Industry level foresight: Designing foresight methods for Lithuanian energy sector

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Abstract

This paper has its starting point in the background analysis of the Lithuanian energy sector after closing down the only Lithuanian nuclear power plant in 2010. Based on the hypothesis that one of the main governance failures in this sector leading to weak industry level strategies is the lack of participatory debate and sufficient linkages between the different actors involved in the dynamic of the energy sector in Lithuania, this paper proposes industry level foresight as an instrument of long term planning. Foresight exercises could become an important instrument for reorienting energy sector policy, building new networks and linkages among the different actors, bringing new stakeholders into the strategic debate, exploring future opportunities State investment (including R&D), etc. The primary objective of this paper is therefore the design of a foresight exercise on energy sector with the aim of producing a long term strategy for this sector. The secondary objective is to address a topic on how to select foresight methods at industry level. The argument is that a better understanding of the fundamental attributes of foresight methods and their linkages to the core phases of a foresight process can provide useful insights as to how the selection of methods is carried out.

The method applied in this paper is dual: firstly, the synthesis of the academic literature on the selection of foresight methods is carried out; secondly, the comparative case study analysis of three foresight cases in the Baltic Sea Region (Poland, Finland and Russia) is applied. Case study analysis allows to explore the usage of foresight methods at industry level in the Baltic Sea Region and to understand if there are any similarities in the approach, also to explore success factors and weaknesses. The analysis in this paper is comprised of four main parts. The first part provides a background analysis on the energy sector in Lithuania and justification for the foresight exercise. Second part describes the underlying frameworks and definitions in the field of foresight research. The third part develops a comparative analysis of case studies of industry level foresight. The third part provides recommendations for energy sector foresight methodology in Lithuania.

The paper combines concepts and frameworks from literature (such as the Foresight Process and the Foresight Diamond) with comparative practical case study analysis. The

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results can be utilised by lecturers and students to describe and understand better the use of foresight methods at industry level, and by practitioners of foresight to better inform decisions during the design of more coherent methodological frameworks; as well as by the energy sector stakeholders in Lithuania and other countries.

Key-words: Foresight exercise, Foresight methods, Participatory governance, Lithuanian energy sector

JEL codes: L9, O14, Q47

Introduction: What is foresight and why conduct it

Foresight has its roots in the *futures research discipline*. The term "future research" is used as a term to describe the whole range of research conducted to help organizations, individuals, and governments explore, prepare for, and respond to changes in the environment. The term *foresight* is used to differentiate against forecasting which predicts the development of a known trend or issue. Foresight, on the other hand, is aimed at identifying new emerging issues for which often no past data is available and therefore forecasting would not be possible (Krystek, 2007). Many scholars have aimed to differentiate terms used in this broad field (e.g., Nick, 2008; Van Duin, 2008; Rohrbeck, 2010). Foresight is a process, which allows identifying future developments in science, technology, economy, and society systematically before these developments become trends (Coates, 1985, Martin 1995, Porter, et al. 2004, Reger 2001). This process involves methods and techniques to gather, assess, and interpret relevant information and to support decision-making (Coates, 1985, Cuhls, 2003).

The emergence of the foresight exercises at a national and industry levels was noticed after the II World War, first noticeable examples in Japan and USA. These exercises mostly focused on technology, as their aim was to identify promising emerging technologies and direct national research funding to the technologies that maximised economic benefit and social welfare (Martin, 1995). Another boom of macro and meso level foresight could be observed in the last two decades of the 20th century due to the support of the European Commission and other influencial international organizations (e.g., UNIDO) at supra-national level. The national foresight projects not only engage in the identification and assessment of emerging technologies, but also trigger research on the methods and practices of exploring the future. There are two important contributions to a corporate foresight perspective. The first one is a large toolbox of future research methods (Heraud and Cuhls, 1999; Gordon and Glenn, 2004; Popper et. al., 2004; Schwarz, 2009). Most of best known foresight methods, such as the Delphi analysis, scenarios and roadmapping, have been pioneered by national foresight exercises. There are permanently based research groups that work on the methods of macro level foresight (e.g. based in Manchester PREST in the UK, or RAND Corporation in the USA).

The general goal of foresight exercise is to create awareness about the external environment and to enable strategists reacting on changes (Patton, 2005). It aims at identifying discontinuities, technological trends, emerging technologies, and future business opportunities in promising areas of strategic research or investment (Martin, 1995; Reger, 2001, 2006). Additional objectives are to provide early warning about potential threats, and supporting planning and shaping the strategy (Reger 2001, Bernhardt 1994). It validates the early warnings, evaluates the possible strategic impact, and provides recommendations, as well as builds networks around a certain issue or problem.

The impact and value created by corporate foresight can be manifold, but value measurement seems to be difficult. The research on corporate foresight lacks insights on impact and value creation. Foresight is believed to having a positive impact on innovation success (Brown and Eisenhardt, 1997). In general, a benefit is seen as soon as the results from the foresight activities are used for decision-making. Furthermore, the early warning provided and the created awareness of opportunities is a great benefit as such (Ashton, 1991). Bürgel et al. (2005) consider foresight activities being successful, if due to those company earnings are made or loss is prevented, new successful projects and programmes are initiated, decision-making is enabled, communication is improved, business units and customers are satisfied, and/ or a corporate or industry level R&D strategy is supported.

At the meso and macro levels, there are other specific, policy-relevant methodological reasons to apply foresight. First, it can offer vital input for "quantum leap" in policy-making in various domains. Usually policies evolve in a piecemeal way, in incremental, small steps. From time to time, however, a more fundamental rethinking of current policies is needed. In other words, policy-makers occasionally need to ask if current policies can be continued: do they react to (early) signs of changes, block or accommodate future developments? Foresight stresses the possibility of different future*s* (or future states), as opposed to the assumption that there is an already given, pre-determined future, and hence highlights the opportunity of shaping our futures. It can enhance flexibility in policy making and implementation, broaden perspectives, and encourage thinking outside the box. Second, foresight can also help in picking up *weak signals*: weak but very important signals that a fundamental re-assessment and re-alignment of current policies are needed. In other words, foresight can serve as a crucial part of an *early warning* system, and it can be seen as an instrument for an adaptive, "learning society" (Havas, Schartinger, Weber, 2004).

