction, of nuclear power stations of an advanced type would be undertaken before 1960 (*The Times*, 10 Julu 1954, 'Parliament – Electricity Supply')

In the press, atomic energy was increasingly seen as the future of electricity production. Attention for atomic energy in the press had tripled since 1953 and peaked in 1955 (see: bibliometric graph in figure 5.1.1) with the formal announcement of Britain's first nuclear power program. It would consist of between 1400 and 1800 MW of electricity production capacity spread out over 12 stations to be realized by 1965. The government stressed that the program's aim was to meet forecast rising electricity demand without using more coal. The press reacted with enthusiasm to the possibility of nuclear power replacing the coal-based system eventually, because the coal shortages were still a pressing problem in the mid 1950s. This is illustrated by the cartoons in figure 5.2.16 and 5.2.17. Figure 5.2.16 shows a woman reading a newspaper outside a coal merchant's shop. The shop window says *Coal Shortage This Winter – Stock Now* and the newspaper headline reads *Atom Power Stations in 6 Years*. The cartoon's caption reads *"Atom Power Forecast: ...and now for the coalman. Stop buying for the next six years or so and down will come his prices too!"*. Figure 5.2.17 shows a woman is walking back empty-handed from a coal merchant's truck towards her husband, who is

holding a newspaper with a headline reading *Prolonged Cold Threatens Coal Supplies.* The cartoon's caption reads Coal shortage: *"He says we can't have any until you've apologized for what you said about his unburnable rubbish when you thought atom power had already arrived".*



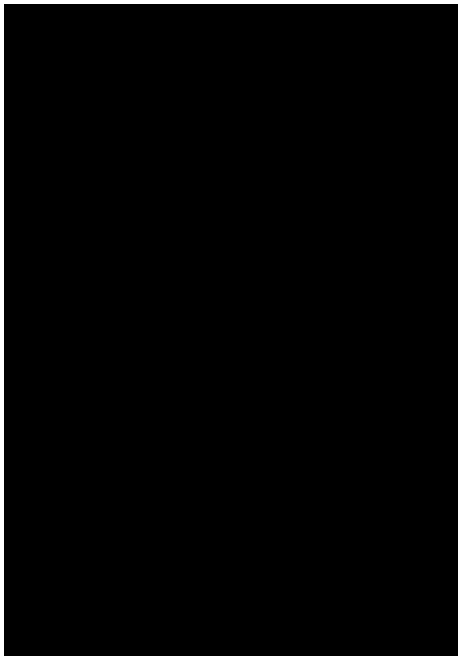


Fig. 5.2.16 Evening News, July 1954 (Artist: Joseph Lee). Source: British Cartoon Archive.

Fig. 5.2.17 Evening News, March 1955 (Artist: Joseph Lee). Source: British Cartoon Archive.

Nuclear power also came to be framed as the solution to another central, energy-related problem. In late 1956, Britain, France and Israel engaged in a joint attack against Egypt following the latter country's decision of to nationalize the Suez Canal. Britain's oil supply was damaged by the temporary closure of the Suez Canal. The situation had increased the public's awareness of the vulnerability associated with dependence on fossil fuels. Thus, nuclear power could be furthered as the solution to the new problem of security of energy supply, which had exacerbated the (earlier) problem of coal shortages. The Suez crisis was taken up into a storyline about nuclear power as a solution to these shortages now that foreign oil could no longer be relied upon as a solution. An editorial in *The Times* explained the situation to the public:

> When President Nasser announced the seizure of the Suez Canal on July 26, plans for the first British nuclear power stations, designed primarily for the generation of electricity, were at an advanced stage. It was known already that the performance of the Calder Hall power station, not yet working, could be improved on substantially. Attention in the interval [between the seizure of the Suez Canal and the opening of Calder Hall, *ed.*] has been concentrated more on Egypt and oil than on atomic energy. The two are connected through coal. Given that expanding requirements for electricity

> can no longer be met by coal, it had become necessary to look to oil to fill the gap, with atomic energy coming up fast. Events in the Middle East (…) have provided a challenge to Britain to develop atomic energy more rapidly. (*The Times*, 20 December 1956, 'Atomic speed').

And indeed, in 1957, high oil prices as a result of the Suez crisis resulted in an expansion of the 1955 nuclear power program (Pocock, 1977: 108). The government announced that instead of 1400-1800 MW, 5000-6000 MW of nuclear generating capacity would now be installed by 1965 (Pocock, 1977: 158)[23].

5.2.5 Experiential commensurability: the domestic atom ('45-'57)

In the immediate postwar years, the promise of the beneficial uses of atomic energy was an abstract one. The intangible idea of the peaceful atom was increasingly translated to concrete impacts on people's daily lives, through exactly what form it would take remained vague. The cartoons in figures 5.2.18 and 5.2.19 illustrate this. Figure 5.2.18 poked fun at promises of atomic transportation. It shows a British lady reading a newspaper headline that says *Atomic Energy – Latest Developments* while being pulled uphill in her wheelchair. The cartoon's caption read *Atomic Chauffeurs: "Keep going, Smithers. It appears it will the some time yet before I can dispense with your services"*. Figure 5.1.19 can be read as a sarcastic comment on procrastination as well as the promises of increased leisure in the dawning atomic age. It showed a man opting to read the newspaper instead of gardening. The cartoon's caption read *Atomic Energy at Home: "He's not bothering about preparing the garden for next year. He says it won't be long now before this atomic energy digs it for him"*.

[23]This expansion also meant that the existing chemical plant for extracting plutonium from the spent nuclear fuel would be insufficient. The newly planned commercial stations' spent fuel elements would be separated into plutonium, uranium and other fission products in a new Magnox reprocessing plant, which would become operational at the Windscale site in 1964 (Pocock, 1977: 125).

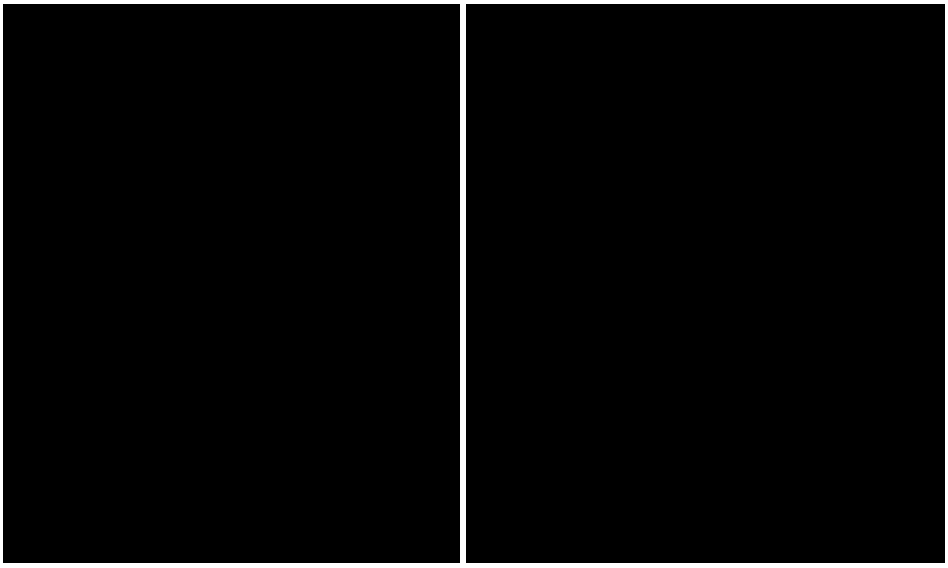


Fig. 5.2.18 Evening News, 22 November 1945 (Artist: J. Lee). Source: British Cartoon Archive.

Fig. 5.2.19 Evening News, 27 November 1945 (Artist: J. Lee). Source: British Cartoon Archive.

'Atomic energy' and 'nuclear power' were quickly becoming household terms in the early 1950s as the concrete (imagined) applications of nuclear technology came into focus. The resulting 'hype' surrounding atomic energy was sometimes responded to with mild sarcasm by contemporary commentators. Figure 5.2.20 pokes fun at a surprising future side-effect of atomic heating by depicting a group of angry men in Santa Claus costumes, who are quitting their jobs. The caption reads: *"Mark my words, this atomic science will do for us. Atomic heats in every home…no open fires…no chimneys…and 'phut' goes the Father Christmas industry!"*. Another comment on the 'atomic hype' can be seen in figure 5.2.21. It shows an enterprising shop owner, who had apparently previously advertised himself as plumber, gas engineer, and electrician, now putting up a sign saying *'nuclear power specialist'*. A passer-by reading a newspaper with the headline 'Atom Power Age Is Here' remarks: *"Ar, very pretty. And one o' these days they'll run gas and electric light and maybe this new stuff to the old village and catch clever young Joe out!"*. The cartoon seems to imply that, since the village apparently has neither gas nor electricity, Joe is misrepresenting himself by using any new technology which comes along as an advertising object, and that nuclear power just happens to be the current rage.

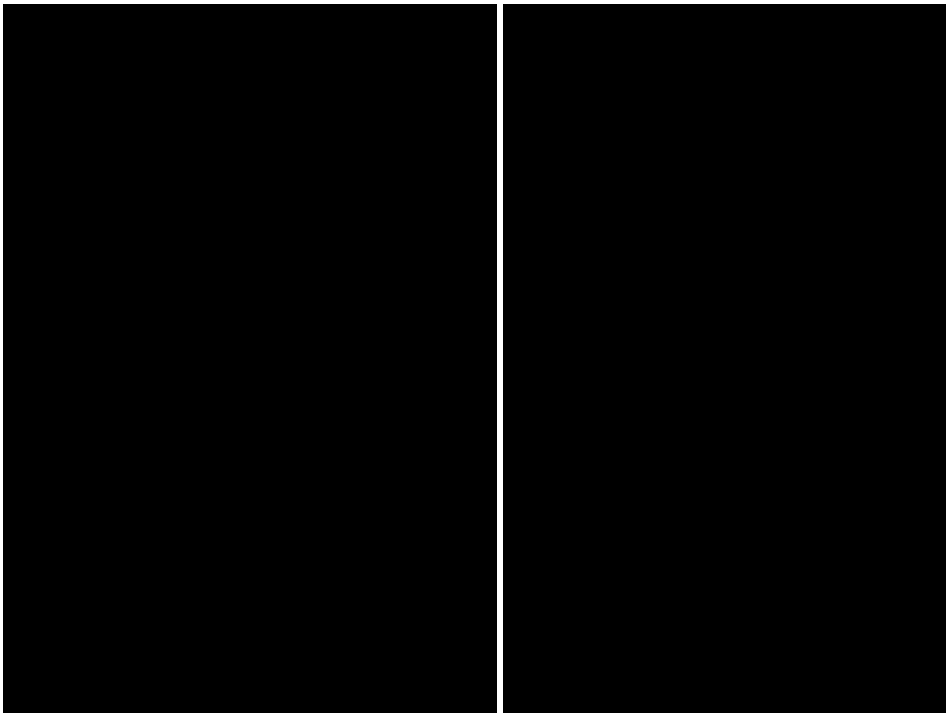


Fig. 5.2.20 Evening News, 19 November 1951 (Artist: J. Lee). Source: British Cartoon Archive.

Fig. 5.2.21 Evening News, December 1951 (Artist: J. Lee). Source: British Cartoon Archive.

In the early 1950s, out of the many possible application domains, the function of atomic energy as a source of domestic electricity came increasingly into focus. This is illustrated by the cartoons in figures 5.2.22 and 5.2.23. Figure 5.2.22 domesticates atomic energy by integrating into future visions of the household. It shows a morning routine in a futuristic *Atom Age Kitchen* that has controls for high-tech innovations such as *Concealed Lighting, Heating and Humidity, Pressure Cooker, Automatic Dishwasher, Fridge and Mechanical Mixers,* and *Television.* The caption reads *When Atom Power Comes: "Sorry breakfast is a bit late, darling ... atom power cut ... letting off a few more bombs at Monte Bello, I suppose."* Figure 5.2.23 domesticates atomic energy by positioning it as a solution to a practical household problem. It shows a newspaper reading "Atomic Energy Electricity Near" is draped over a chair in an ornately decorated room in which a lady, her face covered by a surgical mask, is turning on a tabletop gas lamp. A gentleman sits in a chair downwind of the smoke plume emanating from the lamp and informs the lady: *"Smog or no smog, Emily, if they are going to atomize the electric light switch, I for one am not going near it!".* Interestingly, both cartoons also highlight some negative associations of nuclear power: the first links it to nuclear weapons and the second to the dangers of radiation.

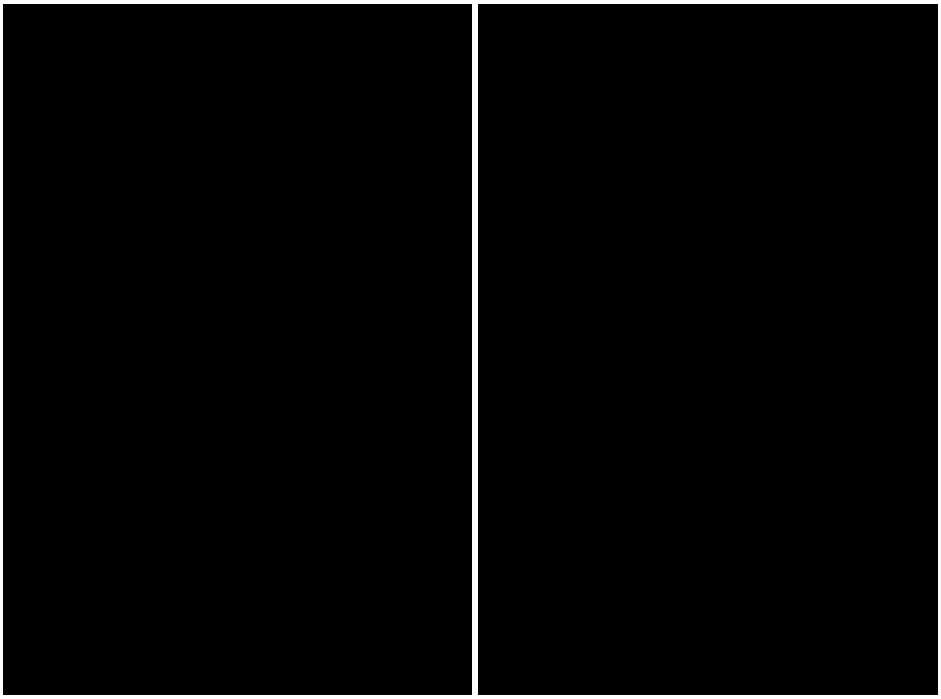


Fig. 5.2.22 Evening News, 8 May 1953 (Artist: J. Lee). Source: British Cartoon Archive.

Fig. 5.2.23 Evening News, 30 October 1953 (Artist: J.Lee). Source: British Cartoon Archive.

After the announcement of the first nuclear power program, the experiential commensurability of nuclear power continued to be emphasized in government campaigns. Figures 5.2.24 and 5.2.25 are two examples from *"(…) a series of advertisements being published so that everyone will understand the nation's electric power programme and the need to speed the job"* (figures 5.2.24, 5.2.25). Alongside providing the public with information about rising electricity demand and the role of nuclear power in meeting it, it showed pictures of nuclear power plants under construction alongside cheerful images of the 'nuclear family'. The advertisements argued that Britain should develop nuclear power quickly because it would impact people's daily lives in various beneficial ways. It was argued to help

> (…) safeguard our full employment and future prosperity (figure 5.2.24)
>
> (…) ensure that the factories are kept running and that shops will continue to be filled with good things (figure 5.2.24)
>
> (…) speed the clean air campaign and aid national health (figure 5.2.25).

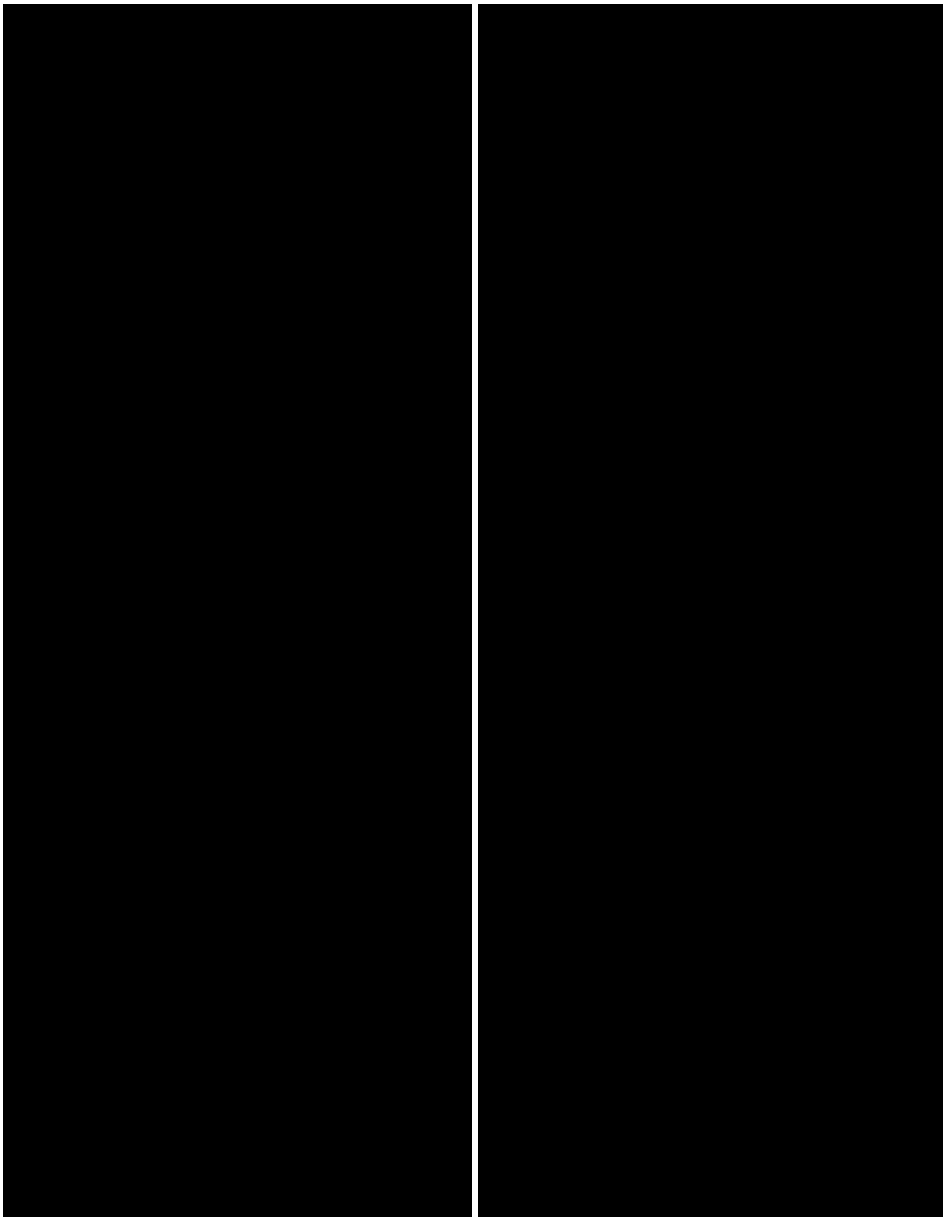


Fig. 5.2.24 The Times, 14 October 14, 1957.

Fig. 5.2.25 The Times, 31 October 31, 1957.

5.2.6 Empirical fit: from Montebello to Calder Hall ('52-'56)

The UK had practical experience with nuclear technology relatively early on. The first of the two Windscale plutonium production reactors, whose construction had begun in

1946, successfully reached criticality in 1950. The successes of these reactors initially remained largely unknown to the public, because of the military nature of the project. But its culmination, the detonation of a nuclear weapon in 1952, was widely publicized. Figure 5.2.26 is a cartoon published during the preparations for the tests in Australia. It shows the construction of a site labeled *Commonwealth of Australia - Test site for British Atom Bombs.* A baby kangaroo, safely tucked away in its mother's pouch, tells its frolicking friends: *"O.K., you just keep playing around out there - you'll soon see why it's better to stay indoors."* Figure 5.2.27 is a cartoon published after the successful detonation of Britain's first nuclear weapon. It shows an atomic explosion near an inhabited island, startling the natives. The caption said *"These whites 'd probably fine you ten bob if you let a firework off in Regent's Park"*, which can be read as a comment on the ethical questions involved in testing nuclear weapons near inhabited islands.

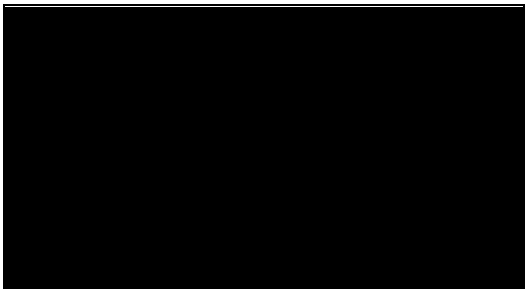


Fig. 5.2.26 Daily Express, 19 February 1952 (Artist: R.C. Giles). Source: British Cartoon Archive.

Fig. 5.2.27 Sunday Mail, 5 October 1952 (Artist: R.C. Giles). Source: British Cartoon Archive.

In a way, the atomic tests constituted empirical proof for the public that British scientists had mastered nuclear technology. However, they hardly constituted empirical proof for the storyline about peaceful applications of the atom. When the UK committed in 1953 to constructing a large-scale nuclear reactor to produce electricity, no facility existed anywhere in the world that could do so in any significant amounts. Nuclear power was still ephemeral in the early 1950s. But by the mid 1950s nuclear power was becoming ever more tangible. International experts were openly discussing detailed reactor designs on international conferences. The public found out about this development through the media. For example, an editor for *The Times* commented on the International Conference on the Peaceful Uses of Atomic Energy, organized by the United Nations in Geneva in August of 1955:

> It has been one of the virtues of the Geneva atomic conference that it has had the air of an ordinary and unsecretive gathering of professional men. (…) The shroud of mystery was ready to be thrown off and the future could be discussed openly and realistically in terms of fuel efficiency, thermal efficiency, and unit cost. (*The Times*, 20 August 1955)

The author also commented on possible drawbacks of committing oneself to one technological option:

> If there is a wide area of agreement on basic economics, there is no agreement yet on the choice between types of reactor. Britain has gone right ahead on the most evident workable proposition, the gas-cooled reactor working on natural uranium. This decision has given Britain a lead in some ways and it still seems virtually certain that Calder Hall will be the first real commercial-scale power station to operate (…). The Americans, on the other hand, have a programme covering various different types of reactor. There is no saying that one or more of these types may not prove their superiority. (…) It is natural to wonder whether Britain may not have hitched its wagon too firmly to one process. The official view has been that the United Kingdom is not wealthy enough to experiment too widely and that it must not lose time in getting useful work out of its reactors. (*The Times*, 20 August 1955)

And indeed, when Calder Hall was opened by Her Majesty Queen Elisabeth II in October of 1956, Britain possessed the world's first commercial nuclear power plant. It was real-world proof that atomic energy could be used for the peaceful purpose of producing nuclear power. Because it was widely publicized, e.g. in a special supplement for The Times entitled 'The Promise of Calder Hall' (figure 5.2.28a), it increased the empirical fit of nuclear power discourse. During the festive opening ceremony (figure 5.2.28b), the Queen framed Calder Hall as empirical proof of earlier claims about the possibility of beneficial uses of the atom:

> This new power, which has proved itself to be such a terrifying weapon of destruction, is harnessed for the first time for the common good of our community. (Source: Sellafield Centre, 2009)

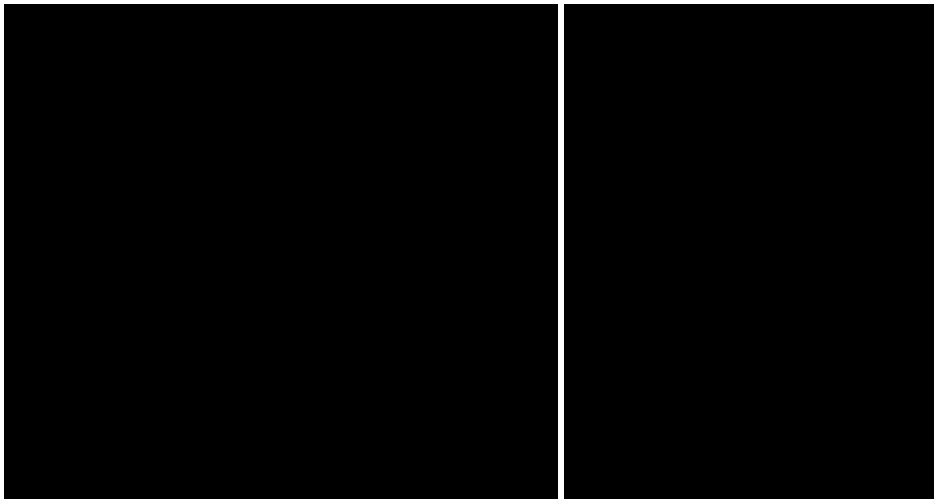


Fig. 5.2.28a Index of The Times special supplement entitled 'The Promise of Calder Hall', 17 October 1956. Source: archives.govt.nz.

Fig. 5.2.28b Calder Hall opening ceremony, 17 October 1956. Source: www.realscience.lancsngfl.ac.uk.

5.2.7 Actor credibility: the Windscale accident of 1957

In 1957, at the height of public attention to nuclear matters (see: figure 5.1.1), the world's first major reactor accident with off-site consequences occurred in Britain. It happened not at the newly-opened Calder Hall power station, but at one of the Windscale plutonium production reactors. An article in *The Times* quotes an official statement that was aimed at reassuring the public:

> The type of accident which as occurred could only occur in an air cooled open circuit pile and could not occur at Calder Hall or any of the power stations now under construction for the electricity authorities. (…) It is untrue to say that a large amount of radioactivity was released; the amount released was not hazardous to the public and what there was, was in fact carried by the wind out to sea. (*The Times*, 12 October 1957)

Yet one day later, the Atomic Energy Authority (UKAEA) announced a ban on the distribution of milk from a 14 square mile area surrounding the site and extended it to a 200 square mile area the subsequent day. This inconsistent behavior on part of the authorities regarding the milk ban created a sense of worry among the general public. A special correspondent for *The Times* wrote:

> At first there was no danger, according to the authorities, then at 48 and 96 hours intervals (…) prohibited areas were created until 200 square miles were covered in all. This was described by the A.E.A. as an essential precaution after the realization that the radioactive field was greater than at first believed. Some critics, not only among the agricultural community, think that the A.E.A. might have been more cautious more early in defining the area - and, since good milk may now be going down the drains with bad, that the scientists should now come out openly and say exactly what are the full implications for all in terms that the layman can comprehend. (*The Times*, 18 October 1957)

The accident instilled a sense of fear in the general public about the negative effects of radiation. Science writer Lord Ritchie-Calder attributed this unrest to

> (…) a case of information given to a scientifically ill-prepared public, which with its instinctive fear aroused would have distrusted official reassurances of any kind (Ritchie-Calder, 1972).

No known deaths resulted from the accident and the economic cost was relatively minor, especially since the hybrid station Calder Hall and its sister station Chapelcross (which would become operational in 1959) were designed to take over much of the Windscale piles' plutonium production anyway (Arnold, 1995). However, the Windscale accident *did* decrease the credibility of the nuclear discourse coalition. A few months after the accident, *The Times* reported on the results of a subsequent investigation:

> The picture which the Fleck committee gives of the Industrial Group of the Atomic Energy Authority is of an organization which is overstretched. The report on the causes of the Windscale accident showed that the accident was partly attributable to

> weaknesses of organization. But the weaknesses were not local to Windscale; they affect the whole group. (…) The moral to be drawn from this story, as from several others in recent months, is that the country's scientific ambitions, and even necessities, have outgrown the educational base on which they must be founded (*The Times*, 20 December 1957, 'Too few at the top')

Although the affected pile was a plutonium production facility and not a power reactor, the accident raised doubts about the safety of nuclear power as an electricity source, as well. In response to the accident, *The Times* reproduced an earlier quote by Minister of Power Lord Mills, and commented on his statement:

> "It is not thought that these [nuclear power] stations are in any way liable to accident," Lord Mills asserted earlier this year, ". . . it is not so much that there is a risk, but that people think there is a risk, for we are dealing with highly toxic materials and with power stations of which we have not yet had long experience." And wherever objectors to the siting of the power stations have alluded to the possibility of danger, they have been met by equally firm assurances from officials of the C.E.A. Rightly or wrongly, confidence in these pronouncements is bound to be shaken by the accident at the Atomic Energy Authority's plant at Windscale. (*The Times*, 16 October 1957, 'Only Frankness Can Reassure')

The situation was further complicated by the military nature of the Windscale piles, which made full disclosure to the public impossible. General reassurances that the power stations used a different method of cooling than the plutonium production piles, had little effect. *The Times* argued that

> the public will require some reassurance about the safety of all nuclear plants, not only that at Windscale (…) [T]here are no good grounds at all for confining what is ultimately made public to brief and highly general conclusions. However comforting their tone, they would not be enough to allay the anxiety the Windscale accident has aroused. All the detail compatible with security should be given, and the relevance or irrelevance of this accident to the risks at other nuclear stations stated in full. (*The Times*, 16 October 1957, 'Only Frankness Can Reassure')

5.2.8 Centrality: oil price drop & financial troubles ('58-'63)

Rather unexpectedly, oil prices dropped significantly between 1958 and 1960. Since coal shortages could now once again be solved through oil imports, nuclear power looked less commercially attractive than it had done at the time of the Suez crisis (Pockock, 1977: 109). This reduced the centrality of the storyline of nuclear power as a solution to an urgent problem. As a result, public attention to atomic energy and nuclear power plummeted between 1958 and 1963 (see: figure 5.1.1). Moreover, substantial delays and budget overshoots experienced during the construction of the first program's stations resulted in severe financial problems for the nuclear power industry by 1962 (Pocock, 1977: 111). These troubles did not go unnoticed with the wider public. The cartoon in figure 5.2.29 summarizes a perception of the state of Britain around 1963 in general, and comments on that of its nuclear industry in passing.

Fig. 5.2.29 Daily Mail, 7 December 1962 (Artist: L. Illingworth). Source: British Cartoon Archive.

The cartoon's caption reads *Semi-Detached* which in the literal sense refers to a type of house, but in the light of the African painting on the wall might also be read as a comment on the decolonization of Africa, the decline of the British Empire, and the perceived weak position of Britain on the world stage. The picture shows Prime Minister MacMillan reading a book called *How To Keep Up With The Joneses*[24]. Outside the window, Soviet Union premier Khrushchev is walking by while US president Kennedy is washing his luxury American car. Inside, we see a withering plant in a pot labeled *nuclear plant*: a pun which comments on Britain's deteriorating nuclear industry.

[24] "Keeping up with the Joneses" is a popular catchphrase referring to using one's neighbors as a benchmark for prosperity etc.

5.2.9 Experiential commensurability: power cuts ('63-'65)

The electricity sector in general was suffering legitimacy problems as a result of a series of power cuts in early 1963. A pay dispute, which led the Electricity Trade Union to instruct its members not to work overtime, led to power failures. When this instruction was cancelled, the work backlog, combined with a particularly severe winter and the resulting increase in electricity demand, resulted in further power cuts. The power cuts interfered with the public's daily lives and routines such as (electric) cooking, watching TV, and domestic lighting. This situation was frequently discussed in the press and parodied in cartoons. Figure 5.2.30 shows a family in a dark room, straining themselves to watch a miniscule image on a large TV. The caption read: *"It sez...Owing to power cuts the picture may be somewhat reduced in size!"*. Figure 5.2.31 shows a person in a bath robe exiting an apartment building labeled *Super Modern All-Electric Flats* with a kettle of water he is apparently unable to boil because of the power cuts. He asks a vagrant who is cooking food outside on a coal stove to boil his water for him. The caption read: *"Do me a favour, old boy"*.

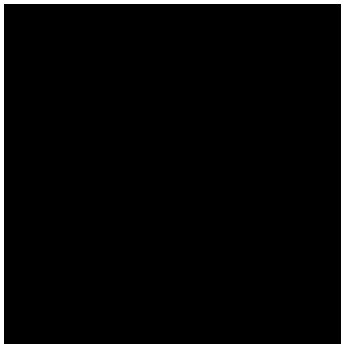


Fig. 5.2.30 News of the World, 13 January 1963 (Artist: G.F. Chrystal). Source: British Cartoon Archive.

Fig. 5.2.31 Daily Herald, 21 January 1963 (Artist: G. Wilkinson). Source: British Cartoon Archive.

The additional generating capacity of the first nuclear power program could not prevent the power cuts of 1963, since only two of the Magnox stations that would make up the program had been completed by that time because of aforementioned delays (Berkeley and Bradwell). The public generally blamed the power cuts on the government. Figure 5.2.32 shows familiar London landmarks covered in snow in the background, while in the foreground a figure in Roman attire (labeled *Ministry of Power*) plays the fiddle. The music stand reads *"Winter Power-Cuts" Theme Again* and the cartoon's caption was *Nero fiddles while Britain freezes*. The cartoon plays on the legend of Roman emperor Nero playing the fiddle while Rome was burning, and thus accuses the Ministry of Power of standing idly by and letting the power cuts happen. In figure 5.2.33, the power cuts themselves had even become a metaphor for failing government. It commemorates the 7th year of office of PM Harold Macmillan and depicts him as an electric light bulb

getting dimmer over time and finally 'blacking out' in 1963. The caption read: *Power Failure.*

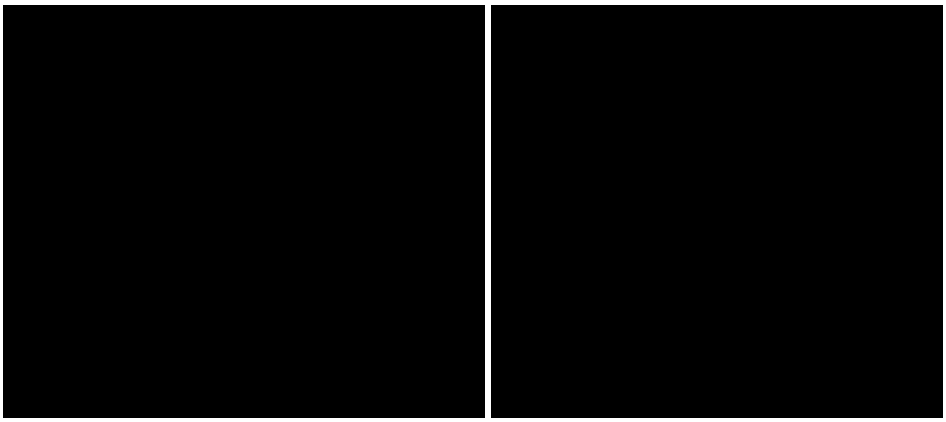


Fig. 5.2.32 Daily Mirror, 19 September 1963 (Artist: S. Franklin). Source: British Cartoon Archive.

Fig. 5.2.33 Daily Mirror, 09 January 1963 (Artist: S. Franklin). Source: British Cartoon Archive.

In response to the situation, the government promised to prevent power cuts in the future. Nuclear power was framed as part of the solution. A second nuclear power program was announced in 1964: it would consist of a further 5000 MW of capacity to be commissioned before 1975. In early 1965, Minister of Power Frederick Lee, announced the AGR (Advanced Gas-cooled Reactor) as the choice for the UK's second program to the House of Commons, stating:

> I am quite sure that we have hit the jackpot with this. (…) Here we have the greatest break-through of all time. (HC Deb, 1965)

But in spite of earlier promises to prevent further power cuts, Britain suffered renewed power cuts in the winter of 1965. The public lost faith in government promises about continuity of electricity supply as once again their daily routines were interrupted and their modern appliances failed to work. Figure 5.2.34 is a cartoon showing a darkened room on which the electric heater is broken, the electric clock has stopped running, and a woman is toasting bread by holding the toaster over a candle. Outside, a number of electricity pylons are visible, and inside, a woman is bandaging her visibly angry husband's foot. The caption reads: *"Same thing every power cut - goes and takes a flying kick at that damn pylon outside the window."*

This time, the power cuts reflected directly on the legitimacy of nuclear power. Figure 5.2.35 is a cartoon which directly connects the power cuts to Lee's overly optimistic statement. It shows an angry-looking couple is collecting firewood in a winter forest, saying *"Because I've noticed that whenever they announce an exciting new break-through in the production of nuclear-powered electricity there's invariably a major power cut within 24 hours - that's why!"*.

Fig. 5.2.34 Daily Express, 18 November 1965 (Artist: R.C. Giles). Source: British Cartoon Archive.

Fig. 5.2.35 Daily Express, 30 December 1965 (Artist: O. Lancaster). Source: British Cartoon Archive.

In response, the program was revised upward to 8000 MW in November of 1965 (Ministry of Power, 1965) in order to ensure that the system could cope with future (winter) increases in peak demand (Pocock, 1977: 170). Regardless, the 1965 power cuts had damaged the experiential commensurability of the storyline about nuclear power as the solution to the power cuts.

