Transition management and the need for mature connections with EU and national innovation policies.

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1. Introduction

Over the past decade, scholars have argued for a socio-technical system innovations and transitions perspective to tackle sustainability problems. The governance problems of initiating such transitions and simultaneously steering them in the direction of more sustainable development are, however, challenging. In the Netherlands, the governance approach to tackle transitions is often called transition management, and experiences with this approach are growing. Outside the Netherlands, Flanders (Belgium) was one of the first regions to experiment with a similar approach. Two transition processes, one in sustainable living and building, and one in sustainable material management, were initiated by the Flemish government in respectively 2004 and 2006. Both were formulated as "experiments in innovative environmental policy", which implies amongst other things that they were set up as rather low profile exercises, with limited formal policy support and with small budgets. Nevertheless, both processes succeeded in formulating a full transition agenda (with a future vision and transition paths) and are currently in a phase of developing and setting up transition experiments. Although they try to break out of the environmental policy field, one of the main limitations of both processes is the fact that they have difficulties in finding integration with other policy domains, in particular "hard" policy domains such as traditional economic innovation policy.

Working towards such an integration between transition processes and innovation policy is quite relevant at a moment that we are witnessing a surge in calls and policy initiatives for "low carbon economies" and "global green new deals". Under pressure of on the one hand the economic-financial crisis and on the other hand the climate and environmental crisis, governments show renewed interest in an industrial strategy of eco-innovation that seems to offer investment opportunities, job creation and environmental protection in one package. Although the term "transition" is sometimes used, the socio-technical transition discourse is not central to these calls. Their origin is rather to be found in innovation and industrial policies mixed with environmental policies.

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This paper wants to contribute to a convergence between (a) innovation and industrial policies, (b) environmental and sustainability policies, and (c) the socio-technical transition approach and transition management. Its overarching research question is which elements can be of use in building a bridge between these strands of policy. Its particular interest is in investigating whether and how transition management processes can position themselves as mature partners for sustainable innovation policies. This seems of particular importance to us since the actors in a well-established policy domain such as innovation policy will have to become convinced of the benefits of introducing new approaches for policy development such as transition management, in order for them to become more effective. Therefore, in general, our discussion is less conceptually focused, but rather starts from the interest of aligning research results with policy concerns in the context of a search process for low carbon and more sustainable economies.

Section 2 briefly introduces the two Flemish transition processes. Sections 3 to 5 bring together arguments that can support the convergence between the mentioned policy fields. Section 6 formulates some conclusions.

2. A bird's-eye view on two Flemish transition processes

Inspired by the Dutch transition management policy (VROM 2001), the Flemish government decided in 2004 to experiment in its environmental policy with transition management. It was decided that the expertise of prof. Jan Rotmans and his team would be hired to give transition management a start in Flanders. This means that the approach to transition management that is tried out in Flanders, is the one developed by ICIS-MERIT and later on further refined in DRIFT. We cannot go into detail here as to the specifics of this approach, but it is relatively well-known and has been described extensively elsewhere (see e.g. Rotmans 2003 and Loorbach 2007 – see also section 5.2. further down). It usually employs a so-called transition arena with niche-players and ahead-thinking regime-players to develop a common problem structuring of the system under discussion, and then moves on to develop a transition agenda. This contains a future vision for the system, transition paths towards that vision, and a series of experiments to test and initiate the paths in reality. The underlying rationale is one of "goal-oriented incrementalism" (Rotmans et al. 2007): controlling a transition is not possible, but transition processes are meant to influence, modulate, accelerate changes along sustainable paths, through processes of learning and experimenting.

In Flanders, the first transition process to adopt this approach was initiated in 2004 in the area of sustainable housing and building (DuWoBo), and Dutch researchers were directly involved in this process. The second process, in sustainable materials management (called Plan C)[2], followed the same transition management approach, and started in 2006, but without Dutch involvement. A few years later on, we see that both processes have succeeded in developing a full transition agenda. DuWoBo as well as Plan C work with a future vision for their system, with transition images, transition paths, and are in the process of launching projects and experiments. Both are relatively well-known in the environmental field and have reached

[2] From here on we will use the acronyms by which the two processes are known in Flanders: "DuWoBo" for the transition process sustainable housing and building (DuWoBo stands for "Duurzaam Wonen en Bouwen") and "Plan C" for the transition process in sustainable material use. Plan C derives it name from the idea that a Plan B is no longer enough to reach sustainable development and sustainable material management, but that a Plan C is needed. The DuWoBo website is www.duwobo.be. The Plan C website is www.plan-c.eu.

several hundreds of people. The longest standing process, DuWoBo, currently succeeds in influencing the agenda setting in the Flemish building sector. Besides tangible results, both processes have other effects: stimulating long-term thinking about sustainable development in both domains, founding a broader knowledge base about system innovation and transitions, networking between organisations and individuals that previously hardly knew each other, introducing new kinds of participatory processes in policy formulation.