In a nutshell, conduction of foresight exercise is most justified in those cases when there is a clear need to "shake" or reshape the system (innovation system, policy or company strategy) and find new routes to cope with existing problems. The above general considerations apply in the context of Lithuanian energy sector. Quite a few pressures – especially the need to build linkages and facilitate cooperation in the sectoral value chain and energy related innovation system, to change attitudes and norms, develop new strategies and solutions, balance budgets – are now pressing the decision makers both at national (macro) and sectoral (meso) levels.

Setting the context: the Lithuanian energy sector

State of art

Lithuania is a small single region country with less than 0.7% of the total EU-27 population. Country's economy, which has grown strongly since 2002, exited the European Union's second-worst recession in 2009. GDP per capita fell by 15% in 2009 and stood 64% below the EU-27 average. Unemployment has risen sharply up to 18.3% in the second quarter of 2010. The economy contracted once again in the first quarter of 2010 after the closure of the country's only nuclear power plant in Ignalina, following the terms of the agreement with the European Union related to the accession of Lithuania to the EU. Lithuania's gross domestic expenditure on R&D was 0.84% of GDP, well below the EU-27 average. The higher education sector is the main R&D performer with 0.64% of GERD/GDP and 56.6% of total R&D in 2009, while the investments of the business enterprise sector remained as low as 0.2% of GDP. The stable low-medium tech dominated structure of private knowledge demand, low numbers of newly born knowledge-intensive companies and low rate of entrepreneurship in general make it difficult to reach the national commitment to the 2% Barcelona target, especially on the private side.

Lithuanian energy sector is characterized by a large dependence on gas and a domination of state owned companies providing electricity. Given the lack of connections to the western and central European gas networks and electricity grid, Russia is the single source for gas to Lithuania. For this reason, the country alongside the other Baltic States is identified as an energy island. The coming years will see a de-monopolising of the state and a range of efforts to decrease the dependence on gas and therefore Russia for the energy provision. The power sector consists of two main sectors: the gas sector and the electricity sector, which in Lithuania are closely and complicatedly interlinked. Natural gas is currently the main fuel for electricity and heat production. However, renewable energy is also becoming important either for the electricity generation or heat generation or for cogeneration (simultaneously generating both electricity and usable heat) (Netherlands Chamber of Commerce, 2010).

Energy sector is a sector of strategic importance to Lithuania. Future strategy for the development of the energy sector is one of the national priorities due to the closure of the Ignalina Nuclear Power Plant (INPP) in 2010. Lithuania's *electricity* generation has been dominated by INPP for over 20 years, providing more than 70 % of the electricity needs. According to the EU accession agreement Lithuania had to shut down the INPP in 2009. A number of combined *heating and power plants* historically being a part of the regional district heating network operate as independent electricity and heat generators. Most of them are owned by local municipalities. A majority of these plants use natural gas as fuel. Until today, the energy market remains monopolised in Lithuania, which significantly limits the distribution of energy from new sources.

Lithuania consumes about 3.2 billion cubic meters of *natural gas* per year. Expectations are that the demand for natural gas in the next ten years will range from 1.6 to 3.7 billion cubic meters per year. 'Lietuvos dujos'; the main natural gas supplier in Lithuania, is owned by E.ON Ruhrgas International AG (39%), Gazprom (37%) and by the Lithuanian state. Natural gas is imported to Lithuania from a single source (Russian Gazprom) creating dependency that leads to higher costs (Lithuania pays higher prices than Germany). The biggest consumer of natural gas in the region is fertilizer manufacturer Achema AB which consumes about 40% of natural gas imported into Lithuania.

The current share of *renewable energy* sources in the final energy consumption is 15%. The EU target for Lithuania for 2020 is 23%. National regulatory regime is conducted by the National Control Commission for Prices and Energy. The Commission sets the purchase price for electricity generated from renewable energy resources. Currently there is 127 MW of installed capacities at the hydropower stations. Lithuania has one big 100 MW capacity hydropower station and 85 small ones with a total installed capacities of 26 MW. By 2020 Lithuania will have to increased hydropower stations' capacity up to 153 MW. Furthermore, the Government has a strategy to increase capacity of *wind farms* up to 500 MW by 2020.

The biggest *oil refinery* in the Baltic States is Lithuanian 'Mažeikių Nafta' which was acquired from Lithuania by the Polish company PKN Orlen. The company is able to refine up to 10 million tons of crude oil per year. Crude oil to the refinery is supplied through the Lithuanian Būtingė off-shore oil terminal. An alternative option to importing oil is through the state owned Klaipėdos Nafta import-export terminal based in Klaipėda sea port. Approximately 82 % of refined products are exported.

Strategies and stakeholders

Due to a high priority at the Government level to the energy sector related issues in Lithuania, the new Ministry of Energy was established in Lithuania in the early 2010 in order to implement the tasks related to national energy sector reform after the closing of the INPP. Lithuania intends to remain a nuclear energy country, but efforts are dedicated to investing in other more sustainable alternative energy sectors. The new Energy strategy was approved by the Government in 2010 and must now be approved by the Parliament. The strategy should achieve energy independence for Lithuania by 2020; its implementation will cost €5-7b. For the coming decade, the aim of the current Lithuanian government is to increase energy independence by connecting to other European networks and grids, to increase the own electricity production through the construction of a nuclear power plant and to increase the efficiency of power generation. After this first phase Lithuania aims for its energy sector to become more competitive (before 2030) and more sustainable (before 2050).