5.2.10 Macro-cultural resonance: Buy British ('57-'67)

In the mid 1950s, Britain had been a world leader in nuclear technology. It had built the world's first commercial nuclear power station. Advertisement campaigns invoked patriotic sentiments by stating that *"Britain leads the World"* in nuclear construction, and reminded the public of Britain's illustrious seafaring past and by employing nautical metaphors such as *"Full speed ahead"* (see: figure 5.2.24). The macro-cultural resonance of nuclear power discourse was thus enhanced by linking it to Britain's golden age. But just a decade later, the nuclear industry was waning and the public noticed. *The Times* wrote:

> Britain's first hopeful venture into the new world of nuclear power has hardly been an unqualified success. Electricity from the atom has not turned out to be as cheap as, ten years ago, most people thought it would be, and Britain's dependence on oil and coal has proved to be far different than expected. Supplies of both are easier (and cheaper) than most experts were willing to forecast at the time of Suez and before. (*The Times*, 16 April 1964, 'Power for the 70s')

The "jackpot" AGR design, the blueprint for the second nuclear power program, was argued to be able to turn the tide. While it was primarily argued for in terms of cost per unit electricity (Pocock, 1977: 168), the choice was at least partly motivated by the desire to exporting British-designed and British-built nuclear technology (Mrowicki interview, 2009). The future market for nuclear technology exports was expected to be substantial. The international market was expected to be fast-growing and fierce

competition was expected especially from the American Light Water Reactor (LWR) design. Rumors about the relative economic attractiveness of the American design were dismissed as propaganda. *The Times* stated that the UKAEA had

> (…) dismissed as "a propaganda story" a contention that the British nuclear power industry faced collapse because of the relative cheapness of the American water-cooled reactor compared with the cost of the British Advanced Gas-Cooled Reactor. And they made clear their distrust of some American cost figures (…) "I am confident that a run of A.G.R. stations will give lower costs in the United Kingdom with the later stations showing substantial advantages over conventional stations or over stations of an advanced Magnox type", [the UKAEA Chairman] added. (*The Times*, 2 September 1964)

The British Nuclear Export Executive was set up in 1966 to exploit this market (Pocock, 1977: 180). Britain hoped to strengthen its export position in the face of expected heavy competition over reactor markets from the US and France (*The Times*, June 11th 1966). This expectation is parodied in the cartoon in figure 5.2.36, where a desperate French onion merchant is depicted sitting on the steps of 10 Downing Street, saying *"Mon Dieu! He strikes a hard bargain - he'll only take a string if I buy three atomic power plants!"*.

Through nurturing the domestic nuclear industry, Britain hoped to recoup some of its past glory. But the public's esteem of the domestic nuclear industry was so low, that the storyline about nuclear power as an export product capable of restoring national greatness, largely fell on deaf ears. Figure 5.2.37 ridicules claims of a high-quality British nuclear export product by showing a UKAEA staff meeting, during which the chairman says: *"We can only hope our competitors are stealing all our secrets"*.

Fig. 5.2.36 Evening News, 17 November 1966 (Artist: David Myers). Source: British Cartoon Archive.

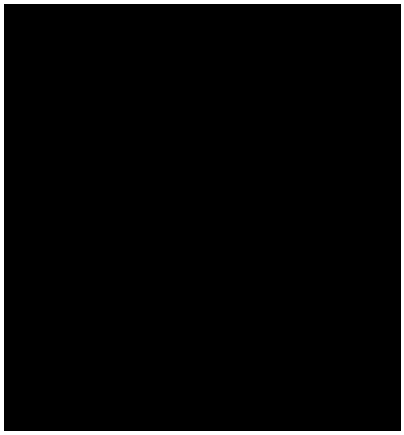


Fig. 5.2.37 The Sun, 1 May 1967 (Artist: K. Waite). Source: British Cartoon Archive.

5.2.11 Empirical fit: technical problems ('63-'69)

The construction of the first nuclear program's Magnox stations had proceeded much slower than had been promised. Those few stations that had come online before the program's deadline had not only exceeded their budgets and their estimated construction time, but also suffered various operational problems as a result of which they were frequently shut down for brief periods. Press coverage of these issues negatively impacted the empirical fit of nuclear power discourse, whose key storyline since 1954 had been the technology's potential for expedient implementation and achieving security of supply. The Magnox technology was framed in the press as expensive and obsolete, and the nuclear industry as waning. The industry replied by arguing that any disappointing results of the Magnox project should not reflect on the technology of nuclear power as a whole, and that the basic premise of generating electricity through nuclear fission was solid. In 1967, *The Times* published a special report written by an editor of the trade journal *Nuclear Engineering*. It argued that

> [i]t is partly due to this diversity in the possible methods of harnessing nuclear power that the growth of the industry has been rather painful. There are, of course, many other reasons for the early difficulties, not least that no commercial organization had previously had experience in selling products with an all up cost of £80m. to £100m. (…) The fundamental attractiveness of obtaining vast quantities of power from relatively small amounts of fuel has sustained the faithful sectors of the industry through a period of public misapprehension concerning safety and the period of disenchantment which followed the first rush of rather excessive enthusiasm. (*The Times*, 3 November 1967, 'Nuclear power')

But the empirical fit of this storyline was low. It lacked real-world proof, as the public perception was that the Magnox program had essentially failed. Practical experiences with the new advanced gas-cooled reactor (AGR) design did little to improve the empirical fit of the nuclear storyline. A prototype of the AGR, which had chosen as the blueprint for the second nuclear power program, had been running at the Windscale site since 1962. The prototype AGR made headlines in late 1963 when unshielded fuel rods caused a radiation leak (*The Times*, 20 November 1963). The cartoon in figure 5.2.38 shows a group of scientists in lab coats - one of them a huge, mutated monster – standing outside the spherical AGR reactor dome sighing in relief and saying *"Whew! That was a near thing"*. The cartoon is a relatively early example of a cartoon using the danger of mutagenic radiation as a comic element, a device which is encountered again more often in later years.

After promises about the impossibility of accidents at nuclear *power* stations following the Windscale accident of 1957, such technical failures were increasingly construed as real-word proof that such safety claims were perhaps untrue. The empirical fit of the nuclear power storyline began to erode. Construction of the AGR stations began in 1965 but was riddled with problems from the start. All stations under construction fell behind schedule. The nuclear industry's construction problems further decreased the empirical fit of nuclear power discourse, as the public noticed the difficulties in the practical

realization of the nuclear power program. The situation was exacerbated by troubles with the existing plants from the first program. In 1969, power cuts were made at six Magnox stations due to corrosion issues (*The Times*, 23 September 1969). The issue was parodied in the press. Figure 5.2.39 is a cartoon showing a group of nuclear inspectors standing outside a cracked spherical nuclear power plant which vaguely resembled a hatching egg. The caption says *"It's either metal fatigue, or we're going to have the biggest chicken in the world!"*.

Fig. 5.2.38 Evening Standard, 21 November 1963 (Artist: R. Jackson). Source: British Cartoon Archive.

Fig. 5.2.39 Evening Standard, 24 September 1969 (Artist: R. Jackson). Source: British Cartoon Archive.

The nuclear industry's technical failures had become a matter of public record and ridicule. Empirical fit of nuclear power discourse was low, in spite of the fact that by the end of the 1960s the first nuclear program was nearing completion and construction had begun on five of the second program's stations.

5.2.12 Epilogue: legitimacy gained and lost

In the decade following the end of WWII, nuclear technology champions had succeeded in creating high cultural legitimacy for atomic energy in general and nuclear power in particular. Successful performances of various nuclear power storylines by technology champions had increased the ‘score’ of nuclear power discourse on all five cultural legitimacy dimensions:

- Actor credibility had increased as the public was made aware of the instrumental contribution by British nuclear scientists to the success of the Manhattan project, which increased the trust their ability to 'tame the atom'.
- The specter of nuclear destruction had created a perceived imperative for global peace, which served to increase the macro-cultural resonance of nuclear power discourse through a storyline about the peaceful applications of atomic energy. Linking it to broader repertoires about techno-scientific progress and modernity had further increased this resonance.

- A postwar coal shortage had increased the centrality of nuclear power discourse through a storyline about atomic energy as a source of electricity, which framed nuclear power as a solution to the energy crisis. The Suez crisis further increased this centrality.
- While the concept of 'peaceful uses of atomic energy' had been an abstract one in the immediate postwar years, nuclear power had become increasingly concrete. Nuclear power was integrated into people's daily lives by linking it to visions about increased domestic comfort through electrification. This had increased the experiential commensurability of nuclear power discourse.
- When Calder Hall was opened as the world's first commercial nuclear power plant, the public had real-word proof that nuclear power was practicable. This had increased the empirical fit of nuclear power discourse.

However, the cultural legitimacy that resulted from a strongly persuasive nuclear power discourse, eroded from the mid 1950s onward. Its 'score' on all five dimensions decreased:

- The credibility of nuclear advocates suffered as a result of inconsistent actions and a general atmosphere of secrecy surrounding an accident with a (military) plutonium production reactor in 1957. This served to draw into question their expertise in the area of nuclear power production, as well.
- An unexpected drop in oil prices in the late 1950s had reduced societal concerns about energy supply, and with it, the centrality of nuclear power discourse: the storyline about nuclear power as a solution to the energy crisis had been a key element, but now it seemed it was no longer needed. The price drop had also left the nuclear industry in severe financial troubles in the early 1960s.
- In the same period, the nation suffered a series of power cuts due to unexpectedly harsh winters. Because these interfered with people's daily lives and practices, they decreased the experiential commensurability of, at first, electrification discourse, in which a storyline about electrification increasing domestic comfort had been a key element. Nuclear power was initially framed as a way to prevent such problems in the future. But when it failed to do so because of construction delays and the industry's financial troubles, this decreased experiential commensurability negatively affected nuclear power discourse, as well.
- A second nuclear power program was announced in the mid 1960s. It was based on a domestically designed reactor. A key reason for this choice was the desire to export British technology on an international reactor market which was expected to grow substantially. Nuclear proponents linked the design to repertoires about Britain's past successes as a trading nation in an attempt to reestablish macro-cultural resonance. But atomic energy had largely failed to contribute to the macro-cultural repertoires it had been linked to earlier. Nuclear power had not effectuated

world peace by taking away the causes for war: nuclear weapons had in fact become a central concern for the public. Neither had it realized the technological progress repertoire: nuclear power was not seen by the public as having 'improved society' in any significant way. The perceived failure of the first nuclear power program trumped proponents' attempts to increase macro-cultural resonance by framing the technology as a vital export product.

- The widely-publicized budget and construction-time overshoots of both the first and second nuclear power programs, as well as a number of technical failures with both associated reactor designs, eclipsed earlier widely-publicized empirical successes such as the Calder Hall station and thus reduced the nuclear storyline's empirical fit.

While performances of various positive storylines about nuclear power had established a positive nuclear power discourse which successfully increased cultural legitimacy in the decade after WWII, it had already substantially decreased by the end of the 1960s.

5.3 Stabilizing and destabilizing legitimacy: 1973-2003

5.3.1 Experiential commensurability: the energy crisis of '73-'74

In early October of 1973, Egypt and Syria engaged in a joint attack of Israeli occupied lands in Golan Heights and Sinai. In response to the West's support of Israel in what came to be knows as the Yom Kippur war, the Organization of the Petroleum Exporting Countries (OPEC) initiated an oil embargo targeting several nations, including the USA, Canada, the Netherlands, and Great Britain. One effect of the use of this 'oil weapon' was an immediate and large increase in the price of crude oil. The oil crisis impacted the public's daily lives and routines. Petrol prices nearly doubled between 1973 and 1975 (The AA Motoring Trust, 2005; see also: figure 5.4.1). The massive price increase was considered an impediment to driving. For example, figure 5.3.1 shows the road to a petrol station. In the background, alternative modes of transportation are visible: a bicycle and a horse-drawn carriage. Next to the road, signs advertising the high price of petrol have replaced speed limit signs. The caption read: *"It's a new speed restriction"*.

Additionally, coal miners' strikes in the harsh winter of 1973-1974 led to renewed coal shortages alongside the existing oil shortages. Newspapers frequently discussed the coal and oil shortages as well as the renewed power cuts they resulted in. For example, figure 5.3.2 shows PM Heath and Chancellor Barber walking pas a number of news headlines: *coal crisis, economic crisis, oil crisis, power cuts.* One says to the other: *"They say Nixon manufactures crises to keep **IN** power!"*.

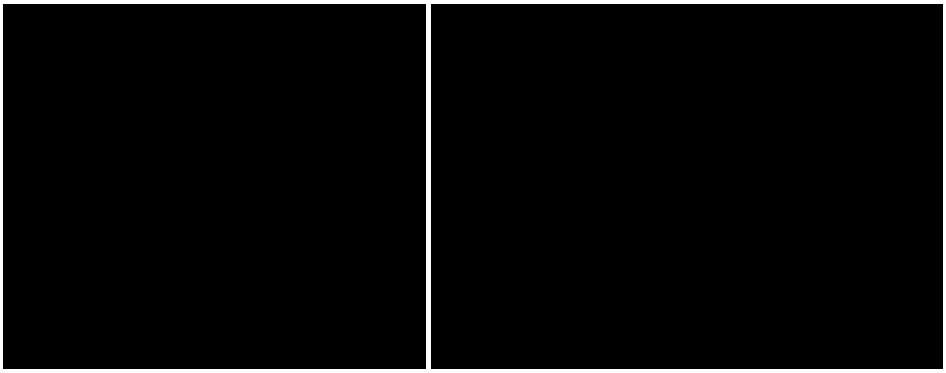


Fig. 5.3.1 Daily Mirror, 31 March 1974 (Keith Waite). Source: British Cartoon Archive.

Fig. 5.3.2 Daily Telegraph, 19 November 1973 (Nicholas Garland). Source: British Cartoon Archive.

As a method to reduce electricity consumption and preserve the coal stock, the government ordered commercial electricity consumers to only use electricity for three days a week over a period in early 1974. The electricity supply industry also called on households to conserve energy by saving fuel and heating only one room in a campaign with the slogan *Fuel Emergency* and warned people that a failure to comply would result in renewed power cuts (figures 5.3.3 and 5.3.4). This further increased the perception of a general energy crisis.

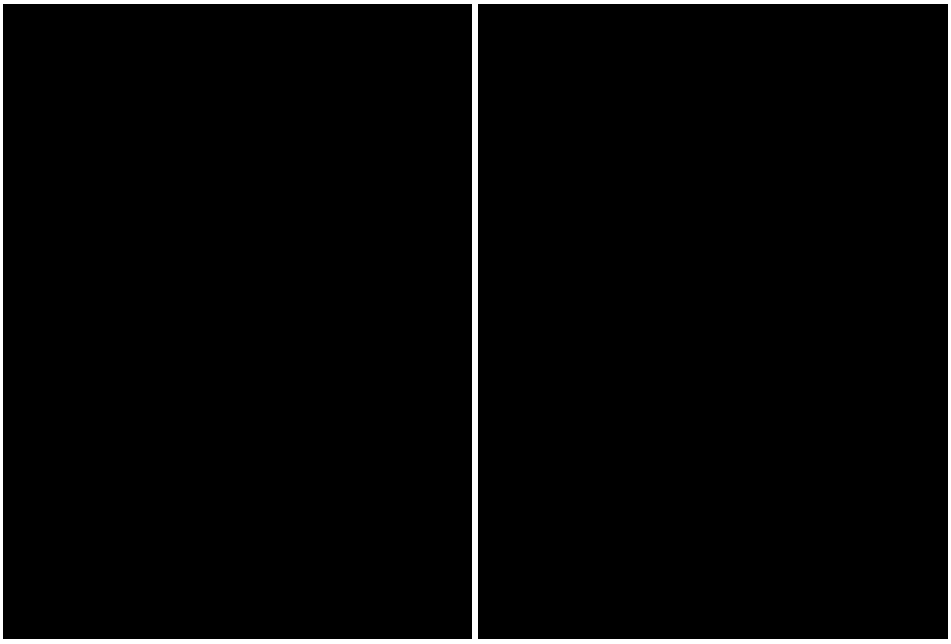


Fig. 5.3.3 Daily Mirror, 27 December 1973.

Fig. 5.3.4 Daily Mirror, 24 December 1973.

5.3.2 Centrality: nuclear power as the solution

The nuclear industry was quick to frame nuclear power as a solution to the energy crisis: a storyline aimed at increasing the centrality of nuclear power discourse. Large companies even advertised their nuclear reactors in the daily press as solutions to the energy crisis (Lamb, 1996: 83). The ad in figure 5.3.5 argues that nuclear power is

> (…) the basis for an electric company. Nuclear plants use a fuel that is in good supply, operate at low fuel costs and with an unparalleled safety record. With each new nuclear plant in operation, we can switch to electricity got more tasks that now use natural fuels and conserve those resources for certain energy uses for which we have no substitute.

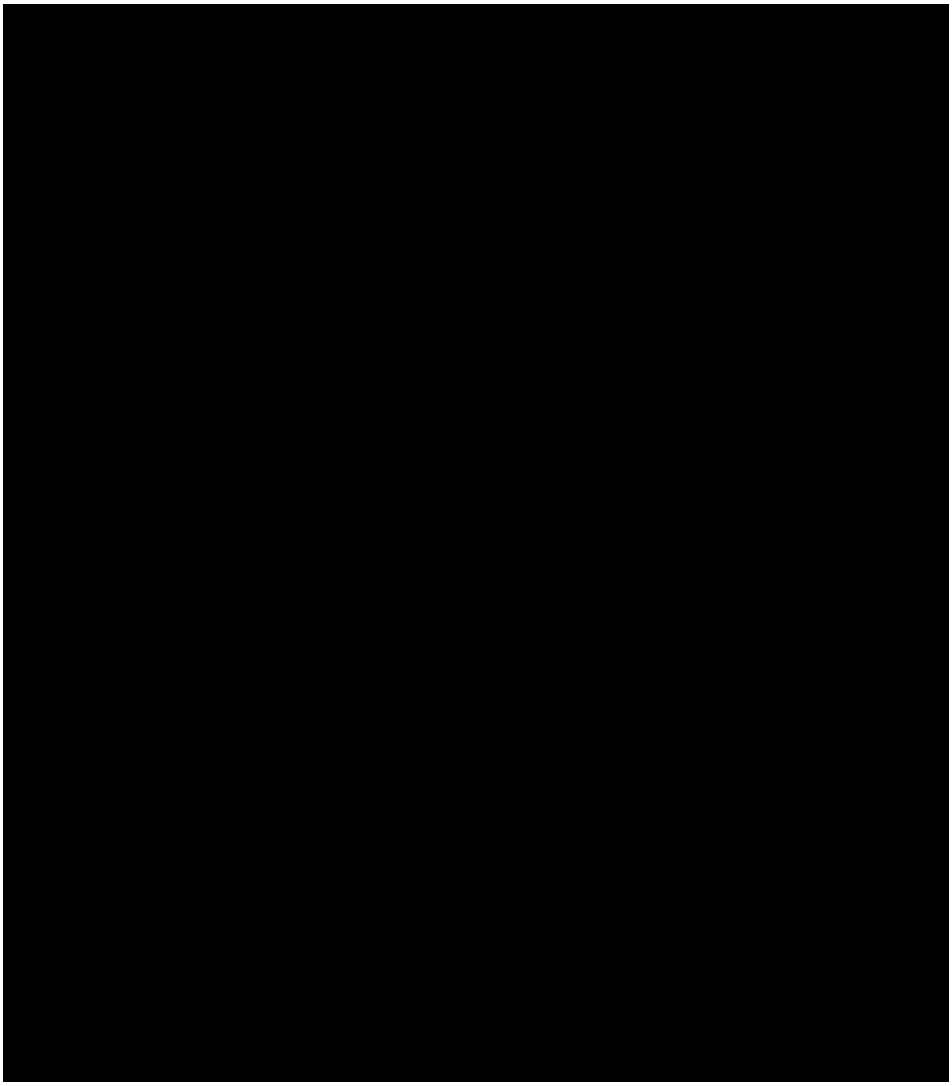


Fig. 5.3.5 Westinghouse advertisement. Source: The Times, 13 March 1974.

The framing of nuclear power as a solution to a central issue successfully increased its centrality. In the first half of the 1970s, public attention to it increased: the number of articles about nuclear power in both *The Times* and *The Guardian* almost doubled (see: figure 5.1.1). Over the same period, a rise in the co-occurrence between 'nuclear power' and 'coal' (framed as its most direct competitor), and between 'nuclear power' and 'price' is observed, both of which had decreased over the second half of the 1960s (see: figure 5.3.6).

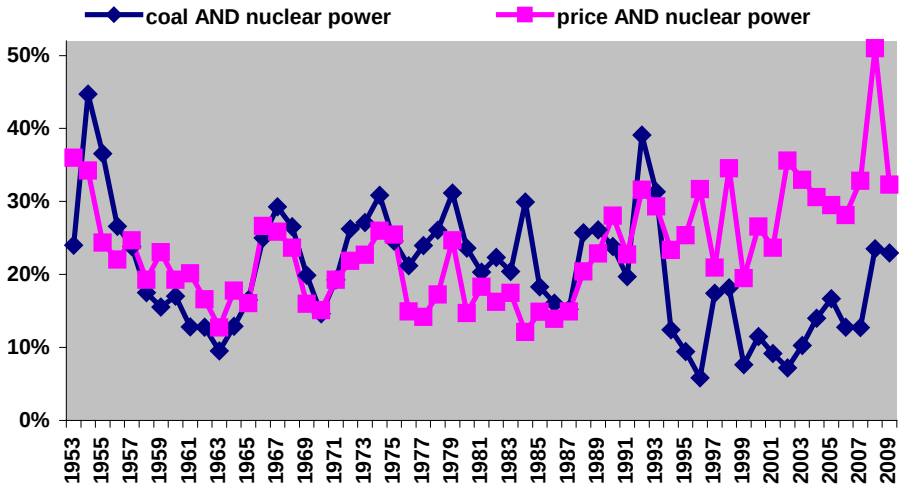


Fig. 5.3.6 Co-occurrence of keywords in legend, % of articles with 'nuclear power'. Source: The Times.

5.3.3 Credibility: light water controversy ('73-'74)

Although centrality was high in the early 1970s, the credibility of the nuclear industry decreased as a result of a controversy over the preferred design for nuclear power reactors in the UK. Because of the energy crisis, the Central Electricity Generating Board (CEGB), the public organization responsible for electricity generation in England and Wales, argued that exporting of British technology was now subordinate to quickly implementing cost-efficient nuclear technology as a means to reduce dependence on middle-eastern states. For the CEGB, this meant an American-designed pressurized water (PWR) reactor. On October 15th of 1973, a front-page article in The Guardian reported that the CEGB would ask the government's permission for the construction-under-license of a PWR, directly linking it to the energy crisis:

> The proposal comes at a time when the need for a big nuclear programme has never been felt more urgently in Government and industry because of the Middle East crisis. Indeed, time is the most pressing reason to buy American because light-water reactors can be ordered quickly, unlike the British designs which are regarded as not properly proven. (*The Guardian*, 15 October 1973)

But American-designed light water reactors had attracted considerable criticism in the USA as doubts were expressed about its safety (see also: subsection 5.3.1). Critical book by American scientists Gofman and Tamplin (Tamplin and Goffman, 1970; Gofman and Tamplin, 1971) formed the basis of a BBC documentary called A Question of Survival which aired in December 1971. It highlighted the potential dangers of the American light water reactor design. Even though British reactor designs did not suffer from the same liabilities as the American LWR's – a point which was stressed frequently in engineering journals of the time – the suspect safety of light water reactors lingered in the public mind. The documentary was widely publicized and captured British public attention for the issue of radioactive pollution. The UK branch of environmental organization Friends of the Earth (FoE), some of whose staff had been trained as nuclear physicists and had closely followed the PWR safety debate in the USA, reacted to the publication of the article in *The Guardian* by mounting a campaign to oppose specifically the introduction of the light water reactor in the UK, but not nuclear power in general:

> Once this first furore had flared up, Amory [Lovins] was all for going in with all guns blazing: now we can just stop this nuclear nonsense. And I said no, we can't. We have no constituency. At that time, we didn't. There wasn't anybody in the UK that was particularly aware of this except people in the business. I said we have no constituency and no leverage. The one thing we do have is the fact that the British nuclear people hate the guts of the American nuclear people. Ever since the 1946 McMahon act, when the Americans suddenly and summarily cut of access to nuclear information and data from their British colleagues, although the Brits had provided most of the important stuff in the first place. I said, therefore, if we are actually to stop this nonsense of the light water reactors, we have to focus on the light water reactors, not on nuclear power per se. And I said, for what it's worth, I have personally no problem with the safety of the British gas-cooled reactors. For one thing, the safest reactor is one that isn't working, and most of them weren't. (Patterson interview, 2009)

The nuclear industry reacted to such criticisms publicly. For example, figure 5.3.7 is a full-page advertisement by General Electric (GE) in *The Times* which explains to the public in great technical detail why American light water reactors would be the design of choice for the UK.

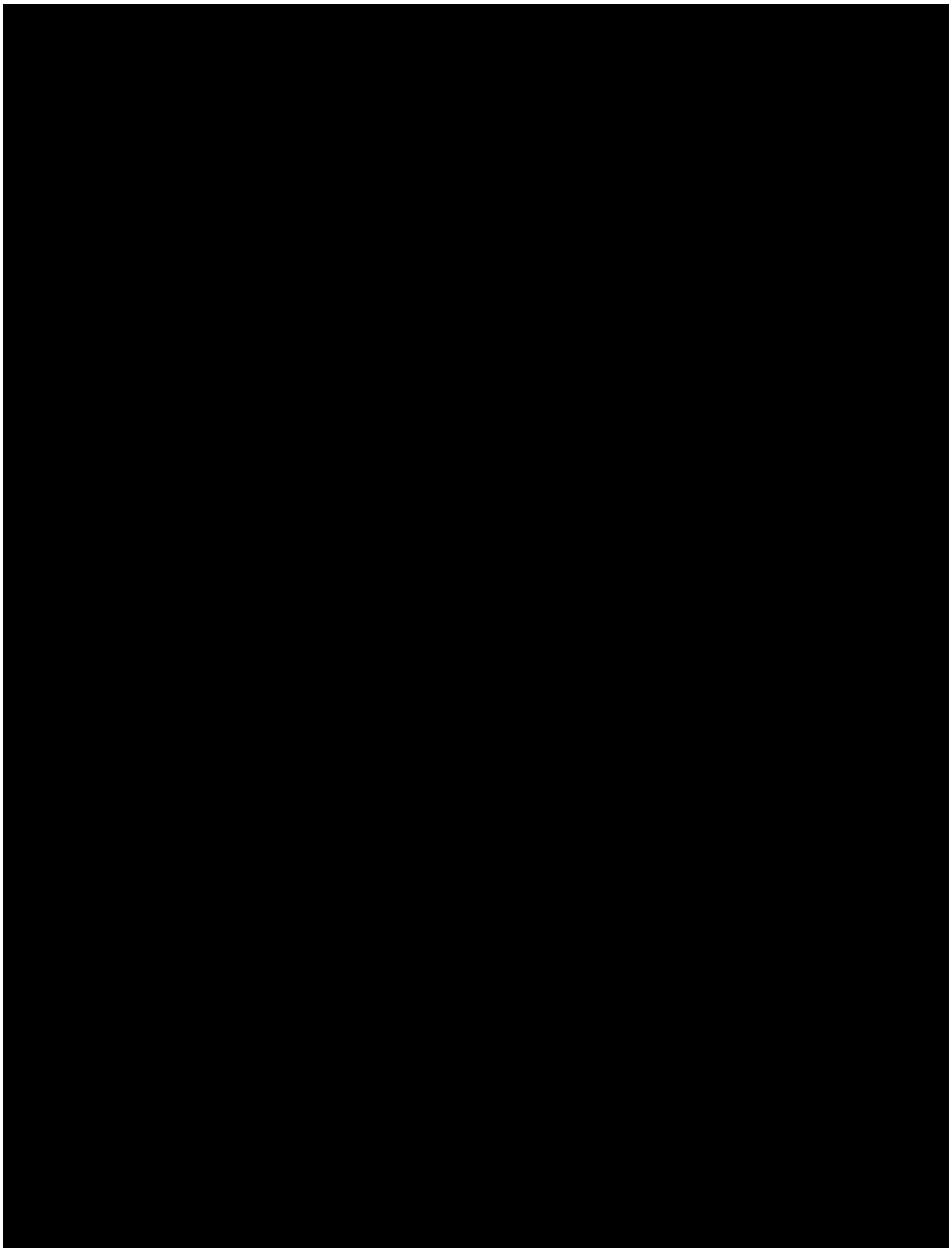


Fig. 5.3.7 General Electric Company advertisement. Source: The Times, 10 January 1974.

In-depth discussions of the pros and cons of the various reactor types appeared in public news media. Some favored the relatively new British-developed Steam Generating Heavy Water Reactor (SGHWR), praising its potential for industry and emphasizing light water reactors' safety issues:

> Britain's own advanced gas cooled reactor programme is hopelessly compromised by massive cost overruns brought about by five-year constructional delays resulting from a series of technical problems with the system. Britain cannot use the latest problems with American reactors as a belated justification for its own paltry commitment to nuclear power. (…) Despite North Sea oil and large reserves of coal, the country needs a sizeable nuclear programme for the final two decades of the century. (…) The 4,000 megawatts of steam generating heavy water reactor capacity provides the British industry with an opportunity to prove itself. (*The Times*, 26 October 1974)

Others favored light water reactors, praising their proven nature and emphasizing the SGHWR's experimental status:

> Given both the insecurity of supply of imported oil and of domestically produced coal (well illustrated during last winter's energy crisis) and the likely continued rise in the cost of these fuels, it cannot be a sensible policy to put the next stage of the nuclear power programme at risk. Yet that would be precisely the position if the Government in fact finally announced a decision in favour of the British heavy water system. The technological risk factor in this entirely new system can only be very high indeed. The story of the advanced gas cooled reactor is a relevant cautionary tale, the lessons of which must not be ignored. (*The Times*, 2 July 1974)

Commenting on this discussion, Patterson wrote:

> Previous nuclear power controversies in Britain had, to be sure, been ferocious and bitter; but they had taken place essentially behind the scenes, between the immediately interested parties and their supporters. This time the controversy came into the open; and the public noticed. (Patterson, 1985: 22)

The CEGB's resolve to commit to a reactor type whose safety issues had become widely discussed in the media, damaged the credibility of the light water reactor's proponents. Friends of the Earth had played a role in this. In late 1973, it had prepared a memorandum on light water reactors for the Select Committee on Science and Technology, which subsequently came out strongly against the American design (Patterson interview, 2009). Targeting the credibility of the light water proponents by highlighting the safety issues proved to be a successful strategy. In early 1974, the new Labour[25] Secretary of State for Energy Eric Varley declared that no reactor system would be licensed for the third nuclear program until it was clear that it could meet British safety standards:

> There is no question of any reactor system being granted a site licence and being built in this country until it is clear that it can meet our safety requirements. There has been in this country a most remarkable public acceptance of nuclear power. Our future

[25] As a consequence of coal miners' strikes, which had resulted in an energy crisis in the winter of 1973-1974, Labour triumphed over Heath's Conservative government in elections organized in February of 1974 (Pocock, 1977: 247).

> energy policy depends upon a large element of nuclear electricity generation, and this public acceptance must be preserved. (HC Deb, 1974)

This requirement was more difficult to meet for foreign designs than it was for British ones. But the British design that had been the blueprint for the second program, the AGR, had image problems, as well: by 1973 none of the five AGR stations had been completed and the project had already gone 50% over budget[26]. And so in July of 1974, Varley announced that he had opted for the other British design, the SGHWR, as the basis for the third nuclear power program, thereby turning down the CEGB's proposal.

5.3.4 Macro-cultural resonance: new environmentalism ('71-'75)

Since Victorian days, Britain had had a tradition of organizations dedicated to the conservation of nature, animals, landscape and the prevention of pollution (Herring, 2005; 2001), such as National Trust for Places of Historic Interest or Natural Beauty (1894). By the 1960s, this had led to a highly institutionalized network of protection organizations that had fostered good relationships with the authorities (Rootes, 2008). Its activities were linked to a macro-cultural repertoire about 'preservationism'. But in the late 1960s and early 1970s, a new macro-cultural repertoire about 'environmentalism' emerged. While preservationism had been a cultured, 'gentlemanly' pursuit that did not clash with widely-held societal values, the new environmentalism was mainly carried by idealistic students with ample leisure time seeking socio-political reform (Herring, 2005). As a result, a new type of environmental organization emerged. The UK branch of Friends of the Earth (FoE), mentioned in the previous subsection, was an early and influential example (Herring, 2005). FoE had been established in the USA in 1969 and had branched out to the UK in 1971. Its first public performance already highlighted that it was a different type of organization from the conservation societies: in 1971, it dumped a large number of non-returnable throw-away bottles outside the British headquarters of Schweppes to attract attention to environmental pollution (Lamb, 1996). It was a great success in the sense that it lauched FoE into the public's attention (Herring, 2005) and put the issue of environmental pollution in the public's agenda (Bugler, 1981). Public attention to the issue of pollution increased exponentially in the early 1970s (see: figure 5.3.8).

In the early 1970s, FoE had not been specifically interested in nuclear power (Herring, 2005:160). This changed when physicists such as Walt Patterson (Canada) and Amory Lovins (USA) became involved in the British FoE chapter in 1972 (Patterson interview, 2009). They had been involved in hearings by the USAEC on the safety of LWR's in 1972 (Patterson interview, 2009), so they understood the technical dimension of nuclear

[26] The problems were worst at the Dungeness B site. Severe technical problems were encountered during construction and the responsible consortium suffered a commercial collapse. The station would be completed only in 1983 (18 years after commencement and 13 years behind schedule) at approximately four times its initial cost estimate (Patterson, 1985).

arguments. This influenced their initial strategy: in the early 1970s FoE's small nuclear team focused exclusively on building in-house expertise and putting forward rational arguments to influential actors (such as the report on LWR's for the select parliamentary committee in 1974; see: subsection 5.3.4). For FoE, nuclear power was clearly just one of the themes on their broader environmental agenda, and their activities regarding this particular theme had mostly been research and lobbying.

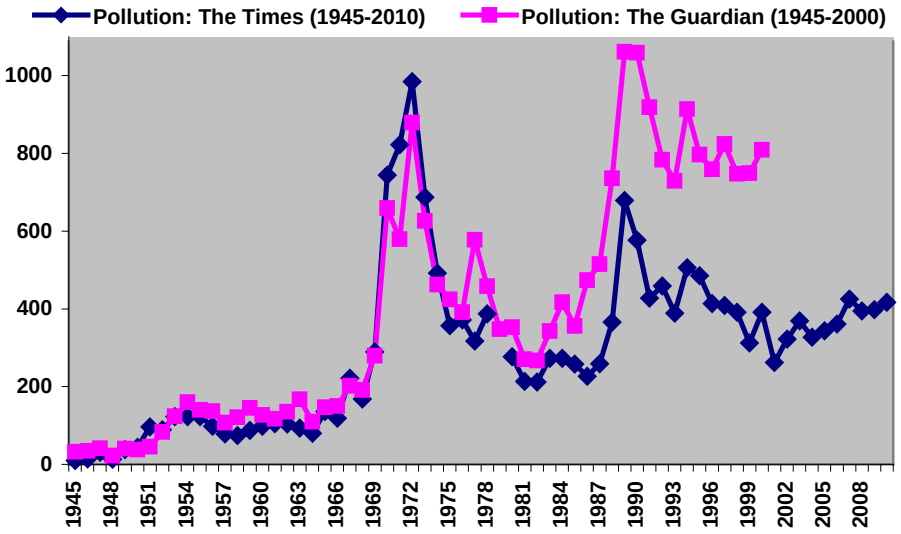


Fig. 5.3.8 Number of articles containing 'pollution'. Sources: The Times and The Guardian.

But in 1975, a concrete issue around nuclear power emerged about which FoE could launch a more public campaign "(…) stir public debate about the proposal, and provide the information to fuel such a debate" (Patterson, 1985: 22). Since 1974, British Nuclear Fuels Limited (BNFL)[27], had been negotiating a contract with Japan for the reprocessing of spent Japanese uranium (Patterson, 1985). The deal would include the construction of a new thermal oxide reprocessing plant (or THORP), to be built at Windscale. The facility would process spent fuel, separating uranium and plutonium (which could be re-used as Mixed Oxide Fuel or MOX) from radioactive wastes which would be stored at the facility. The deal's proponents stressed the increased employment opportunities, and argued that it was a profitable venture. FoE disagreed. In May of 1975, FoE published a mock newspaper called *Nuclear Times*. It contained an article which criticized BNFL's economic calculations. It contained another one entitled *Windscale To Be World Capitol For Radioactive Waste* (Lamb, 1996), which argued

[27] In February of 1971, a de-merger of the production division of UKAEA had resulted in an organization called British Nuclear Fuels Limited (BNFL) which would seek commercial reprocessing business abroad (Mrowicki interview, 2009).