However, both processes also wrestle with several tensions and limitations (Paredis 2008). These range from the problem of consolidating the processes (including stable funding and a stable management structure) to questions such as how to select, initiate and learn from experiments; how to reach citizens and include consumers; and how to connect to and influence regime processes such as traditional economic innovation policy.

As said, this last question is the focus of this paper. It is obvious that, if transition management processes are meant to influence socio-technical regimes and/or support the development of niches – such as transition theory claims – this cannot be done solely from the margin of environmental policy. Transition processes have to be able to link up with regime policies and regime players by finding their way to the policy agenda. We now turn to a discussion of which evolutions can be used to strengthen the links between transition processes, innovation policy and environmental policy.

3. Connecting with the growing discourse and strategies on low carbon economies, and beyond

Probably the most important underlying rationale for studying socio-technical system innovations and transitions, has always been their relevance for the transition we are currently facing, i.e. a transition to a more sustainable society (see e.g. Rotmans et al. 2001). Although the calls for more sustainable development patterns and eco-innovation are 15 years and older, sustainable development policies have hardly been at the heart of industrial countries' policies. But the combination of a global economic-financial crisis with a global climate and environmental crisis, a food crisis and in the South a continuing development crisis, has led to a search for new solutions. On a global level, UNEP launched a call and work program for a *Global New Green Deal*. UNEP calls for "a bold initiative" and "an expanded vision", not just to revive the economy and create employment opportunities, but also to "protect vulnerable groups; reduce carbon dependency, ecosystem degradation and water scarcity; and further the Millennium Development Goals of ending extreme world poverty by 2025" (UNEP 2008, p. 8).

Industrialised countries that embrace such an approach, usually do not take such a broad view, but restrict themselves to programs for a "low carbon economy". This is essentially an industrial strategy of eco-innovation that promises to offer investment opportunities, job creation and environmental protection in one package. One of the most recent examples is the *Low Carbon Industrial Strategy* of the British government, published in March 2009. This industrial strategy is meant to be a cornerstone of the climate policy of the UK, laid down in the *Climate Change Act* that aims at CO_2 reductions of 26% by 2020 and 80% by 2050. The British state that "the transition to a low carbon world will transform our whole economy (…) It will change our industrial landscape, our supply chain, and the way in which we all work and consume (…) A low carbon industrial strategy must seize the opportunities that come with change: a new industrial activism for a new green industrial revolution" (UK

Government 2009, p. 1-2). The strategy is based on background studies that the global market for low carbon goods and services is currently worth 3 trillion Pound, and is projected to grow to over 4,3 trillion by 2015.

On a Flemish level, the ambitions are much less outspoken regarding the development of a low carbon economy. In January 2009, the Flemish government and social partners signed the *Pact 2020*, a long-term strategy with the objective of turning Flanders into a leading knowledge economy by 2020, strongly internationally oriented and creating welfare in a sustainable way, including a 'greening' of the economy. Most economic objectives of the Pact focus on growth, competitiveness and jobs, but it also aims at "important steps towards a cyclical economy with a minimum use of resources, energy, materials and space" and "a transition towards a sustainable energy system, sustainable material use and sustainable mobility" (Vlaamse Regering 2009, p. 6 and 16).

For most European countries, it is to be expected that the framework and initiatives developed by the European Commission will be of great importance. The 20-20-20 objective (20% reduction of CO2 emissions, 20% increase in energy efficiency, 20% renewable energy by 2020) adopted by the EU as part of the climate change strategy (March 2007), can be considered as an overarching policy objective for stepping up eco-innovation and initiating the transition to a low carbon economy. A recent report lists a number of European initiatives that can contribute to this goal and make it concrete. These include (Bleischwitz et al. 2009):

- The Eco-design Directive
- The Competitiveness and Innovation Framework Programme
- The 7th Framework Programme for Research and Technological Development
- The Environmental Technology Action Plan
- The Directive on the Energy Performance of Buildings
- The European Action Plan on Sustainable Consumption and Production and Sustainable Industrial Policy
- The European Directive on Waste from Electrical and Electronic Equipment
- The European Energy Label

Not in this list, but potentially important for initiating transitions:

- The Lead Market Initiative for Europe
- The Strategic Energy Technology Plan

Such a list – and it probably is not even complete – inevitably evokes questions of coherence and coordination in making a transition to a low carbon economy. Obviously, the sudden acceleration of interest in low carbon economies, is a possibility for "integrating" the socio-technical transitions discourse. For one thing, it may offer a framework for formulating a coherent set of policies, and connecting to existing policies. It also has a view on how change happens and may be initiated. And it offers possibilities to keep a broad perspective on the low carbon transition, by embedding it in a wider sustainability transition, with a balance between technological, socio-cultural and institutional innovations[3]. We return to these points in section 5.