However, the funds are not secured yet for the implementation of the Strategy. Moreover, the recent decision of the Government to build a new nuclear power plant has been received with a lot of criticism and harsh and controversial discussions in the society. Despite the scope and urgency of the need to resolve problems of the energy sector, no wider discussions with the public or the key sub-sector on the alternative scenarios of how the sector could be developed in the future were organised so far (as of early 2011).

A number of researchers and research institutes (best known is the Energy Institute under the Ministry of Economy) work on research related to energy sector in

Lithuania. Some of the institutes as well as other stakeholders are involved in the activities of the national technology platforms in Lithuania. At the moment, there are at least six national *technology platforms* in Lithuania related to the energy sector:

1. National Biofuels Technology Platform, represented by the six small and medium sized companies (SMEs) and five public research institutes or universities.

2. National Biomass and Biofuel Production and Consumption Technology Platform, represented by the two small and medium sized companies (SMEs) and six public research institutes or universities.

3. National Photoelectricity Technology Platform, represented by four SMEs, two consultancy companies, two research institutes or universities, and two associations / NGOs.

4. National Heat Energy Technology Platform, represented by one SME, two business associations and two research institutes / universities.

5. National Hydrogen and Fuel Cells Technology Platform

6. National Energy Efficiency Technology Platform.

Currently, all of the Lithuanian NTPs have their representatives at the European technology platforms. It has to be noted that representatives of the key sub-sectors such as gas or energy do rarely participate in any networking activities.

Rationale for foresight exercise

Several factors indicate the potential need for a "quantum leap" in the development of energy sector in Lithuania. First of all, despite a newly approved Energy strategy, too many differences in the viewpoints on how the energy sector should develop still exist among the stakeholders. This is partly due to the reason that no public debate was organized around key energy sector related decisions, including such an important decision as construction of a new nuclear power plant.

Secondly, highly important challenges are pressing for development of new generation of solutions, e.g. to ensure the country's energy (electricity and gas) supply independence from one source (Russia). The closure of the Ignalina Nuclear Power Plant in 2010, the global economic and financial crisis and the related State budget crisis highlighted this long existed problem. It also pinpointed towards the need for development of alternative energy sources. Furthermore, an urgent challenge is to increase the energy use efficiency (e.g. there is a high energy efficiency potential in the heating sector). There remains also an unexplored potential in the expansion of the renewable energy sector (wind power, biomass, biogas and waste utilization energy).

Finally, there is a need to discuss and decide on the State funding priorities in the energy sector (and the sub-sectors) for the new EU structural assistance programming period from 2014 to 2020. Many EU Member States have already initiated the discussions on the funding priorities for the forthcoming period.

It is hypothesized that industry level foresight could be an effective method for organizing the debates, building linkages between stakeholders and developing new strategic solutions. Therefore, the aim of this paper is to assemble information to guide selection of approaches and methods for this hypothesised activity based on theoretical considerations and on selected case study analyses. Next chapter describes and explores the various influencing factors on the selection of foresight methods.

Conceptualising selection of foresight methods

Concerning the research type, a comparison can be made of inductive research, i.e., research aimed at identifying new phenomena, and deductive research, i.e., research aimed at testing phenomena. In inductive research, a further differentiation is made into conceptual work and empirical work using case studies or econometrics. Concerning the maturity of critical futures research discipline and research related to foresight in particular, it can be seen that most of the research until today has been inductive, thus aimed at theory development. This leads to the conclusion that the research discipline has not reached maturity yet, but can be classified as being at the transition from theory development to theory testing.

So far the selection of foresight methods has been dominated by the intuition, insight, impulsiveness and – sometimes – inexperience or irresponsibility of practitioners and organisers (Popper, 2008). Topic of selection of foresight methods has been widely discussed in both academic and professional literatures but mainly from one single angle – that is, how to select foresight methods. From that point of view researchers and consultants promote the use of particular methods, such as scenario technique, Delphi, cross-impact analysis, backcasting, gaming, roadmapping, and others. From that point of view researchers and consultants promote the use of particular methods. The paper of Dr. Rafael Popper "How are foresight methods selected?" (2008), on the other hand, revealed that the selection of foresight methods (even if not always coherent or systematic) is a multi-factor process, and needs to be considered as such. This paper aims to build on the work of Rafael Popper and other scholars and to propose a comparative framework, which would include essential elements of the foresight methodology for comparing three industry level foresight studies selected for this analysis from the Baltic Sea Region. The proposed comparative framework can be developed and expanded in the future. But first the main factors in the foresight process and methodology are discussed.

Essential elements of foresight methodology

The transport scenario deals with typical logistical routine task which occur in care facilities like the transport of food trays, medication, laundry, waste and mail.

In order to make valid decisions, the selection of the right methods is essential. Popper (2008) describes two fundamental ''attributes'' of foresight methods: (a) nature; and (b) capabilities. With regards to their *nature*, methods can be characterised as qualitative, quantitative or semi-quantitative:

- *Qualitative methods* generally provide meaning to events and perceptions. Such interpretations tend to be based on subjectivity or creativity that is often difficult to corroborate, for example opinions, judgements, beliefs, attitudes, etc. There are 15 qualitative methods according to Popper (2008): backcasting, brainstorming, citizens' panels, environmental scanning, essays, expert panels, futures workshops, gaming, interviews, literature review (LR), morphological analysis, questionnaires/surveys, relevance trees, scenarios, and SWOT analysis.

- *Quantitative methods* generally measure variables and apply statistical analyses, using or generating – at least in theory – reliable and valid data, such as socio-economic indicators. The mapping considered three quantitative methods: bibliometrics, modelling/simulation, and trend extrapolation/megatrends (or simply extrapolation).

- *Semi-quantitative methods* are basically those that apply mathematical principles to quantify subjectivity, rational judgements and viewpoints of experts and commentators, i.e. weighting opinions and probabilities. The mapping included six methods from this category: cross-impact/structural analysis, Delphi, key technologies, multi-criteria analysis, stakeholder mapping and (technology) roadmapping.