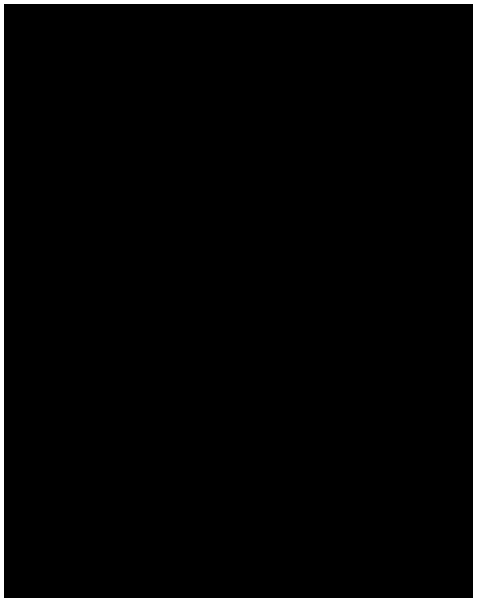
that the plans would make Windscale "one of the world's main radioactive dustbins" (Herring, 2005: 163). Initially, it attracted little interest, (Patterson, 1985) but when sensationalist tabloid *Daily Mirror* picked up on the story in October of 1975, the issue suddenly sparked public attention. The newspaper published a front-page article about it. The headline *Plan To Make Britain World's Nuclear Dustbin*, recycled FoE's methaphor (figure 5.3.9). The article stressed the dangers of storing the waste in Britain:

> Would you fill your house with bottles of poison just because someone paid you to do it? (…) It's no use trying to disguise the danger under words like "reprocessing" as if nuclear waste were cans of peas." (*Daily Mirror*, 21 October 1975)

The story ignited a national uproar (Hall, 1986: 149). A day after the article, *The Times* quoted Labour MP William Molloy:

> Even to the non-expert, the history of the grave dangers of even controlled nuclear waste are of such magnitude and constitute dangers of such enormous possibilities that this subject must be debated fully. (*The Times*, 22 October 1975)

The cartoon in figure 5.3.10 framed the issue by depicting a disheveled-looking Britannia, a personification of British nationalism, stirring laundry with her trident in a washtub marked *Windscale*. John Bull, another personification of England, is bringing a linen basket labeled *Japan*, while Britannia says: *"So it's come to this – taking in other people's dirty washing"*. This article brought widespread publicity to FoE's campaign, which had become increasingly coherent over 1975 (Herring, 2005).



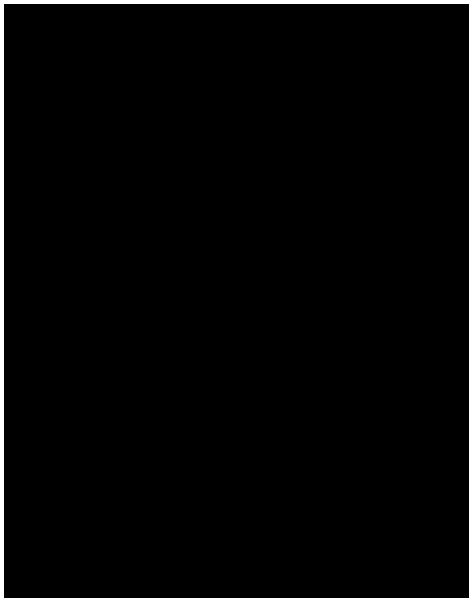


Fig. 5.3.9 Frontpage. Source: Daily Mirror, 21 October 1975.

Fig. 5.3.10 Observer, 26 October 1975 (Artist: Wally Fawkes). Source: British Cartoon Archive.

The media frenzy caused by the 1975 publication of the *Daily Mirror* article about the plants for a reprocessing facility brought widespread publicity to FoE's information campaign (Herring, 2005: 164). By emphasizing the issues with the reprocessing of spent nuclear fuel, FoE had contributed to the framing of spent nuclear fuel as 'waste' and 'dirty' by national press. It had successfully linked nuclear power to the increasingly popular macro-cultural repertoire about pollution.

5.3.6 Credibility: FoE and the Windscale inquiry ('75-'77)

In the early 1970s, FoE had played a role in the reduced credibility of light water proponents. But at the same time, they had worked on increasing their *own* credibility with regard to nuclear matters. An inquiry about the reprocessing controversy (subsection 5.3.5) would prove to be their litmus test. Energy secretary Tony Benn gave his approval for the BNFL contract in early 1976. Its application for the construction of a new reprocessing plant now had to be judged by the Cumbria County Council. Unless Environment secretary Peter Shore would call the application in for review by the government, theirs would be the final decision on the matter. FoE found it unacceptable that such an important matter should be left to local authorities and demanded that the issue be taken to government (Patterson, 1985: 80-81). By late 1976, Shore was still undecided (HC Deb, 1976). The cartoon in figure 5.3.11 frames his dilemma by depicting Shore carrying a box labeled *Nuclear Debris* and *Windscale*, confused by a litter box labeled *Keep Britain Tidy*[28].

In December, Shore announced that there would indeed be a public inquiry. It was to be held at Whitehaven (near Windscale) and would begin in June of 1977. During the hearings, 146 witnesses testified and some 1,500 documents were submitted (Hon. Mr. Justice Parker, 1978). FoE was one of the principal objectors. Patterson, FoE's leading witness, described the inquiry as a thorough procedure, during which "[e]very conceivable argument for and against the THORP proposal had been canvassed and challenged" (Patterson, 1985: 85). FoE had invested many resources into building a detailed, fact-based case for the Windscale Inquiry, since they both had the expertise, and it fit their strategy of focusing on issues perceived as winnable:

> We always tried to define an issue we thought we could win within an achievable time and in recognizable form rather than a broad-brush hand waving thing like, you know, banish nuclear weapons or anything like that. It was to be a particular target, with a date and a timetable. (Patterson interview, 2009: 23:40)

[28] Shore had previously called on local authorities to cut waste. The cartoon thus highlights the paradoxical nature of Shore's dilemma.

Fig. 5.3.11 Sunday Telegraph, 26 November 1976 (Artist: John Jensen). Source: British Cartoon Archive.

The inquiry was heavily discussed in the press. Public attention to nuclear power reached its highest point in 15 years (see: figure 5.1.1). In terms of co-occurrence with nuclear power, the waste issue peaked in 1977, as well: some 20% of all articles mentioning 'nuclear power' also included 'waste'. Co-occurrence with 'reprocessing' and 'proliferation' reached its all-time maximum in 1977, as well: respectively 28% and 13% of *The Times* articles with 'nuclear power' also mentioned these words (figure 5.3.12).

The Inquiry's final report was published in March of 1978. It answered the three main questions (whether fuel from UK reactors should be reprocessed at all; whether this should occur at Windscale; and whether foreign fuel should be reprocessed) affirmatively and concluded that permission for the construction of THORP should be granted without delay[29]. The report came as a severe disappointment to FoE, which felt it had made a strong case but couldn't retrace its arguments in the final report:

[29] Under normal circumstances, Shore would have received the report, announced his decision and then published the report as an underpinning of the decision (Patterson, 1985: 86). But because many MP's had supported a motion asking for a debate about the matter *before* Shore would decide on it, an unusual procedure was followed: Shore formally rejected BNFL's application, but transferred the final say to the House of Commons. Because pro-nuclear forces had a substantial majority there, the outcome of the vote was never in doubt (Rüdig, 1994: 79).

> It was like a kick in the stomach. We couldn't believe, given that the inspector had clearly understood the nuances of the argument that we were putting forward, which was a very detailed and very carefully structured argument…it's probably the most concentrated work I've ever done anywhere, on that case. And I could not believe that the inspector, Parker, could just basically ignore and turn his back on everything that he had teased out of us and accept arguments in his reports which we had clearly demolished in front of him. It was an outrageous performance. Certainly from my point of view, it poisoned the well completely. From that point on, I never ever trusted anything that the government said on nuclear issues. (Patterson interview, 2009)

A review in *The Times* criticized

> (…) the uncompromising way in which Mr Justice Parker dismisses most of the arguments of the scheme's opponents. (…). He is clearly confident, however, that the chances of serious difficulties being caused by the process itself are extremely remote. (*The Times*,7 March 1978).

In the perception of a large share of the public, Friends of the Earth had won the argument (Lamb, 1996). Environmental historian Horace Herring writes:

> Overall the inquiry established FoE's leadership of the anti-nuclear movement with the media. As Martin Ince, a freelance journalist, remarked in *Undercurrents* no. 28 'One thing that Parker's inquiry proves is that nuclear opposition in Britain is Friends of the Earth'. (Herring, 2005: 188)

Clearly, the expertise displayed during the hearings had increased the credibility of the new environmental organization with the general public.

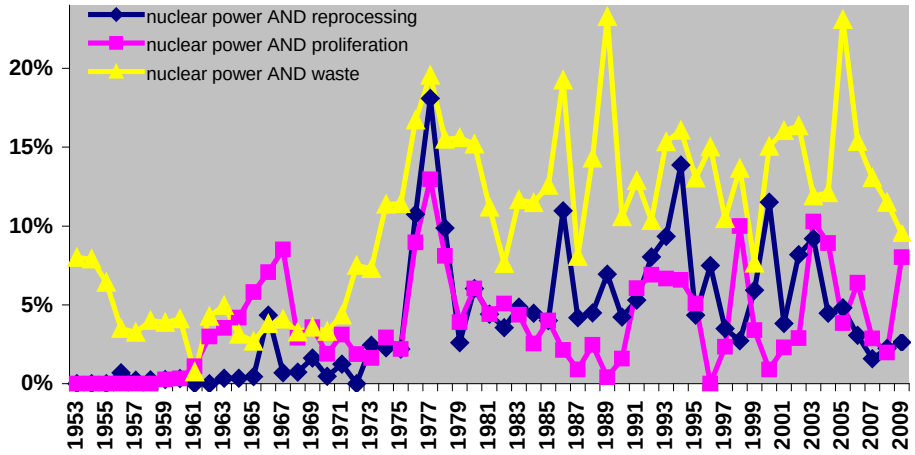


Fig. 5.3.12 Co-occurrence of keywords in legend, % of articles with 'nuclear power'. Source: The Times.

5.3.7 Centrality: leveling demand & saving the industry '74-'78

In the early 1970s, nuclear power had been framed not only as an urgent solution to the energy crisis, but also as the technology of choice for meeting the expected future increase in electricity demand. Shortly after the 1973 article in *The Guardian* (see: subsection 5.3.4) the CEGB announced its proposal to build 18 light water power stations with a capacity of some 43,000 MW, to be ordered between 1974 and 1983 (Pocock, 1977). Their calculations were based on the assumption of a 6% annual increase in electricity demand (Patterson, 1985). But this assumption had been incorrect. While it had been steadily increasing since the 1920s, domestic electricity consumption unexpectedly fell in the mid 1970s and remained roughly level until the mid 1980s, while industrial electricity demand had leveled off already in the early 1970s and fluctuated around this value until the early 1980s (Department for Business, Enterprise and Regulatory Reform, 2008).

The UK now had production overcapacity, while three of the five second program's AGR stations had not even been completed yet (Patterson, 1985). It became increasingly clear to the public that nuclear power was not the solution to the central problem it had been claimed to be. Because of its reduced centrality, the government decided on a severe budget cut for the first of the proposed third nuclear power program's SGHWR stations (Sizewell B). The cut meant that no station could be ordered before 1979 (Patterson, 1985). The issue was heavily discussed in the press. The *Daily Mirror* quoted Walter Marshall (Chief Scientific Advisor to the Department of Energy), who had commented on this issue during the presentation of an energy R&D report:

> At this moment we could probably get away with no nuclear construction programme. The demand for electricity is so flat that we don't really need any new atomic power stations, but if we didn't have a construction programme, we wouldn't have a nuclear industry. And then it would be difficult to start up again when we needed the atomic power stations. (*Daily Mirror*, 9 June 1976)

This could not be allowed to happen, because

> (…) there would be no future for countries which did not heavily rely on nuclear power near the end of this century. (*Daily Mirror*, 9 June 1976)

The publication in late 1976 of the Royal Commission on Environmental Pollution's report *Nuclear Power and the Environment* (Royal Commission on Environmental Pollution, 1976) reiterated this. In a review of the so-called Flowers Report (after its chairman Sir Brian Flowers), *The Times* stated:

> [T]he Royal Commission has (…) demonstrated very clearly that the existing nuclear power programme has a safety record which cannot be bettered. What is more they underline the importance of electricity supplies from atomic power to this country. (*The Times*, 23 September 1976)

Neither were they worried about the accumulation of hazardous material from the processing in Britain of spent nuclear fuel from foreign power stations[30] (The Times, 23 September 1976). In spite of the belief that nuclear power would eventually be necessary for Britain, British power plant manufacturers now feared that, unless a nuclear power plant was ordered soon, they might not survive (Patterson, 1985). In late 1977, the CEGB recommended that the government approve the construction of an AGR to take pressure off the industry. At that point, they had gained some practical experience now that two of the second program's five AGR stations had been completed. Secondly, they suggested to simultaneously order an (American) PWR to obtain experience with the light water system, as well (*The Times*, 19 December 1977). The government agreed with the first suggestion: it definitively abandoned the SGHWR project and approved the construction of two AGR stations (Heysham and Torness).

Although the conclusions of the Windscale inquiry were not yet known to the public at the time of this decision, some commentators felt that this decision hinted at approval for the reprocessing plant as well, because of the resulting additional future waste. *The Times* argued that the decision had

> (…) technical implications favouring a decision to proceed with the nuclear fuel reprocessing plant proposed at Windscale. (…) Mr Benn's decision had "let the cat out of the bag on the report on Windscale", Mr Trevor Skeet, Conservative MP for Bedford, shouted. (*The Times*, 26 January 1978).

And indeed, the Windscale inquiry report (published two months later) substantiated its advice to grant permission for the reprocessing plant by referring to the necessity of industrial survival:

> It is necessary to keep the nuclear industry alive and able to expand, should expansion be required. (Hon. Mr. Justice Parker, 1978: 84)

For the public, future security of supply had been a central issue. The proposed construction of new nuclear power plants as a means to realize this had increased the centrality of nuclear power discourse. But when it had become clear that electricity demand was leveling off, its centrality decreased. In response, storylines were altered: new construction was now framed as necessary to ensure the survival of the domestic industry and the preservation of relevant engineering knowledge for some unspecified point in the future when it might be required after all. To the public, this was a far less central issue. This 'circular' argument, in which nuclear power was essentially framed as its own legitimation, thus failed at restoring the centrality of the nuclear power storyline.

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[30] The commission was, however, very concerned about the fast breeder reactor. A large fast breeder program would require large quantities of plutonium, reopening questions about the proliferation of nuclear weapons and the dangers of a "plutonium economy".

5.3.8 Macro-cultural resonance: direct action and pacifism ('75-'79)

Patterson denies that FoE was part of an anti-nuclear movement (Herring, 2005) and dislikes being labeled anti-nuclear:

> I have always hated the adjective anti-nuclear. It is like a stamp on your forehead that says this person's opinion can be disregarded. We know what it means. It's a black - white, yes - no, Manichean approach to energy policy and therefore fails completely to address the nuances and the subtleties. (…) Part of the reason of course is that the nuclear people refer to us as anti-nuclear because for *them* the question is: "Do you build this nuclear plant or not?" It's a yes/no question. For me and my colleagues, it was always an either/or question. Either you build this nuclear plant, or you do something more sensible with the money, the time and the people. (Patterson interview, 2009)

But not everyone agreed. Several dedicated anti-nuclear organizations emerged from 1975 onward. Some, like SCRAM, felt that the nuclear power issue was important enough for a dedicated campaign and not just one issue on a broader environmental agenda (Herring, 2005). Others had been formed to oppose specific nuclear construction projects (e.g. Half Life, which opposed the almost-completed Heysham AGR). Although these were decidedly anti-nuclear *organizations*, performing anti-nuclear storylines and contributing to an anti-nuclear discourse, it would be misleading to characterize them as part of a broader anti-nuclear *movement* in the mid 1970s. The organizations were not coordinated, nor did they have a clear common interest or goal (Herring, 2005). Instead, it was a fairly disorganized coalition of various factions and interest groups. It consisted of worried locals living near plants or project sites ('NIMBY'); conservationists worried about effects on landscape and animal life; people whose livelihoods were threatened by nuclear power (such as miners); environmentalists with broader ecological concerns; conservative left-wing political activists (e.g. socialists); and anarchists with a broader agenda of opposition against the state (Herring, interview 2009).

While FoE had used conventional tactics of lobbying and discussing, which had given them an 'insider' status in the eyes of more radical activists (Rootes, 2008), many other factions used non-conventional tactics (such as peaceful demonstrations[31]) to get their point about nuclear power across. Some also partook in the Windscale inquiry as objectors. FoE's nuclear team did not particularly appreciate the input of the more radical groups:

> In the latter part of the 70s, when it was clear that nuclear power was a major source of public discontent and concern, there were many small factions, some local around a particular site and some that were variously spin offs at universities and things of that

[31] In April of 1976, for example, SCRAM organized an occupation of the proposed AGR site at Torness which drew about a hundred people: the first example, albeit small-scale and festive, of direct action geared towards nuclear power in the UK (Hall, 1986: 142).

> kind, who were less concerned with the details of any particular nuclear proposal than they were with the generality of the nuclear power structure and its role in the state and so on and so forth. I have to say that as far as I was concerned they muddied the waters pretty badly. They had quite a lot of input to the Windscale inquiry in 1977. They queued up for funding and were, I thought, egregiously self-indulgent at the Windscale inquiry, spending a lot of time ranting and raving in front of the panel, and as a result, allowing the very hard-edged case that my colleagues and I had put forward to be muddied and smeared completely, so much so that the inspector could then pretty much disregard the case we had made in favor of all the hand waiving and ranting that was coming from other directions (Patterson interview, 2009)

The failure of the 'rational approach' to influence the outcome of the Windscale inquiry, which became apparent in 1978, had two effects on activists engaging with nuclear power. Firstly, it exacerbated the differences of opinion among activists about the optimal strategy. While moderate groups like FoE maintained that public inquiries provided a good stage for the performance of their arguments, increasing numbers of other groups came to see non-violent direct action, in which emotion played a larger role than rationality, as the only useful course of action. Direct action strategies were increasingly frequently applied in the late 1970s. For example, after the government's announcement of the Torness and Heysham AGRs in 1978, SCRAM organized a peaceful occupation of the Torness site (see: figure 5.3.13). But when construction work started in November, The Torness Alliance attempted to block the bulldozers to obstruct it (Welsh, 2001; figure 5.3.14). FoE continued to distance itself from such direct action, fearing that it might alienate its audience:

> We had the fringe crazies in the UK as well who were determined to turn this into a violent confrontation. And my colleagues and I knew that this was, from a policy point of view, suicide, because we would lose the broad swath of the public that was at that stage quite sympathetic to our arguments. If you have this self-indulgent fringe whose delight is to throw Molotov cocktails, then if the authorities can link you with them, if they can say "They're all anti-nuclear", then that's a win for the authorities. (Patterson interview, 2009)

Nevertheless, direct action sentiments existed and found fertile ground with a new environmental organization: Greenpeace. The originally Canadian NGO had protested against nuclear weapons testing in the early 1970s, whaling and seal hunting in the mid 1970s, and nuclear waste dumping in the late 1970s, all by non-violently disrupting such activities through their presence. From the mid 1970s onward, independent Greenpeace groups had formed all over the world, including in the UK.

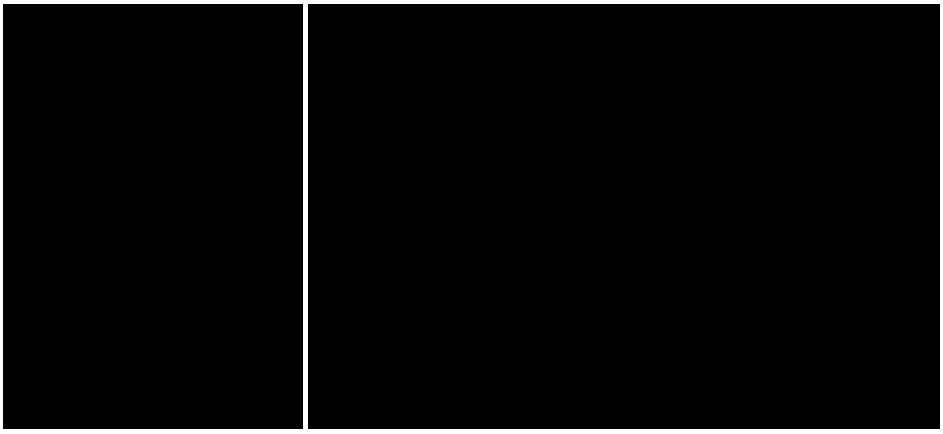

Fig. 5.3.13 SCRAM poster for Torness occupation, 1978. Source: Bannink (2011).

Fig. 5.3.14 Screenshot from Torness: Together We Can Stop It (1978 documentary by Leslie Benson, Sue Cowgill and Trevor Back). Source: www.exposureroom.com.

Secondly, calls for a more coordinated anti-nuclear movement intensified (Rüdig, 1990). The Anti-Nuclear Campaign (ANC) was established in the late 1970s an umbrella organization, in an attempt to unite the hundreds of small, local anti-nuclear groups into a coordinated anti-nuclear *movement* (Herring, 2005:31). The traditional conservation societies and Friends of the Earth did not partake in this initiative, but it was strongly supported by the National Union of Miners (NUM) (Rüdig, 1994).

But although the ANC had collapsed by 1982 (Stichting Laka, 1995) and a large, coordinated national anti-nuclear *movement* never emerged, many diverse anti-nuclear *storylines* had gradually materialized over the late 1970s. What had started out as a critique of a particular technological option by contentious experts (articulated in generally accepted terms of nuclear discourse) had gradually turned into an independent discourse *outside* traditional nuclear discourse. It was an antagonistic alternative for giving meaning to the technology: a heterogeneous collection ofvarious storylines about the undesirability of nuclear power, created and performed by anti-nuclear groups across the UK.

In the late 1970s and early 1980s, these anti-nuclear groups sought connection with the Campaign for Nuclear Disarmament[32] (Herring, 2005) and campaigned against both nuclear power and nuclear weapons (Welsh, 2000). This joining of the two issues was

[32] Established in 1957, the CND was initially a group of prominent individuals lobbying for defense policy change. But the campaign quickly caught on with the general public and turned into a mass movement. In early 1958, CND organized a march from Trafalgar Square to the Aldermaston Atomic Weapons Research Establishment. It became a yearly phenomenon, drawing as much as 150,000 people in 1962. The CND had been in decline since the 1963 Test Ban Treaty, but the deepening Cold War led to the CND's resurgence in the late 1970s (Welsh, 2001).

performed symbolically during demonstrations. For example, at a large occupation of the Torness nuclear power plant construction site in 1979, activists wove the CND (or 'peace') logo into the site's fence: a symbol of common opposition against both civil and military uses of nuclear technology (Welsh, 2001). Similarly, the photograph in figure 5.3.15 shows signs reading *Stop Torness* and *No Nukes Is Good Nukes* side by side. Figure 5.3.16 is a screenshot from a documentary about the Torness demonstration, showing the CND logo laid out on the ground in flowers.

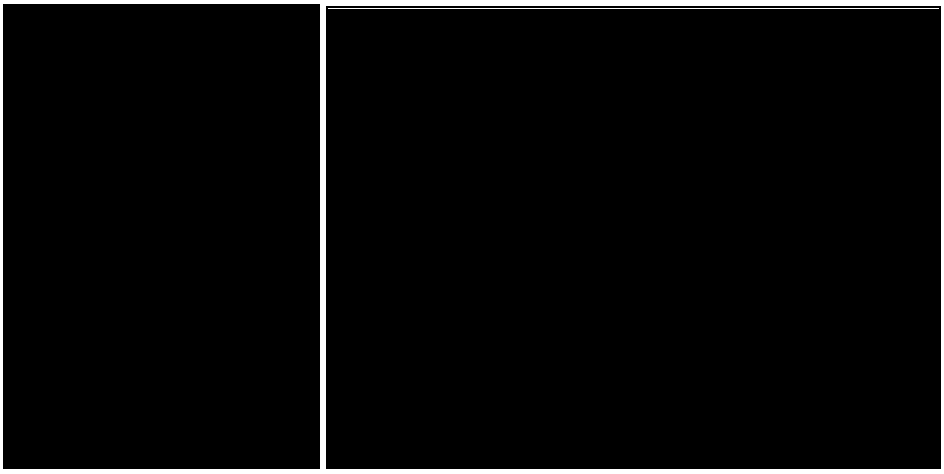

Fig. 5.3.15 Photo of activist protesting against both nuclear power and nuclear weapons at Torness, 1979 (Artist: M. Lowe). Source: Internationaal Instituut voor Sociale Geschiedenis.

Fig. 5.3.16 Screenshot from On Site Torness 1979 (documentary by Scott and Sharples, 1979). Source: Scottish Screen Archive.

Through these and similar performances, activists symbolically linked the technology to the increasingly prominent macro-cultural repertoire of pacifism, in an attempt to increase the macro-cultural resonance of anti-nuclear discourse. These attempts largely failed: the coordinated national campaign against nuclear power collapsed in 1982 (Stichting Laka, 1995). The remaining anti-nuclear power groups were once again separated from the peace movement (Rüdig, 1990; 1994).

5.3.9 Empirical fit: Three Mile Island '79

In the government's 1978 response to the CEGB's proposal to build both AGR and PWR stations, it had been vague about what the long-term future for PWR in the UK would be (Patterson, 1985: 47). The PWR was to undergo a period of detailed evaluation to investigate if it met British safety requirements. But a year later, an event occurred which would be construed as empirical proof of the safety issues involved in the PWR design. In March 1979, the Three Mile Island nuclear power station, a PWR near Harrisburg, Pennsylvania (USA), suffered a partial core meltdown, followed by the release of radioactive substances into the environment. A media frenzy broke out in the USA, and the event featured heavily in the British press as well. The 'safety' and 'health'

themes in nuclear discourse suddenly became much more prominent. The co-occurrence between 'nuclear power' and 'safety' in *The Times* articles almost doubled from 20% in 1978 to 38% in 1979: its highest value over the period under study. Co-occurrence with 'health' peaked, as well at some 17% (see: figure 5.3.17).

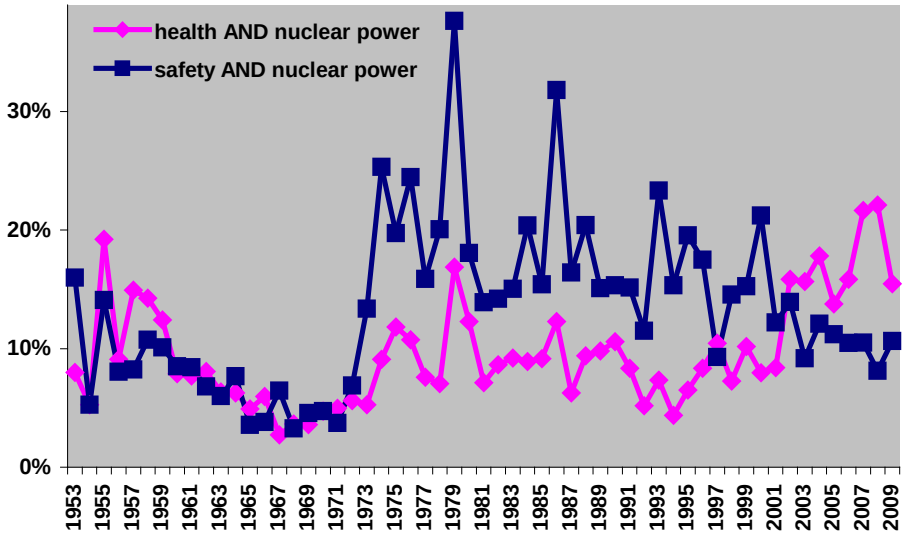

Fig. 5.3.17 Co-occurrence of keywords in legend, % of articles with 'nuclear power'. Source: The Times.

Cartoonists also commented on the accident in their trademark 'pictorial editorials'. In figure 5.3.18, a British cartoonist combined the threat of widespread radioactive contamination as a result of the accident with a cynical view on the American penchant for marketing. It depicts men in radiation suits in a typical American diner, serving an apparently radioactive hamburger[33] to a startled-looking customer. The caption read *"How do you like your hamburgers?"*. A week later, the *Guardian* ran a cartoon depicting a nuclear power plant emitting a mushroom cloud, commonly associated with the detonation of an atomic bomb, from its smokestack (figure 5.3.19).

The chairman of the British Electricity Council immediately expressed his concern about the effects that such framings of the accident could have on people who had not yet made up their minds about nuclear energy. He accused the media of "over-reaction, arguing that "nuclear plant [sic] has been demonstrated to be safe, clean, and environmentally desirable" (*The Guardian*, 3 April 1979). Soon after, *The Guardian* ran an article provocatively entitled *Nuclear War - Anthony Tucker hears Mr Benn confirm*

[33] A cheeseburger advertised as a 'Meltdown' was indeed temporarily sold in Harrisburg after the accident (Caputi, 1991).

a hidden battle for British reactors in which Tony Benn revealed the political lobbying behind the PWR evaluation:

> Mr Tony Benn, Energy Minister, yesterday confirmed that for the past 10 years Britain has been subjected to unprecedented political, industrial and commercial pressures to abandon our own Advanced Gas Cooled atomic reactors (AGRs) in favour of Pressurized Water Reactors (PWRs) of the kind which caused the Harrisburg crisis (*The Guardian*, 5 April 1979).

Benn suggested that Britain's own AGR reactors were safer:

> Commenting on the general effect of Harrisburg, Mr Benn said that "no government, anywhere in the world, can now lightly approve of nuclear systems of that type." (…) [H]e pointed out that the present government has consistently backed British nuclear scientists "who have built up 22 years experience of our own gas-cooled system which is quite different in design from the American PWR and has a fine safety record." (*The Guardian*, 5 April 1979)

Friends of the Earth attempted to counter this sentiment in the press:

> The brief and turbulent history of the AGR affords no grounds for confidence in the design safety – indeed, quite the reverse. (…) There is no public access to detailed safety studies on the AGR. Without this the public is right to be sceptical about official pronouncements on safety (*The Guardian*, 11 April 1979)

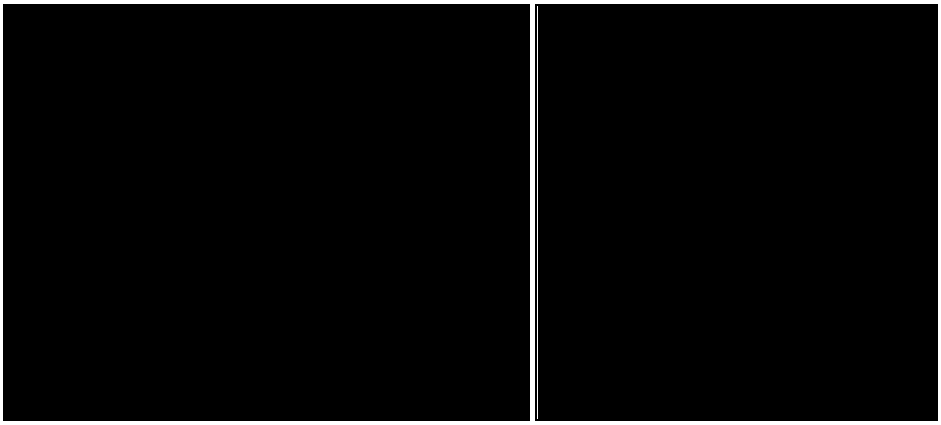

Fig. 5.3.18 Evening Standard, 3 April 1979 (Raymond J ackson). Source: British Cartoon Archive.

Fig. 5.3.19 The Guardian, 11 April 1979 (Artist: unknown).

In the wake of the Three Mile Island accident, demonstrations were organized by several anti-nuclear groups. At 15 existing plants and proposed sites, they protested against the PWR and the national and international pressures to adopt it (*The Guardian*, 9 April 1979). Figure 5.3.20 shows a poster calling for an anti-nuclear demonstration exactly one year after the accident. Figure 5.3.20b shows construction material at the Torness nuclear power plant construction 'decorated' by anti-nuclear protesters with

graffiti reading *Do you want Harrisburg here?* In such performances, the Harrisburg accident was framed by as empirical proof for the danger of the PWR design in particular, and nuclear power in general. As such, it increased the empirical fit of anti-nuclear discourse.

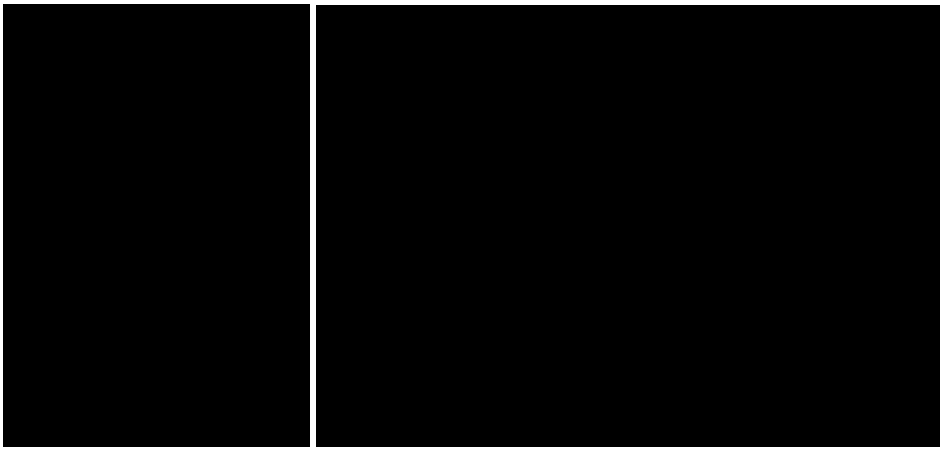

Fig. 5.3.20 Poster for anti-nuclear demonstration in 1980. Source: Bannink (2011).

Fig. 5.3.20b Screenshot from On Site Torness 1979 (documentary by Scott and Sharples, 1979). Source: Scottish Screen Archive.

But the protests were to no avail. In May of 1979, the incumbent Labour government was defeated in elections by Margaret Thatcher's strongly pro-nuclear Conservative party. Tony Benn, who was by then considered an opponent of the PWR technology, was replaced by David Howell. In late 1979, the new energy secretary gave the go-ahead for the construction of a PWR station. He publicly justified this by appealing to short-term industrial interest and long-term energy security:

> Even with full exploitation of coal and conservation, and with great efforts on renewable energy sources, it will be difficult, if not impossible, to meet this country's long-term energy needs without a sizeable contribution from nuclear power. (…) We believe that there must be continuing nuclear power station orders if our long-term energy supplies are to be secured and current industrial uncertainties are to be resolved. (…) We are concerned with building up to 30 per cent of electricity capacity from nuclear power, leaving a variety of sources for power, light and heat in future. What we are concerned about is our children and our children's children and whether they freeze or not and whether their industries work or not. (HC Deb, 1979)

Regarding the size of the program Howell announced not so much a new nuclear program, but certainly the *possibility* of one:

> Looking ahead, the electricity supply industry has advised that even on cautious assumptions it would need to order at least one new nuclear power station a year in the decade from 1982, or a programme of the order of 15,000 megawatts over 10 years. The precise level of future ordering will depend upon the development of electricity demand

> and the performance of the industry, but we consider this a reasonable prospect against which the nuclear and power plant industries can plan. (HC Deb, 1979)

In an attempt to counter the framing of Harrisburg as empirical proof of the dangers of nuclear power, he blamed the procedures instead of the technology and reframed Harrisburg as a valuable lesson:

> We attach overriding importance to the-safety of nuclear power and will want to ensure that the lessons of events at the Three Mile Island station in the United States have been learnt. (…) What went wrong at Harrisburg had most to do with procedures and much less to do with the integrity of the PWR. (HC Deb 18, 1979)

In late 1980, the location for the PWR was announced to be the Sizewell: an attempt to overcome public opposition since the site already had a first-program nuclear power plant since the 1950s (Rüdig, 1994: 86-87). The ANC spoke out against the construction of a PWR at Sizewell (see for example: figure 5.3.21). Anti-nuclear campaigners also again mobilized the Three Mile Island accident by highlighting the 'madness' of building a PWR at Sizewell so soon after it had been proven to be unsafe at Harrisburg. For example, figure 5.3.22 shows a campaign button which unmistakably links the two issues by demanding *No Harrisburg At Sizewell*. Such protests had little effect other than to show that direct action was not very effective: as a result, it was no longer pursued as a strategy by most anti-nuclear groups afterwards (Rüdig, 1994).