[3] The relevance of this is visible in discussions on the British *Low Carbon Industrial Strategy*, that relies amongst other things on carbon capture and storage and on new nuclear power, both heavily contested concepts from a broader sustainable development perspective.

4. Using the parallel but convergent developments in innovation and environmental policy

As has been said above, the socio-technical transition discourse does not feature in most of the plans on low carbon economies. Their origin is rather to be found in innovation and industrial policies mixed with environmental policies. The concrete form these plans take, will be one of the determinants in their potential contribution to a low carbon transition: What is the role assigned to societal objectives in innovation policy? Which institutions and instruments will be used or set up? What is the leeway for radical innovators versus regime players? What is the role of government versus other actors in such transition? How can strategic convergence be achieved on key issues such as the 'energy mix'? Where and under which conditions will the money be spent?

In 4.1. and 4.2. we investigate how over the last decades innovation and environmental policy have changed in answering these kind of questions. During this evolution they have grown closer to each other, so that a more integrated approach towards system challenges seems possible. However, in 4.3. we discuss several remaining problems for such an integration, making the point that current innovation and environmental policy approaches may not yet be suitably equipped to tackle the challenge of low carbon and more sustainable economies.

4.1. Innovation theory and policy: from first to third generation

Until the beginning of the nineties, innovation policy in OECD countries adhered to a linear view of innovation: the process of innovation starts in the laboratory of the scientist, is taken up in the design process of engineers, the new technology is tried out in demonstration projects and finally marketed and diffused. This approach to innovation resulted in technology push policies, with a lot of money going into R&D and fundamental research, in the creation of spin-offs and in selectively fostering critical sectors and picking winners (Goorden 2004). The main argument for policy intervention is market failure: knowledge is a public good and the benefits of innovation can thus easily be captured by all market players. This leads to insufficient incentives for private firms to invest in innovation and is thus a rationale for public support for R&D (Foxon and Pearson 2008). In Flanders from the mid eighties onward, the technology push strategy materialised in the "DIRV"-campaign, or the campaign for a Third Industrial Revolution. The objective was to create a new structural foundation for the Flemish economy, on the basis of long-term policies, with investments in micro-electronics, biotechnology, and environmental technology. More recently, a similar kind of approach led to investments in broad band technology and materials technology.

During the nineties, the approach to innovation changes and we witness a move to a second generation innovation policy. This does not mean that the previous policy model is completely abandoned, but rather that under the influence of new insights and principles, other accents and instruments enter the policy field. The most important renewal is the introduction of a systems perspective through the concept of national systems of innovation (Freeman 1987). In general terms, an innovation system can be defined as "those elements and relations which interact in the production, diffusion and use of new economic useful knowledge"(Lundvall, cited in Andersen 2008). This view draws attention to at least three fundamental aspects of innovation processes (Foxon 2006). First, innovation does not follow a linear process, but is the result of multiple interactions between players in a systemic and dynamic process. Second, actors wrestle with bounded rationality. They are not perfectly informed, as presupposed in neo-classical theory, but fall back on experience, customs,

imitation behaviour. Consequently, innovation processes are influenced by the actors's environment, following an uncertain path. Continuous learning therefore becomes vital. Third, institutions and rules have a central role in stimulating or preventing innovation. For these kind of reasons, the rationale for policy intervention switches to system failures: public support is justified because the innovation system and its actors exhibit characteristics that prevent it from functioning optimally. Policy instruments now cover the full innovation trajectory, not just the phase of R&D and experimentation. The focus of intervention also includes networking and interaction between innovation actors, learning processes and exchange of knowledge, the influence of institutions and rules.

The national innovation systems framework is currently the basis for innovation policy, internationally (OECD, EU) as well as at the level of EU member states (Andersen 2008). At the Flemish level, the switch is visible in the 1999 *Innovation Decree* that provided a legal framework for broadening support mechanisms and creating institutional leverages to stimulate collective innovation platforms. An important feature is that the government pursues a generic policy of innovation support, not choosing between technologies, but allowing a bottom-up development, where the direction of technological change is left to the innovation actors to decide (Van Humbeeck et al. 2004). The signature in 2003 of an *Innovation Pact* between all social actors, further consolidates this approach. However, because of its links to the Lisbon targets, it also exhibits some features of what is sometimes labelled a third generation policy.