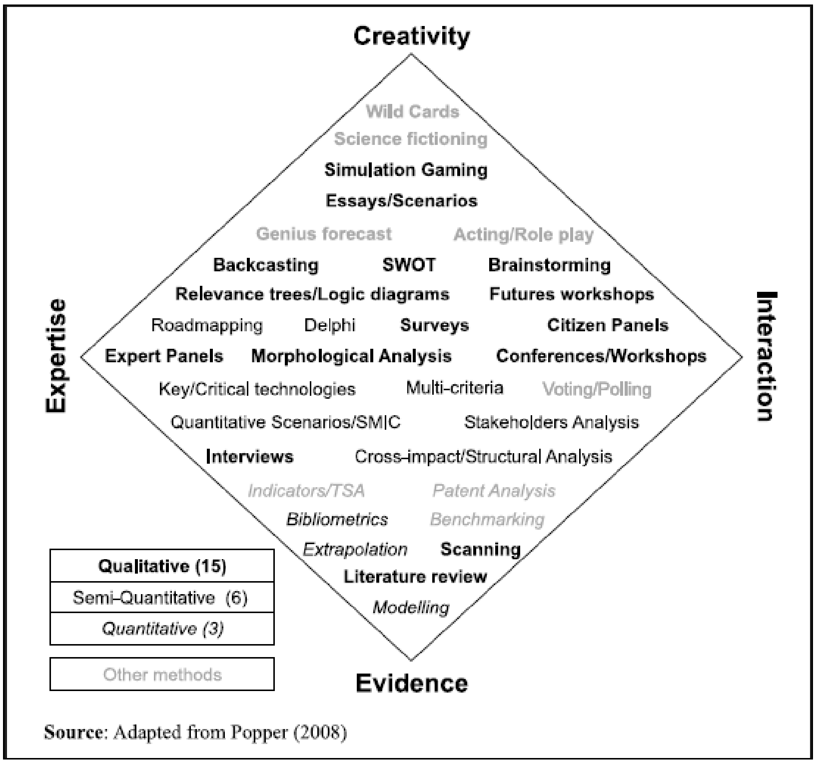


Figure 1: Foresight methods Diamond

The second attribute refers to *the capabilities* of methods – in other words, the ability to gather or process information based on evidence, expertise, interaction or creativity. These attributes are not exclusive or restrictive; in fact, they could be better understood if presented as ‘‘genetic’’ components of a method. Using the same analogy, the ‘‘genetic structure’’ of an activity carried out using expert panels could be estimated as consisting of: 70 per cent expertise, 10 per cent evidence, 10 per cent creativity, 10 per cent interaction; while the same activity carried out using citizens’ panels could consist of: 10 per cent expertise, 10 per cent evidence, 10 per cent creativity, 70 per cent interaction (Popper, 2008):

- *Creativity* refers to the mixture of original and imaginative thinking and is often provided by artists or technology ‘‘gurus’’, for example. These methods rely heavily on the inventiveness and ingenuity of very skilled individuals, such as science fiction writers or the inspiration that emerges from groups of people involved in brainstorming sessions (Ansoff, 1975; Cassingena Harper and Pace, 2004; Popper, 2008).

- *Expertise* refers to the skills and knowledge of individuals in a particular area or subject and is frequently used to support top-down decisions, provide advice and make recommendations. These methods rely on the tacit knowledge of people with privileged access to relevant information or with accumulated knowledge from several years of working experience on a particular domain area. Expertise often allows for a more holistic and comprehensive understanding of the theories, hypotheses and observations of a study (Kuusi, 1999; Scapolo and Miles, 2006; Popper, 2008).

- *Interaction* recognises that expertise often gains considerably from being brought together and challenged to articulate with other expertise (and indeed with the views of non-expert stakeholders). So, given that foresight studies often take place in societies where democratic ideals are widespread, and legitimacy is normally gained through ‘‘bottom-up’’ and participatory processes, it is important that they are not just reliant on evidence and expertise (see also Andersen and Jæger, 1999; Cuhls, 2003; Brummer et al., 2007; Popper, 2008).

- *Evidence* recognises that it is important to attempt to explain and/or forecast a particular phenomenon with the support of reliable documentation and means of analysis of, for example, statistics and various types of measurement indicators. These activities are particularly helpful for understanding the actual state of development of the research issue (Porter et al., 1980; Armstrong, 2006; Popper, 2008). The above attributes are the building blocks of the Popper’s *Foresight methods Diamond* (Popper, 2008, see Figure 1).

Fundamental elements of foresight processes

The night shift scenario aims at the assistance of the care worker as she is responsible for two floors all by herself.

Foresight has been increasingly understood as a systematic process with five interconnected and complementary phases: (1) pre-foresight; (2) recruitment; (3) generation; (4) action; and (5) renewal (Miles, 2002; Popper, 2008).

The *pre-foresight* or scoping phase is where strategic and early process decisions are made. The strategic decisions have to do with elements related to the overall aspirations of an exercise (rationales, general and specific objectives, work plan, expected outcomes, etc.). The *recruitment* phase is about enrolling key individuals and stakeholders who can contribute with their knowledge and expertise on particular issues and promote the research process within their own networks. For practical reasons it is presented as the second phase of the process but the engagement of and interaction between stakeholders is needed through the life of a study. Two fundamental elements of this phase are analysed in this paper:

1. *Target groups* – refer to the type of stakeholders (users/audiences/contributors) that have been involved in the study. Eight categories are considered: government agencies and departments, research community, firms, trade bodies and industrial federations, NGOs, intermediary organisations, trades unions and ‟other audiences”.

2. *Participation scale* – refers to the level of openness of a study, but openness is not necessarily well captured by simply looking at the scale of participation given that its scope is more important; however, the latter has not been captured in the mapping.