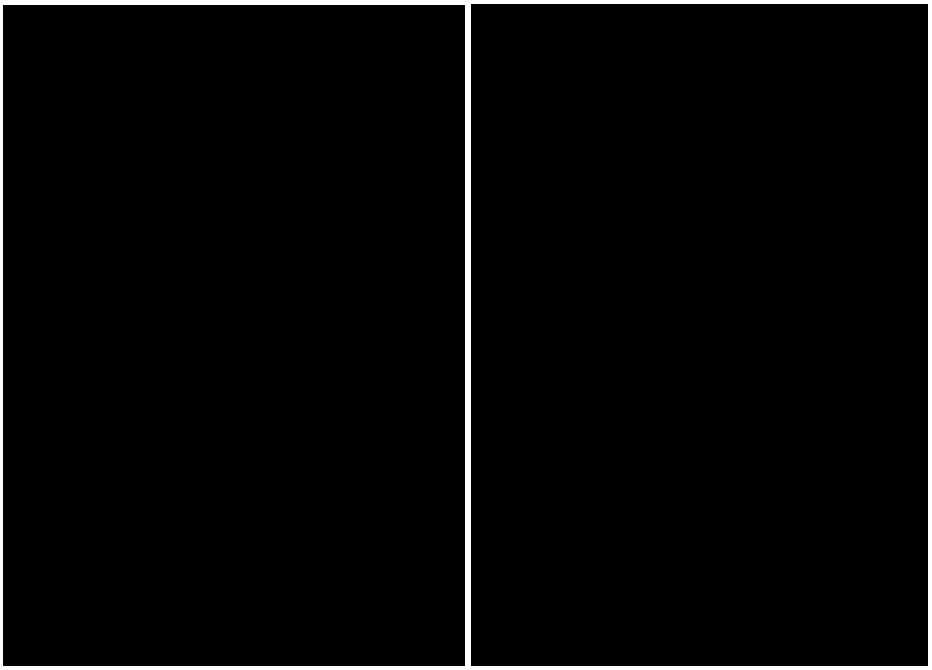

Fig. 5.3.21 ANC poster against Sizewell B, 1979 (Artist: S. Brown). Source: Bannink (2011).

Fig. 5.3.22 Anti-nuclear campaign button, approx. 1981. Source: private collection.

5.3.10 Centrality: Sizewell B and the miners '80-'86

In spite of the high empirical fit of the anti-nuclear storyline, the government pushed through the plans for a PWR station. However, when the CEGB's application for the station came in 1981, the government could not approve it without another public inquiry. It commenced in early 1982. The government had refused to fund objectors (such as FoE), which meant that as the inquiry dragged on, only groups with substantial resources were able to attend the inquiry in its entirety (Rüdig, 1994). Many felt this to be unfair because, since the CEGB was a state-owned utility, *their* costs would be implicitly paid for from public funds (Davies, 1987). As it had been at Windscale, the inquiry was comprehensive: every possible objection to the Sizewell B plant was addressed (Rüdig, 1994). The inquiry would eventually run until March 1985. At the time, it had been the longest in the history of the public inquiries (Potter, 1985). It had been a long and fairy dull affair: as time passed, the inquiry became increasingly ignored by the press as well as the general public (Rüdig, 1994). Newspaper bibliometrics substantiate this: public attention for nuclear power decreased substantially in the first half of the 1980s. In *The Guardian*, 40% fewer articles containing the selected keywords appeared in 1985 compared to 1980; in *The Times* the number had even decreased by 60% (see: figure 5.1.1): the public apparently didn't perceive nuclear power as a central issue.

But for the government, new nuclear construction was still quite central. A tense relationship had existed between nuclear power and the coal-fired electricity generation regime for decades. For example, during the implementation of the second nuclear power program, local miners had already opposed the construction of the Hartlepool AGR station, which they saw as a threat to their livelihoods because it would be sited on a coal field. In the late 1960s, the National Union of Miners (NUM) had opposed nuclear power, which they argued would reduce employment in the coal industry (Pocock, 1977). And during the harsh winter of '73-'74 a national coal miners' strike, had even brought down the Conservative government.

During the Sizewell B inquiry, in 1984, NUM president Arthur Scargill announced a new national strike because the National Coal Board (NCB), the public company that controlled the nationalized coal mining industry, had announced the closure of several coal mines. But this time, the Conservative government had prepared. A government policy of stockpiling coal and converting some coal-fired power plants to run on oil successfully enabled utilities to meet electricity demand throughout the winter of '84-'85. Nuclear power, too, had been part of a strategy to reduce the power of the coal miners. Leaked cabinet minutes from October 1979 (some two months before the announcement of a third nuclear program) show that the new Conservative government had seen nuclear power as a deliberate strategy to undermine potential coal miner strikes:

> (…) a nuclear programme would have the advantage of removing a substantial portion of electricity production from the dangers of disruption by industrial action by coal

miners or transport workers. *(Minutes of the 13th Meeting of Ministerial Committee on Economic Strategy, 23 October 1979. From: Winterton and Winterton (1989)).*

The public was aware of the political leverage nuclear power would provide over the NUM. The cartoon in figure 5.3.23, published in the Daily Express at a point when the strikes had been going on for over seven months, depicts Scargill as an old man in a museum, looking at a large lump of coal. The exhibit reads *Coal – Black Substance Once Used For Energy Purposes – Replaced By Atomic Energy because of the Great Coal Strike 1984 – 2024 A.D.* In reality, the strike lasted March of 1985. Its conclusion was widely seen as a major victory for Thatcher's Conservatives.

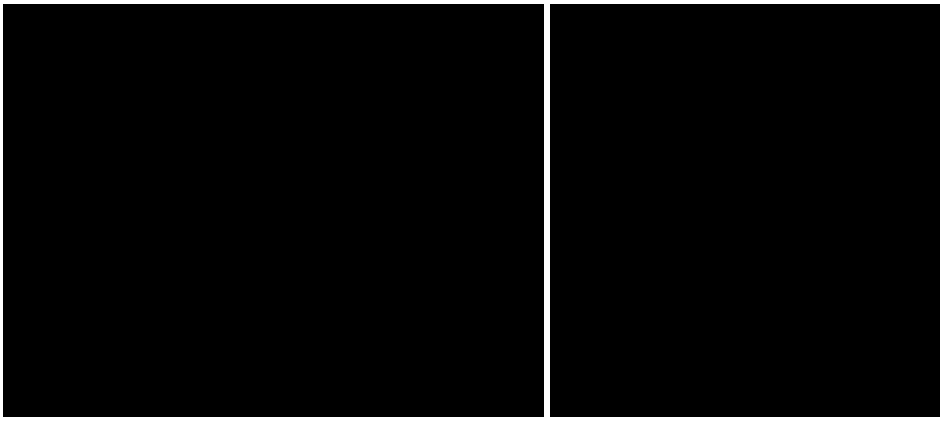

Fig. 5.3.23 Daily Express, 17 October 1984 (Artist: Michael Cummings). Source: British Cartoon Archive.

Fig. 5.3.24 Observer, 10 March 1985 (Artist: Wally Fawkes). Source: British Cartoon Archive.

But the government's clear ambition to phase out coal and expand nuclear generating capacity had an effect on the Sizewell B inquiry. Many members of the general public now expected that the government was so committed to nuclear power that a negative outcome was unlikely (Davies, 1987). When the Sizewell B inquiry closed just four days after the formal end of the strike, the transcription of the inquiry procedure contained some 16 million words, 195 witnesses had been heard and 4,330 documents had been submitted into evidence (Davies, 1987). The large volume of documents of an inquiry whose result many felt would be predetermined, was ridiculed in the press. Figure 5.3.24 shows wheelbarrows loaded with stacks of paper labeled *Sizewell Report.* One of the figures utters: *They'd use it for fuel if it hadn't cost so much.*

The political urgency for nuclear power as leverage did not translate to increased centrality of nuclear power in the eyes of the public. The government now attempted to raise nuclear power's centrality through other means: by warning that its abandonment would lead to recession. The *Times* quoted Energy secretary Peter Walker:

> "If we care about the standards of living of generations yet to come we must meet the challenges of the nuclear age and not retreat into the irresponsible course of leaving our

> children and grandchildren a world in deep and probably irreversible decline." The recession and huge unemployment that came after the 1973 oil shock had been nothing compared with the likely impact of eradicating nuclear power, he added. (*The Times*, 27 June 1986)

Opponents of nuclear power, such as environmental organizations, factions within the Labour party, and the National Union of Miners were not impressed:

- Friends of the Earth believed that Walkers statement undercut the Sizewell B inquiry:

  > Last night, Mr Stewart Boyle, energy campaigner at Friends of the Earth, said Mr Walker appeared to be preparing the public for a quick decision on Sizewell B, regardless of what the inquiry recommended. (*The Times*, 27 June 1986)

- Labour didn't find Walker's arguments very convincing:

  > Mr Stan Orme, the Labour spokesman on energy, said Mr Walker had "failed miserbly" in his attempt to convince the people of the benefits of nuclear power. (The Times, 27 June 1986)

- The National Union of Miners disagreed with Walker's assessment, as well. At the annual Trades Union Congress, Scargill argued:

  > "The real reason why we have a nuclear programme", he said, "is because Mrs Thatcher's Government said it was needed in order to defuse and defeat the Transport and General Workers' Union and the NUM in any industrial dispute. You saw that clearly during the miners' strike." (*The Times*, 5 September 1986)

In response, the *Daily Telegraph* published the cartoon in figure 5.3.25, which depicts Scargill as a caveman with a club labeled *NUM* laying at his feet, throwing coal at a nuclear power plant in a vain attempt to stop what the cartoonist apparently sees as the inevitable future of electricity production.

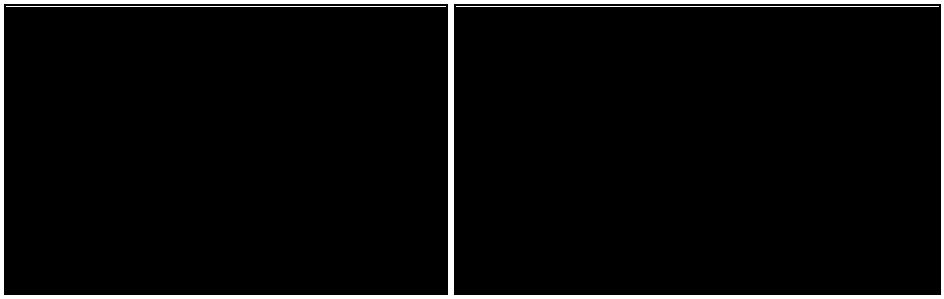

Fig. 5.3.25 Daily Telegraph, 5 September 1986 (Artist: George Gale). Source: British Cartoon Archive.

Fig. 5.3.26 Daily Telegraph, 27 June 1986 (Artist: Nicholas Garland). Source: British Cartoon Archive.

The idea that it was no longer possible to abandon nuclear power, as Walker had suggested, inspired the cartoon in figure 5.3.26. It depicts Walker holding a lamp labeled *Nuclear Power*, while being grabbed by an aggressive-looking genie that is emerging from that very same lamp[34]. The caption says *"Yes Master?"*. It suggested that the tables had turned: the benign genie that was promised before to be able to save humanity (see: figure 5.2.11) now held Britain by the throat.

Increasingly, nuclear power was talked about in the press as having predominantly been pursued for political reasons instead of urgent societal issues. Moreover, the decision to construct Sizewell B in spite of heavy opposition fueled the perception that public involvement could not influence the outcome of nuclear policymaking. This lack of interest further decreased the centrality of pro-nuclear discourse.

5.3.11 Experiential commensurability: health risks '83-'86

A 1983 Yorkshire Television documentary entitled *Windscale: The Nuclear Laundry* suggested a causal link between radioactive releases and a significantly higher local incidence of childhood leukaemia. Before the documentary, substantial public interest in the health hazards associated with emissions from nuclear installations had not been evident in the UK (Thomas, 1992). But now, the apparent link between Sellafield and cancer brought the negative effects of nuclear power close to home for the public. Macgill (1987) describes the documentary's method:

> The programme featured university research personnel monitoring unusually high concentration of radiation in the environment around Sellafield, emotive interviews with some of the people who lived in that environment, and interviews with concerned medical experts and statisticians. Viewers were left to draw their own conclusions about whether children in the vicinity of Sellafield were environmental victims of Sellafield's radioactive environment from the programme's disclosures (…) (Macgill, 1987: 90)

Because it was framed as possibly impacting people's daily lives, it increased the experiential commensurability of anti-nuclear discourse. The documentary contributed to it increasingly becoming a 'discourse of fear' (Lehtonen and Martiskainen, 2010) and caused public outcry. An Advisory Group was set up to investigate (Black, 1985), partly to 'find out the facts' and partly to assuage the public (Macgill, 1987: 106). The 1984 Black report (after chairman Sir Douglas Black) indeed found a higher incidence of childhood leukaemia near Seascale, but no scientific proof that this was caused by Sellafield (Black, 1984). The report advised further research. As a result, the Committee on Medical Aspects of Radiation in the Environment (COMARE) was established. Its report, published in 1986, largely agreed with the conclusions of the Black report: locally, clusters of high leukaemia were found but the estimated radiation dose from

[34] The image refers on a tale in the Book of One Thousand and One Nights, which narrates how Aladdin, by polishing an oil lamp, releases a genie who subsequently grants him three wishes.

Sellafield discharges could not account for this elevated incidence (COMARE, 1986). The report's conclusions inspired the sarcastic cartoon of figure 5.3.27. It shows a *New TV Ad* for Sellafield, showing the facilities and reading *Visit Sellafield: We've Got Nothing To Hide'*. The presenter (under-secretary of state for the environment Willam Waldegrave) adds to that *"…because radiation is invisible, folks!"*.

Fig. 5.3.27 Evening Standard, 3 July 1986 (Artist: John Kent). Source: British Cartoon Archive.

5.3.12 Empirical fit & centrality: from leaks to Chernobyl '81-'87.

Although Sellafield's link to health issues could not be proven, it was indisputable that the installation had routinely suffered leaks and other technical problems throughout its history. In 1981, Windscale had been renamed Sellafield, which was rumored to have been a 'window dressing' strategy to dissociate from Windscale's bad reputation. But the problems persisted, and in the early 1980s, began to negatively impact public opinion about nuclear power (Stichting Laka, 1995).

Environmental organizations like Greenpeace framed these issues as empirical proof of the danger of nuclear power through various performances. For example, in early 1985, activists in radiations suits dumped five tons of Cumbria mud on the front doorstep of the Department of Environment in London, accompanied by signs reading *'danger – radiation'* and *'A Present From Cumbria'* (figure 5.3.28). The activists showed passers-by that the mud was radioactive by using an (amplified) Geiger counter (*The Guardian*,

27 February 1985). The mud was thus mobilized as real-world proof of the danger of nuclear power. Increasingly, these framings of the leaks and discharges as empirical evidence of the danger of nuclear power were taken over by the press. For example, the cartoon in figure 5.3.29 shows Sellafield bursting at the seams, narrowly held together by *Sellatape* duct tape[35], and a discarded *Windscale* sign in the bottom left corner. Two executives walking away from the site, saying *"If that doesn't work we can always change its name again"*, which referred to the 1981 name change.

Fig. 5.3.28 The Guardian, 27 February 1985 (Photographer: Martin Argles).

Fig. 5.3.29 The Observer, 23 February 1986 (Artist: Willy Fawkes). Source: British Cartoon Archive.

The leaks and incidents led to calls for the closure of the reprocessing installation, but these were rejected by the Environment secretary, who compared the public fears of radiation to "fears of witchcraft in the Middle Ages" (*The Guardian*, 3 March 1986). But soon after, the 'discourse of fear' would be substantiated with a real-world event. On April 26th of 1986, a light water-cooled, graphite-moderated reactor at the Chernobyl nuclear power plant in the Ukraine suffered a meltdown, propelling a cloud of radioactive material over Europe. The accident suddenly increased the centrality of the issue of nuclear power. Public attention to nuclear power increased substantially: the bibliometric graph of figure 5.1.1 shows a distinct peak for 1986 (although more pronounced for the progressive *The Guardian* than for the more conservative *The Times*). In terms of co-occurrence with 'nuclear power', the words 'safety' and 'radiation' peaked in 1986, as well (respectively 32% and 19%; see: figure 5.3.30).

Some newspapers linked the disaster at the Soviet plant to the nuclear industry's lax response to Sellafield's problems. Figure 5.3.31 shows several Soviet nuclear scientists talking. The caption read: *"We have sought advice from the United Kingdom and they suggest we change the name"*, which again refers to the 1981 name change from Windscale to Sellafield. Although relatively few people died during the Chernobyl

[35] Sellotape is a leading brand of adhesive tape in the UK. Presumably the brand name is used because of it resembles the name Sellafield.

accident, a far greater number of deaths was expected as a result of radiation. It was framed in the press as empirical proof that nuclear power was unsafe. For example, figure 5.3.32 shows a mutated, two headed sheep commenting on Chernobyl, saying that *"(…) there may be thousands dead and dying, which of course raises questions about the entire future of nuclear power"*.

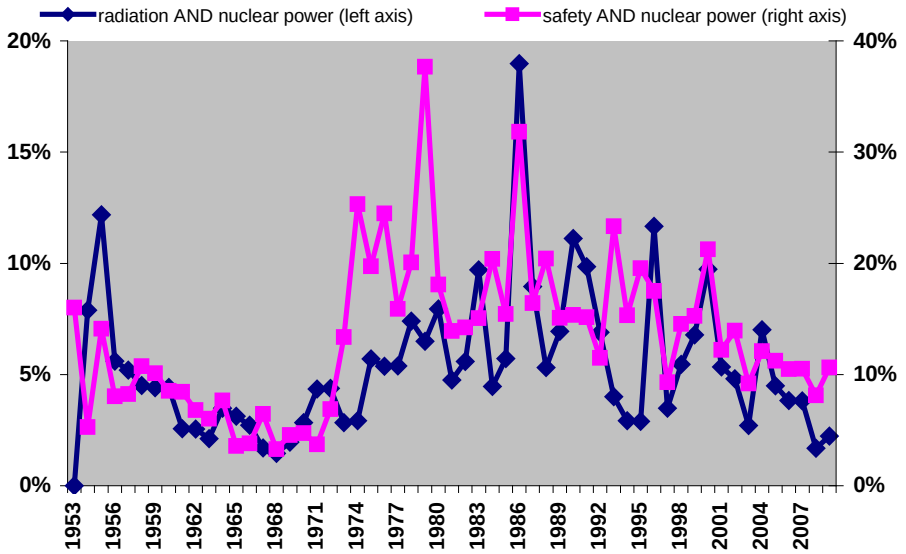

Fig. 5.3.30 Co-occurrence of keywords in legend, % of articles with 'nuclear power' (The Times)

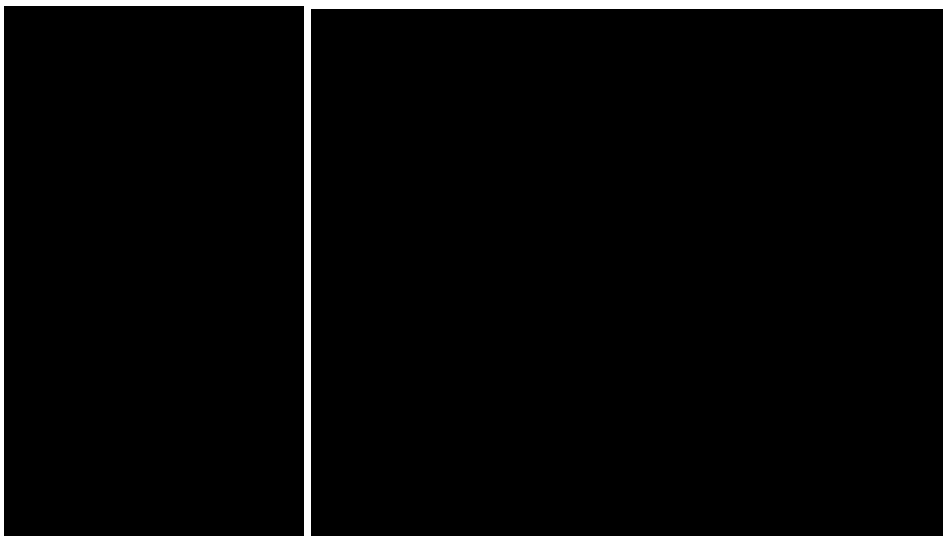

Fig. 5.3.31 The Guardian, 30 April 1986 (Artist: B. McAllister). Source: British Cartoon Archive.

Fig. 5.3.32 The Guardian, 23 June 1986 (Artist: Steve Bell). Source: British Cartoon Archive.

As had been the case with the Harrisburg accident, nuclear industry officials were quick to reassure the public by stating that

> (…) an accident on the scale of Chernobyl could never happen here because of Britain's high safety standards. (*The Times*, 2 May 1986)

Some called for the inclusion of the facts of Chernobyl into the report of the Sizewell B inquiry, which was still being written at the time, while others even favored redoing the inquiry completely. But the government decided that Chernobyl would not be a consideration in the report:

> [T]he report of an inquiry is the report of the conclusions from the evidence given at the inquiry, and it cannot go further and include matters which have arisen since the inquiry. (…) [T]he reactor in the Soviet Union is totally different from any kind of reactor here. (…) [T]he record of safety in design, operation, maintenance and inspection in this country is second to none. I hope the right hon. Gentleman will think it right to support the furtherance of such an excellent nuclear industry. (HC Deb, 1986)

The purpose of the Sizewell B inquiry was to advise the relevant Secretary of State. The Secretary would then accept or dismiss the findings, but *exclusively* on the basis of information gathered during the inquiry. Since the Chernobyl accident had happened after the inquiry had closed, the inspector could not mention the accident in the final report (Davies, 1987). The report was published in early 1987. It dismissed the major arguments of the objectors. But fears about radiation persisted. Figure 5.3.33 shows PM Margaret Thatcher and several politicians getting ready to read the report. The men are clad in radiation suits, while Thatcher says: *Please bear in mind, this is only the report.*

Fig. 5.3.33 Daily Telegraph, 27 January 1987 (Artist: George Gale). Source: British Cartoon Archive.

As expected, the Sizewell B station was subsequently approved by the government in March. The CEGB quickly filed applications for the construction of two more nuclear power plants. Those that had opposed the plant were outraged (Patterson interview,

2009) and felt they had been co-opted during the inquiry. The press echoed these sentiments. Figure 5.3.34 shows a group of angry bystanders in front of a nuclear power plant under construction, while Thatcher walks by a series of news billboards reading *"We Were Duped" – Friends of the Earth*, *More Nuclear Power Stations*, and *Sites Sought for Nuclear Dumping.* While most anti-nuclear activists felt defeated, some saw it as a reason to renew their efforts. Figure 5.3.35 linked the Sizewell B issue to the anti-nuclear weapons campaign upon news of the British government signing a weapons treaty[36]. It shows several peace activists addressing a sad-looking woman. The caption reads: *"An arms treaty needn't break us up, Paula – we'll just up tents to Sizewell and start all over again".*

Fig. 5.3.34 Daily Mirror, 1 November 1988 (Artist: Charles Griffin). Source: British Cartoon Archive.

Fig 5.3.35 Sunday People, 15 May 1987 (Artist: Alan de la Nougerede). Source: British Cartoon Archive.

5.3.13 Macro-cultural resonance: privatization '80-'89

Over the 1980s, the British government pursued a social and economic policy informed by a free-market ideology whose main tenet was that government activity should be constrained (and eventually replaced) by market forces. Thatcher's politics were strongly influenced by the views of liberalist economist such as Friedrich Hayek and came to be referred to by the eponym 'Thatcherism' (Hall, 1979). Thatcherism is often seen as a form of neo-liberalism: an ideological paradigm that uses the language of markets, efficiency, consumer choice and individual autonomy to extend 'market thinking' into all domains of society (Ong, 2006). One cornerstone of Thatcherism was privatization (Lawson, 1992). The transferring of government functions to the private

[36] In April of 1987, Britain, Germany, France, Italy, Japan, Canada, and the USA had established the Missile Technology Control Regime (MTCR) as a means to limit the proliferation of nuclear weapon delivery systems.

sector with the aim of increasing efficiency by introducing free market competition had gained momentum in the 1980s under the leadership of Thatcher in the UK and Reagan in the USA. Privatization was framed as a kind of 'panacea' which would ensure decreases in prices, corruption and bureaucracy, and increases in quality and available choices in virtually all societal domains.

But this privatization policy was not undisputed. Throughout the 1980s, newspapers published numerous cartoons which depicted the tragic-comical consequences privatizing public transport, post offices, health care, water supply, roads, prisons, the army, the police, the security service, and even the royal family. Figure 5.3.36 plays on this 'privatize everything' theme as well, and shows Thatcher and Energy secretary Nigel Lawson advertising various nationalized organizations such as Rolls-Royce, British Gas, British Airways etc. When Thatcher asks *What are we going to do for cash after we've sold off all this lot?,* Lawson replies *That's simple!...we'll nationalize them again!*

Fig. 5.3.36 Private Eye, 4 April 1983 (Artist: John Kent). Source: British Cartoon Archive.

Nuclear power came to be linked to the macro-cultural repertoire of neo-liberalism through the privatization of the electricity sector. In the early 1980s, Lawson had argued for privatization of the electricity sector, because he believed that major investment decisions taken by politicians regarding energy policy were often not economically rational, and that large nationalized monopolies led to inefficiency (Ham and Hall, 2006). Preparations began after the 1987 elections, which left the Conservative party in office for a third successive term. The goal was to privatize the entire electricity sector within one parliamentary term, while securing the future of nuclear power (Winksel, 2002).

The linking of nuclear power, through privatization, to the macro-cultural repertoire of neo-liberalism - with its economic vocabulary of markets, efficiency, and consumer choice - influenced pro-nuclear discourse. In the late 1980s, the 'security of supply' theme became less important as OPEC's influence diminished, oil prices decreased, North Sea oil provided cheap energy, and the NUM had been defeated (Rough, 2009, in: Lehtonen and Martiskainen, 2010). As economics dominated the electricity sector privatization debate in the late 1980s, the co-occurrence of 'nuclear power' with both 'electricity' and 'cost' in *The Times* articles more than doubled between 1987 and 1989 (respectively from 26% to 53%, and from 19% to 44%; see figure 5.3.37).

This 'economization' of nuclear discourse had an adverse effect on its innovation journey. A close inspection of the nuclear power sector in preparation of its sell-off brought to light a record of extremely poor economic performance, which was thought to negatively impact its chances survival in the private sector. The view that the economics of nuclear power were problematic was confirmed in the Electricity Act of late 1988. It included a Non-Fossil Fuel Obligation, which forced regional electricity companies to purchase a share of their electricity from 'non-fossil sources' which in practice meant nuclear power plants. A Fossil Fuel Levy, paid by suppliers of electricity from non-renewable energy sources, would finance this plan (Winksel, 2002).

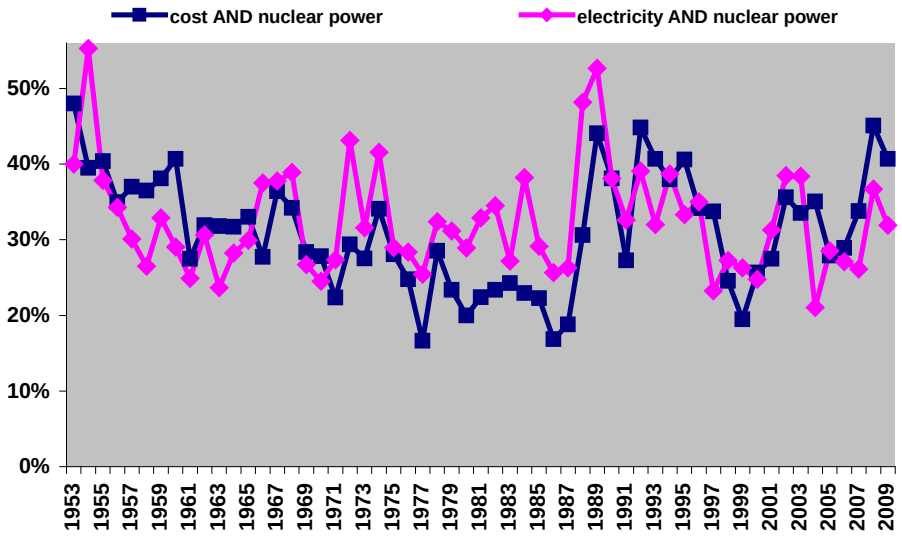

Fig. 5.3.37 Co-occurrence of keywords in legend, % of articles with 'nuclear power'. Source: The Times.

In late 1989, it was announced that all commercial nuclear power plants in England would be withdrawn from the sale, on the grounds that it had become obvious that the cost of generating nuclear electricity was too high for the industry to survive in the private sector. Moreover, a moratorium on nuclear power was announced. No new nuclear plants would be authorized before a government review of the sector, to be

conducted five years later in 1994. The cartoon in figure 5.3.38 comments on the situation by depicting Thatcher standing by a door and Energy secretary John Wakeham sitting on a couch holding an infant labeled *Nuclear Sell-Off Fiasco*. The image implied that privatization champion Thatcher had left the new energy secretary Wakeham 'holding the baby' (an expressing meaning 'to be left with the responsibility of resolving a problem').

Fig. 5.3.38 The Independent, 10 November 1989 (Artist: Nicholas Garland). Source: British Cartoon Archive.

The Fossil Fuel Levy, paid by suppliers of electricity from non-renewable energy sources as a means to fund the Non-Fossil Fuel Obligation, was first imposed in 1990. It was passed to consumers in the cost of the electricity supplied. In the first half of the 1990s, this substantially raised every consumer's electricity bills. Because it was evident to the public that it was essentially a means to support the nuclear power industry, the experiential commensurability of *anti*-nuclear discourse increased: as its critics had argued all along, nuclear power had been expensive instead of cheap, and now the public noticed it in their everyday lives. But another issue would impact its experiential commensurability even more.

5.3.14 Experiential commensurability: the waste issue '86-'97

Until the early 1980s, most of the British nuclear industry's low-level waste (LLW) and intermediate level waste (ILW) had been disposed of through dumping it in the Atlantic ocean[37]; something Greenpeace had intensively campaigned against. In 1983, a

[37] Solutions for high level waste (HLW) had been sought in the 1970s along the lines of underground storage. But strong local public opposition to test drillings in the 1980s had forced the government to find another route. In 1981, it was announced that HLW would be incorporated into glass using a process called vitrification, put in containers, and stored for a minimum of 50

moratorium on the dumping of nuclear waste at sea by the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter* had put an end to this practice. The government set up the Nuclear Industry Radioactive Waste Executive (Nirex) to investigate an alternative: underground storage.

But storing the waste on land would bring it to the doorstep of the public, which had been keenly aware of the possible health risks associated with nuclear waste since the Windscale inquiry. Wherever sites were proposed, pockets of opposition sprang up by people who felt it would threaten their health and thus negatively impact their lives. As a result, the experiential commensurability of the waste issue increased locally. In reaction to the local opposition, the government issued Special Development Orders to permit access to the sites (HC Deb, 1986). But when test drillings were scheduled in late 1986, hundreds of activists barricaded the site for weeks. A month later, access could only be gained through a heavy police presence. The national press largely sympathized with the local protesters. The cartoons in figures 5.3.39 and 5.3.40 visualized two widely held opinions: that underground storage was not a real solution, and that the government's authoritarian actions to enforce it were unacceptable. Figure 5.3.39 shows a huge carpet, under which containers labeled *nuclear waste* are visible. Two officials observe the scene, while one says *And this is our storage facility*. The image performs the idiom 'sweeping something under the carpet', which in this case frames nuclear waste as a problem that is being hidden instead of dealt with. Figure 5.3.40 depicts radioactive waste as a monster, being transported by men in radiation suits, protected by a cordon of police officers while a group of protesters are whisked away by a helicopter.

Fig. 5.3.39 Today, 17 September 1986 (Artist: K. Kallaugher). Source: British Cartoon Archive.

Fig. 5.3.40 Daily Mirror, 18 September 1986 (Artist: C. Griffin). Source: British Cartoon Archive.

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years (to allow the waste get cooler) pending a more long-term disposal route. Source: nda.gov.uk.

As a result, the proposed sites were abandoned out of fear for the impact of this authoritarian strategy on the 1987 elections. Nirex went back to the drawing board[38]. In an attempt to involve the public, Nirex published a consultation document, which invited the public to choose between burying the waste beneath the seabed or beneath land. In 1989, Nirex had reduced the number of possible locations to two, but because a local referendum ruled out the Dounreay location, the Sellafield location was announced in 1991. Anti-nuclear groups mobilized the controversial issue of underground storage of nuclear waste to argue against nuclear power in its entirety. For example, the poster in figure 5.3.41 reads *Is Digging A Hole Really The Answer?* The poster also quotes a passage from the 1976 Flowers report:

> a quite inadequate effort has been devoted to the problems of long term waste management and that there should be no substantial expansion of nuclear power until the feasibility of a method of safe disposal of high level wastes for the indefinite future has been established beyond reasonable doubt.

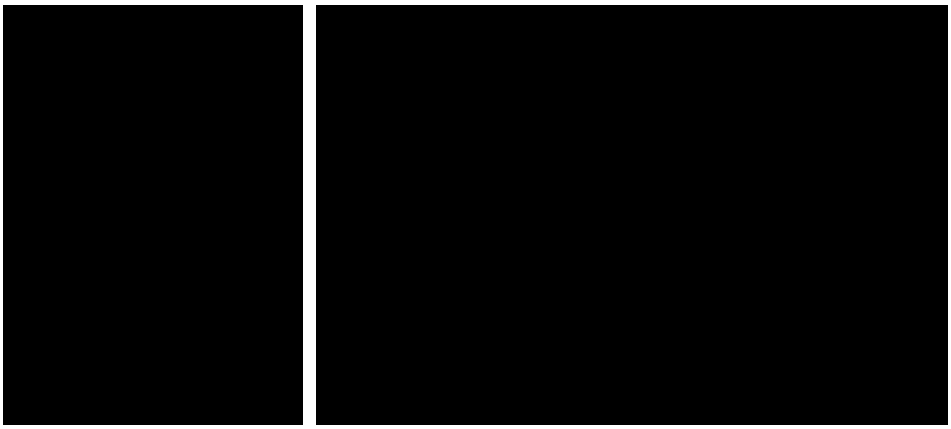


Fig. 5.3.41 Poster protesting against underground storage of nuclear waste. Source: Bannink (2011).

Fig 5.3.42 The Guardian, 16 January 1997 (Artist: Steve Bell). Source: British Cartoon Archive.

By linking the (locally) controversial *storage* of nuclear waste to the (nationally) undesirable *production* of this waste, the experiential commensurability of anti-nuclear discourse was increased. Nirex applied for planning permission in 1994. When the Cumbria County Council rejected their application, it appealed to Environment secretary John Gummer who announced a public inquiry. Objectors such as FoE and Greenpeace presented a technically substantiated case against the facility during the inquiry, which would run until early 1996. As result, Gummer formally rejected the

[38] In the meantime, low-level wastes were stored above-ground at the Low Level Waste Repository (LLWR) in Drigg, sear the Sellafield facility.

Nirex application in 1997. The cartoon in figure 5.3.42 commented on the situation of having a nuclear power industry, but nowhere to put the waste. It depicts a row of constipated elephants, coming from the Sellafield site and queuing up outside a lavatory booth labeled *Closed Indefinitely by Order Cumbria C.C.* The elephants are *white* elephants, a metaphor for possessions "unwanted by their owner but difficult to dispose" or "entailing great expense out of proportion to its usefulness or value" (Random House dictionary, 2009). Nuclear power had been framed as a wild horse in the late 1940s and early 1950s, but half a century later, it had become a white elephant.

5.3.15 Credibility: reprocessing scandals '90-'00

The nuclear reprocessing industry's problems had persisted and, ever since the 1975 *Daily Mirror* article, so had press coverage of these problems. Environmental organizations had mobilized these problems to discredit the industry, such as when they called for immediate closure following the publication of a 1986 report by the Environment Select Committee which stated that Sellafield had caused the Irish Sea to be "the most radioactive sea in the world" (*The Guardian*, 14 March 1986).

In the early 1990s, controversies over the opening of the new THORP facility had once again increased the prominence of the reprocessing theme in nuclear discourse: co-occurrence between 'nuclear power' and 'reprocessing' in *The Times* articles rose from 4% in 1990 to 14% in 1994: its highest value since the Windscale inquiry of 1977 (see: figure 5.3.12). Environmental organizations such as Greenpeace labored to bring the issue to the attention of the general public. One Greenpeace-organised event that managed to create some media attention was a benefit concert (figure 5.3.43) and subsequent demonstration at the Sellafield site (figure 5.3.44) by popular Irish rock group U2 (Cogan, 2006).

But in spite of such performances, the THORP facility was granted permission by the government to start operations in late 1993. In return, Environment secretary John Gummer had promised annual reports and specific limits on uranium discharges (*The Guardian*, 16 December 1993). THORP went into commercial operation in late 1997. The opening of an additional reprocessing facility caused a further increase in discharges into the Irish Sea. This negatively affected the credibility of those who had promised improvement.