The concept third generation policy was introduced by Lengrand (2002). It refers to a horizontal innovation policy in which innovation becomes a theme in all policy domains, while simultaneously the coordination between policy domains is improved in order not to obstruct innovation processes. Besides, because of its integration with other policy domains, the objective of innovation policy is meant to broaden from stimulating growth and competitiveness to also addressing other societal problems, such as health care, education, mobility, climate change, sustainable development. To reach such goals, greater public involvement and new stakeholders should be included in the innovation debate. Until now, concrete manifestations of such a third generation policy are not very visible and it remains more discourse than reality. The recent establishment of an Interdepartmental Directorate for Knowledge and Innovation around societal challenges in the Netherlands has created a new institutional interface between different Ministries and can be seen as a step in this direction (Nederlandse regering, s.d.). On Flemish level, the administrative reform of 2007 integrated the departments of Science, Innovation and Economy into a single policy domain and the concept of 'horizontal innovation policy' was adopted already in 2005, but implementation is cumbersome. In January 2009 the government signed the *Pact 2020* with social partners. This is meant as a long-term commitment to strengthen the competitive position of the Flemish economy driven by innovation, but also to simultaneously reach other societal goals and innovate in sectors such as environment, work, care and health. Some individual initiatives to forge 'breakthroughs' have already been taken but instruments and a policy to reach such goals simultaneously still have to be installed. It is there that transition approaches can show their added value, as we will discuss in sections 4.3. and 5.

4.2. Environmental policy: from first to third generation

While innovation theory, practice and policy went through several changes over the last decades, a somewhat comparable kind of development was taking place in the environmental policy field. We use the characterisation of Grin et al. (2003) to describe this evolution.

Although this characterisation was originally developed for Dutch environmental policy, it fits the Flemish situation rather well. According to Grin et al., it is possible to distinguish between different generations of environmental policy on the basis of the central problem definition and the steering concepts that are being used. When new problems appear or when existing problems are perceived differently, new steering concepts are developed to tackle the problems. We take the field of waste policy and the current evolution towards sustainable material management in Flanders to illustrate these points. Waste policy was in most industrialised countries one the first environmental policies to be developed and it can look back at experiences of 30 to 40 years.

In the early seventies, environmental problems such as the waste problem reached the societal and political agenda. The first generation of environmental policy focused on controlling the negative environmental effects of economic activities. Environmental problems were mainly conceived as health problems and policies targeted specific environmental compartments, such as of water, air and soil. Environmental regulation and financial incentives such as taxes were designed to influence behaviour. By the beginning of the nineties, it became obvious that this end-of-pipe policy did not work for all problems, e.g. the problem of the ozon layer, acid rain and pollution from diverse and diffuse sources. A second generation of environmental policy announced itself, focusing on prevention and a cradle to grave approach. Environmental problems were no longer just a health issue, but became part of a broader goal: sustainable development. Because a prevention policy demands much more cooperation of the different actors involved in the problem (e.g. industry, citizens), governments tried to actively involve stakeholders and also aimed at self-steering of actors, within a framework set by politics. According to Grin et al. (2003) we are now in need of a third generation of environmental policy, which in the Netherlands was introduced with the 4th national environmental plan NMP4 (VROM 2001). This new generation is needed to tackle new and persistent problems such as climate change and loss of biodiversity. Because of their complexity and structural characteristics, these kind of problems cannot be solved with the instruments of the second generation. Structural changes at systems level are required in order to get a grip on these kind of problems. This in turn demands a long-term approach and a new steering philosophy in which objectives are formulated interactively with forward-looking stakeholders. Sustainable development now depends on system innovations, that can possibly be initiated through transition management. It should be mentioned that the three generations exist alongside each other. It remains necessary to control negative environmental effects as well as to invest in prevention policies, but an additional transition policy is needed to tackle persistent, structural problems.

These broad developments can also be found in Flemish waste policy, were we notice a movement from waste disposal over waste management to, currently, the first experimental steps in a sustainable materials transition[4]. This development started in the early seventies when most municipalities still had their own, small-scale and hardly controlled dumping grounds. Economic growth, the birth of the consumer society, new products and materials caused a rapid growth in waste. Waste became an issue of public health. The government reacted with amongst other things a Decree on Waste ("Afvalstoffendecreet") and the formation of OVAM, the Public Waste Agency of Flanders. Policy was very much top-down, focused on controlled landfilling and incineration. During the eighties, the physical infrastructure of waste management changed dramatically from decentralized, small-scale and uncontrolled, to large-scale and controlled landfilling and incineration.