The *generation* phase is the ‟heart” of a foresight process, given that here is where prospective knowledge and shared visions are generated. It is therefore the phase in which ‟codified knowledge” is fused, analysed and synthesised; ‟tacit knowledge” is gathered and contrasted with codified knowledge; and (hopefully) ‟new knowledge” is generated, such as shared visions and images of the future. This phase involves three interdependent activities:

1. *Exploration* – using methods like scanning or brainstorming to identify and understand important issues, trends and drivers;

2. *Analysis* – using methods like expert panels, extrapolation or SWOT to understand how the context and main issues, trends and drivers influence one another; and

3. *Anticipation* – using methods like scenarios or Delphi to anticipate possible futures or suggest desirable ones.

The *action* and *renewal* phases are heavily influenced by the type, quantity, quality, relevance, usability and timely production of codified (and process-related) outputs, among others. Action is about reaching commitment from key players who are ready to embark on the "business of transforming and shaping the future" through the implementation of the policies and decisions produced in the generation phase. At this phase, the foresight process should link with traditional strategic planning processes in order to define realistic medium-to-long-term action plans. This bridge between foresight and planning is sometimes achieved with methods like roadmapping and morphological analysis, for example. Renewal is a mixture of intelligence and wisdom. It is about gaining knowledge and understanding of the opportunities and threats identified in the codified outputs and the process itself. This phase requires the use of evaluative approaches and, in particular, of traditional social research methods like interviews and opinion surveys.

Evolution of approaches to foresight

Interestingly, the research available suggest there is a shift in approaches to foresight since the 50s-60s and nowadays. Van der Duin (2004), Danheim and Uertz (2008) and Rohrbeck (2010) compared the evolution of future research in companies with their innovation processes. In their analysis, they show that the technology focus of corporate innovation management in the 1950s and 1960s was equally present in the way companies were exploring the future. And while the innovation processes changed over time to include the market perspective and later networking as a way to boost the company's own innovation capacity, so did the future research activities. In the 50s up to the 80s future research aimed particularly at forecasting future developments by using s-curves, mathematical modelling, and Delphi studies. In the 1990s, the limitations of forecasting became apparent, and future research moved away from attempting to predict the future toward identifying possible, probable, plausible, and preferable futures (Rohrbeck, 2010). Contemporary research on corporate foresight claims that corporate foresight is represented by four different modes (Daheim and Uertz, 2008): (1) the *expert-based* foresight emphasizes knowability by expertise; (2) *model-based* foresight that aims at calculating change by using quantitative and "subjective" models and matrices; (3) *trend-based* foresight aims to react to change and emphasizes projectability by development; its main characteristics are trends, weak signals, early warnings, development of trend-databases and monitoring systems. Scholars claim that nowadays the latter is a predominant mode of foresight activities at corporate level (Daheim and Uertz, 2008). The fourth stream views organizational foresight as the interaction between the way people simultaneously construe and are constrained by the temporal structures that are both enacted and changed through practice (Cunha, 2004). This rather pro-active ("shape the future") than reactive approach that relates to the concept of "*open*" ("collaborative", "participatory") foresight is named to be the next generation of corporate foresight (Daheim and Uertz, 2008), see Table 1.

Table 1. Development of approaches to corporate foresight

Dominant CF Paradigm	Expert-based Foresight	Model-based Foresight	Trend-based Foresight	Context-based „Open" Foresight
Assumption: The future can be ...	Known by means of expertise	Calculated by means of models	Projected by means of (scanned) developments	Shaped by means of interaction
Key Characteristics	Belief in Experts dominant, but: 70s: Turn to the qualitative and wider environment First Opening towards "soft sciences"	Quantitative and "subjective" Models Extrapolation Systems Dominated by "hard science"	Trends Weak Signals Early Warning Mix of qualitative and quantitative Indicators	Integrating "soft" and "hard" approaches; Understanding & Interpreting /evaluating change; Opening up: Participation, Interaction & process; Action- and innovation-oriented; More attention on discontinuities
Perspective	Exploring Change	Calculating Change	Reacting to Change	Understanding & Anticipating / Shaping Change
Output	Delphis, Roadmaps, Scenarios	Models & Matrixes	Trend-databases, Monitoring	Scenarios; Wild Cards; Action Plans & Innovation

Dominant CF Paradigm	Expert-based Foresight	Model-based Foresight	Trend-based Foresight	Context-based „Open" Foresight
			Systems	Ideas

Source: Daheim and Uerz, 2008

Therefore, another element that is being added into current foresight projects is *participation*. The reason behind the addition is the need to involve stakeholders early in order to ensure that the insight creation is followed by actions. Public research institutions and companies are expected to be more willing to engage in R&D activities when they have participated in the process of defining the R&D priorities (Salo and Cuhls, 2003). A lesson for industry level foresight activities is that for achieving better results it should also move toward qualitative methods and more active participation of the internal and external stakeholders.

Analysis framework

Having described the attributes of foresight methods and the elements of a foresight process, it is now time to recall the empirical questions of the paper: How are foresight methods selected in the contemporary practices in the Baltic Sea Region (BSR)? How could Lithuania learn from this experience? The answer requires tackling 8 elements, related to the attributes of industry level foresight methods and process design. These elements (criteria) are reflected in a comparative framework described in Table 2. This framework serves as a basis for comparative case study analysis.

Table 2. Framework of criteria of comparative case study analysis

Type	Elements/criteria	Analysis questions
General	Aim, scope, time horizon, domain coverage	What is the aim of industry level foresight and how does it reflect in methods selection? What is the scope and domain coverage of foresight exercise? What is the time horizon (10, 20, 30 years or more)? Who initiates the foresight exercises in the BSR (top-down vs bottom-up approach)?
Methods mix	Ratio between qualitative and	What is the ratio between qualitative and quantitative methods in the methods mix?

Type	Elements/criteria	Analysis questions
	quantitative methods	
	Ratio between creativity, expertise, interaction and evidence	What is the ratio between creativity, expertise, interaction and evidence?
Participation level	Level of involvement of stakeholders Role of different stakeholders	What stakeholders are involved in foresight process? What is their role? How is participation enhanced, what is overall level of participation? What is the role (if any) of SMEs in industry level foresight exercises and what are (if any) benefits for SMEs in being involved in these exercises?
Value	Outputs and results Success factors	What are the main outputs and results? What are the success factors and limitations?