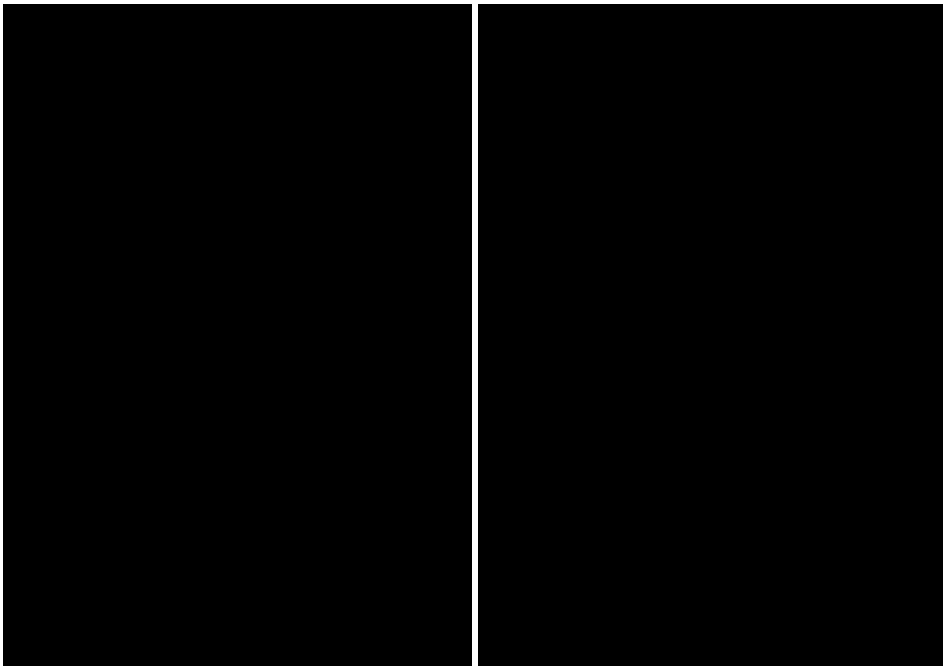


Fig. 5.3.43 Press photo of U2 on the beach near Sellafield, 20 May 1992. Source: Urban Image.

Fig. 5.3.44 Concert programme / fold-out poster for Greenpeace-organized concert against THORP, 19 May 1992. Source: www.911.com.

The issue of discharges became more pressing when in 1998, the *Convention for the Protection of the Marine Environment of the North-East Atlantic* (OSPAR) went into force after having been ratified by 15 European nations including the UK. During a ministerial meeting of the OSPAR commission, Deputy PM John Prescott refused to accept that the negotiations were about the closure of individual plants and did not want to commit to specific closure dates (*The Guardian,* 23 July 1998). This further decreased the credibility of the government in matters of reprocessing. The cartoon in figure 5.3.45 ridicules Prescott by depicting him frolicking on the beach amidst dead fish and birds. Sellafield is discharging waste in the background and a discarded newspaper reading *Nuclear Waste: Prescott 'No' To Closure* is seen in the foreground[39].

[39] The cartoon's design and its caption *Sellafield Is SO Bracing* are parodies of a well-known advertisement commissioned by Great Northern Railways in 1908 to promote the coastal town of Skegness (figure 5.3.46). The original poster features a character dubbed The Jolly Fisherman, frolicking on a pristine beach.

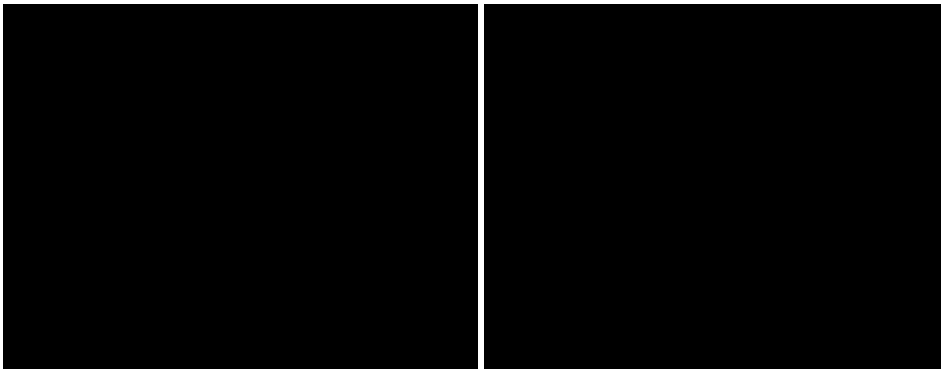


Fig 5.3.45 Daily Telegraph, 23 July 1998 (Artist: Peter Brooks). Source: British Cartoon Archive.

Fig 5.3.46 Great Northern Railways advertisement, 1908 (Artist: John Hassal). Source: National Gallery of Australia.

Nevertheless, an agreement was reached: the UK's older reprocessing facility would cease operations by 2020, and the new THORP facility would have to substantially decrease its discharges. It was hailed as a victory by environmental organizations (Forwood interview, 2009), and a Greenpeace spokesman referred to the agreement as signaling "(…) the beginning of the end for reprocessing" (*The Guardian*, 24 July 1998).

Two years later, reprocessing reached the press once again. Co-occurrence between 'nuclear power' and 'reprocessing' peaked in 2000 (see: figure 5.3.12) as newspapers published about unplanned discharges, the discovery of falsified quality control documents, and suspect batches of suspect nuclear fuel shipped to Sellafield's customers in Japan and Germany (*The Guardian*, 25 March 2000). The scandal led to an investigation by the Nuclear Installations Inspectorate (NII), which found faults in at every level of the company. It cast international doubts on the expertise of BNFL. It even lead to contracts being cancelled: it had damaged the nuclear industry's credibility. Figure 5.3.47 shows a company official opening a letter he received from BNFL in a radiation-proof box, saying to a co-worker: *"It's from BNFL – You can't be too careful"*.

Meanwhile, the press reported that British Energy (the privatized nuclear electricity generation company) was considering renegotiating its contracts so that spent fuel would be stored instead of reprocessed (*The Guardian*, 25 March 2000). The THORP facility, which by then had never worked at full capacity, was starting to look to the public like a white elephant, as well. The cartoon in figure 5.3.48 captures this sentiment, showing one on top of a Sellafield building, playing in its own excrement while reassuring us that everything was in fact under control (*"Top 'o the world, ma!"*).

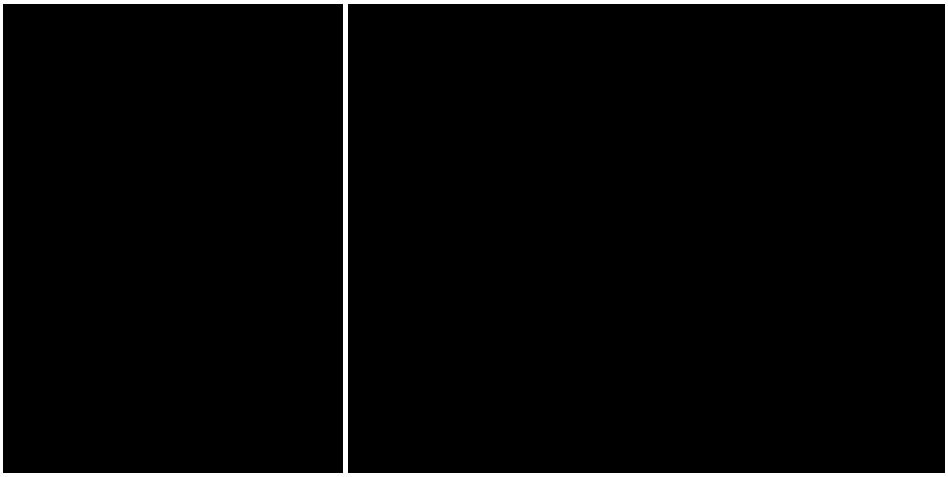


Fig. 5.3.47 The Guardian, 13 April 2000 (Artist: David Austin). Source: British Cartoon Archive.

Fig. 5.3.48 The Guardian, 28 March 2000 (Artist: Steve Bell). Source: British Cartoon Archive.

5.3.16 Epilogue: low legitimacy

Because of a weakening pro-nuclear discourse and an increasingly strong anti-nuclear alternative to it, the cultural legitimacy of nuclear power had decreased substantially since Chernobyl. Since that time, and throughout the 1990s, public attention to nuclear power had declined (see: figure 5.1.1). In those articles that were published over this period, the co-occurrence between 'nuclear power' and 'risk' gradually increased (figure 5.3.49).

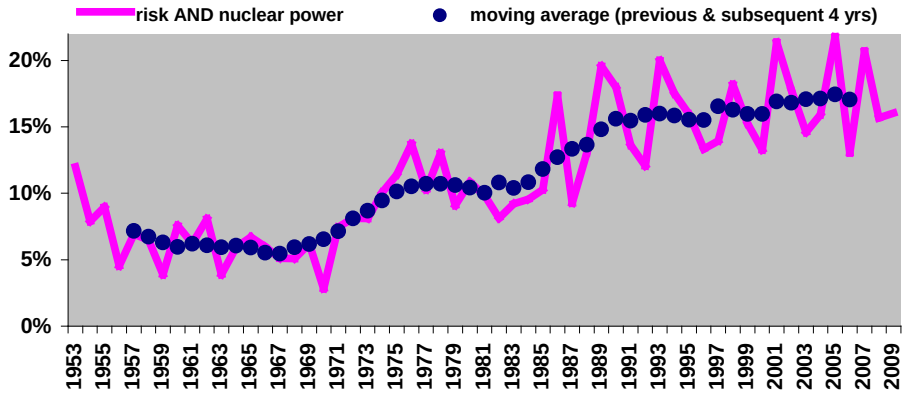


Fig. 5.3.49 Co-occurrence of keywords in legend, % of articles with 'nuclear power'. Source: The Times.

Nuclear power was talked about less, and *when* it was talked about, it was increasingly framed in terms of its risks (Lehtonen and Martiskainen, 2010). By the mid 1990s, prospects for nuclear power looked grim. In 1995, the government published the nuclear review that it had promised in 1989. It concluded that the first-generation Magnox

plants would remain in public ownership because of the high decommissioning costs, and that seven AGR stations and Sizewell B (which had not been completed) would be privatized after all because of the performance improvements since 1989. But more importantly, the government announced that under the rules of privatization, it would not subsidize the construction of any new nuclear power plants (Winksel, 2002).

The subsequent Labour victory in the 1997 general elections, which put an end to 18 years of Conservative government, seemed to seal nuclear power's fate. A 1998 report by the Select Committee on Trade and Industry Committee stated that nuclear power expansion, at least in the short run, was improbable:

> There is at present no realistic prospect of the construction of new nuclear power plant in the UK. (…) The purely commercial prospects for new nuclear plant are not significantly more attractive now than they were then. (Department of Trade and Industry, 1998)

Four years later, a 2002 Energy Review reiterated the policy set out in 1995 that nuclear power would not be subsidized:

> Nuclear power seems likely to remain more expensive than fossil fuelled generation, though current development work could produce a new generation of reactors in 15–20 years that are more competitive than those available today. Because nuclear is a mature technology within a well established global industry, there is no current case for further government support. The decision whether to bring forward proposals for new nuclear build is a matter for the private sector. (…) Nowhere in the world have new nuclear stations yet been financed within a liberalised electricity market. (Performance and Innovation Unit, 2002)

Nuclear power, many now believed, had run its course. The cartoon in figure 5.3.50 ridicules nuclear power by depicting it a knight holding a shield labeled *Nuclear Power*, riding on an emaciated horse. The knight is poking his lance at a forest of wind turbines: a reference to literary figure Don Quixote's famously misguided and futile attack on windmills. The 2003 White Paper entitled *Our Energy Future: Creating a Low Carbon Economy*, took over the 2002 Energy Review's key points on nuclear power:

> Nuclear power is currently an important source of carbon-free electricity. However, its current economics make it an unattractive option for new, carbon-free generating capacity and there are also important issues of nuclear waste to be resolved. These issues include our legacy waste and continued waste arising from other sources. This white paper does not contain specific proposals for building new nuclear power stations. However we do not rule out the possibility that at some point in the future new nuclear build might be necessary if we are to meet our carbon targets. Before any decision to proceed with the building of new nuclear power stations, there will need to be the fullest public consultation and the publication of a further white paper setting out our proposals. (Department of Trade and Industry, 2003)

It devoted relatively little attention to nuclear power: its focus was squarely on setting out a strategy to tackle the climate change issue. The report was widely welcomed by environmentalists as a visionary document whose realization promised a new style of

wide-ranging public engagement (MacKerron, 2009: 82). The primacy the report gave to renewables over nuclear power inspired the cartoon in figure 5.3.51. The image shows a nuclear power plant, labeled *BNFL Mothballs B Power Station*, cracking and bursting at the sides. On top of the reactor, a wind turbine with Tony Blair's features is visible. The wind turbine runs on an exhaust plume escaping from the cracked reactor dome, reminding the public that this sudden commitment to renewable energy does not solve the problems associated with the UK's fleet of obsolete and dangerous nuclear power stations.

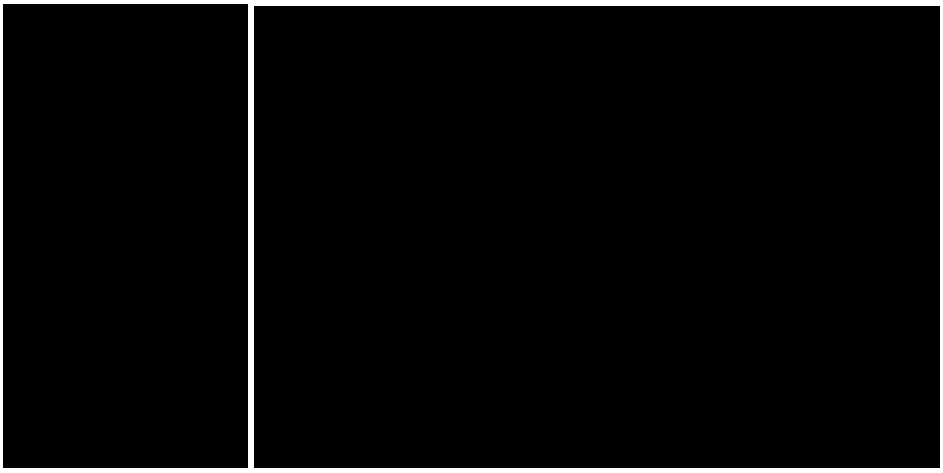


Fig. 5.3.50 Daily Telegraph, 8 August 2002 (Artist: Steve Fricker). Source: British Cartoon Archive.

Fig. 5.3.51 The Independent, 25 February 2003 (Dave Brown).

5.4 Reconstructing legitimacy: 2005-2010

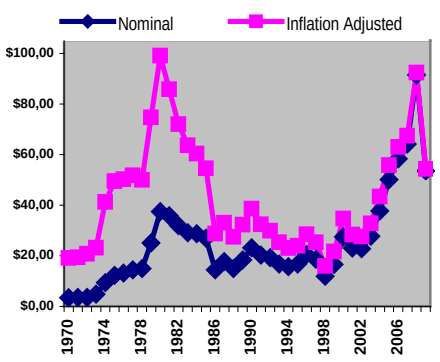
5.4.1 Centrality: nuclear power back on the agenda '05

In late 2005, PM Tony Blair announced a new review of the UK's energy policy. In the press, Blair was quoted as stating the increased centrality of the energy issue due to increased fossil fuel prices, security of supply and climate change as the main driver for this review:

> Mr Blair confirmed details of the energy review, saying: "Round the world, you can sense feverish rethinking. Energy prices have risen. Energy supply is under threat. Climate change is producing a sense of urgency." (*The Independent*, 30 November 2005, 'Greenpeace protest on nuclear energy forces Blair to switch venue')

Indeed, oil prices had almost doubled between the publication of the 2003 White Paper and Blair's 2005 announcement (see: figure 5.4.1). Also, a 2005 conflict between Russia and the Ukraine over gas (whose supply to Europe could be, and in early 2006 briefly was, simply 'switched off' by Russia) had underscored the UK's dependence on foreign

fossil fuels. Finally, public attention for climate changed had approximately tripled in both *The Times* and *The Guardian* over the same period (see: figure 5.4.2).



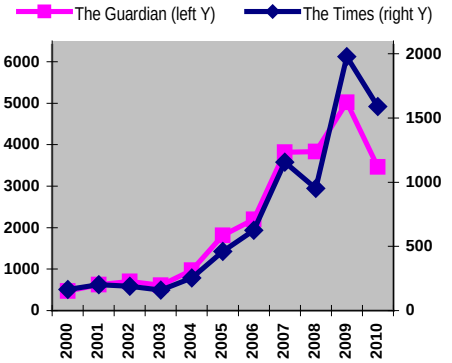


Fig. 5.4.1 Historic crude oil prices (nominal & inflation adjusted). Source: IOGA; Bureau of Labor.

Fig. 5.4.2 Number of articles including 'climate'. Sources: The Guardian and The Times.

In 2005, the government linked nuclear power to this central issue energy issue. While it acknowledged that renewables were indeed indigenous alternatives to this foreign dependence, it argued that an 'energy gap' due to the upcoming decommissioning of most of the UK's existing nuclear power plants left new nuclear construction the only realistic option to meet all these challenges simultaneously. For example, Sir David King, chief scientific advisor to the government, framed the issue this way:

> "We need indigenous energy sources so we don't rely on imported gas from Russia. We're the last in the pipeline across Europe, so a second requirement is that we have a secure energy supply. Indigenous supplies include all renewables and nuclear." Relying on renewable sources including wind, solar and wave power to replace lost capacity when existing nuclear power stations close would be a "remarkably tough challenge," he said. "At the moment 24% of energy on the grid comes from nuclear power; by 2020 that will be down to 4%. That gap of 20% is going to be very difficult to cover over the period 2010 to 2020 without new nuclear build. (*The Guardian*, 21 October 2005)

The government thus linked nuclear power simultaneously to two central issues:

- The issue of climate change; by arguing that nuclear power production did not result in the emission of CO_2;
- The issue of energy security; by arguing that it offered independence from Middle Eastern oil-producing states as well as Russian gas.

This linking influenced nuclear discourse. Since the year 2000, climate change had become an increasingly prominent theme in nuclear discourse in the press: between 2000 and 2005 the number of articles that mentioned both 'nuclear power' and 'climate' in *The Guardian* had quadrupled (see: figure 5.4.3). The co-word graph for 'nuclear

power' and 'security' (a more common word than climate, whose co-occurrence with 'nuclear power' had been a relatively steady 10% before), roughly doubled over the same period (see: figure 5.4.3). The government had successfully increased centrality through a storyline that linked nuclear power to two issues the public perceived as urgent. As of 2005, nuclear power appeared to be back on the agenda. From 2005 onward, public attention for the climate change issue increased even further (see: figure 5.4.2). And with it, the climate change theme in nuclear discourse grew ever more prominent as well. In 2009, some 40% of all The Times articles that mentioned 'nuclear power' also mentioned 'climate' (see: figure 5.4.3).

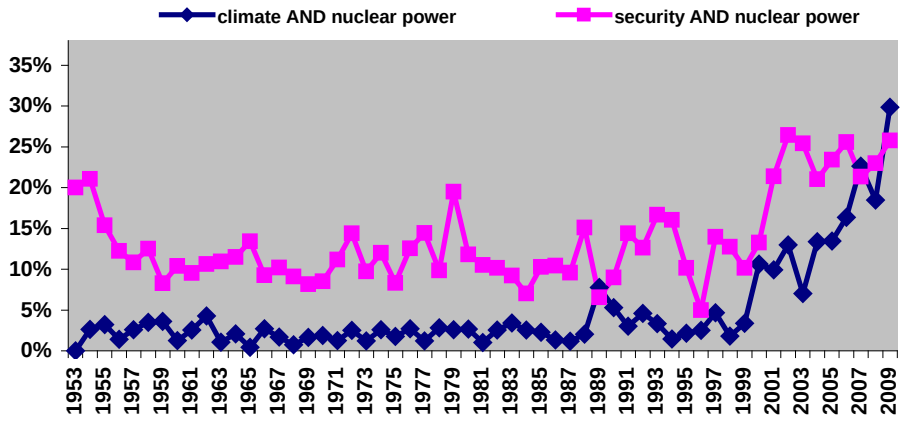


Fig. 5.4.3 Co-occurrence of keywords in legend, % of articles with 'nuclear power'. Source: The Times.

As the public sense of urgency about the climate change issue grew, it evolved from a 'challenge' to a 'critical threat'. Increasingly, militaristic terminology was used. For example, Prince Charles publicly suggested framing the issue as a war:

> Perhaps we should see this as a war we simply have to win. In wartime, it is remarkable how solutions can be found to challenges that were previously considered insoluble. (*The Scotsman,* 20 January 2007).

The cartoon in figure 5.4.4 visually captures this idea of a 'war on climate change'. It is set in the future (as evidenced by the newspaper headline reading *2050)* and shows a desolate landscape in the background. In the foreground, a malnourished boy is playing with an oil truck and some polar bears (both symbols strongly associated with the climate change issue). A similarly girl malnourished girl sits on her grandfather's lap and asks *Grandpa, what did you do in the war against climate change?*. The cartoon parodies a famous 1915 WWI recruitment poster depicting a very similar scene (figure 5.4.5). Like the recruitment poster, the cartoon is a type of 'emotional blackmail' which plays on the public's guilt and urges it to 'act now'. By the end of the decade, the centrality of the climate change issue was very high. And because nuclear power had

been vehemently suggested as its solution, the centrality of pro-nuclear discourse was similarly high by association.

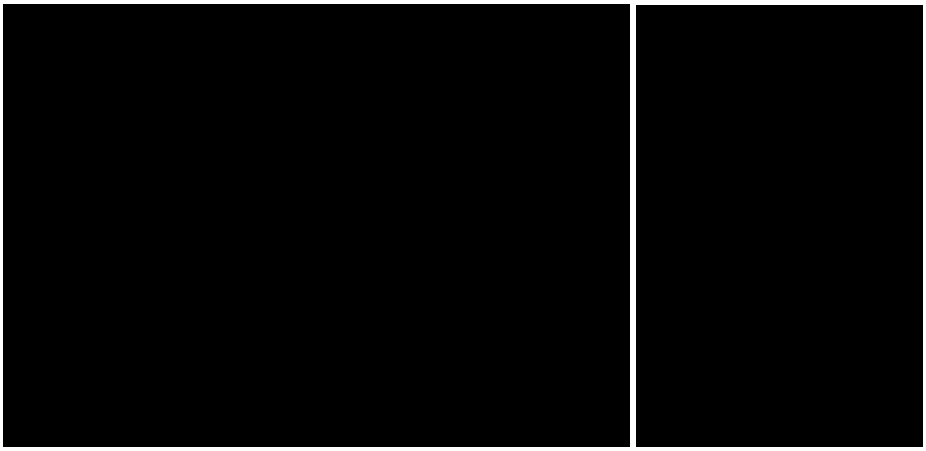


Fig. 5.4.4. The Observer, 20 December 2009 (Artist: Chris Riddell).

Fig. 5.4.5 British WWI recruitment poster, 1915 (Saville Lumley). Source: Victoria and Albert Museum.

5.4.2 Credibility: '05-'07

Nevertheless, the *way* in which the government had gone about putting nuclear power back on the agenda attracted some criticism. It would negatively impacted the credibility of the government - the main articulator of the 'nuclear renaissance' storyline. For example, after Blair's 2005 announcement of a new energy review, speculation emerged about the 'true motives' for his sudden backing of nuclear power. A *BBC News* article suggested that Blair's turnabout may have been the result of nuclear industry lobbying:

> Mr Blair is thought to have made the decision to hold an energy review - paving the way for the return of nuclear - after a meeting in September 2005 at Chequers with his advisers and representatives of the nuclear industry. Those close to the debate believe it is these advisers (…) who have most influenced the prime minister's thinking. (*BBC News*, 23 May 2007)

Others believed that Blair has always been in favour of nuclear power. For example, Greenpeace's Jean McSorley argued that

> It was Mr Blair, she argues, who in 2003 insisted on the door being left open for nuclear in the government's energy white paper, which proposed a large increase in renewable energy. (…) "I don't believe Tony Blair has been influenced by lobbying. Both he and the industry have just been waiting for the right time to make their move", says Ms McSorely. (*BBC News*, 23 May 2007)

A 2006 report published by the government's own Environmental Audit Committee, which questioned the renewed interest in nuclear power because it would not be able to

solve the energy gap, further undermined the storyline about nuclear power as a means to bridge the energy gap:

> [T]he committee strongly warns Tony Blair against opting for a new generation of nuclear power stations. The report says these would not come on stream quickly enough to have any effect on supply. (*The Observer,* 16 April 2006).

But the issue which most damaged the government's credibility in nuclear matters was a controversy over the *procedure* leading up to the 2006 energy review. The Department of Trade and Industry published its energy review, whose announcement had been welcomed by industry and the TUC but maligned by the Liberal Democrats and environmental organizations, in July of 2006. The report, entitled *The Energy Challenge* (Department of Trade and Industry, 2006), confirmed that nuclear power was back on the agenda: new stations would be built over the subsequent two decades while existing ones are decommissioned. Greenpeace had responded to its publication in 2006 by launching legal action, claiming that the government had failed to deliver on its promise to engage in "the fullest public consultation" before any decision to proceed with the building of new nuclear power stations (see: subsection 5.3.16). In early 2007, a High Court judge ruled in favor of Greenpeace: in the consultation preceding the 2006 energy review, the government had failed to give adequate information about waste management and the cost of nuclear power (MacKerron, 2009:85). The *Guardian* reported that the judge had stated that:

> (…) something had gone "clearly and radically wrong" with the consultation paper, issued last January. "The 2006 consultation document contained no information of any substance on any of the issues identified as being of crucial importance," he said. "It was not merely inadequate but it was also misleading." (*The Guardian,* 16 February 2007)

The ruling negatively impacted the government's credibility. But a widely-publicized response to the ruling by Tony Blair himself possibly damaged it even more. Although he promised to launch a new consultation,

> [t]he prime minister insisted last night that new nuclear power stations had to be part of future energy provision. "This won't affect the policy at all," he said. (*The Guardian,* 16 February 2007)

The press criticized the non-inclusive nature of the consultation process, as well as Blair's resolution to not be influenced by the outcome of the new one. For example, the cartoon in figure 5.4.6 depicted Tony Blair as a two-headed and glowing demonic figure, sitting in a chair holding two coffee mugs featuring the radiation trefoil. One of the heads says *What's all the fuss about? I consulted with you!* upon which the other head replies *You most certainly did…*

The government's credibility in matters of nuclear power was further called into question by the environmental movement when it appeared to have deliberately reframed the conclusions of a 2006 report by the Committee on Radioactive Waste

Management. The CoRWM had been set up in 2003 as an independent committee by the government to advise on the management the UK's existing stockpile of nuclear waste ('legacy waste'). It published its report in July of 2006 (CoRWM, 2006), concluding that geological disposal (the storage of radioactive waste deep underground) was the best available option. It also insisted that its conclusions for legacy waste should not be extrapolated to apply to 'new' waste, because for that case, the option of not producing it exists. The CoRWM explicitly did not want its report to be used to legitimize new nuclear construction. Yet in spite of their efforts, the proposed solution was used by the government to argue for new nuclear power plants, claiming that the waste management issue had been solved (Lehtonen and Martiskainen, 2010; MacKerron, 2009).

Fig. 5.4.6 The Guardian, 16 February 2007 (Artist: Martin Rowson).

5.4.3 Macro-cultural resonance: environmentalist dilemma '05-'10

By framing nuclear power as the only realistic solution to the central problem of climate change, nuclear proponents linked the technology to the macro-cultural repertoire of environmentalism – a repertoire that had predominantly been linked to anti-nuclear discourse before. Aside from increasing centrality, it also provided the possibility to argue for a solution to the problem that had plagued nuclear power since the early attempts at privatization: its unfavorable economics. For example, Sir David King, chief scientific advisor to the government, argued that the possibility of carbon taxes would make nuclear power economically competitive:

> Prof King, one of Tony Blair's most trusted advisers, said the public debate on nuclear power needed to focus on the environmental benefits. "It's important we do take the public with us on the environmental debate. That is why I'm trying to sell it - it's precisely because of the emissions." He added that the possible introduction of carbon taxes would make nuclear power a cheaper option than coal. "People are concerned about nuclear energy in terms of its expense, but if we had just €23 [£15.50p] per tonne on carbon dioxide then you already switch the economic argument in favour of nuclear." (*The Guardian*, 21 October 2005)

But even if a carbon tax would not materialize, the economics of nuclear power would not be a public concern: the 2006 energy review had stated clearly that under the rules of the privatized electricity sector, the costs of their construction, decommissioning and waste management would remain a matter for the private sector.

Environmental organizations like Greenpeace and Friends of the Earth responded with protests. Some felt that climate change, an issue which the environmental movement had labored to put on the agenda, was being 'hijacked' by pro-nuclear forces. This was visualized succinctly in the cartoon of figure 5.4.7, which appeared in democratic-socialist weekly magazine *Tribune.* A figure (presumably Tony Blair) is wearing a campaign button that parodies the traditional anti-nuclear 'smiling sun' logo. It is modified so that it reads *Nuclear power? Yes please!* instead of *Nuclear power? No Thanks!* (Additionally, the smiling sun itself sits atop a stem as if to suggest a nuclear explosion, drawing attention to the link between nuclear power and proliferation).

Fig. 5.4.7 Tribune Magazine, 2 December 2005 (Artist: Alex Hughes).

Arguing that climate change was not a problem was not an option for environmental organizations so instead, they argued that nuclear power was not a solution. For

example, Steve Shallhorn (Greenpeace Australia Pacific CEO) responded to the publication of *The Energy Challenge* by stating:

> "Mr. Blair has been very public about the enormous risk posed by climate change. Unfortunately he's come up with the wrong answer to the right question. Mr. Blair is using climate change as a pretext to prop up a desperate nuclear industry," said Steve Shallhorn, CEO Greenpeace Australia Pacific. (12 July 2006, source: www.greenpeace.org)

Greenpeace thus agreed with the government's framing of climate change as a serious problem, but took issue with its proposed solution. Its framing of nuclear power as the 'wrong answer to the right question' was performed in various protest actions. Figure 5.4.8 shows a Greenpeace activist with a *Nuclear: Wrong Answer* banner in the rafters of the conference room where Blair announced the energy review, while figure 5.4.9 shows an activist wearing a radiation suit and gas mask, carrying a sign with the same message.

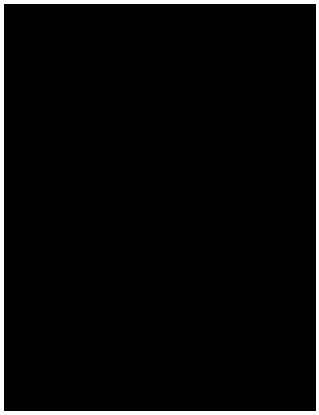


Fig. 5.4.8 Press photo of Greenpeace activist. Source: The Independent, 30 November 2005.

Fig. 5.4.9 Greenpeace photo of protest action, 29 November 2005. Source: www.greenpeace.org.

But others felt it was the *right* answer to the right question. Both pronuclear and antinuclear discourse now offered a viable and coherent framework for making sense of nuclear power in relation to climate change. As a result, press reactions to the publication differed widely. Some framed it as a necessary step in the prevention of climate change. For example, the center-right conservative newspaper *Daily Telegraph* argued that

> The logical solution, in terms of both climate protection and energy security, is the building of new nuclear power stations. It is Greenpeace and Friends of the Earth that are obsessive in their opposition to nuclear power. We should not allow the fundamentalists to blind us to its benefits. (*Daily Telegraph*, 12 July 2006)

In contrast, others framed nuclear power as a distraction and argued that a commitment to nuclear power would counteract 'real' solutions for the climate change issue. For example, the center-left, liberal newspaper *The Independent* argued:

> [W]hat has really changed is not the situation on the ground, but something rather less predictable: the Prime Minister's mind. Even before he ordered this review six months ago, it seems that Tony Blair had decided that an expansion in UK nuclear power would be part of his political legacy. (…) [T]he reality is that nuclear investment will inevitably squeeze out the funds that would be available for expanding wave, wind and solar power. (*The Independent*, 12 July 2006)

The sense-making dilemma was not limited to the press. Now that the pro-nuclear storyline was linked to elements from the 'environmentalist' repertoire, those who subscribed to the environmental norms and values were no longer 'automatically' anti-nuclear. It caused a schism in the environmental movement, which had traditionally opposed to nuclear power because of its pollution, waste issues, and proliferation risk. Environmental activist and *The Guardian* columnist George Monbiot wrote:

> If someone had worked out how to cause a war within the environment movement, they could not have developed a better means than nuclear power. In public we will line up to attack the energy review published by the government today. But in private we will reserve some of our venom for each other, as we start to ask ourselves whether we have made the right decision (*The Guardian*, 11 July 2006)

In early 2008, the government published a White Paper entitled *Meeting the Energy Challenge: A White Paper on Nuclear Power*. The document stated its objectives as follows:

> Our two key energy challenges are to tackle climate change by reducing carbon dioxide emissions and to ensure secure, clean and affordable energy as we become increasingly dependent on imported fuel. (Department for Business, Enterprise and Regulatory Reform, 2008)

Nuclear power was framed as a 'two birds with one stone' solution. Its framing as a weapon in the battle against climate change was enabled by a storyline about its 'zero-carbon' image; its framing as secure was enabled by a storyline about how using uranium offered independence from fossil-fuel exporting states; its framing as clean was enabled by a storyline about the resolution of the waste issue through geologic disposal; and its framing as affordable was enabled by a storyline about the costs being carried by the private sector and the possibility of carbon tax. Therefore, the White Paper's main conclusion could only be that a new program of nuclear power plants was desirable:

> The Government believes new nuclear power stations should have a role to play in this country's future energy mix alongside other low-carbon sources; that it would be in the public interest to allow energy companies the option of investing in new nuclear power stations; and that the Government should take active steps to facilitate this. (DBERR, 2008: 155)

A *Guardian* cartoonist commented the government's framing of nuclear power as "secure, clean and affordable" in figure 5.4.10.

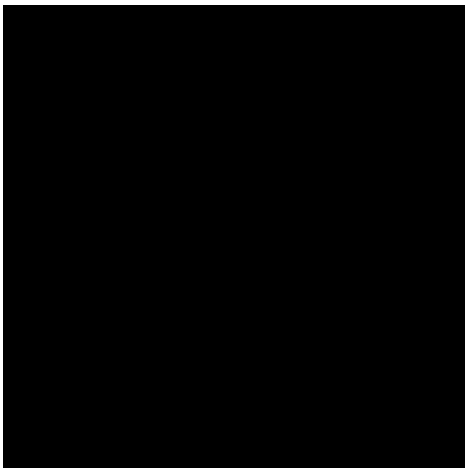
Fig. 5.4.10 The Guardian, 11 January 2008 (Artist: Steve Bell).

The image shows three white elephants, by then an often-used metaphor for nuclear power stations (see also: figure 5.3.40). An elephant labeled *Clean* is spraying excrement, while an elephant labeled *Secure* is pulling at power lines, and an elephant labeled *Affordable* is burning money. Interestingly, while it ridicules all the White Paper's framings of nuclear power that pertained to the 'second' energy challenge, it does *not* comment on the 'first' energy challenge: tackling climate change. Nuclear power, in spite of its faults, was increasingly seen as a viable climate change mitigation tool.

The increased macro-cultural resonance of nuclear power with the climate change repertoire exacerbated the schism in the environmental movement. Some members of the environmental movement changed their attitude toward nuclear power: from framing it as undesirable to framing it as a 'necessary evil'. The public 'conversion' of several prominent environmentalists, such as former Greenpeace director Stephen Tindale, drew much media attention. The self-stated reason for his change of heart was a weighing of its advantages for climate change mitigation versus its disadvantages in terms of waste and proliferation. This weighing had come out in favor of its advantages due to the perceived scale and urgency of the climate change problem:

> My change of mind wasn't sudden, but gradual over the past four years. (…) It was kind of like a religious conversion. Being anti-nuclear was an essential part of being an environmentalist for a long time but now that I'm talking to a number of environmentalists about this, it's actually quite widespread this view that nuclear power is not ideal but it's better than climate change (*The Independent*, 23 February 2009)

But many environmentalists continued to oppose the framing nuclear power as a suitable climate change solution. The UN Climate Change Conferences proved a popular stage for performaning the 'wrong answer' storyline. For example, at its 2008 conference in Poznan (Poland), Greenpeace framed nuclear power as a "dangerous distraction from investment in renewable power" by proclaiming it a *Mickey Mouse climate solution*[40] (see: figure 5.4.11). A year later, at the 2009 conference in Copenhagen (Denmark), several environmental NGO's (all partners in the international anti-nuclear campaign *Don't Nuke The Climate*) jointly decorated the iconic Little Mermaid statue in the Copenhagen harbor with a radiation mask and a sign reading *Don't Nuke The Climate* (see: figure 5.4.12) in an attempt to "symbolize nuclear industry's attempts to exploit the climate crisis for its own economic survival" (Source: www.dont-nuke-the-climate.org).



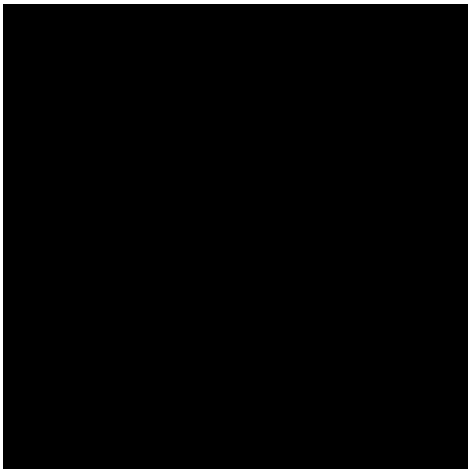


Fig. 5.4.11 Greenpeace poster, 2008. Source: www.greenpeace.org.