[4] This and the next two paragraphs are largely based on Loorbach et al. (2004)

However, by the end of the eighties, it was obvious that this policy was insufficient to control the waste problem. The system accelerated from controlled waste disposal towards integrated waste management. In the second Waste Plan (1991-1995), a shift is noticeable on the level of problem analysis and objectives: the focus of attention moves from the end of the waste chain (disposal and incineration) to the beginning (prevention, re-use, recycling). Industry becomes structurally involved in the waste chain, with the development of a waste market and a recycling industry. The population is mobilised through sensitization programs and a tariff system. During the nineties, selective collection, recycling and re-use become common practice and the first waste prevention programmes are applied. The transition towards the present waste management system is a result of external changes (pressures), innovations in technology, infrastructure, institutions, market, self-organisation of social actors, culture, practice as well as planning and policy.

Nevertheless, although the waste management infrastructure and market are highly efficient, although regulation and policy are in place and controlled, and although recycling and re-use are common practice, the waste problem itself is not under control. The total amount of waste production is still growing, materials and products are not fully designed with recycling and 'closing the loop' in mind, lost materials and value are still important concerns, etc It seems that the only way out is to reframe the problem. In order to meet the challenges posed by sustainability – such as creating a highly material-efficient cyclical economy – a strong argument can be made for a fundamental reorientation of the role and goals of waste management, namely as a sub-system of a broader sustainable materials management system. This kind of transition is of course more complex and challenging than the waste transition of the last decades, not in the least because material use is linked to an institutional regime that heavily relies on economic growth, technological innovations and more efficiency, while these probably cannot be the only carriers of the transition. Questions abound of course: what exactly is sustainable material management? How should such a system be organised or managed? At what pace should and can we transform our current unsustainable system?

What seems undisputable is that sustainable system innovation requires room for changes in perspective and practice, for new structures and culture, for experiment and (failure-friendly) social learning, and that it cannot be controlled or planned. From this understanding and out of concern to make progression beyond optimisation of the current waste management system, OVAM ordered a study on the potential of the transition approach for sustainable materials management in 2004 (Loorbach et al. 2004). It then decided to initiate a transition process in 2006, Plan C (see section 2). This illustrates that it is possible to start such a reorientation on a small scale and within existing institutions.

4.3. Taking innovation and environmental policy one step further

Over the last two decades, innovation as well as environmental policy have evolved from a first to a second generation policy, and they are currently on the verge of a third generation. During this process, and starting from quite opposite traditions, environmental and innovation policy seem to be converging. Environmental policy is traditionally a strong policy field, with a top-down culture, geared to a regulative approach of the environmental domain. Innovation policy (or traditionally “science and technology” policy) has cultivated a strong bottom-up approach, relying on the self-organisation of the field by market forces and scientific communities. It has remained a rather weak policy field: although budgets were steadily increasing, these were allocated without much declared policy priorities.

The convergence between the two domains can be traced back to a common and growing understanding of how to deal with complex societal challenges and it is visible on at least two levels. First, both policy fields are evolving towards a more balanced role of policy instruments and of government intervention. Environmental policy recognises that changes cannot be forced just by proclaiming new regulations and it understands its role more as one factor in a multi-party undertaking. Innovation policy has broadened its scope from provider of subsidies for R&D to an actor in an innovation system where networking, learning processes and the influence of institutions and rules also play a role. Second, both fields are developing a discourse with a broader scope, although this third generation policy still remains more discourse than action. Under this development, environmental policy is supposed to engage in socio-economic innovations to stimulate the conditions for sustainability, while innovation policy is meant not only to stimulate growth and competitiveness, but also to address other societal problems, such as health care, education, mobility, climate change, sustainable development.

Is this enough to confront challenges such as the development of a low carbon economy or a more sustainable society? In their discussion of environmental and innovation regimes, Foxon and Pearson (2008, p. S149) state that "both theoretical and empirical arguments suggest that these separate regimes are unlikely to be able to address adequately the challenge of promoting a transition to more sustainable systems of production and consumption". If innovation policy and environmental policy really want to move into the realm of low carbon and sustainable economies, they seem to face several challenges.
Some of the most important challenges for innovation policy include:

- The innovation system approach aims at stimulating technological change, but says to be neutral as to the direction of that change. This choice is to a large extent left to the innovation actors themselves (Van Humbeeck et al. 2004). Obviously, as mentioned already, in the transition to a sustainable economy innovation policy will have to systematically incorporate a broader societal agenda than just growth and competitiveness.
- It almost logically follows that innovation policy also has to be broadened on another level as well. Currently, innovation policy is just starting to discover non-technological innovation and innovation in services in the economic domain. Taking on a societal sustainability agenda instead of just growth and competitiveness, also requires a new balance between technological, institutional and socio-cultural innovation (Jackson 2009).
- Finally, it seems unlikely that the required levels of societal innovation, including efficiency jumps of the factor 10 kind, can only be reached through product and process innovation. This implies that the innovation of socio-technical systems has to be placed on the agenda (Geels 2005). The current innovation system approach focuses on the improvement of the coherence within the existing system and therefore tends to privilege incremental innovations and incremental system changes. Although Schumpeterian 'creative destruction' is acknowledged on micro-economic level this approach has not yet developed a model for managing system innovation.