Comparative industry level foresight case study analysis

Poland: Foresight in Energy Sector 2030

The aim and scope

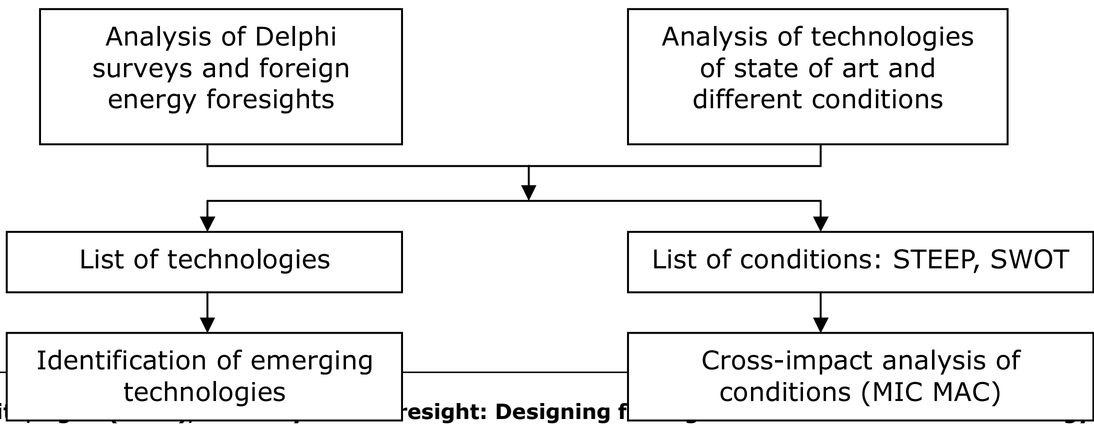
The foresight exercise on the future of energy sector in Poland was launched in 2006 on the request of Polish Ministry of Economy by the consortium of research and development institutes. The ultimate objective of the project was to provide advice on energy R&D priorities, based on sound expert knowledge. One of the key requirements was seen as a re-assessment of the future role of nuclear power in Poland to ensure security of power supply and diversity, and avoid dominance by coal for reduction of CO_2 emissions. The project was co-financed in equal shares by the

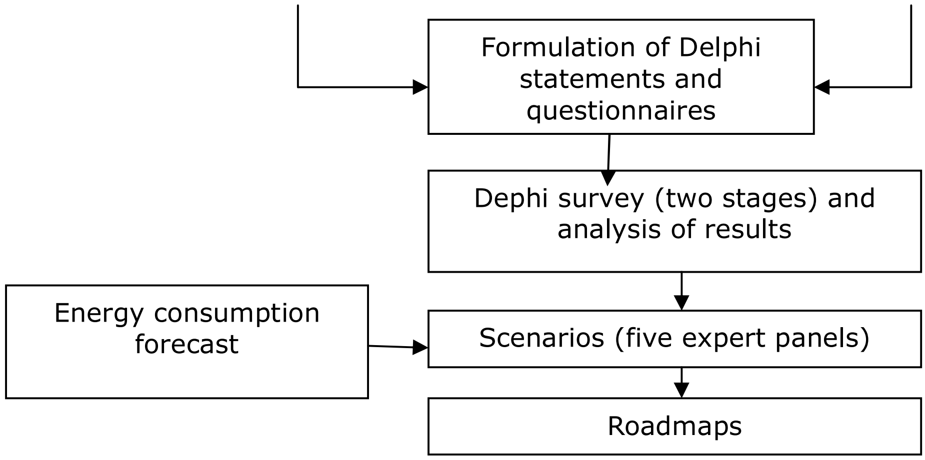
Ministry of Economy and the research organizations. Central Mining Institute was a leading unit in this project. The energy foresight focused on an assessment and implementation of new technologies, essential for fuel and energy production and utilization. The aim of the exercise was the identification of key technologies of strategic importance for national economy development and national energy security, followed by the elaboration of scenarios of their development by 2030. The foresight exercise was conducted in eight thematic groups: hard coal and lignite based power generation technologies; coal treatment technologies; technologies for management of combustion waste products; technologies for oil and gas industries; renewable and alternative fuels based power generation technologies; hydropower, wind power and geothermal technologies; nuclear power generation technologies; hydrogen energy technologies.

Participation and coordination

The joint research project involved R&D institutes, *energy companies and industry*. The focal point of the foresight study is Delphi survey with two rounds of expert consultations. Polish study follows a strict sequential order of analysis, which can be broadly divided into the following phases:

- Defining the input to the Delphi questionnaire and execution of a two round, on-line Delphi survey,
- Developing future scenarios that combine social and technological features on the basis of the Delphi results and research performed within five sectoral panels,
- Creation of the roadmaps.





Source: Stańczyk, Czaplicka-Kolarz, Świądrowski (2006)

Figure 2. Foresight methodology sequence in Poland

The key stages of the project were the following: (a) analysis of the results of previous Delphi surveys and energy foresights conducted in other countries; (b) review and analysis of the state of the art technologies, market, social, environmental, political and economic conditions related to energy sector; (3) identification of problem fields in terms of technologies and conditions; (4) impact analysis based on problem fields analysis; (5) formulation of Delphi statements, that is factors determining the energy demand in the defined timescale; (6) production of Delphi questionnaire, accessible on the internet for recognised experts and wide consultancy group of stakeholders; (7) the analysis and quantitative assessment of Delphi survey data and technology scenario (roadmap) building.

The Delphi survey asked for expert judgments on anticipated technological developments, as well as political and social trends (including a future electricity demand), which are likely to have an important influence on the future constellation of the energy system. The questionnaire thus comprised two main parts, technical statements and questions refer to societal visions. In total, the final questionnaire embraced 125 statements. Technical statements were divided into 8 subgroups addressed to individual energy fields including nuclear energy area. The core of the Delphi method implemented in the study was a multi-round survey. With each questionnaire the participating experts received the results from the previous rounds.