Fig. 5.4.12 Photograph taken at UN Climate Change Conference 2009, Copenhagen. Source: www.greenpeace.org.

However, nuclear power was not only linked to the broader climate change repertoire. In the past, it had been strongly linked to the technological progress repertoire: a 'grand

[40] This is a derogatory idiom based on the well-known Disney character. In popular discourse, if something is "Mickey Mouse" (always appears before a noun) then it is of poor quality or not to be taken seriously.

narrative' whose main premise is that technological and scientific advances will inevitably improve the human condition. The technological progress repertoire itself had not disappeared: in spite of some criticism in the late 1970s and early 1980s, it was still carried by large portions of the public, and the government in particular. What *had* largely disappeared was its link to nuclear power. This was the result of the perceived failure of nuclear power to result in 'improvements in the human condition' (and of claims that it had in fact resulted in the opposite). But now that nuclear technology was 'back to save humanity' from climate change, the link with technological progress repertoire could be - and was - restored. In July of 2008, Blair's successor PM Gordon Brown called for the construction of at least eight new nuclear power plants. In his speech, he used the following words:

> The prime minister called for "a renaissance of nuclear power" more than 20 years after major power station crises at Three Mile Island in the US and the Soviet plant at Chernobyl put a brake on nuclear stations as a growing energy source. (*The Guardian*, 14 July 2008)

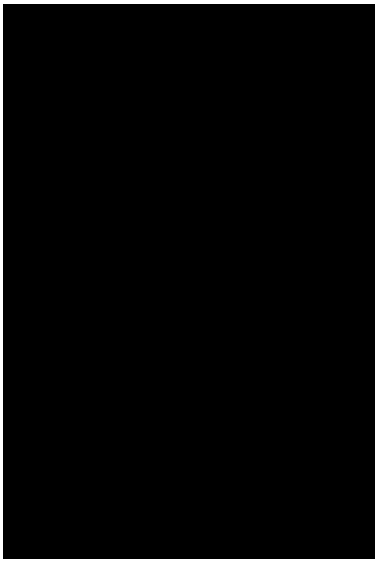
At a Labour conference in late 2008, Business secretary John Hutton also used the term nuclear renaissance:

> Britain needs to undergo a "renaissance in nuclear power", and coal will continue to be a "critically important fuel" for the country (*The Guardian*, 22 September 2008)

The renaissance metaphor in relation to nuclear power had been occasionally used in the press before (e.g. *The Guardian*, 9 November 2000, 'At this price? British Energy'), but this time, it caught on. The term 'renaissance' is typically associated with the cultural movement that bridged the Middle Ages and the Modern era. In popular parlance, it has the connotation of an unambiguously *positive* 'rebirth' out of a supposedly more primitive era. For the proponents of nuclear power, the metaphor was a perfect fit. It provided a way to give meaning to nuclear power's checkered history: not by denying it, but by implicitly acknowledging it as an outdated form of the technology that was deservedly abandoned. And it also evoked the metal image of good things to come: nuclear power, with its technological advances in terms of efficiency and safety, would provide a bridge to an era of sustainable and secure energy. Framing new nuclear construction as a renaissance linked the technology to the technological progress ideal, and thus increased the macro-cultural resonance of pro-nuclear discourse further.

Anti-nuclear activists who disagreed with this framing attempted to ridicule it. For example, Greenpeace reacted by modifying the Mono Lisa – arguably the most famous Renaissance painting – to look decidedly unhappy in front of a background of nuclear power plants (figure 5.4.13). But the 'nuclear renaissance' storyline was so popular that 'grassroots' pro-nuclear groups emerged who argued for nuclear power – something which previously had largely been the domain of the nuclear lobby. One such group, *Nuclear Power Yes Please*, changed the anti-nuclear Smiling Sun emblem into a Smiling Atom (see: figure 5.4.14) and adopted it as their logo. It proved to be a popular

'viral marketing' strategy as the logo currently appears on websites and weblogs of nuclear proponents around the world.



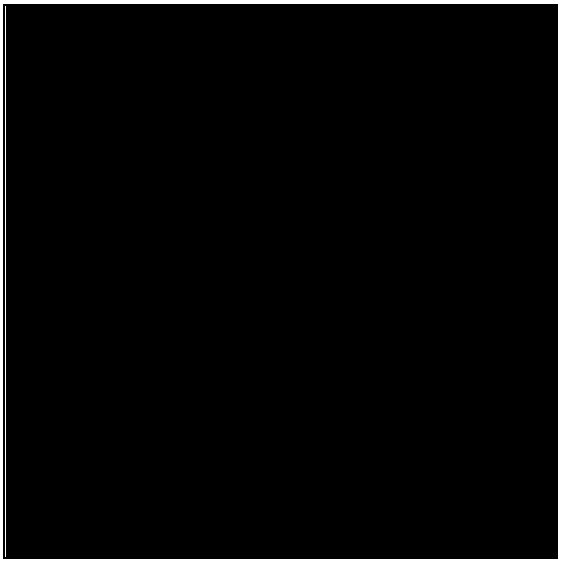


Fig. 5.4.13 Anti-nuclear poster, 2008 (Artist: Elaine Hill). Source: www.greenpeace.org.uk.

Fig. 5.4.14 Pro-nuclear logo. Source: www.nuclearpoweryesplease.org.

5.4.4 Epilogue: a nuclear renaissance?

In the early 1970s, the centrality of pro-nuclear discourse had been low. But the '73 energy crisis had affected public's daily lives. A storyline about nuclear power as the solution had increased the centrality of nuclear power discourse by framing it as necessary to meet future electricity demand increases. But this centrality diminished over the 1970s as it became evident that electricity demand had in fact leveled. In the 1980s, the Conservative government attempted to rebuild the centrality of nuclear power discourse by articulating a storyline about how abandoning nuclear power would lead to recession. But these attempts largely failed because the public had come to believe that nuclear power had mostly been leverage against the unions. When the government 'forced through' the Sizewell B plant in spite of substantial opposition, the perception that public involvement had no bearing on the outcome of nuclear development led to apathy and further decreased centrality. Moreover, low and stable oil prices during the 1990s (see: figure 5.4.1) ensured that it remained low.

The heavily publicized bickering by industry experts over the pros and cons of various reactor designs in the mid 1970s had not helped the credibility of the pro-nuclear discourse coalition. The credibility of industry experts further decreased as their predictions about future electricity consumption were proven wrong. When the nuclear industry's poor technical and economic performance record came to light during

preparations for privatization in the late 1980s, the press had framed it as a 'cover-up' and the nuclear advocates' credibility was dealt another blow. Because a key element of pro-nuclear discourse had been a storyline about nuclear power as an economically competitive electricity source, the empirical fit of pro-nuclear discourse also suffered. Moreover, the nuclear reprocessing industry's apparent inability to prevent leaks at the Sellafield facility combined with cover-ups, inadequate safety measures and scandals about falsified documents, had destroyed whatever credibility the nuclear industry had left and at the same time reduced the empirical fit of pro-nuclear discourse, as the storyline about nuclear technology as safe and reliable could be argued to be demonstrably false.

In the 1970s, the macro-cultural repertoire of technological progress, to which nuclear power had been linked in the past, had come under fire in certain segments of society. Nuclear power had also previously been linked to the macro-cultural repertoire of Britain as a world leader, but decolonization and recession had eroded that repertoire, as well. The macro-cultural resonance of pro-nuclear discourse decreased further when an American reactor design was chosen over British ones in the early 1980s: the storyline about British excellence had been one of its cornerstones. And when the macro-cultural repertoire of neo-liberalism had increased the emphasis on efficiency and cost under Thatcher, this left nuclear power an unattractive option for electricity generation.

While nuclear proponents had reframed nuclear power and tweaked their storylines in an unsuccessful attempt to increase its legitimacy, another discourse had emerged. What had started as criticisms directed at specific aspects of the nuclear industry in the 1960s and early 1970s, had grown into a full-fledged anti-nuclear discourse over the late 1970s and early 1980s. In the eyes of the public, the expertise displayed by nuclear critics in the various public inquiries over specific proposals had increased their credibility. The linking of the emerging anti-nuclear discourse to broader repertoires about environmentalism and (to a lesser degree) pacifism, had increased its macro-cultural resonance. Large-scale accidents with foreign nuclear power plants such as Three Mile Island and Chernobyl, as well as a string of leaks and incidents at the Sellafield reprocessing facility, had been mobilized as proof of nuclear power being inherently unsafe. Publicity about reprocessing issues and government plans to store nuclear waste underground had left the public feeling that instead of improving their daily lives as it had been promised to do, nuclear power might in fact hurt their health and that of their children. The storyline about nuclear power as a health risk served to increase the experiential commensurability of anti-nuclear discourse.

An increasingly weak pro-nuclear and increasingly strong anti-nuclear discourse resulted in a decreasing cultural legitimacy of nuclear power over the 1990s and contributed to its disappearance from the policy agenda in the early 2000s. But in 2005, it made a comeback when the government argued for nuclear power as a solution for the increasingly urgent issue of energy security due to increasing prices and decreasing stability of fossil fuel supplies. This increased the centrality of nuclear power once again

and placed it back on the policy agenda. And by framing nuclear power as a solution to climate change as well, the government linked it to the macro-cultural repertoire of environmentalism, which had predominantly been invoked in *anti*-nuclear discourse before.

A new pro-nuclear storyline framed nuclear power as a tool for simultaneously tackling the two 'energy challenges' of climate change and a secure, clean and affordable energy supply. Its low-carbon nature was mobilized to argue for its climate change mitigation potential; the independence from fossil fuel exporting states enabled by the use of uranium was mobilized to argue for it being secure; the 'resolution' of the waste issue offered by geological disposal was mobilized to argue for it being clean; and the notion that any investments would have to come from the private sector was mobilized for it being affordable. It was a storyline aimed at legitimizing the construction of new nuclear power plants in what came to be popularly referred to as a 'nuclear renaissance'. Through this metaphor, nuclear power was once again linked to the technological progress repertoire. By implicitly acknowledging that the technology had been deservedly abandoned before and by explicitly stating that a technologically more advanced generation would provide a bridge to an era of sustainable and secure energy, the macro-cultural resonance of pro-nuclear discourse was further increased.

As the perceived centrality of the climate change issue increased, the environmental movement faced a dilemma. Traditionally anti-nuclear, some activists now framed nuclear power as 'the lesser of two evils' in the war against climate change. Others continued to oppose it, framing it as ‘the wrong solution to the right problem’ and accused the government of 'hijacking' the climate change issue to legitimize their desire for new nuclear construction. A series of controversies over the government's 'true motives' for new nuclear construction and the relapse to a more technocratic energy policy were mobilized by environmental organizations in an attempt to reduce the nuclear proponents' credibility, but this failed to result in policy change.

In late 2008, the French state-owned electricity generation and distribution company Électricité de France (EDF) announced a takeover of British Energy. The deal was welcomed - and had been partly brokered - by the government (*The Guardian*, 20 September 2008). After the European Commission cleared the takeover (*The Guardian*, 22 December 2008) the Nuclear Decommissioning Authority (NDA) announced its willingness to provide construction sites of two nuclear stations on land bordering the Sellafield site (Mrowicki interview, 2009). In late 2009, the government published a list of eleven sites which could accommodate future nuclear power stations. In late 2010, the list was reduced to eight sites, all of which already housed either operating or shut-down nuclear power plants. The government insisted that no public funds would be made available for the construction, operation and clean-up of these plants, but because the high construction and decommissioning costs might deter potential investors, "(…) the definition of what constituted a subsidy was likely to be fought over in the coming months" (BBC News, 2010).

Chapter 6: Analysis and conclusions

6.1 Introduction to the chapter

In the field of innovation studies, an emerging interest in the concept of cultural legitimacy can be discerned. Cultural legitimacy, i.e. the perceived appropriateness of an innovation in terms of norms, values and beliefs is typically construed there as an 'intangible resource' that increases the propensity of other actors to provide other necessary resources in the early phases of innovation journeys (e.g. Rao, 1994). This is usually where the story ends: create an innovation, establish its cultural legitimacy, and implement it. But others have justifiably pointed out that cultural legitimacy is important in later phases of innovation journeys as well, because it relates to the societal embedding of innovations and the emergence of resistance against innovations (e.g. Geels *et al.*, 2007; Rip *et al.*, 1995). If an innovation is not perceived as appropriate or desirable by the wider public during implementation, societal opposition can emerge which may result in policy change that affects the innovation journey. For these reasons, an understanding of cultural legitimacy is necessary (although arguably not sufficient) to understand the success or failure of innovation journeys.

Yet this crucial concept of cultural legitimacy has not been systematically interrogated in the context of innovation journeys to date. This is where this dissertation' main contribution lies. After an extensive review of discourse theory, cultural sociology and social movement studies literature, this dissertation has argued that cultural legitimacy should be understood as a transient outcome of a *process of cultural legitimation*. This process of cultural legitimation of an innovation is understood as the struggle for hegemony of a discourse that signifies the innovation as desirable and appropriate in terms of societal values, norms and beliefs. Cultural legitimacy, then, is a discursive construct, resulting from the temporary dominance of this perspective over others: it signifies a transient closure around the meaning of the innovation as appropriate and desirable. This dissertation theorized and empirically investigated the cultural legitimation process as it relates to innovation journeys by addressing three main research questions:

RQ1: What are the specific mechanisms through which cultural legitimacy of innovations is established and contested?

RQ2: How can we conceptualize the longitudinal interactions between cultural legitimation and innovation journeys?

RQ3: How does cultural legitimacy relate to policy in innovation journeys?

In this chapter, I make a cross-case analysis of the cultural legitimation of nuclear power during the Dutch and British innovation journeys. In section 6.2, I draw conclusions with regard to the first research question about the discursive mechanisms behind the construction and contestation of the cultural legitimacy of nuclear power. In section 6.3, I draw conclusions about the phases of cultural legitimation during

innovation journeys. In section 6.4, I address the issue of how cultural legitimacy relates to policy in innovation journeys. And finally in section 6.5, I discuss the external validity of my conclusions, pinpoint underdeveloped themes in the framework, and outline a future research agenda to address these weaknesses.

6.2 RQ1: Constructing and contesting cultural legitimacy

6.2.1 Discursive dimensions

The first research question was about how the cultural legitimacy of an innovation is established and contested. This dissertation argued that the main mechanism for constructing cultural legitimacy involves articulating storylines aimed at organizing a coalition around that discourse that supports its institutionalization, e.g. the translation of the discourse into policy. Relevant audiences, which may or may not include the wider public (see: section 6.3), need to be persuaded of a certain interpretation of the innovation through persuasive performances of these storylines.

Because innovation studies pay little attention to how this process plays out, this dissertation has examined the struggle over the interpretation of nuclear power in terms of the discursive mechanisms by which plausibility and salience are constructed. It used a set of analytical dimensions, derived from social movement studies literature, for analyzing specific performances. These dimensions are:

- **empirical fit**, whose construction involves mobilizing real-world events and occurrences as proof (in order to increase an audience's perception of the claims being 'true').
- **articulator credibility**, whose construction involves mobilizing status or expertise (in order to increase an audience's perception of trustworthiness of those making the claims).
- **centrality**, whose construction involves creating discursive linkages to important or central issues (in order to increase an audience's perception of the importance of the claims).
- **experiential commensurability**, whose construction involves creating discursive linkages to everyday experiences and daily lives (in order to increase an audience's perception of its relevance of the claims).
- **macro-cultural resonance**, whose construction involves creating discursive linkages to broader, widely accepted repertoires (in order to increase an audience's perception of the appropriateness of the claims in terms of broader norms, values and beliefs).

In Chapters 4 and 5, these dimensions were used to structure my narrative about the cultural legitimation processes of Dutch and British nuclear power. In this section, I will examine each dimension separately across the cases to draw conclusions on their utility.

6.2.3 Analysis: empirical fit

Empirical fit is the analytical concept I used for examining the mobilization of real-world events and occurrences as proof with the goal of convincing an audience of the truth of certain claims.

Dutch case

In the Dutch case, Hiroshima and Nagasaki were mobilized as empirical proof that the unimaginable energy inside the atom could be released. Although some expressed the expectation that this might one day benefit humanity, such claims could not be substantiated with empirical evidence: the reality of the atomic bomb and the subsequent fear of nuclear war prevailed. A 'warlike atom' discourse shaped the interpretation of the concept of atomic energy: in the perception of the public immediately after WWII, atomic energy meant death and destruction. To break the dominance of the warlike atom discourse, the government embarked on a propaganda campaign that consisted of various performances of a 'peaceful atom' discourse. Empirical fit played a prominent role in this campaign in 1957, when the first reactor on Dutch soil was prominently displayed to by a highly interested public at the exhibition 'Het Atoom'. The reactor was linked to the 'peaceful atom' discourse by mobilizing it as real-world proof of the Dutch ability to assemble and operate a working nuclear power reactor.

Empirical fit became relevant again after the emergence of an anti-nuclear discourse, which signified the technology as inappropriate and undesirable. Throughout the 1970s this discourse had gained strength, but its empirical fit had been low because its claims of dangers were hypothetical whereas the discourse coalition around nuclear power could point to the successful construction and operation of two domestic nuclear power plants. However in 1979, opponents linked the Harrisburg accident to the anti-nuclear discourse by mobilizing it as real-world proof of their claims of risk and danger association with the technology. The media became an area for a discursive struggle around this issue, with nuclear advocates highlighting design differences between the Dutch and the US reactors, citing human error as the cause, and emphasizing that it had been only a partial (and thus ultimately controllable) meltdown. A similar discursive struggle occurred around the nuclear accident in Chernobyl in 1986, with anti-nuclear movement actors mobilizing it as the definitive proof of their claims that nuclear power was inherently dangerous and that large-scale accidents were more likely than their opponents had argued.

UK case

In the UK, the atomic bombings in Japan were mobilized as empirical proof of the destructive power of the atom, as well. The 'warlike atom' discourse increased its dominance over interpreting the concept of atomic energy with detonation of the UK's own atomic bomb in 1952, but was juxtaposed with a 'peaceful atom' discourse following the nuclear power project’s shift from a purely military to a civilian one. The

opening of Calder Hall, the world's first commercial nuclear power plant, in 1956 was prominently mobilized as empirical proof of the 'peaceful atom' discourse: the atom could now finally be harnessed for productive rather than destructive purposes. Yet subsequent budget and construction-time overshoots, as well as technical failures, were framed in the media as empirical proof against the core storyline in the peaceful atom discourse: that of nuclear power as a readily available, cost-efficient and secure source of electricity.

In later years, the mechanism of mobilizing real-world events to substantiate claims resurfaced, when the Harrisburg accident was mobilized by a small group of actors (e.g. Friends of the Earth, but also proponents of domestic reactor designs) as empirical proof of the danger of American pressurized water reactor design. It resulted in a public inquiry about the CEGB's subsequent application for the construction of a similar reactor at Sizewell. In the subsequent period, environmental movements increasingly mobilized reports on reprocessing facility leaks, as well as the Chernobyl accident, as proof of the danger of nuclear power, but the government approved the Sizewell-B plant regardless.

6.2.4 Analysis: articulator credibility

Articulator credibility is the analytical concept I used for examining the mobilization of status or expertise with the goal of convincing an audience of the trustworthiness of those making certain claims.

Dutch case

The campaign to educate the Dutch public about the peaceful uses of atomic energy was embarked upon by scientists and a technocratic government. Both were considered by the wider public to be respected, competent, trustworthy and credible: they had been given a societal mandate to restructure and rebuild Dutch society in the postwar years. Prominent scientists played a key role by giving lectures and authoring popular-scientific books, implicitly and explicitly linking their status and expertise to the peaceful atom discourse.

Articulator credibility played a key role in the later contestation of nuclear power, as well. Because arguments against nuclear power could easily be dismissed as 'irrational fears', its opponents sought out the support of concerned scientists who were willing to link their names and reputations to a discourse which signified nuclear power as undesirable. Through this mechanism, the discursive struggle was partially transformed from one of rational versus emotional interpretations, to one of conflicting rational interpretations.

A 'reverse' mechanism operated after the Harrisburg and Chernobyl disasters: instead of the anti-nuclear movement increasing their credibility by mobilizing expertise (as they had done before), they increased their credibility by emphasizing that the accident showed that they had been right about the risks *all along*. Many opponents of nuclear

power also attacked the credibility of the government after its decision to reject the Broad Societal Discussion's results, and those that had chosen not to participate highlighted their own credibility by pointing out that they had already expected this.

UK case

Even before WWII, British accomplishments in atomic physics had resulted in a public perception of the competence of scientists, and their participation in the Manhattan project served to enhance this perception. When after Hiroshima the question was raised whether perhaps science had given mankind a power which it was not ready to yield, promises that the power of the atom could be harnessed for peaceful purposes by a close collaboration between politics and science were generally accepted. But although the Windscale accident of 1957 did not result in a general perception that nuclear power was undesirable, it did impinge on the credibility of the UKAEA, one of the main articulators of the nuclear power storyline. The credibility was further damaged when promises of nuclear power as an economically competitive and secure energy sources failed to materialize over the 1960s.

In the early 1970s, Friends of the Earth labored to enhance the credibility of their arguments against the light water reactor by developing and emphasizing their scientific expertise, e.g. in the Windscale inquiry. While their arguments were not institutionalized (in the sense that they did not affect policy), this *did* enhance the credibility of anti-nuclear discourse with the wider public and established FoE's identity as its main articulator. By the late 1990s, Greenpeace had largely taken over that role. It attempted to undermine the credibility of the pro-nuclear discourse e.g. by showing how the how the nuclear reprocessing industry consistently failed deliver on their promises to lower radioactive releases into the Irish Sea in the 1990s, and by showing how the government had failed to deliver on its promises to engage the public in consultation before deciding on new nuclear construction.

6.2.5 Analysis: centrality

Centrality is the analytical concept I used for examining the construction of discursive linkages to important or central issues with the goal of convincing an audience of the importance of certain claims.

Dutch case

In its campaign to convince the Dutch public of the appropriateness and desirability of nuclear power, the government linked the peaceful atom discourse to the issue of dependence on imported fossil fuels. Following the 1956 Suez crisis, the vulnerabilities of reliance on finite and foreign resources had been a central theme in the public sphere, and the peaceful atom discourse was linked to it by framing nuclear power as the solution to the squandering of natural resources (‘potverteren’). Essentially the same mechanism operated in the early 1970s, when the *The Limits To Growth* and the 1973 oil crisis were mobilized by the government in concrete nuclear expansion plans. While

the emerging anti-nuclear movement did not question the centrality of the *problem*, they did contest the appropriateness of nuclear power as its *solution* in a response to the government's plans. And more recently, the government similarly linked pro-nuclear discourse to the increasingly central issue of climate change.

UK case

The postwar coal shortage was a key issue to which the peaceful atom discourse was linked by proposing nuclear power as a solution. It led to a broadly carried public perception of the atom as the future British energy supply: a nuclear power discourse. It was in this context that the first nuclear power program was announced in 1954. The centrality of the nuclear power discourse was further increased by the 1956 Suez crisis, which provided an increased sense of urgency about the implementation of the nuclear power program with the general public, and resulted in an increase in the program's proposed size. But the decreasing centrality of the energy issue (e.g. because of decreasing oil prices) consequently also decreased the centrality of nuclear power discourse to which it had been prominently linked. The energy issue became more central again after the 1973 oil crisis and the widespread campaign aimed at persuading the general public to reduce their energy consumption. Once again, nuclear power was framed as the solution: the nuclear industry even embarked to campaigns to convince the wider public of the desirability of their specific *designs*. But again, the centrality of nuclear power discourse decreased as the centrality of the energy issue to which it had been linked was reduced due to an unexpected leveling of energy demand in the decade after the mid 1970s. However, this did not lead to policy change: via a circular argument in which new nuclear power plants were argued to be necessary for saving the nuclear industry, new construction was legitimized in spite of an extant electricity production overcapacity.

Low and stable oil prices throughout the 1990s meant that nuclear power could not be successfully linked to the energy issue in that period. So in the late 1990s and early 2000s, after nuclear power had fallen out of grace as a result of its perceived poor economic performance and the resulting 'privatization fiasco', various articulations already framed it as a possible solution to another issue: that of climate change. With the increasing centrality of the climate change issue in the mid to late 2000s, the centrality of the pro-nuclear discourse increased, as well. Simultaneously, a new way was found to link nuclear power to the energy theme again, this time in the form of the issue of an 'energy gap': an expected mismatch between electricity supply and demand in the near future resulting from the scheduled decommissioning of older nuclear power plants. As the perceived importance of this issue grew, the centrality of pro-nuclear discourse, which interpreted nuclear power as the only viable solution to both the climate and the energy gap issues, increased.

6.2.6 Analysis: experiential commensurability

Experiential commensurability is the analytical concept I used for examining the construction of discursive linkages to everyday experiences and daily lives with the goal of convincing an audience of the relevance of certain claims.

Dutch case

Articulating experiential commensurability played a key role in the government's campaign in the late 1950s to increase the cultural legitimacy of nuclear power. In various articulations, the peaceful atom discourse was linked to the wider public's everyday experiences in all societal domains: atomic energy could be used for measuring the cleanliness of laundry, making homogeneous paints, preserving foodstuffs, diagnosing and curing various diseases, and providing a source of power for electricity generation as well as transportation over land, sea and air. Yet in spite of these promises, first noticeable effect on the general public's daily lives was an increase in their electricity bills because of the Kalkar levy. Anti-nuclear actors mobilized this event to argue for a withdrawal from the Kalkar project, which increased the experiential commensurability of the anti-nuclear storyline.

However, the increasingly radical strategies (e.g. from indirect to direct action and even violence and sabotage) adopted in later years by anti-establishmentarian elements in the anti-nuclear movement served to lower the experiential commensurability of anti-nuclear discourse with the wider public, which could not identify with their goals and actions. But the relevance of anti-nuclear discourse for the daily lives of the wider public increased again later on. When a radioactive cloud from the accident reached the Netherlands a temporary ban on spinach and milk powder that was instigated and caused a run on canned foods. Subsequent ant-nuclear movement articulations successfully linked this event to the undesirability of nuclear power.

UK case

The possibility of peaceful uses of the atom 'around the house' was discussed in the public sphere immediately after WWII, albeit in very abstract terms. The Minster of Supply's 1953 statement that, after the success of atomic energy would constitute a new source of industrial power and the announcement of a nuclear power program in 1954 led to a narrowing of the peaceful atom discourse to the idea of nuclear power. The government embarked on a publicity campaign that stressed the importance of nuclear power for people's everyday lives in keeping the factories running, the shops filled, and the air clean. In the early to mid 1960s, the issue of power cuts, which directly interfered with people's daily practices, was mobilized to increase the experiential commensurability of nuclear power discourse by framing nuclear power as a solution. This strategy was rendered ineffective, however, by renewed blackouts which new nuclear power plants were not able to prevent. Nevertheless, these renewed blackouts were used to legitimize an increase in the proposed size of the second nuclear power program. In later years, environmental organizations like Greenpeace enhanced the

experiential commensurability of anti-nuclear discourse by emphasizing the concrete health impacts associated with the reprocessing industry and the transport and storage of nuclear waste

6.2.6 Analysis: macro-cultural resonance

Macro-cultural resonance is the analytical concept I used for examining the construction of discursive linkages to broader, widely accepted repertoires with the goal of convincing an audience of the appropriateness of certain claims in terms of broader norms, values and beliefs.

Dutch case

In the postwar years, reconstruction and industrialization were important, widely carried and highly institutionalized macro-cultural repertoires. The peaceful atom was linked to these broader macro-cultural repertories through emphasizing its application as a source of industrial power as well as the possibility of a national industry emerging around it.

Over the 1970s, linking nuclear power to the emerging counterculture repertoires was a crucial part of the anti-nuclear movement strategy. It linked anti-nuclear discourse to emerging environmentalist repertoires e.g. by creating a storyline about the sea dumping of nuclear waste. It also linked it to the peace and disarmament repertoire e.g. through a storyline about the risks of the proliferation of plutonium associated with nuclear power production. It was linked to anti-establishmentarian repertoires through a storyline about how nuclear power was undemocratic and necessitated a police state. And finally, anti-nuclear discourse was linked it to a technocracy repertoire e.g. by creating a storyline about establishment experts downplaying (risks of) accidents. The government's 1985 rejection of the Broad Societal Discussion's conclusions revived the technocracy link: the decision was framed as proof of the government pursuing technological progress at all costs and against the will of the people, which increased the macro-cultural resonance of the anti-nuclear discourse. More recently, nuclear advocates linked pro-nuclear discourse to the increasingly widely accepted climate change repertoire by creating a storyline about nuclear power as an inevitable part of a strategy for meeting internationally agreed criteria for carbon dioxide emission reduction.

UK case

After WWII, the desirability of progress and the imperative for peace constituted widely-shared and taken-for-granted macro-cultural repertoires. The peaceful atom discourse was linked to both: the development of peaceful applications of atomic energy was not only an inescapable part of general techno-scientific progress, but it would also usher in an era of prosperity that would remove the incentives for war. The strategy was successful: even the Campaign for Nuclear Disarmament was not opposed to nuclear power between the late 1950s and the late 1970s. When the peaceful atom discourse gradually turned into a nuclear power discourse, it was linked to a macro-cultural repertoire of national greatness by connecting the early nuclear successes to Britain's

illustrious past. Yet the subsequent framing of domestically designed reactors as important future export products which would make Britain a world leader in nuclear technology stood in sharp contrast to the poor performance of the first nuclear power program.

While in the Dutch case early anti-nuclear sentiments were articulated by an emerging counter-culture movement, UK counterculture in the late 1960s and early 1970s was more concerned with the social class system and nuclear weapons than with nuclear power. Neither was the emergence of new environmentalism in the late 1960s and early 1970s initially strongly linked to nuclear power: only Friends of the Earth argued against a specific reactor design (and not the totality of nuclear power), while other environmental organizations were initially disinterested. This changed in the late 1970s, when attempts (unsuccessfully) were made to organize local 'NIMBY' resistance to nuclear power into a national movement, and Greenpeace started campaigning against the sea dumping of nuclear waste. In spite of some attempts, no strong link between anti-nuclear discourse and peace and disarmament was made (i.e. for the majority of the public, they remained separate issues).

Nevertheless, the nuclear power innovation journey was stalled in the 1980s, when the macro-cultural repertoire of neo-liberalism was linked to nuclear power through privatization of the electricity sector. Privatization meant that the appropriateness of nuclear power would be judged in terms of markets, efficiency, and consumer choice. But its history of poor economic performance meant that it was not perceived as appropriate in these terms, which reduced the macro-cultural resonance of pro-nuclear discourse in this context.

6.2.8 Conclusions on analytical utility

A common outcome of a discourse analysis is a description of the evolution over time of the discourse(s) under study. The cases have shown that in the Dutch and British order of discourse (i.e. the possible ways of talking) about atomic energy, a warlike atom discourse emerged in the public sphere as a result of Hiroshima and Nagasaki. It was successfully juxtaposed with a peaceful atom discourse, which was aimed at legitimizing the development of nuclear technology. As the latter discourse became increasingly centered around the application of electricity generation, it was transformed into a nuclear power discourse. When criticisms and alternative interpretations first appeared, they were initially expressed within (and in the terms of) this discourse, and did not question the cultural legitimacy of the concept of nuclear power. In terms of discourse theory, the boundaries of a discourse appear where meanings are articulated in a way that is not compatible with that discourse (Phillips and Jørgensen, 2002: 143). So when alternative interpretations emerged which no longer signified nuclear power as generally appropriate and desirable, an analytically distinct anti-nuclear discourse emerged.

But in addition to mere description of that discursive evolution, this dissertation has aimed to investigate *how* this cultural legitimacy was constructed and contested. It did so by showing how both proponents and opponents of nuclear power strategically constructed storylines about the (il)legitimacy of the technology, and how they aimed to convince various audiences by increasing the *plausibility* and *salience* of these storylines. The various concrete performances on the above dimensions thus reproduced various discourses, but changed them over time, as well. Generally, the cases have shown that the above dimensions are useful for structuring analytical narratives about the cultural legitimation process. By enabling a detailed analysis of the plausibility and salience of nuclear power storylines (as strategic performances of pro- and antinuclear discourses), the proposed dimensions offer a useful framework for understanding various aspects of the strategic construction and contestation of the cultural legitimacy of nuclear power.

Plausibility, or the perception of the truth of the storyline, was achieved through constructing empirical fit and articulator credibility. The concept of empirical fit proved especially useful for showing:

- ...the definitive establishment of cultural legitimacy in the early phase. Performing to increase empirical fit appears to have been the 'keystone' of the early peaceful atom discourse. While the early nuclear power storyline was salient (i.e. it resonated with broader cultural repertoires, it was perceived as central, and it spoke to people's everyday needs) and its articulators were trusted, it lacked plausibility in the sense that the only 'empirical proof' readily available to the public was the detonation of atomic bombs. Highlighting early successes in peaceful applications served as a the final step in convincing wider audiences of the appropriateness of nuclear power.
- …the discursive struggle over the interpretation of external events. It enables the analysis of specific events as the concrete battlegrounds on which antagonistic discourses interact. In both cases, nuclear accidents (e.g. Harrisburg, Chernobyl) were mobilized as real-world proof of the undesirability and inappropriateness of nuclear power by some. Conflicting interpretations of such events function as a kind of 'proxy wars' in the larger conflict between pro- and antinuclear discourse.

The concept of actor credibility proved especially useful for showing:

- …the relatively uncontested authority of government in nuclear matters in the early phase of its innovation journey and the involvement of prominent scientists in public performances of the peaceful atom discourse.
- …the strategy, pursued by proponents throughout the innovation journey and across cases, of reframing anti-nuclear sentiments as 'irrational' and pro-nuclear sentiments as 'rational', and the subsequent dismissal of these former arguments through an appeal to reason.

- …the different strategies by which opponents of nuclear power responded to this by establishing their own credibility (e.g. either by contesting the merit of the rational/irrational distinction, building their own expertise, enrolling outside experts, or attacking the credibility of their opponents).

Salience, or the perceived importance of the storyline, was achieved through constructing centrality, experiential commensurability and macro-cultural resonance. The concept of centrality proved especially useful for showing:

- …how nuclear power was a 'solution in search of a problem', in the sense that the nuclear power storyline was adjusted throughout its innovation journey by reframing the technology as the preferred means to address a variety of issues that the public perceived as important.
- …how the perceived importance of the nuclear power storyline rose and fell with the perceived urgency of these issues to which it was presented as a solution[41]. Since the transformation of the peaceful atom discourse into a nuclear power discourse, these had been energy-related issues such as fossil fuel depletion, dependence on foreign nations and (more recently) climate change.

The concept of experiential commensurability proved especially useful for showing:

- …the importance of articulating expectations about how an innovation will positively impact the wider public's everyday lives when no concrete material artefact yet exists that conveys this experience. In the early stages of the innovation journey, before implementation was begun, nuclear power was framed in terms of the wider public's everyday lives so as to render the concept less abstract.
- …that the most effective articulations of expectations about how nuclear power would *negatively* impact people's lives centred around the subject of public health.
- …how radical (and sometimes violent) direct action strategies by anti-nuclear actors could alienate the wider public from their goals, but simultaneously increase the centrality of the subject and the credibility of more moderate exponents of the anti-nuclear movement (i.e. a 'radical flank effect', Haines (1988)).

The concept of macro-cultural resonance proved especially useful for showing:

- …how nuclear power was rendered culturally legitimate by strategically linking it to taken-for-granted discourses, e.g. modernization, techno-scientific progress and industrialisation.

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[41] It is tempting to interpret the media attention graphs of figures 4.1.1 an 5.1.1 as 'indicators of centrality', because they relate to how important the subject is in the media. But beyond the problematic assumption that media coverage accurately reflects public attention, it is even more important to recognize that such a graph would at most reflect the *success* of such attempts.

- …the interaction (or lack thereof) between anti nuclear power discourse and emerging discourses which *questioned* the aforemention taken-for-grantedness of modernization and progress discourses (e.g. by the peace- and environmental movements).
- …how the more recent framing of nuclear power as an inevitable part of a strategy for combating climate change can be understood as a hegemonic intervention aimed at achieving a fixation of the meaning of nuclear power as desirable *across* antagonistic discourses (see: subsection 6.3.5).

But while the above concepts have proven to be generally useful for structuring the narrative, it is equally important to recognize that the proposed discursive strategies of linking storylines to occurrences, expertise, key issues, everyday life and broader discourses are not deterministic (i.e. they are not used in a predetermined order, nor does the same strategy necessarily produce the same result in different audiences, periods, or countries). This is partially because actors are to some degree free in picking and choosing strategies for persuading audiences, and are to some degree limited in their choice of strategies by the prevailing political opportunity structures. This means that it is not only possible, but indeed very likely, for the cultural legitimation process to play out very differently between cases. Even so, some patterns of commonality between cases can be found, for example in terms of the audiences which are addressed at certain points in time, the stages on which the storylines are performed, and the goals of the performances. These patterns of commonality are the subject of section 6.3. Moreover, beyond the differences in how the cultural legitimation processes played out in the Dutch and British cases, the innovation journeys' *outcomes* differed substantially, as well. These differences can only partially be attributed to the differing cultural legitimation strategies. Section 6.4 will argue that for a full understanding of innovation journey success or failure, an understanding of cultural legitimation is a necessary, but not sufficient, condition.