Some of the important challenges for environmental policy include:

- Further integration with the socio-economic agenda, of which the innovation agenda is a part. Problems such as climate change (but as we have seen also the waste and materials problem) cannot be controlled through environmental policy alone. This requires linking up with other policy fields.
- The effective realisation of a third generation policy with a socio-technical transition perspective. It seems necessary to investigate which domains of environmental policy can

be strengthened by initiating such an approach. Leroy et al. (2006) remark that the problems facing Flemish environmental policy follow a trend toward multi-level, multi-actor and multi-domain problems, but that the governance model in place is not yet suited to come to grips with them.

- In the case of Flanders, the two existing transition processes are still regarded as experiments in innovative environmental policy. Consolidating and reinforcing both processes is necessary to harvest results from what has been achieved so far. Reaching out of the environmental policy field and better connecting them with a broader agenda is a next step.

5. What do transition theory and transition management have to offer?

The renewed attention for eco-innovation and the calls for a low carbon economy, provide an opportunity to position socio-technical transition studies and policies as promising approaches to tackle such questions. In doing so, it seems sensible not to present them as something completely new and different, but as a potential next step in the ongoing evolutions in innovation and environmental policy frameworks. In section 4 we have shown that the transition approach can hook onto developments that are already going on in innovation and environmental policy, and that it may have the potential to take these developments beyond their present boundaries. The socio-technical transitions perspective could provide both policy domains with concepts that allow a qualitative leap in the tackling of these challenges. It seems possible to position transition approaches as a bridge between environmental and broader sustainability policies on the one hand, and innovation and industrial policies on the other. We now develop this argument somewhat further, less on a conceptual level, but rather from the point of view of usefulness in policy preparation and implementation: what is the usefulness of all this work for policy-makers interested in furthering low carbon and more sustainable societies? This is line with a remark by Geels et al. (2008, p. 530) that "a clear challenge, from a policy perspective, is to consolidate this richness into a common set of core concepts that can be used to inform policy makers." We use the two main lines of research in transition studies (How do transitions happen? How can transitions be governed?) to discuss some of the potentials we see for the moment.

5.1. A perspective on how change happens in complex systems, providing new heuristics to policymakers

Working towards low carbon and more sustainable societies, implies addressing highly complex systems such as the energy, mobility, food, water and materials system. If the transitions community succeeds in establishing a mature connection with the policymakers community, the results of socio-technical transition studies can play an important role in meta-level learning for policy development in the mentioned systems: learning about which elements play a role in transitions, how these are connected, to which anchor points this leads for policy intervention. Essential for such a form of policy learning is the "translation" from research-driven, academic conceptualisation into heuristics for policy practitioners.

Transition studies have already developed several strong heuristics[5]. The multi-level perspective (with its landscape, regime and niches) is probably the best known heuristic

[5] Not unimportant from a perspective of policy learning, is that several of the heuristics discussed here have also been translated into visualisations (e.g. the well-known logistic transition curve). These always facilitate learning.

(Geels 2005). Using the MLP in an innovation policy context provides a much broader view of the selection environment in which innovation processes have to find their way. "Such transitions not only entail new technologies, but also changes in markets, user practices, policy and cultural discourses, and governing institutions (…) it looks at dynamic interactions and co-evolution between these elements (…) [and] focuses on multiple actors and social groups" (ibid., p. 524). The socio-technical perspective thus provides a nuanced view of change. Geels et al. use the image of a "sustainable innovation journey" to capture the uncertain nature and search processes that are involved in such a transition. It is this complexity that socio-technical studies try to investigate.

Using the MLP in a sustainable development context may result in a different conceptualisation of sustainability policies. Instead of the current focus on win-win-win situations and the balance between the ecological, social and economic pillars of sustainable development, the focus could switch to using landscape pressures and internal regime contradictions to disturb incumbent regimes and provide room for sustainable niches. The MLP is often used analytically to understand past or ongoing transitions. It might be interesting to try some more forward-looking exercises, as demonstrated by Shackley and Green (2007) in their exploration of the transition to a decarbonised energy system in the UK.