This procedure helps to obtain clearer judgments on highly uncertain issues. At the same time, the anonymity of the process ensures that the opinions of influential individuals do not dominate the findings. In contrast to simple surveys, which are limited to gathering information, Delphis integrate elements of expert discussions, which bring about additional value by generating consensus among participants and by building up a shared view on future visions (Szczurek et. al., 2007).

The second important task of the project concerns creation of Road Maps which correspond to variant scenarios of nuclear power development in Poland up to 2003 year. The process was launched with STEEP and SWOT analysis aimed at isolating the main drivers of Polish future energy system. These analyses were useful to establish by the working group the preliminary list of possible variables (drivers) related to future energy demand and supply as well as economical, political and social fields, which are likely to have an important influence on the future development of nuclear option. The list was then submitted to the external experts and discussed at the workshop. Finally 38 variables were selected. Then analysis has been carried out with the computer code MICMAC based upon a Boolean algebra concept.

The strength of the MicMac application lies in identifying variables of indirect importance and particularly those, which are likely to elude the analyst. Once the experts have discussed and defined the impact between each of the 38 variables in the nuclear energy system, the matrix generated by the program helped to group the different variables by influence and dependence. Finally the following strategic factors have been selected: *support of government policy to nuclear option, competitiveness, public acceptance, environmental protection, energy security, energy demand, and level of infrastructure*. In the next step three social visions have been formulated, each corresponding to a cluster of related key factors development. They had optimistic, realistic and pessimistic character (Szczurek et. al., 2007).

Preliminary list of the key technologies has been prepared by the working group. Then, as the result of the prioritisation procedure, the final list of key technologies was established. In the next step, three technology visions for nuclear power future in Poland were identified. The first considers only one LWR technology unlike the two other scenarios which include HTGR reactors and waste disposal technology as well. Combining social and technological vision and taking into account Delphi results, three scenarios of the nuclear power development in Poland have been created and corresponding Road Maps have been elaborated.

Outputs and results

With a time horizon of 2030, this expert survey not only provided a useful perspective on long-term developments of energy technologies, but also evaluated these technologies against different sets of social values or visions. Therefore the results of energy foresight in Poland are those:

- The key technologies for energy sector development scenarios building were selected;
- Two option prognosis of energy consumption for the period to 2030 were elaborated.

Technology Roadmaps for nuclear energy, developed within the project, highlights the R&D needed, give provisions to government policies and indicates actions between government and industry. The knowledge gathered gives insight into the possible future constellations of nuclear power sector and on the actions necessary to increase the likelihood of the successful implementation nuclear technology in Poland.

Finland: National Priorities for the Forest-Based Sector Technology Platform

The aim and scope

In 2005, a national foresight process was conducted in Finland to support the development of the Strategic Research Agenda of the European Forest-Based Sector Technology Platform. Since 2003, the Commission has encouraged industrial stakeholders to set up European Technology Platforms, which the European Council, too, has promoted as one of the coordination tools to set up European research and technology development priorities, action plans and timeframes.

The planning of the technology platform for the forest-based sector was started in autumn 2003 by the European Confederation of Woodworking Industries, the Confederation of European Forest Owners and the Confederation of European Paper Industries. As a result of a Europe-wide consultation of the key stakeholders, the Vision for 2030 document on the key challenges, opportunities and strategic objectives for the sector was published in February 2005. This document served as the basis for the further preparation of the European Strategic Research Agenda (SRA) process. The national process was systematically run to identify key national priorities in connection with the European process.

This national process was based on the Robust Portfolio Modelling (RPM) screening methodology, which consisted of the Internet-based solicitation and assessment of research themes, identification of promising research themes through RPM and several participatory workshops.

Participation and coordination

While European dimensions were well represented in the management structure of the Forest-Based Sector Technology Platform (FTP) (e.g., through the representatives of multi-national companies, industrial confederations, and the Commission), the recognition of national, regional and local interests called for additional inputs from member states. This was achieved by establishing national support groups that acted as "mirror groups" of the European FTP and also by establishing national value chain working groups. The national support groups consisted of representatives of *industrial firms*, research organizations and funding agencies with interests in the forest-based sector. They provided national views and inputs to SRA and were in charge of mobilising the national SRA work. The FTP had inherent connections with some four to five other technology platforms, whereby responsibilities for synchronisation were assigned to the Scientific Council and Advisory Committee. Moreover, the Vision for 2030 document highlighted links with other policy areas.

In the national process, different kinds of stakeholders were invited based on their expertise and responsibilities. The steering group consisted of the coordinators of the value chain working groups and invited experts to gather together research, industry and policy expertise. The coordinators identified and invited respondents to submit research themes and referees who were responsible for assessing them. The support team at the Helsinki University of Technology contributed to the process design and provided the methodological expertise and the IT infrastructure. This team also produced tentative analyses of solicited and assessed research themes for the value chain workshops.

To support the value chain coordinators in inviting the most suitable respondents and referees, their roles and responsibilities were explicitly defined. Respondents were established researchers or research managers at universities, research institutes and *industrial firms* with the capacity for producing innovative research themes for each value chain. Specifically, the respondents were requested to study the Vision for 2030 document and to propose research themes through the project website.

Referees were highly competent researchers and industrials capable of evaluating research possibilities in view of the Finnish and European forest-based sector. They were responsible for assessing the solicited research themes. Some participants assumed several roles in the process. For example, many respondents were invited to participate in the value chain workshops and to contribute to the further analysis of the themes.

Furthermore, although the roles and responsibilities were identified formally, the organisation was many-faceted with partly overlapping duties. For instance, the coordinators participated both in management activities and expert workshops while in some value chains there were experts who assumed the responsibilities for respondents and referees alike or even participated in several value chains. This created additional interactions between value chains and process steps enabling the efficient cross-feeding between the value chains (Könnölä, Salo, Brummer, 2009).