6.3 RQ2: Cultural legitimation phases in innovation journeys

6.3.1 Introduction

The second research question was about how the longitudinal interactions between cultural legitimation and innovation journeys can be conceptualized. In subsection 2.3.3, I argued that because of a shift over time in (1) the stages on which storylines are performed, (2) the audiences at which they are directed, and (3) the goals of the performances, it should be possible to discern analytically distinct *phases* of cultural legitimation. Acknowledging that contestation can occur in all phases, and that the process can be halted in any given one, I proposed a tentative conceptualization of the cultural legitimation process in innovation journeys of four phases:

1. *Construction of cultural legitimacy*. In this phase, cultural legitimacy is established in order to obtain the necessary resources to initiate developmental activities. It is about innovation champions convincing resource controllers of the appropriateness and desirability of an innovation in terms of the latter parties' norms, values and beliefs. This involves framing the innovative idea as a solution to some perceived problem or need. Resource controllers are the main audience at which the legitimating performances are aimed: wider publics are less important in this phase.

2. *Extension of cultural legitimacy*. In this phase, cultural legitimacy is extended to wider society. It is about convincing wider society of the cultural appropriateness and desirability of the innovation, so as to facilitate its societal embedding. This involves performing storylines on *public* stages such as the media, public debates etc. Civil society is now the main audience of the performances, which are aimed at 'enrolling' the general public into the discourse.

3. *Stabilization of cultural legitimacy:* This phase is about maintaining cultural legitimacy: ensuring that wider society continues to interpret the innovation as appropriate and desirable as it becomes increasingly applied. Maintenance of cultural legitimacy involves "(...) symbolic assurances that all is well, and (...) attempts to anticipate and prevent or forestall potential challenges to legitimacy" (Ashforth and Gibbs, 1990, p. 183).

4. *Destabilization of cultural legitimacy*. The stability of meaning achieved in the previous phase is not necessarily permanent. If new social groups articulate coherent alternative interpretations that signify the innovation as *un*desirable or *in*appropriate, an antagonistic discourse emerges. Organized opposition against the innovation can then be seen as the performance of such antagonistic discourses, and if these performances are persuasive, the cultural legitimacy of the innovation is (either rapidly or gradually) lost as its inappropriateness and undesirability becomes the dominant interpretation.

In the subsequent subsections, I analyze to what extent the hypothesized cultural legitimation dynamics were indeed present in the case studies of Chapters 4 and 5. While I conclude that the model is useful for conceptualizing the cultural legitimation process during the nuclear power innovation journey between its inception and its fall from grace in the late 1980s to early 1990s, the subsequent period shows that the loss of cultural legitimacy does not necessarily imply the termination of its innovation journey. For this reason, I refine the process model by making it cyclical.

6.3.2 Construction phase

Dutch case

The construction of cultural legitimacy first occurred in the initiation and development phases of the nuclear power innovation journey, which in The Netherlands was characterized by a long gestation period. In de pre-WWII period, Dutch scientists had

closely followed the international breakthroughs in the domain of atomic physics. They had convinced policymakers to acquire uranium for research purposes already in 1939. At that time, the possibility of a controlled release of atomic energy for constructive rather than destructive purposes had been more an abstract idea than a concrete plan aimed at meeting a specific need. Yet several contingent events served to translate the initial innovative idea of controlled nuclear fission to a concrete plan for nuclear power reactors:

- One was the detonation of the atomic bombs over Hiroshima and Nagasaki. These dramatic events constituted empirical proof that the energy inside the atom could be released (albeit for destructive purposes). Moreover, scientists discursively constructed these events as a compelling reason for a technocratic government, arguing that disaster could only be averted if scientists and governments worked closely together.
- A second was the devastation brought on The Netherlands itself during WWII. In the postwar years, industrialization was thought to be a key driver for reconstruction as well as restoration of national pride. Nuclear fission was discursively constructed by scientists as a possible new industry of global importance, in which The Netherlands could be a forerunner.

Immediately after WWII, in a period in which 'atomic energy' was more or less exclusively talked about in terms of atomic destruction in the public sphere, scientists had thus successfully persuaded resource controllers (i.e. the government) of the appropriateness of controlled nuclear fission. This enabled the allocation of substantial financial resources to research aimed at assessing the possibility of electricity production through nuclear fission (resulting e.g. in the establishment of FOM and IKO). By 1950, this resulted in a concrete plan which entailed the construction of a small test reactor and a full-scale reactor which was argued to be important for industry.

During the development phase, design paths diverged (e.g. FOM worked on a natural uranium reactor based on the Kjeller reactor, while KEMA pursued a domestically designed suspension reactor). The unexpected availability of enriched uranium from the USA and the UK following the Atoms for Peace program resulted in some convergence of these development paths (e.g. it rendered the natural uranium reactor design superfluous). Throughout this phase, FOM scientists had sought out international collaboration (e.g. engaging in a partnership with Norway for a reactor in Kjeller in 1951). Moreover, the articulation of concrete plans for using atomic energy as a means of electricity generation had enabled the establishment of networks between relevant actors, e.g. partnerships between FOM, industry and (through KEMA) the electricity sector. Nuclear research became increasingly framed as applied research, i.e. directed towards concrete, peaceful applications of atomic energy. The government, FOM, KEMA and industry thus established a new joint organization for nuclear research in 1955 (RCN). The cultural legitimacy of nuclear power had successfully been created among resource providers, and a network of actors had emerged around the idea.

Although they had different interests, collective actors such as science, industry, the electricity sector and the government had all been enrolled into a discourse coalition by a shared storyline about the development of nuclear power plants.

British case

In the UK case, the innovation journey had started with an extended gestation phase, as well. A 1941 report for the War Cabinet had already contained the notion of the 'Use of Uranium as a Source of Power', and British scientists had actively participated in the Manhattan Project. When the USA denied British scientists access to their nuclear research after WWII, the government resolved to develop an independent nuclear deterrent. Two nuclear reactors were constructed and although it was suggested early on that these might be designed to produce both plutonium and electricity, the resulting delays in plutonium production were deemed unacceptable. This emphasizes that nuclear power was exclusively a military project at the time. But the abstract idea of nuclear electricity production was translated to a concrete plan in response to several contingent events:

- A postwar coal shortage and an extremely harsh winter in 1947/1948 were discursively constructed by scientists as a reason to construct a hybrid reactor which would produce plutonium as well as generate electricity from waste heat.
- The successful detonation of the UK's first nuclear weapon in 1952 increased the demand for cheap plutonium for building a nuclear arsenal. A hybrid reactor was argued to decrease the cost of plutonium by also producing electricity.

Much like in the Dutch case, atomic matters were initially discussed in the public sphere mostly in terms of the atomic bomb and its consequences. But throughout this period, the cultural legitimacy of nuclear electricity increased among policymakers, leading to the public announcement of the world's first large-scale electricity-producing nuclear power plant in 1953. Scientists had designed and tested natural uranium graphite moderated reactors, heavy water moderated reactors, and fast-breeder reactors. These paths converged with the government's announcement of the first nuclear power plant 1953 on the design that, while producing electricity, offered the best plutonium output (Magnox). But soon after, the nuclear electricity storyline affected the structure of the nuclear sector. What had still been a purely military project under control of the Ministry of Supply in 1951 (when calls for a transfer of responsibility to an independent organization had been rejected), had changed into a civilian project by 1954 with the establishment of the UKAEA. The UKEA functioned as in intermediary between the electricity supply sector, and industry. To stimulate the involvement of industrial actors, four consortia (each consisting of a generator manufacturer, a boilermaker and a civil engineering contractor) were established. Through a system of turnkey contracting, each consortium would be responsible for the design and construction of a number of Magnox plants for the Central Electricity Authority (CEA) as part of the country's first

nuclear power program. As in The Netherlands, a coalition of relevant actors had gathered around the storyline of nuclear power production.

Conclusions

While in The Netherlands a public discourse about atomic energy emerged only after Hiroshima, it had already existed in the UK well before WWII as the result of British breakthroughs in atomic physics and their popularization by the media (which may explain why the Dutch public attention graph in figure 4.1.1 starts at zero and rises between 1945 and 1953, while its UK counterpart in figure 5.1.1 shows a steady presence of the topic over the same period). Regardless, in both countries the threat of nuclear destruction dominated the public's discussion about and interpretation of 'atomic energy' in the immediate postwar years. In the technology's initiation phase, the public interpretation in the public sphere of the atom was generally a negative one. Yet outside the view of the public, scientists in both countries had successfully labored to convince their governments of the appropriateness of pursuing research into nuclear power production. Nuclear power research and development was framed as desirable in terms of the beliefs of resource controllers (in the UK: the belief that large quantities of plutonium were required for defense, and in The Netherlands: the belief that new growth industries were required for postwar reconstruction). In both cases, prominent nuclear scientists headed new organizations, established by the government on their advice, to assess the viability of the innovative idea. Discourse institutionalization took place when in changes in the organizational structure started reflecting the changing meaning of atomic energy (e.g. the establishment of RCN and the UKAEA). A storyline was articulated which successfully enrolled additional actors which were considered relevant for achieving this goal (e.g. industry, the electricity sector) into a discourse coalition around the idea of a nuclear power plant. This shared storyline fixed the meaning of nuclear power as desirable: it shaped the electricity sector's interpretation of nuclear power as a means to provide a secure power supply, and the industry's interpretation of nuclear power as a means to tap new markets and realize profits. In summary, both cases thus support the proposed 'construction of cultural legitimacy' phase that involves convincing resource controllers of the appropriateness and desirability of the innovative idea, in order to obtain the necessary resources to initiate developmental activities.

6.3.3 Extension phase

Dutch case

The extension of the cultural legitimacy of nuclear power to wider society began already during the development phase of the nuclear power innovation journey. In the storyline about the development of nuclear power plants, the innovation was argued to

have a large impact on The Netherlands. It would be financed to a large extent with public money[42]. Hence, the societal embedding of nuclear power was considered to be important. However, the threat of nuclear destruction had dominated public discourse about atomic energy since the end of WWII. To counteract this, a 'propaganda campaign' was initiated (Van Lente, 2008). It included public lectures, popular-scientific books and educational material, which extolled the future benefits of atomic energy research in all societal domains. The propaganda can be seen as a series of coherent performances of a 'peaceful atom' discourse that was juxtaposed with the 'warlike atom' discourse. The campaign corresponded with a substantial increase in public attention between 1953 and 1957 (see: figure 4.1.1), as well a decrease in the co-occurrence of 'atomic energy' and 'atomic bomb' in newspaper articles over the period (see: fig. 4.2.12). At the height of public attention, the educational exhibition 'Het Atoom' was organized to create a "healthy atmosphere" for the decisions about investments in nuclear power that Parliament still needed to make, as well as to motivate young people to pursue a career in the nuclear sector (Van Lente, 2008: 150). It was successful at assuaging "unmotivated" public fears about the dangers of radiation, whose effects had become visible to the public in the aftermath of Hiroshima and Nagasaki. Nuclear power had become a staple in visions of the future, which contributed to the impression of living in an 'atomic age'. Briefly after the exhibition, the government announced its intention of having an operational nuclear power plant a mere five years later.

British case

Public attention to nuclear power increased substantially after 1954 announcement of the first nuclear program. But since WWII, the atomic bomb had dominated atomic energy discourse in the public domain. This received a new impulse with the UK's own successful atomic detonation in 1952. As a result, promises of a concrete peaceful application were met with some skepticism. When the government tripled the size of the proposed program in 1957 (following an increase in oil prices resulting from the Suez crisis), it thus embarked on a publicity campaign that was aimed at informing the general public of its nuclear power program and emphasizing its urgency and desirability. In the British case, these strategic attempts at expanding the cultural legitimacy of nuclear power to the wider public were made at the beginning of the implementation phase of the nuclear power innovation journey. The technology's implementation began earlier than in the Dutch case: the world's first large-scale commercial nuclear power plant (Calder Hall) opened in 1956, at the height of public

[42] Between 1955 and 1969 (the opening of the first Dutch nuclear power plant), approximately one billion guilders of public money was spent on nuclear power, as opposed to some 120 million by Dutch industry and the electricity sector combined (Tweede Kamer, zitting 1971/1972, no. 11761, source: www.kernenergieinnederland.nl).

attention to nuclear power (see: figure 5.1.1). Further implementation subsequently proceeded in three programs (consecutive in terms of planning but partially overlapping in practice), each consisting of several nuclear power plants of a similar design.

Conclusions

Both cases confirm that the wider public was considered to be a relevant social group in this context, and strategic attempts were made to extend the cultural legitimacy of nuclear power to civil society. In both countries, the 'warlike atom' had been the dominant discourse about atomic energy since the end of WWII. In an attempt to change this, it was juxtaposed with a 'peaceful atom' discourse through publicity campaigns. The ‘peaceful atom’ engaged in a discursive struggle with the ‘warlike atom’ over the public's interpretation of atomic energy. Some performances attempted to achieve hegemony by displacing the boundaries between the two discourses (e.g. arguing that the peaceful applications of atomic energy would solve world hunger, which would in turn thereby take away the incentives for using its warlike applications). But most were simply underpinned by a ‘knowledge deficit’ model. This model assumed that any public skepticism about nuclear power was caused by insufficient understanding of how it worked, and that educating the public would thus ensure its belief in the virtues of science and the technology it produced.

In summary, both cases support the proposed ‘extension of cultural legitimacy’ phase, which includes performances geared towards enrolling the wider public. Yet a qualification also needs to be made. While the initial model suggested that construction of cultural legitimacy takes place during initiation and development phases of the innovation journey and extension during implementation, the cases show that that overlap can exist: while in the British case, extension of cultural legitimacy indeed maps onto the implementation phase, extension was already sought in the development phase in the Dutch case.

6.3.4 Stabilization phase

Dutch case

The stabilization phase occurred during implementation of nuclear power in The Netherlands. Although the possible dangers of atomic energy were public knowledge, concrete events involving (alleged) radioactive contamination in the late 1950s were successfully framed as reminders to exercise caution and intensify research efforts, instead of as incentives to abandon atomic energy. This phase was also characterized by negotiations about nuclear power outside the view of the public. The Suez crisis had increased the perceived urgency of nuclear power, but the unexpected abundance of cheap oil afterwards, as well as the discovery of large amounts of natural gas just two years after the ambitious 1957 announcement, had altered the perception of the economic feasibility of nuclear power. Nevertheless, the perceived appropriateness and desirability of nuclear power persisted in policy circles: although the government

acknowledged in 1961 that it had been too optimistic about costs, it still believed that eventually nuclear power would become so widespread that the economic value of the domestic gas reserve would plummet. Therefore it favored a policy of quickly selling it off. In 1964 the construction of a first power reactor, designed to be large enough to learn from but small enough so as not to result in substantial economic losses, was initiated. In 1969, a regional electricity company unilaterally decided to order a far larger second plant with a German company, thereby sidelining the Dutch industry and government. In 1972, during the plant's construction, rising oil prices combined with the expectation of an ever-increasing electricity demand had brought the government to propose some 35 new nuclear power plants.

British case

As nuclear power became less economically interesting because of falling oil prices in the late 1950s, the nuclear industry encountered financial difficulties. In the first half of the 1960s, the press reported on a waning nuclear industry, obsolete designs, and large budget- and construction time overshoots for the first program's power plants. Yet all criticism was aimed at the organization of the British nuclear industry and the choices it had made; not at the technology of nuclear power as such. A generalized perception of the desirability and appropriateness of nuclear power persisted with the general public throughout the implementation of the first nuclear power program in spite of well-publicized setbacks. Because nuclear power was still considered to be the future of the British electricity supply system, the government announced a second program in 1964. It was based on a domestic design which was hoped to become an export product in what was expected to be a growing international market. This time, some contestation of the general desirability of nuclear power emerged by actors with a vested interest in the coal mining industry. Yet it occurred mostly behind the scenes as political lobbying targeting civil servants and politicians, instead of as attempts to mobilize public opinion. Although the lobby was well-connected, it failed to convince the government, which still felt that "coal was finished, nuclear was the future" (Herring, 2005). The Club of Rome report and the 1973 oil crisis further strengthened this view. Among the general public, the cultural legitimacy of nuclear power remained largely intact.

Conclusions

In neither case did incidents (e.g. the Windscale fire of 1957 in the UK, and radioactive contamination incidents in The Netherlands) lead to a generalized perception of nuclear power as inappropriate or undesirable. The incidents *did* create a minor stir among the Dutch and British publics, because the dangers of radiation had become public knowledge following Hiroshima and Nagasaki. But they were successfully drawn into the peaceful atom discourse, which fixed their meaning as 'irregularities' that only served to emphasize the need for more research and the establishment of a good regulatory framework. Although in the UK case, the inconsistent response and sparse information provided by authorities regarding the accident *was* interpreted by some as proof of the opaque nature of the nuclear establishment, it did not lead people to

question the broad concept of civilian nuclear power. In discourse theory terms, these events had been 'floating signifiers' which had been successfully filled with meaning in such a way that they could not come to be interpreted as reasons to stop pursuing nuclear power. Turning to the graphs in figure 4.1.1 and 5.1.1, a remarkably similar pattern in both cases is visible: a large increase in press attention to the subject between 1953 and 1957, followed by a somewhat more gradual decrease until the early 1970s. In discourse theory terms, the articles in which the keywords appear are specific articulations of meanings of nuclear power. One reading of these up-and-down dynamics is that they correspond with the stabilization of these meanings: the rise signals discursive struggles between the warlike atom discourse and the peaceful atom discourse, and when closure occurs around the meaning of nuclear power as an appropriate and desirable mode of electricity production, attention decreases as ambiguity is reduced.

In summary, both cases support the proposed ‘stabilization of cultural legitimacy’ phase. Both cases show a period after the extension of cultural legitimacy in which the cultural legitimacy of nuclear power remains largely unquestioned. In this phase, the cultural legitimacy of nuclear power was successfully maintained, although this required more effort in the British than in the Dutch case: the perceived failings of the first British program negatively influenced the public's perception of the appropriateness of specific technological choices by the British nuclear industry, and the second program was contested by coal miners’ representatives. But neither led to a broad questioning of the cultural legitimacy of the basic concept of nuclear power: critical press accounts only stated that the UK may have been going about it the wrong way.

6.3.5 Destabilization phase

Dutch case

During construction of the second Dutch nuclear power plant, the first signs of organized opposition against nuclear power emerged. In 1971, critical accounts of nuclear power based on American research found root with the emerging Dutch counterculture movement, which was concerned about themes such as technocracy, nuclear weapons and the environment. It enrolled the support of concerned scientists, who produced a report criticizing the expansion plans of 1972 and suggested a five-year moratorium on nuclear power in 1974. Yet the Club of Rome's report and the oil crisis had prompted the government to announce the construction of 3 nuclear power plants, to be operational by 1985. Additionally, it gave the Ministry of Economic Affairs a decisive say in all nuclear decisions in order to improve coordination of nuclear development, as well as to prevent future unilateral decisions to bypass Dutch industry such as had occurred in the Borssele case. These developments had coincided with a rise in environmental awareness in the late 1960s and early 1970s, which had led to the establishment of several new environmental organizations. These took an interest in

nuclear power in the second half of the 1970s. In the same period, the initially local groups in opposition against nuclear power increasingly started collaborating on a national level, aiming to influence public opinion e.g. through demonstrations. When an emerging anti-nuclear movement began linking the technology to themes in broader environmental and counterculture discourses (e.g. sea dumping of waste, health risks of radiation, proliferation of plutonium), an anti-nuclear discourse emerged which constituted a coherent alternative framework for interpreting nuclear power as undesirable and inappropriate. The contested legitimacy of nuclear power resulted in a policy stalemate, which the government attempted to break by announcing (in 1978) a broad societal discussion aimed at including citizens in the decision-making. Negotiations about the scope and terms of the discussion ensued as anti-nuclear movement strategies radicalized. The broad societal discussion constituted the main stage in this period for the discursive struggle between opponents and proponents of nuclear power (even though some anti-nuclear groups refused to partake, they had to legitimize their refusal to their audiences and could not simply ignore it).

The discussion was not very successful in including wider society in the policy process: participation was lower than expected and interest in nuclear power decreased as issues like unemployment became more central over the course of the discussion. But neither was the pro-nuclear discourse victorious: hardly anyone changed their mind and those opposed to nuclear power remained so. The BSD resulted in an advice against the construction of new nuclear power plants. This advice was rejected by the government in 1985, which cited international commitments and long-term energy security as the main reasons for doing so. The anti-nuclear movement withered during and after the broad societal discussion, in part because increasingly radical strategies by small anti-establishmentarian elements in the movement had alienated the wider public, and in part because many movement actors were disappointed by the government's rejection of their arguments and had moved on to other goals (e.g. opposing nuclear weapons or promoting alternative energy). Yet the results of the BSD show that in spite of the absence of a strong movement which actively performed the anti-nuclear discourse, the discourse had established itself as a persuasive alternative framework for interpreting nuclear power. When Chernobyl occurred just prior to elections and led to a societal outrage, coalition parties were forced to postpone their expansion plans in order to remain in power. Chernobyl could only be interpreted by the government as a reason to halt their expansion plans because it occurred in the context of a strong anti-nuclear discourse which argued against the desirability of nuclear power. Fearing that 'pushing through' their expansion plans in spite of the low cultural legitimacy of the technology might translate to a low legitimacy of the coalition parties' authority (and consequently, losing the upcoming elections), expansion plans were postponed. Through this indirect mechanism, the low cultural legitimacy of nuclear power could cut short its innovation journey. Themes in anti-nuclear discourse such as safety, health risks, waste issues, and proliferation became institutionalized: they were reiterated throughout the 1990s in policy documents as reasons not to consider new nuclear construction in the near future.

British case

When the government was considering a 1973 proposal by the electricity sector for a third program of light water reactors, the new environmental organization Friends of the Earth produced an influential report arguing against this American design on safety grounds (but not against nuclear power as such). But from the mid 1970s onward, the nuclear industry became contested following a controversy around nuclear waste reprocessing, which led to a 1977 public inquiry about a proposed new reprocessing facility. Over this period, local groups emerged which *did* oppose the concept of nuclear power as a whole and engaged in protest actions in an attempt to sway public opinion. But no coordinated, national anti-nuclear movement emerged, and no policy influence was achieved: a third nuclear power program was announced in 1978. The new (1979) Conservative government saw nuclear power in part as a means to break the power of the coal miners' union and favored the American PWR design. A public inquiry held between 1982 and 1985 rejected arguments against its construction. But over that period, the controversy over nuclear power strengthened. Reports of radioactive releases during reprocessing activities, leaks at nuclear power plants, and waste transportation, dumping and storage issues were increasingly mobilized by environmental organizations like Greenpeace as proof of the undesirability of nuclear power. Although this time around, the controversies *did* destabilize the cultural legitimacy of nuclear power, this did not in turn affect nuclear power policy. The nuclear innovation journey was eventually cut short not by the low cultural legitimacy of nuclear power since the 1980s, but by the Conservatives' own privatization agenda. Preparations for privatization of the electricity sector showed in 1989 that nuclear power could not survive in the private sector. It led to an 'economization' of the nuclear energy debate. The government initiated a moratorium on new nuclear power plants pending a review of the sector. While the 1995 review announced that several of the more economically viable stations could be privatized after all, it also stated that no new nuclear power plants would be subsidized. The 1997 Labour victory sealed the fate of nuclear power: it would no longer be pursued. Yet still, the main criterion for viewing nuclear power as undesirable was its poor economics: those energy policy documents that mentioned nuclear power after 1997 mainly argued against it in terms of its bad commercial prospects. Of the key themes in anti-nuclear discourse (safety concerns, proliferation etc.) only the waste management issue found its way into the energy policy discourse.

Conclusions

The emergence of a new broad macro-cultural repertoire about the environment shaped the cultural legitimation process in different ways between the two cases. In The Netherlands, alternative interpretations of nuclear power gradually coalesced into a coherent 'anti-nuclear' discourse about the undesirability and superfluousness of nuclear power. Around it, a diverse discourse coalition of e.g. scientists, environmentalist, and (left-wing) emerged, which over time developed into a coordinated, nation-wide anti-nuclear movement. Performances of this discourse were

so successful that key storylines (e.g. safety concerns, waste issues, proliferation risk) were taken up in mainstream political party manifestos for the 1977 elections. The discursive struggle between the pro- and anti-nuclear discourses destabilized the cultural legitimacy of nuclear power, and rendered the concept ambiguous and contested once again. Pro- and anti-nuclear discourses battled over the interpretation of the Harrisburg accident, nuclear waste storage, enriched uranium shipments to Brazil etc. In the graph of figure 4.1.1 this corresponds with a substantial increase in public attention over the 1970s. Nuclear power became so controversial in society that the nuclear policy process had come to a stop and that the government felt that it had to initiate a broad societal discussion. Framed as an experiment in dealing with societal controversies and a way to include civilians into the energy policy process, the Ministry of Economic Affairs (which desired an expansion of the nuclear program) saw it as a means to dissolve the antagonism between pro-nuclear and anti-nuclear discourse in favor of the former, and thus generate the public's consent without resorting to coercion.

Conversely, controversies in the 1970s in the British centered mostly around issues with specific reactor designs and aspects of the reprocessing industry. While these may be analytically considered as performances of an anti-nuclear discourse, no significant coalition emerged around it. Residents of proposed sites opposed test drillings, broader environmental organizations took an interest in the waste issue, and a handful of dedicated anti-nuclear groups emerged on the local level, but attempts at creating a nation-wide coordinated anti-nuclear movement failed. Although the anti-nuclear campaign managed to increase the public's attention to nuclear issues somewhat over the 1970s through media coverage (see: figure 4.1.1), it only had marginal influence on public opinion. It did not manage to achieve broad societal or political support or enroll the trade unions (Herring, 2005: 206). No significant destabilization of the cultural legitimacy of nuclear power occurred as a result of this campaign. Unlike in the Netherlands, the key themes in anti-nuclear discourse never significantly impacted the policy agenda, and nuclear decision-making remained dominated by economic and political concerns.

So, the environmental repertoire contributed to the destabilization of the cultural legitimacy of nuclear power in the Dutch case, whereas significant destabilization occurred in the British case later on, and mostly as a result of the privatization agenda. But regardless of the differences in timing and causes, destabilization occurred in both cases and led to a dominant interpretation of nuclear power as *un*desirable and *in*appropriate in the 1990s. Both cases thus support the proposed 'destabilization of cultural legitimacy' phase; although they also show differences in the degree to which this low cultural legitimacy shaped innovation journey outcomes (see: section 6.4).

6.3.6 Re-entering construction and establishment: a new cycle

Over the 1980s and 1990s, a new macro-cultural repertoire emerged. The apparent rise of global annual mean temperatures over the 1980s had led to a theory on anthropogenic

global warming. Following the 1992 Earth Summit in Rio de Janeiro climate change became an increasingly central concern, and the 1997 drafting of the Kyoto Protocol forced many nations to (re)consider their emission reduction strategies. In the Dutch and the British cases, this placed nuclear power in a new light.

Dutch case

From the early 1990s onward, nuclear power was discussed as a possible solution to global warming in government documents but rejected partly because of its low cultural legitimacy. The first Dutch nuclear power plant was decommissioned in 1997, and the second would be decommissioned by 2003. But in 2002, the year of the Dutch ratification of the Kyoto protocol, a the new center-right coalition favored keeping it open until 2013. Nuclear power was reframed as a cost-effective tool in the Dutch efforts to realize the Kyoto emission reduction targets. The increased centrality of what was now a climate change debate led to a further extension of the power plant's license in 2006: it would now remain open until 2033. The 2010 elections resulted in a coalition agreement that stated that the government would in principle grant permits for the construction of new nuclear power plants: new nuclear construction was no longer just an option, it was a requirement and a priority. While pro-nuclear actors engaged in renewed performances to increase the cultural legitimacy of nuclear power by framing it as a solution to climate change as well as a means to safeguard Dutch energy independence, environmental organizations reacted by attempting to undermine their arguments. But in spite of these contentious performances, the centrality of the nuclear power issue has not increased significantly since 1995, when nuclear power was announced by the government to have run its course in The Netherlands.

British case

A 2003 White Paper on energy had declared nuclear power to be an unattractive option for carbon-free electricity generation because of its poor economics. Although it did not completely rule out new construction for meeting emission targets, it promised intensive public involvement in any future decisions. But increasing oil prices and an increasing sense of urgency about the climate change issue led to a 2006 energy review which confirmed that nuclear power was back on the agenda: new plants would be constructed as old ones were phased out. Greenpeace responded with contentious performances and by launching legal action, claiming that no public consultation had taken place. Although they won, it did not affect policy: a 2008 document reiterated the government's framing of nuclear power as a clean, secure and affordable technology. Signs of a schism in the environmental movement appeared, as some prominent members came to believe that nuclear power was 'the lesser of two evils'. In 2010, a list of possible locations for new construction was published. Although the government insisted that no public funds would be made available for the construction, operation and clean-up of these plants, new policies (such as design pre-lincensing) were developed to attract investors.

Conclusions

In both cases, the closure around the meaning of nuclear power as *in*appropriate and *un*desirable proved to be transient. In spite of the destabilization and loss of cultural legitimacy in the early 1990s, the technology was revived in the mid 2000s, as nuclear power advocates linked the technology to the increasingly central climate change discourse. Climate change constituted a floating signifier that pro-nuclear actors successfully drew into their discourse by framing nuclear power as a tool for mitigating CO_2 emissions. Perhaps this framing of nuclear power as a solution to climate change can best be seen as a 'hegemonic intervention' (Laclau, 1993). Hegemonic interventions take place in an antagonistic terrain, i.e. where discourses collide, and achieve fixation of meaning *across* antagonistic discourses:

> One discourse is undermined from the discursive field from which another discourse overpowers it, or rather dissolves it, by rearticulating its elements. (Phillips and Jørgensen, 2002: 48)

Phillips and Jørgensen (2002: 48) provide an example about how the reason that soldiers could be recruited among workers in WWI is that the already established worker identity was suppressed through a hegemonic intervention in favor of a national identity. Analogously, the recent 'switching sides' of some environmental movement actors, who now support nuclear power, could be similarly understood as the result of a hegemonic intervention that suppresses other environmental values in favor of carbon neutrality. If this hegemonic intervention is successful, it could lead to the cultural *re*legitimation of nuclear power.

6.3.7 Conclusions about innovation and legitimation phases

The above subsections show that in both cases the nuclear power innovation journey was a complex and erratic process, which involved national interests such as energy and industry policy, dozens of organizations and institutions, material infrastructures, political agendas, and symbolic meanings. Nuclear power was envisioned to be a core component in the socio-technical system (a cluster of elements including regulations, user practices, infrastructures, meanings etc.) that realizes the societal function of electricity supply. Innovation journeys from one socio-technical system to another are referred to as *transitions* (Geels and Schot, 2010). Such transitions require wider societal embedding (Geels and Schot, 2010: 11) and if societal embedding is insufficient, this can cause so much resistance that the innovation journey is halted prematurely (Rotmans and Loorbach, 2010: 128). Nuclear power was envisioned to take over (or at least become the dominant technology in) the electricity production system in both The Netherlands and the UK. In both cases, its development was a purposive attempt at a transformation of the electricity production system (Geels and Schot, 2007). And in both cases, this attempt failed. In figure 6.3.1, a successful transition is visualized as a stylized logistic function or ‘S-curve’ which proceeds through a sequence of phases (Rotmans and Loorbach, 2010) somewhat similar to the take-off /

growth / stabilization phases in the ‘technology life cycles’ model (Geels, 2002). Yet this image also emphasizes the possibility of different, less successful, manifestations.

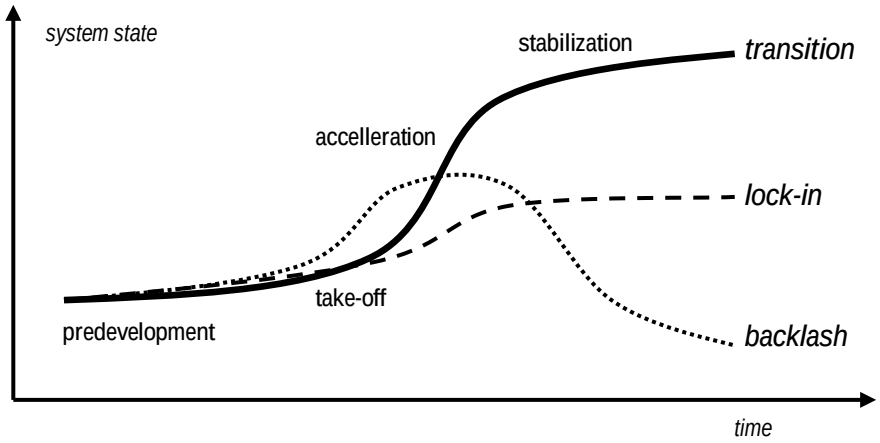

Fig. 6.3.1 Stylized transition paths. Adapted from: Rotmans and Loorbach (2010: 131).

In terms of figure 6.3.1, the Dutch nuclear power innovation journey best fits the 'backlash' scenario. After initial wide societal enthusiasm about the technology during the initiation and development phases, opposition emerged immediately after the take-off of implementation. The discursive struggle between pro- and antinuclear discourses managed to polarize wider society in its perception of the desirability of the technology, which incapacitated nuclear policy decisions, blocking further implementation and eventually terminating the innovation journey.

In contrast, the UK situation best fits a 'lock-in' scenario. Implementation began early on, in the context of wide societal enthusiasm about the technology. Over the 1960s, disappointing technical and economic performance of the first program of nuclear power plants decreased this enthusiasm but did not lead the wider public to question the cultural legitimacy of the idea of nuclear power production. In the context of cheaper-than-expected fossil fuels and dearer-than-expected nuclear power, nuclear power was no longer strictly necessary, but abandoning it was not an option because the fledgling nuclear industry which had emerged around the home-gown design would face collapse. So, an improved version of the first program's core design was chosen for the second program under the expectation that it could be an important export product. Over the 1970s, societal criticism emerged around specific aspects and choices of the nuclear industry, but as the emerging environmental movement did not speak out against nuclear power as such, this did not translate into a widely help perception of the inappropriateness of the technology. By the time the third program was being considered, an electricity production overcapacity existed, but ordering new plants was considered important for saving the industry, preserving nuclear engineering knowledge, and breaking the power of the unions. The cultural legitimacy of nuclear power decreased in over the 1980s as various leaks, reprocessing issues and waste

management controversies were mobilized by the broader environmental movement, but this did not translate to policy results: it was the 'economization' of nuclear discourse during the privatization rush of the 1980s which eventually resulted in the poor economic performance of the earlier plants being interpreted as a reason to no longer pursue nuclear power.

Yet in both cases, the cultural legitimation process which appeared to have stopped with the loss of cultural legitimacy of nuclear power in the 1990s was resumed in recent years. This dynamic does not fit, however, with the phase model of the cultural legitimation process as articulated in Chapter 2. As such, I refine the model by adding a 'second cycle', whereby the cultural legitimation process can re-enter the construction phase (when innovation proponents perform their reframing of the technology before audiences of resource controllers outside the view of the wider public) and the extension phase (when innovation proponents performing the new storyline to gain wider societal support or prevent renewed opposition). This minor refinement to the longitudinal conceptualization of the dynamics of cultural legitimation in innovation journeys (RQ2) appears in figure 6.3.2 as an arrow which connects the destabilization phase to the construction and extension phases.

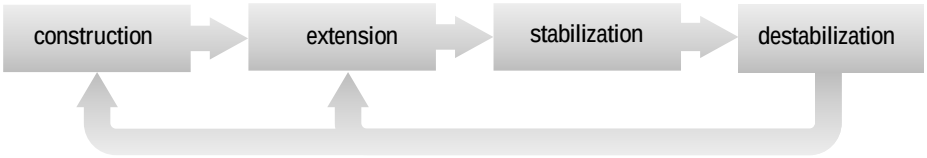

Fig. 6.3.2 Cultural legitimation phases in innovation journeys, modified. Source: own illustration.

6.4 RQ3: Cultural legitimacy and policy

6.4.1 Introduction

The third research question was about the relation between cultural legitimacy and policy in the context of innovation journeys. Clearly, policy played a key role in shaping the outcomes of nuclear power innovation journey in both the Dutch and British case. But to what extent was this policy influenced by the contestation of the cultural legitimacy of nuclear power? Generally, the question about the causal effect of discourse on policy change remains a contested issue (Doria *et al*., 2006: 212). One interesting contribution comes from the theory of discursive institutionalism (Campbell, 2001; Schmidt, 2008), which argues that discourse *can* at times be influential in policy change, but is not always so (Kern, 2009: 44). To show if, when and how it is influential, one must trace discursive processes of coordination and communication (Schmidt, 2008: 311):

- *coordinative discourse* takes place between policy actors (e.g. civil servants, experts etc.) and involves the creation, elaboration and justification of policy ideas (Schmidt, 2008: 310)
- *communicative discourse* takes place between political actors (e.g. political leaders, government spokespersons) and civil society, and involves the former persuading the latter of "the necessity and appropriateness" (Schmidt, 2008: 310) of the policy ideas generated in coordinative discourse, as well as the latter responding in various ways to these attempts.