A second framework that might turn into a useful heuristic is the "functions of innovation systems" approach, developed in the context of technological innovation systems (Hekkert et al. 2007). The functions[6] and their interactions are useful in analysing how TIS work and why some innovations succeed while others fail. A policymaker that has mastered these functions and how they interact, will find it easier to find entry points for stimulating niches. The functions can also be used on a more general level of innovation systems (broader than TIS), as demonstrated in the work of Foxon (2008a). This move might also open up the opportunity to "scale up" transition theory and analysis from a mainly niche focus to (industrial) regimes and 'long waves' in growth dynamics. The approach can further be strengthened by researching the conceptual integration between TIS and MLP (Markard and Truffer 2008).

A third framework gets somewhat less attention in transition studies, but might be very useful to correct the technological bias that, in spite of other intentions, often slips in. We refer here to the social practices approach developed by Spaargaren and others (Spaargaren et al. 2002, 2006, 2007). This approach gives insight in how consumer routines develop and how these influence transitions. The social practices approach has not only been developed as an analytical tool, but Spaargaren also builds upon it to work towards guidelines for policymakers for making social practices more sustainable. When elements from this approach – such as de- and re-routinisation of social practices, development of heuristics for more sustainable practices, and the analysis of consumption junctions where consumer and producer meet– become common knowledge to policymakers, they will broaden the palette of possible interventions.

These and other core 'storylines' in transition studies could be further developed from the perspective of turning them into useful heuristics for policymakers. Potential other topics include: diagnosis of lock-ins and path dependency, co-evolution of regime components, dynamics of strategic niche management, shifts in conceptions of normality (such as those of comfort, cleanliness and convenience – Shove 2003).

[6] Hekkert et al. (2007) distinguish seven functions of TIS: F1 entrepeneurial activities, F2 knowledge development, F3 knowledge diffusion through networks, F4 guidance of the search, F5 market formation, F6 resource mobilisation, F7 creation of legitimacy/creative destruction.

5.2. A perspective on governance of socio-technical systems, with the potential to provide strategic orientation towards low carbon and more sustainable societies

As mentioned above, the greater part of transition research has from the beginning been inspired by the issue of sustainable development. The aim was not only to analyse and understand socio-technical system innovations and transitions, but also to use the knowledge gained for solving sustainability problems. Even though transition researchers such as Loorbach explicitly state that "it is possible to influence societal change based on the understanding of transitions" (Loorbach 2007, p. 32), the translation from "insights in transitions" to "governance for sustainability transitions" is not that straightforward. Transition theory and empirical case studies predominantly help in understanding and analysing radical change as such, in that process building on sociology and history of technology, innovation studies, evolutionary economics, complexity theory. Applying these insights to governance of transitions, aimed at sustainable development, requires additional insights from e.g. political theory and sociology (Van den Brug and Spaargaren 2006). The governance approach to do this is generally known as transition management.

Even without the development of a specific approach such as transition management, the insights from transition theory already teach that a broader set of instruments is needed to influence transitions than is usual in current innovation and environmental policy. Policies often fall back on either classic forms of top-down steering, or on a bottom-up market model. When transition theory draws attention to complexity, uncertainty, co-evolution, multi-levels and multi-actors, it is logical that "additional policies" come to the front, such as "networks, community building, visions, experiments/learning, etc" (Geels et al 2008, p. 524). The complexity means on the one hand that the role of policy becomes less obvious and unequivocal, which implies that policy relying purely on technology push or relative prices will fall short and that a broader strategic framework is needed. On the other hand, more entry points for policy seem to present themselves, while also the role of other actors deserves attention. Strategy development and strategic interaction therefore become a core issue. When comparing this with national innovation system theory, we see that the governance structure of the relations between the actors is also an important condition to foster productivity in knowledge creation and diffusion and in the resilience of the system towards changes in the environment, but that NIS theory has not evolved into a multi-level perspective on their co-evolution. This handicaps policies for structural change, e.g. as needed for the Flemish 'Pact 2020' agenda.

From the complexity and uncertainty that are characteristic of a transition, it almost logically follows that steering of a transition in the strict sense of the word is impossible. A term sometimes used is "goal-oriented incrementalism" (Grin 2004, Rotmans et al. 2007): transition governance is a step-by-step approach, aimed at influencing, adjusting, accelerating change, and inspired by the long-term objective of sustainable development. This formulation breaks with the "neutral" approach of national innovation systems, where every innovation is good as long as it contributes to growth and competitiveness. Transition governance demands some sort of vision of where we are heading. The necessity of such a strategic guidance point is, by the way, underpinned by the research on TIS and functions of innovation systems. The function "guidance of the search", which in practice often refers to clear long-term objectives of government and a stable policy framework, is necessary to develop a renewable energy sector (Negro 2007, Hilman et al. 2008).