Thus, the question about the relationship between cultural legitimacy and policy is reconceptualized as a question about the relationship between coordinative and communicative discourse, and answering it comprehensively necessitates analyzing both. However, this dissertation deals exclusively with the discursive struggles about the cultural legitimacy of nuclear power, which are firmly located within what Schmidt calls communicative discourse. The narratives of Chapters 4 and 5 do occasionally deal with coordinative discourse, but only when it obviously intersects with communicative discourse (e.g. during public consultations and public inquiries). Nevertheless, the Dutch and British cases as described in Chapters 4 and 5 do hold some clues about their relationship. I argue that the mechanisms of discursive influence should be analyzed in terms of the possible directions of discursive interaction between communicative and coordinative discourse (see: figure 6.3.3).

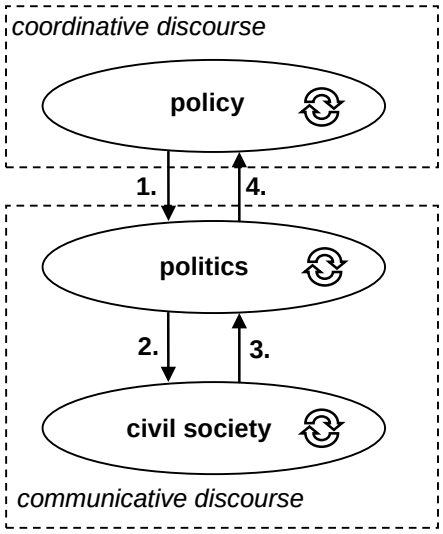

Fig. 6.3.3. Schematic representation of discursive institutionalism. Arrows represent (possible directions of) discursive interactions. Circular ones represent internal discursive interactions between actors in the three domains. Source: own illustration based on Schmidt (2008).

6.4.2 Top-down discursive interaction

Discursive institutionalism argues that a typical direction of discursive interaction is 'top down', whereby policy elites generate ideas, which political elites then communicate to the public (Schmidt, 2008: 311). In this case, arrow 2 in figure 6.3.3 represents

> a mass process of public persuasion, political leaders, government spokespeople, party activists, “spin doctors,” and more communicate the policy ideas and programs developed in the coordinative discourse to the public (Schmidt, 2008: 310).

Political actors shape mass public opinion "by establishing the terms of the discourse and by framing the issues for the mass media and, thereby, for the mass public" (Schmidt, 2008: 311). Certainly the cases of Dutch and British nuclear power show this direction of discursive interaction. The *construction* of the cultural legitimacy of nuclear power in the initiation phase of the innovation journey is represented in figure 6.4.2 by the circular arrows in the policy actors and political actor domains. The subsequent process of mass persuasion (arrow 2) then closely resembles what this dissertation argued to be the *extension* of cultural legitimacy to the public: a peaceful atom discourse was articulated by political actors in such a way as to render nuclear power policy culturally legitimate with civil society. The media reproduced this discourse, which in turn shaped the public's interpretation of nuclear power.

In these phases, communicative discourse does not shape coordinative discourse: it has no effect on policy other than that it reinforces it. If policy change happens at all, it happens as a result of changes in coordinative discourse (i.e. among policymakers), which Kingdon (1995) would argue to be the result of the strategic actions of policy entrepreneurs in manipulating uncertainty (a mechanism which is not systematically investigated in this dissertation). Any policy changes are subsequently legitimized to wider audiences, which causes cultural legitimacy to appear to analysts as "a condition tied to beliefs more than as a process of ongoing contestation in deliberative discursive processes" (Seabrooke, 2006, in: Schmidt, 2008: 320).

6.4.2 Bottom-up discursive interaction

If top-down would be the *only* direction of discursive interaction, then there would be no mechanism for communicative discourse to influence coordinative discourse: it would have no causal effect on policy. But the theory of discursive institutionalism argues that the direction of discursive interaction can be 'bottom up' as well. In the cases of Dutch and British nuclear power, several of these can be discerned. Bottom-up mechanisms were either from communicative discourse to coordinative discourse (e.g. 'direct' influence on policy, arrow 4 in figure 6.3.3), or within communicative discourse, from civil society to political actors ('indirect' influence on policy).

I. Direct influence ("arrow 4")

To understand the first type of bottom-up mechanism (influence of communicative on coordinative discourse), it should be mentioned that the category of 'politics' does not

refer exclusively to party leaders and government spokespersons etc. In discursive institutionalism, political actors can include "members of opposition parties, the media, pundits, community leaders, social activists, public intellectuals, experts, think-tanks, organized interests, and social movements" (Schmidt, 2008: 310). These actor groups "communicate their responses to government policies, engendering debate, deliberation, and ideally, modification of the policies under discussion" (Schmidt, 2008: 310).

- One example is lobbying, a common form of advocacy by which organized interests (e.g. industry, social movement organizations, scientist) attempt to effectuate policy change. This mechanism which was most likely crucial in nuclear power policy decisions. However, the opaque nature of this process renders it difficult to draw conclusions. Anecdotal evidence suggests that lobbying played a role:
    - In the Dutch case, scientists succesfully convinced policymakers of the desirability of nuclear research in the first decade after WWII (i.e. the construction of cultural legitimacy).
    - In the British case, the chair of the National Coal Board attempted to influence nuclear policy in the mid 1960s to protect the interests of the coal industry.
    - Greenpeace actively engaged in lobbying about nuclear waste policy in the 1990s on the European level (Ayliffe interview).
- Another example can be seen in the British case, where in 1973, the Friends of the Earth nuclear campaign group was a collection of public intellectuals which, as part of a wider social movement organization, successfully influenced the Select Committee on Science and Technology's stance on light water reactors through a highly technical memorandum.
- In the British case, public inquiries about specific nuclear projects can be conceptualized as examples of this mechanism, as well: the objectors who submitted written or oral evidence in these inquiries were typically political actors such as environmental movement organizations or dedicated anti-nuclear groups. While interested members of the general public were free to submit evidence as well, no attempts were made at including civil society as a whole (unlike in the Dutch broad societal discussion).
- Another possible mechanism for the influence of communicative on coordinative discourse is proposed by the punctuated equilibrium theory of policy change. It argues that attention is a scarce commodity for macro-political institutions and that as such, issues are routinely delegated to typically opaque and conservative policy subsystems resulting in policy. But when the media prominently (re)produces negatives images about (the subject matter of) these policies, the issues climb the macro-political agenda, which sometimes results in macro-political institutions making changes in the aforementioned subsystems (which in turn can, but do not

necessarily, lead to radical policy change). An example of this in the British case is when the 1975 'nuclear dustbin' controversy (and the subsequent controversy over a radioactive leak cover-up) in the media forced the Environment secretary to call in for government review an application for the construction of a new reprocessing plant. This led to a public inquiry (i.e. a possible avenue of direct influence) regarding a policy decision which otherwise would have been routinely delegated to the relevant local city council.

II. Indirect influence ("arrow 3")

The second type of bottom-up mechanism involves civil society. From a top-down perspective, the main role of civil society is that of an audience for cultural legitimation. In this case members of the wider public remain "institutional dopes blindly following the institutionalized scripts and cues around them" (Campbell, 1998: 383, in: Schmidt, 2008: 320). Any discursive *interaction* in the sphere of communicative discourse then remains solely on the level of civil society in the form of 'public conversations' (which are represented in figure 6.3.1 by a circular arrow). This happens when some policy, announced and legitimized by political actors, is talked about by members civil society in positive or negative terms, but is not 'fed back' to these political actors. This situation arguably occurred in the Dutch nuclear power innovation journeys throughout the 1960s.

Yet discursive institutionalism argues that civil society *can* exert influence on communicate discourse in a variety of ways. In each case, the direction of discursive influence is from civil society to political actors, but *within* the realm of communicative discourse (arrow 3 in figure 6.3.3):

> [T]he general public of citizens and voters to whom this communicative discourse is directed also contribute to it. As members of civil society, they engage in grass-roots organizing, social mobilization, and demonstrations; (…) and as members of the electorate, their voices are heard in opinion polls, surveys, focus groups, and, of course, elections - where actions speak louder than words (Schmidt, 2008: 310-311).

The cases of Chapters 4 and 5 provide ample illustrations:

- One example of civil society exerting 'bottom up' influence in communicative discourse about nuclear power was by participating in protest actions organized by political actors such as anti-nuclear movement organisations. While in the British case these organizations were never able to sway the opinion of the mass public, in the Dutch case they succeeded in mobilizing many members of civil society to take part in civil disobedience (e.g. not playing the Kalkar levy) and large-scale demonstrations. The demonstrations were performances of an anti-nuclear discourse in the communicative sphere and aimed at creating awareness and influence public opinion (i.e. enrolling additional members of civil society into the anti-nuclear discourse coalition). What had started out as a collection of social movement organizations had over the 1970s grown into a broad social movement

against nuclear power and increased polarization of mass public opinion about nuclear power.

- Another example of civil society exerting 'bottom up' influence in communicative discourse about nuclear power was by participating in public consultations and discussions. In the Dutch case, civil society's 'feedback' to politics can be argued to have been the result of the coincidence of two factors. The unilateral decision by a utility company to sideline government and industry and order a German nuclear power plant had led policymakers in the early 1970s to implement regulatory changes which gave the government a decisive say in all nuclear matters but also placed it under parliamentary control. This coincided with aforementioned increased polarization of mass public opinion about nuclear power as a result of successful performances of an anti-nuclear discourse. As a result, the highly contested cultural legitimacy of nuclear power was able to cripple the nuclear policymaking process (Lagaaij and Verbong, 1998: 93) and left macro-political actors no choice but to initiate a 'broad societal discussion', both as an experiment in dealing with societal controversies and a way to include civilians into the energy policy process.
- The most direct way in which civil society can exert 'bottom up' influence in communicative discourse about nuclear power is by voting. In the Dutch case, this was particularly relevant in the aftermath of the Chernobyl accident. Although the government rejected the conclusions of the aforementioned broad societal discussion in favor of the construction of two nuclear power plants, the societal upheaval over Chernobyl, whose meaning was successfully fixed as proof of the danger of nuclear power by a strong anti-nuclear discourse, forced macro-political actors to order a re-assessment of their nuclear power policy (out of fear for losing the upcoming parliamentary elections.

But while the cases illustrate that civil society can clearly influence *communicative* discourse in addition to being shaped by it (arrow 3 in figure 6.3.3), they also illustrate that this does not always translate to (indirect) influence on *coordinative* discourse in the policy sphere. For example, the large-scale Dutch demonstrations did not result in policy effects, and the British and Dutch governments rejected the conclusions of, respectively, public inquiries and the broad societal discussion (i.e. arrow 4 of figure 6.3.3 was not always present).

6.4.3 Communicative / coordinative coupling and policy styles

Both cases show that, in terms of figure 6.3.3, manifold discursive interactions occurred within the communicative discourse on nuclear power. The form and direction of these interactions differed between cases and over time, but the cases clearly show that cultural legitimacy was, in Seabrooke's (2006) terms, not simply a condition determined by beliefs, but a process of ongoing contestation in deliberative discursive processes.

Yet they also show that, in spite of mechanisms that are theoretically present for the direct influence of communicative discourse on coordinative discourse, this seems to have occurred relatively rarely in practice. In both countries, throughout the process, policymakers apparently felt confident enough to reject the outcomes of various public participation instruments and/or implement nuclear power policies in spite of intense public contestation. Discursive institutionalism acknowledges this possibility:

> [T]here may be no arrows between coordinative and communicative discourses. Coordinative policy ideas may remain in closed debates out of public view, either because they might not be approved (…) or because the issues are too technical to capture the sustained interest of the public (Schmidt, 2008: 311)

This leads me to hypothesize that the success of communicative discourse in influencing coordinative discourse depends not only, as Schmidt argues, on (1) the persuasive articulation of its substantive ideas, and (2) addressing "the right audiences (specialized or general publics) at the right times in the right ways" (Schmidt, 2008: 312), but also on the degree to which coordinative discourse, carried by policy actors, is 'open' to being influenced by communicative discourse. This relates to the issue of authoritative power: if a particular policy is legitimate in policy circles, it does not matter if it is not perceived as legitimate by others if there is no viable mechanism for them to exert influence. Scott (2001) has argued

> There is always the question of whose assessments count in determining the legitimacy of a set of arrangements. Many structures persist and spread because they are regarded as appropriate by entrenched audiences, even though their legitimacy is challenged by other, less powerful actors (Scott, 2001: 59)

For example in the Dutch case, regulatory changes were announced in the 1974 proposal that gave the Ministry of Economic Affairs a decisive say in all nuclear power related decisions. Aimed at increasing the government's power over the electricity sector (e.g. to prevent future unilateral decisions to bypass Dutch industry such as had occurred in the Borssele case), it placed the process under parliamentary control which constituted an avenue for anti-nuclear organizations the power to frustrate expansion (Lagaaij and Verbong, 1998: 93). This meant that the communicative discourse on nuclear power could now impact the coordinative discourse: the wider public could stop or delay the nuclear power innovation journey through parliament. In the UK, however, the main avenue of influence for members of the wider public on the energy policy was through public consultations about policy documents and public inquiries about (planning permission for) specific projects. Any controversies around nuclear power were channeled into these routine instruments for taking on board opposing views, which were then typically rejected so that projects could proceed as planned. As the wider public had no further means to block the innovation journey, the communicative discourse on nuclear power had less effect on coordinative discourse in the British case.

So, there may be *structural* features of the policy process which reduce or enlarge the opportunities for discourse to influence policy: the political opportunity structures may

differ between innovation journeys, and even over time within a single innovation journey. In other words, the influence of discourse on policy may depend, alongside the content and process of discursive interaction, on *policy styles* (Jordan and Richardson, 1982). But tempting as it may be to explain the differences in the influence of discourse on policy between the Dutch and British cases as a difference in *national* policy styles (e.g. more consensual versus more authoritarian), this is probably too simple a model. In policy studies, the empirical observation that within countries, many different policy styles exist which in addition change over time, has led to a replacement of macro-level generalizations about national policy style as a "unique configuration of institutional and cultural features" by a "disaggregation which addresses policymaking at the level of sector, sub-sector or programme" (Padgett, 1990: 165-166). It is argued that policy communities develop around specific programs or policies, which develop their own policy styles. So instead of focusing on national institutional and 'cultural' features, it focuses on the structural characteristics of specific issues or policy sectors (Padgett, 1990: 165). This led to the concept of *sectoral policy style*, which is defined as

> (…) distinctive patterns in the procedures and norms governing the interaction of participants in the policy process. These patterns are systematically related to key characteristics of the sector (Padgett, 1990: 166)

Padgett (1990) argues that for electricity supply sector policy styles (arguably the sector most relevant to the nuclear power policy process in both countries throughout most of its innovation journey) these 'key characteristics' are:

- the relationship between the sector and the state;
- the structure of sectoral interest representation;
- ownership / market relations.

Although Padgett is not interested in the discursive construction of these characteristics, anecdotal evidence from my case studies illustrates the key role that discourse can play with regard to these dimensions of the policy process. For example in the British case, the privatization and liberalization of the electricity sector obviously changed the relationship between the electricity supply sector and the state, but also resulted in a closure around the meaning of nuclear power as undesirable (because of its poor economic performance) on the policy level. So, I argue that for a comprehensive understanding of how discourse and cultural legitimacy relate to policy, the aforementioned dimensions of sectoral policy styles need to be systematically investigated, as well.

Finally, the situatedness and specificity of sectoral policy styles (which can differ between sectors and over time) have implications for the extent to which the Dutch and British case studies can be generalized across different cases and contexts. The issue of generality will be a key topic in this dissertation's next and final section: the discussion.

6.5 Discussion

6.5.1 Generality of the conclusions

This dissertation used the case selection method of *intensity sampling,* which involved selecting information-rich cases that manifest the phenomenon of interest intensely, but are nevertheless more typical than the absolute extremes (Patton, 2002; Gray, 2004). In doing so, it aimed at a compromise between the visibility of cultural legitimation processes and the versatility of its explanation.

This latter concept is important because the generality of process theories depends on their versatility, i.e. "the degree to which it can encompass a broad domain of developmental patterns without modifying its essential character" (Van de Ven, 2007: 156). The greater the number of cases and contexts to which the explanation can be applied, the more general it is. However, this does not mean that the explanation has to apply *uniformly* and *consistently* across these cases and contexts. These criteria for generality belong to variance theory, where independent variables are assumed to continuously operate on dependent variables over time through efficient causality. If they do not do so uniformly or consistently across cases or context, new variables need to be distinguished to explain variance (Van de Ven, 2007: 152).

Instead, process theories employ *formal* causality, which emphasizes the pattern ('form') in which events are arranged over time. Cases which are explicable in terms of the same process model can still differ substantially in their specific sequences of events because of the inherent complexity of the process. Indeed, Chapters 4 and 5 show that in each case, contingent and contextual events occurred which formed a part of the cases' particular histories and continued to influence 'how the story plays out' (Van de Ven, 2007: 156). So in this dissertation, generality should be about the degree to which the above mechanisms and patterns of cultural legitimation can be (incrementally) adjusted to explain cultural legitimation in different cases and/or different contexts. In this subsection, I will address the generality of my explanation across cases (i.e. its versatility in explaining the cultural legitimation process of nuclear power in other countries) and across contexts (i.e. its versatility in explaining the cultural legitimation process in different types of innovation journeys)

1. Versatility across cases

Distinguishing the same mechanisms and patterns in two case studies has increased their potential versatility across cases, compared to distinguishing them in just a single case study (Yin, 2009). Moreover, the fact that The British and Dutch cases were chosen using intensity sampling rather than extreme case sampling (i.e. they are not outliers but, respectively, 'above average' and 'below average' adopters of nuclear power) has reduced the likelihood that the cases present a distorted image of the cultural legitimation process in nuclear power innovation journeys.

The proposed mechanism of cultural legitimation as well as the general pattern through which it proceeds (construction, extension, stabilisation, destabilisation) uphold in two cases which are characterized by different political interests regarding the technology, different systems for addressing societal controversies, different contingent occurrences, and different adoption levels of the innovation. This increases the likelihood that the mechanisms and patterns distinguished in these cases can also encompass the cultural legitimation process during nuclear power innovation journeys in other countries. In other words, it increases the versatility (and thereby the generality) of the explanation across *cases.*

2. Versatility across contexts

Although the cases differ substantially, the *context* for both case studies is nuclear power. The question thus presents itself to what extent the mechanisms and patterns discerned in these specific innovation journeys can encompass *different* (i.e. non-nuclear) innovation journeys. Because both cases involve the same innovation, the explanation offered can obviously not yet claim to have high versatility across contexts. To make such claims, cases involving different innovations would have to be selected following a literal replication logic. These cases should show that the basic mechanisms and patterns discerned in this dissertation can be *adapted* in such a way as to explain the cultural legitimation process in innovation journeys involving different technologies, as well.

Literal replication involves articulating the conditions under which a phenomenon is likely to be found (Yin, 2009: 54). This means specifying the contexts that the mechanisms and patterns *most likely* apply to. The proposed model of cultural legitimation strongly emphasizes discursive struggles, contestation and resistance. Accordingly, nuclear power was chosen as a context which displays such an antagonistic pattern of proponents and opponents. Does this mean that the analytical perspective only has explanatory power for cultural legitimation in contexts which also involve contestation? Probably, but then again this doesn't narrow down the field very much. It has been argued that antagonism has become a pattern in the societal embedding of all new technologies, and that innovators have even come to anticipate it (e.g. Rip and Talma, 1998). Research has shown that societal resistance plays a prominent role even in such product innovations as medicines (e.g. Geels *et al.*, 2007) and personal music players (Du Gay *et al.*, 1997).

Arguably, the resistance against nuclear power was more visible and forceful than the resistance encountered in aforementioned examples. I know of no cases in which people took to the streets in protest against iPods. As to the reasons for this, one might for example argue that because of its technical characteristics, nuclear power *inherently* polarizes society along the lines of culturally determined attitudes toward risk, or that it is intrinsically linked - through plutonium production - to nuclear weapons and therefore to (geo)political ambitions. If true, then the case of nuclear power is indeed idiosyncratic, and the cultural legitimation framework articulated in this dissertation

cannot be applied to different contexts without fundamental (instead of incremental) revisions. In that case, the generality of the model would be limited to other cases of nuclear power innovation journeys, and would not be versatile across contexts.

Yet I believe this dissertation has shown this 'intrinsic' difference in perception of nuclear risks and its 'intrinsic' link to nuclear weapons to be discursively constructed. I have argued these to be storylines which, with varying degrees of success, managed to enroll actors into different discourse coalitions. This is not to say that the technological realities of the case did not matter: nuclear power reactors produce plutonium regardless of discourses. Yet it is whether or not this fact is discursively mobilized in arguments for or against the technology - rather than the fact itself - which determines its effects on public perception and societal resistance.

I would argue that the form and strength of the opposition against nuclear power had less to do with the technology itself, and more with the decisions-making process. For many innovations, adopting or rejecting them is optional. Individuals decide, more or less independent of other members of the system, whether they want to use them or not. The extent to which the innovation is considered culturally legitimate will play a role in this decision. If it is *not* perceived by individual actors as appropriate or desirable, those actors can 'vote with their feet' and express their opposition by not buying and/or using it. But this is clearly not the case with nuclear power, where the decision of whether or not to adopt ultimately lies not with the consumer but with the government and/or the electricity sector. It is an 'authority innovation decision': the choice to adopt an innovation is made by relatively few individuals in a system who possess power, status or technical expertise (Rogers, 2003: 28-29). Individual members are *affected* by the consequences of this decision, but have little or no *say* in the matter. The strategy of not adopting the innovation is not available to actors who feel that it is inappropriate or undesirable. Different methods and channels for express opposition are thus sought, e.g. trying to influence the authority innovation decision through organizing into social groups, engaging in public protests, seeking media exposure and changing public opinion.

I therefore hypothesize that the generality of the model extends to those innovation journeys that involve authority decisions. Examples of these can be found in all societal domains (e.g. infrastructural projects such as the Betuwelijn in the transportation domain, or participation in the international development of military technology such as the Joint Strike Fighter in the national defense domain), but they prominently include low-carbon innovations in the energy supply domain (e.g. CO_2 storage, wind power). Unsurprisingly, all these topics are considered controversial by the government (Tweede Kamer der Staten Generaal, 2010). If the mechanisms and patterns discerned in this dissertation can also be used to understand and explain the cultural legitimation processes of these innovation journeys, then they can claim to be versatile across contexts as well as across cases.

6.5.2 Underdeveloped aspects and research agenda

Underdeveloped aspects

While the proposed mechanisms and dynamics have proved generally useful for understanding the cultural legitimation process in nuclear power innovation journeys, this dissertation cannot (and does not) claim to explain everything. Notably, three aspects are admittedly underdeveloped and should ideally be addressed in future research.

1. Generality across contexts

The mechanisms and patterns of cultural legitimation derived from nuclear power innovation journeys cannot claim to be generalizable across contexts (i.e. applicable to non-nuclear innovation journeys) based on the case studies of Chapters 4 and 5 alone. In subsection 6.5.1 it was argued that the conditions in which the model is *most likely* to apply were contested innovation journeys that involve authority decisions, especially in the energy domain. To verify if the model can indeed be generalized to this context, literal replication strategy would have to be pursued, in which the versatility of the model in explaining such cases should be tested.

2. Downplaying other dimensions

This dissertation argues that, while cultural legitimacy is not a sufficient explanation for innovation journeys, appreciation of its mechanisms and dynamics is necessary to understand a key dimension of innovation journeys: their societal embedding. Simultaneously, it acknowledges that to fully explain exactly how innovation journeys play out, other dimensions such as power relations, markets, (sunk) investments, politics etc. have to be taken into account. But the trade-off of this dissertation's sophisticated conceptualization of cultural legitimation (which stems from its interest in societal embedding) is that its conceptualization of these other dimensions is underdeveloped. Simply arguing that these dimensions, too, are discursively constructed and that the discourses co-evolve is insufficient:

> The challenge for research here is to go to a much finer analysis at both empirical and theoretical levels, and to move from the statement that everything is coevolving with everything else to the identification of what is coevolving with what, how intense is this process and whether indeed there is a bi-direction of causality. (Malerba, 2006: 18)

So, for a sufficient explanation of innovation journeys, a framework should be developed which includes all relevant dimensions of innovation journeys and is equipped to systematically analyze the interplay between these.

3. Exogenous broader discourses

In this dissertation's analytical perspective, the dynamics of the broader repertoires to which the innovation is strategically linked remain analytically exogenous. For example, climate change is treated in this dissertation as a repertoire which is mobilized

to create a storyline aimed at the cultural (re)legitimation of nuclear power. Yet how such broader repertoires (1) come into being, (2) become influential and eventually taken-for-granted in wider society, and (3) are influenced by discourses about specific innovations, remains unexplained (e.g. the degree to which nuclear discourse shaped the discourses it drew on).

4. Discursive construction of interests

This dissertation emphasizes the purposive translation of actors' interests into storylines and their performance of these aimed at convincing audiences of the desirability and appropriateness of nuclear power. Yet these interests (i.e. the reasons why actors want to further or resist nuclear power implementation) remain more or less exogenous to my narrative. I believe this choice is justified by my research interest, which lies with *how* actors strategically construct and contest the cultural legitimacy of an innovation to enhance or undermine its societal embedding; as opposed to *why* they chose to do so in the specific case of nuclear power. Yet in discourse analysis, such interests are argued to be discursively constructed, as well (e.g. Foucault, 1969). For a 'full' discourse analysis of nuclear power, the discursive construction of interests should thus be taken on board. This dissertation does not do so because it is concerned only with how an innovation is discursively legitimized in terms of societal norms, values and beliefs. Therefore, while it can make claims about a *specific* discursive activity, namely the cultural legitimation of nuclear power, it cannot claim to offer a comprehensive discourse analysis of nuclear power.

Future research agenda

Instead of articulating a hypothetical agenda for future research aimed at repairing the above weaknesses, I will describe how a concrete research project, which has been initiated in 2011, can contribute to addressing most of these issues. To explain how it will do so, I will first briefly discuss the research interests of the field of transition studies, which forms the context of the project.

Over the past decade, the field of transition studies has analyzed innovation journeys which produce radical changes in socio-technical systems. In the light of some persistent problems confronting contemporary modern societies, it is especially interested in socio-technical change towards a sustainable society (Grin *et al.*, 2010: 1). In the societal domain of energy production, which faces issues like climate change, depletion, and security of supply, low-carbon innovations are thought to be able to contribute to radical socio-technical change.

Recently, the notion has gained strength that the innovation journeys of low-carbon technologies are contested, antagonistic processes rather than consensual and rational ones (Smith and Raven, 2009). Regardless of the pathway by which niche innovations (attempt to) break through and replace the incumbent regime (Geels and Schot, 2007), the process involves conflicting interests and shifting power relations. Conceptualizing technological development as an evolutionary process, special attention is given to how

incumbent technologies; industrial, socio-cognitive and material structures; markets and user practices; policies and political power; and cultural legitimacy *all* constitute 'selection environments' for such niche innovations. These innovations typically display a bad fit with these environments at the onset of their innovation journeys, and are consequently selected against.

If these innovations are to contribute to a sustainable energy system, some form of protection is clearly required. Yet the concept of protection has not yet been empirically interrogated in a systematic fashion (Smith and Raven, *forthcoming*). This observation has resulted in an ESRC/NWO-funded research project that will look more closely at protection. Protective spaces are not just constructed through subsidies: protective spaces have to *shield* the innovation from mainstream selection pressures in all of the aforementioned environments. And to effect performance improvements, protective spaces have to *nurture* the innovation, as well. Moreover, to enable the innovation to become more influential in the wider social world, the protective spaces have *empower* the niche innovation to change mainstream selection criteria (Smith and Raven, *forthcoming).* The cultural dimension of these three functions of protective space (shielding, nurturing, empowering) can be understood in terms of the concepts of this dissertation:

- Shielding involves creating a protected space in which an innovation can be experimented with without being subjected to mainstream selection pressures. This requires the construction of cultural legitimacy: the articulation of storylines that persuade resource controllers to supply the necessary resources for initiating an innovation journey.
- Nurturing involves securing resources for further development if the innovation, e.g. the articulation of positive expectations and the building of networks. This amounts to the *extension* of cultural legitimacy: convincing wider groups of relevant actors of the desirability of the innovation and enrolling them into a supportive discourse coalition.
- Empowering means that the innovation as well as the values it is linked to become taken-for-granted. In terms of this dissertation, this would mean that the innovation becomes *implicitly* appropriate once the discourse that interprets it as desirable and appropriate achieves hegemony.

The research project will theorize and analyze protective spaces by studying the contested innovation journeys of CO_2 capture and storage, off-shore wind turbines, and grid-connected solar PV. In doing so, it will also address some of the aforementioned weaknesses of this dissertation:

- It has the potential to increase the versatility across contexts of the cultural legitimation model, because the cases of CO_2 capture and storage, off-shore wind turbines, and grid-connected solar PV meet the criteria for literal replication to the context of *different* contested innovation journeys which involve authority

decisions. If the mechanisms and patterns proposed in this dissertation can be incrementally adapted (as opposed to fundamentally revised) to understand the cultural legitimation of these low-carbon innovation journeys, this increases the versatility across contexts – and with it, the external validity – of the process model.

- It has the potential to repair the issue of the downplaying of other key dimensions of innovation journeys in favor of cultural legitimation processes. Because the new project systematically investigates the development of protected spaces not only in terms of their cultural, but also their institutional, economic, regulative and infrastructural dimensions and the interactions between these, it should provide more insight into their relative importance of cultural legitimacy in various innovation journeys over time.
- It can potentially clarify how innovation discourses shape the broader repertoires they draw on, by looking at the *empowering* function of protective space. Empowering is argued to involve altering the selection environment in order to enable the innovation to break through. An innovation becoming an unquestioned part of societal identity and a 'staple' in visions and expectations would be a form of empowerment. Consequently, empowerment constitutes a possible feedback mechanism through which a persuasive storyline about a specific innovation contributes to the success of its innovation journey, which in turn increases the sphere of influence of the broader repertoire which this storyline draws on (e.g. environmental values becoming axiomatic in policy).

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Summary

The complex, long-term and iterative nature of the technological innovation process is succinctly captured by the term 'innovation journey'. Previous studies of innovation journeys have increased our understanding of innovation processes in firms and the embedding of the resulting technological innovations in markets. However, technological innovations require not only embedding in business environments but also in regulation environments and wider society. This dissertation addresses the latter dimension of innovation journeys through the concept of *cultural legitimacy*: the perceived appropriateness or desirability of an innovation in terms of societal norms, values and beliefs. The dissertation is specifically interested in cultural legitimacy in relation to innovation journeys that involve purchases by governments and utilities of expensive capital goods (e.g. for defense, communications, transport, energy supply). Technological innovations in this category strongly relate to cultural legitimacy because their innovation journeys frequently involve societal contestation of authority-based decisions.

While extant innovation studies literature recognizes the *effects* of cultural legitimacy (e.g. on attracting resources), it says less about how cultural legitimacy is created and contested, and how it plays out over time. This dissertation seeks to address these issues. The first research question is thus: *what are the specific mechanisms through which cultural legitimacy of innovations is established and contested?* The second research question is: *how can we conceptualize the longitudinal interactions between cultural legitimation and innovation journeys?* And finally, because policy is expected to play a significant role in the aforementioned category of innovation journeys, a third question is added: *how does cultural legitimacy relate to policy in innovation journeys?*

To provide preliminary answers to the first two research questions, Chapter 2 critically reviews four broad approaches to culture (a production of culture view, a structuralist view, an interpretive approach and discourse theory). It evaluates these approaches and synthesizes a new analytical perspective for analyzing cultural legitimacy during innovation journeys. To answer the first question, it proposes that proponents and opponents of an innovation strategically construct storylines about its (il)legitimacy. These storylines aim to convince various audiences by constructing *empirical fit* (by mobilizing real-world events as evidence), *credibility* (by mobilizing expertise or status), *centrality* (by linking to events an audience perceives as important or urgent), *experiential commensurability* (by linking to an audience's daily lives and practices), *macro-cultural resonance* (by linking to broader cultural repertoires). To answer the second question, the new perspective proposes that cultural legitimation proceeds in a sequence of (I) *construction* of cultural legitimacy (aimed at convincing resource controllers of its appropriateness), (II) *extension* of cultural legitimacy (broadening the innovation's cultural legitimacy to wider society), (III) *stabilization* of cultural legitimacy (maintaining the cultural legitimacy of the innovation as it diffuses, which

may involve discursive struggles between opponents and proponents), and possibly (IV) *destabilization* of cultural legitimacy (the rapid or gradual loss of cultural legitimacy of the innovation as its inappropriateness and undesirability becomes the dominant interpretation). To answer the third question, the Chapter reviews policy process theories for theoretical insights into the way societal issues can shape policy agendas – an issue which is revisited in Chapter 6 where new hypotheses about the third research question are articulated based on this dissertation's case studies.

Because the dissertation combines qualitative and quantitative methods in a new way, Chapter 3 reflects thoroughly on its epistemology and methodology. It explains the choice for a process theory epistemology, justifies a multiple case study method, articulates the rationale behind the selection of Dutch and British nuclear power innovation journeys (1945-2010) as its empirical case studies, identifies relevant data sources, and describes how these are mobilized.

The two case studies are described in Chapters 4 and 5. The narratives are structured using the perspective articulated in Chapter 2, which ensures an analytical focus on cultural legitimation. In the Dutch case, the enthusiasm of the 1950s and 1960s was supplemented with opposition after initial implementation of nuclear power for electricity generation purposes (in the early 1970s). The discursive struggle between proponents and opponents subsequently polarized wider society in the late 1970s and eventually incapacitated nuclear policy decisions, leading to an interruption of the innovation journey in the 1980s. In the British case, implementation began in the mid-1950s during a period high societal enthusiasm about nuclear power, which dwindled over the 1960s as a result of disappointing performance. But unlike in the Dutch case, criticism of specific nuclear industry aspects did not lead to a substantial societal debate about the desirability of nuclear power. While the British environmental movement mobilized various controversies in the 1980s, it was eventually the sector's poor economic performance in the context of energy sector privatization which interrupted its innovation journey. In recent years however, nuclear power in the Netherlands and the UK was reframed as a solution to the climate change challenge in an attempt to resume the innovation journey.

The conclusion Chapter compares and analyzes the two case studies. In relation to the first research question, Chapter 6 concludes that the five proposed dimensions offer a useful framework for analyzing the mechanisms through which cultural legitimacy is constructed and contested. The five dimensions enable a focused analysis of innovation storylines. In relation to the second research question, it concludes that the proposed sequence of phases matches well with both cases. However, it also finds that in both cases, the loss of cultural legitimacy in the 1980s and 1990s was followed in recent years by a discursive revival of nuclear power under the banner of climate change. The case studies thus suggest a cultural legitimation cycle, wherein the process re-enters the construction phase (when proponents perform reframing activities of the technology before audiences of resource controllers outside the view of the wider public) and the

extension phase (when they perform the new storyline to recoup wider societal support). Although the case studies did not explicitly analyze the policy dimension, they do underscore that policy is crucial for explaining innovation outcomes. This dissertation acknowledges that while an understanding of cultural legitimation is necessary for explaining innovation journeys, it is not sufficient. It suggests improving the analytical perspective by reconceptualizing the third research question about the relation between cultural legitimacy and policy in innovation journeys as a question about the relation between *coordinative discourse* (i.e. policy-internal discourse) and *communicative discourse* (i.e. discourse between political actors and civil society). The Chapter ends by discussing the external validity of the conclusions, identifying underdeveloped themes and issues, and articulating a future research agenda.

Biography

Bram Verhees was born in Helmond on September 1st 1977. After graduating from Helmond's *Carolus Borromeus College* in 1996, he enrolled in the *Technology and Society* program at *Eindhoven University of Technology* (TU/e). In 2005, he graduated cum laude on research done at the *Energy Research Centre of The Netherlands* (ECN). After working as a freelance science journalist, he started his PhD research in 2006 at the TU/e's *Technology, Innovation & Society* group. Bram's research about the relation between cultural legitimacy and innovation journeys formed part of a broader project by the *Dutch Knowledge Network for System innovation and Transitions* (KSI). Bram presented papers at this network's annual meetings, as well as meetings by the *Sustainability Transitions Research Network* (STRN) and the *Society for the Social Studies of Science* (4S). In addition, he enjoyed a brief stay at the University of Sussex' *Science and Technology Policy Research Unit* (SPRU). The results of his PhD research are presented in this dissertation. Since September 2011, Bram has been employed as a postdoctoral researcher at Eindhoven University of Technology's *School of Innovation Sciences*. He is currently working on a joint project with SPRU to systematically analyze the mechanisms and dynamics of protective space as they relate to sustainability transitions.