The best known application of transition governance is “transition management” such as it has been developed by Jan Rotmans and his team at ICIS and DRIFT. Transition management offers a clear toolbox for policymakers that hope to initiate transition processes in socio-technical systems (see Loorbach 2007 for the methodological elaboration). In the toolbox, we find instruments such as a transition arena, sustainability visions and transition images, transition pathways, transition experiments. The central instrument is the transition arena, a space where a group of maximum 15 individuals meets with essentially two goals: developing a shared understanding of the problem at hand, and developing a shared sustainability vision for that problem. In a second phase, the arena is enlarged with new participants that help in identifying different themes or sub-systems, and describing possible pathways or strategies towards these images. The transition agenda brings all the work together and can be considered as a joint action and innovation plan of all actors involved in the arena for the sustainable development of a specific societal system (ibid., 147). The transition agenda is operationalised through execution of transition experiments. The main aim of the experiments is to test and learn whether the formulated strategy and transition paths contribute to the desired change.

Although transition arena’s have been criticised on several issues – such as their underestimation of power relations (Shove and Walker 2007, Smith and Stirling 2008) and their unclear democratic status (Hendriks 2007) – in Flanders, the two transition processes DuWoBo and Plan C succeed in playing a role in the renewal of environmental policy. But transition arena’s can also become part of a broader portfolio of governance instruments for innovation. In fact, transition arena’s and processes fit into the philosophy of third generation innovation policy: they introduce innovation in new policy domains, and they link innovation to new societal issues. Furthermore, it seems possible to frame them as embryonic governance for new emerging innovation systems that are able to fulfil the different functions that innovation functions are expected to fulfil (cf. footnote 5). If we look at the Flemish processes, we see that they create new knowledge (F2) and diffuse knowledge in the transition network (F3). The formulated vision and transition agenda give guidance to the network and the experiments that are set up (F4). They become a shared vision for which transition actors try to create legitimacy and a broad political and social base (F7). Mobilising resources (F6) by linking experiments to subsidy programs is underway. However, they are embryonic systems in the sense that these functions could further be strengthened and not in the least because market formation (F5) and entrepeneurial activities (F1) are still very limited. The function approach can however be used to further develop both processes.

Nevertheless, transition management is not a panacea for all stages of a transition. It may be useful in what is sometimes called the pre-development phase, but afterwards other policy mixes of appropriate instruments are needed. Transition theory and governance have to be developed further in this respect.

6. Some conclusions

Throughout this paper, we have repeatedly used illustrations from Flemish innovation, environmental and transition policy. While some of the governance challenges are undoubtedly context-specific and depending on the specific way these policies are institutionalised in Flanders, we think the problem of policy integration and its relation to challenges such as low carbon economies and a new industrial agenda, are not unique but relate to an international context. After all, particular policy developments (such as the

Flemish) reflect a general trend towards the adoption of systemic policy frameworks in most countries in the face of the challenges of complexity and mutual dependency. The discussion here can hopefully contribute to a broader understanding of transition governance and its relation to sustainability and innovation policies in a European and global perspective.

Over the last decade, socio-technical transition studies have developed a challenging new perspective on (1) how radical socio-technical change comes about and can be analysed, and (2) how transitions can possibly be influenced in the direction of more sustainable societies. The further development of these two strands of research becomes all the more relevant in the light of the recent calls for low carbon economies and global green new deals. However, one of the concerns underlying this paper, is the fact that these propositions for 'change management' at the societal level may not be enough to inform the topical discussions on low carbon economies and more sustainable societies. Scholars will also have to adopt an active role in the learning loop between the further development of the theoretical approach and actual policy experiences. The further development of a conceptual framework for transition theory and management is then a necessary but insufficient condition in the adoption of effective new policy practices towards system innovation.

One of the necessary moves is linking ongoing evolutions in e.g. innovation and environmental policy with transition insights. When policymakers understand how transition approaches fit into the evolution of innovation and environmental policies, and that they are in fact a next step, needed to tackle new, more complex and dynamic and therefore more uncertain problems, it may be easier to "convince" decision makers of their value. It is crucial that the present crisis is understood in terms of a 'lock-in' in counterproductive growth dynamics that urge for radical system innovation.

Secondly, we think that putting more work in translation from research-driven, academic conceptualisations into heuristics for policymakers is a necessity. This relates to the understanding of transitions as well as to the governance of them. Developing science-policy interfaces to facilitate translation will be needed. In this process, it may also be necessary to dig deeper into the renewal necessary at policy level, in order to cope with the challenges of transition. Transitions are not only needed in socio-technical systems, but also in the segmented policy system itself. The current segmentation greatly hinders the development of integrated whole-of-system policies such as transition policies.

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