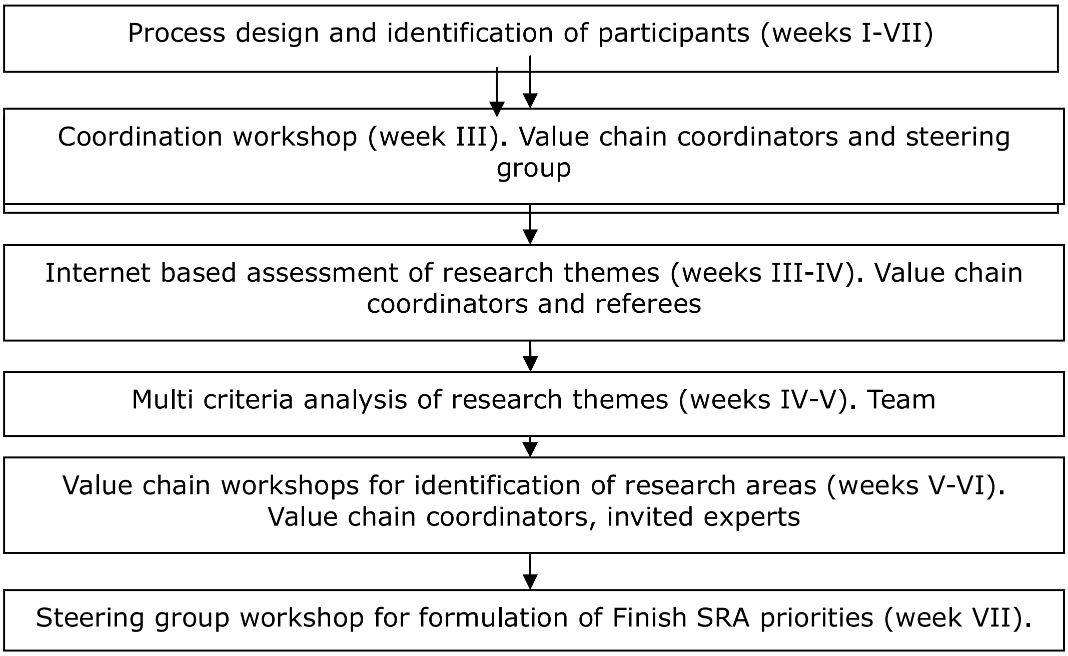
Methodology and process design

This process was started in March 2005 with the objective of collecting about ten strategic priority areas as a key input to the European SRA process. Shortly thereafter, the support team launched a project website to facilitate the work of five value chain working groups in the following areas: forestry, pulp and paper products, wood products, bio-energy and specialties/new businesses. Each value chain working group was given the opportunity to take part in the *Internet-based solicitation and assessment* of research themes, the results of which were further analysed with RPM.

Results from the Internet-based consultation process were envisaged as a key input to *the value chain workshops* where promising themes were discussed with the aim of synthesizing the ten most essential ones from the national process to the European SRA process. Apart from this core objective, the national SRA process was expected to assist the national actors in participating in the European context, to offer an opportunity for methodological development, and to provide experience on how national stakeholders could be best engaged in European coordination tools. It was expected that the process would attract quite a bit of interest in Europe, wherefore English was adopted as a working language (Könnölä, Salo, Brummer, 2009).

Overall, the process consisted of seven steps (see Figure). The process design relied heavily on the use of *Internet-based group support systems* because it would have been impossible to organise a large number of face-to-face meetings within the seven-week period that was allotted to the process. A further reason for this was that

Internet-based distributed work can provide efficient and systematic support for stakeholder participation while permitting features such as anonymity and flexibility in terms of time and place. Due to the limitations of the Internet as a platform for social interaction, however, the process was run in conjunction with the *workshops*.



Source: adapted from Könnölä, Salo, Brummer (2009)

Figure 3. Foresight methodology sequence in Finland

The consideration of multiple perspectives was supported, among other things, by *multi-criteria assessments* where the referees evaluated research themes with regard to three criteria (novelty, feasibility and industrial relevance). The simultaneous consideration of multiple criteria led to the question of how the relative importance of these criteria should be weighted: for example, research themes that are not very novel may still be industrially relevant and hence interesting. This realization was the rationale for adopting the *robust portfolio modelling (RPM) methodology* (Liesiö et al., 2006) in the analysis of research themes.

In this methodology, different perspectives can be accommodated not only through the consideration of multiple criteria (as the basis of the participants' assessment ratings) but also by incorporating different interpretations about the relative importance of the three criteria. The task of identifying most promising themes for workshop discussions was framed as a project portfolio selection problem with incomplete information about the relative importance of assessment criteria.

The visualisations of the results of the analysis were presented at the *value chain workshops*, where they were taken up in the discussions and used in the clustering of themes and formation of national SRA priorities. The RPM framework contributed to the legitimacy of the results because this systematic methodology was also described transparently on the project website. Results from RPM screening were used as supporting information only because final syntheses and analyses were carried out in the workshops. In the RPM-analysis, the value chain coordinators had a major role in the adoption and shaping of results. In each value chain workshop, approximately half of the submitted research themes were taken up in the discussions that guided the final decisions.

In some value chains, themes with high core index and/or high novelty and/or industrial relevance were identified first; after that the final themes were defined by synthesising these themes. In some other chains, the coordinator had already developed a tentative clustering before the workshop so that the final themes were created by assigning the solicited themes to the proposed clusters. This helped in the identification of missing themes and served to highlight what clusters were apparently important apart from the solicited research themes.

Outputs and results

The national foresight process contributed to the development of the European SRA, which defined the following strategic key objectives for the platform:

1. Development of innovative products for changing markets and customer needs.

2. Development of intelligent and efficient manufacturing processes, including reduced energy consumption.

3. Enhancing availability and use of forest biomass for products and energy.

4. Meeting the multifunctional demands on forest resources and their sustainable management.

5. The forest sector in a societal perspective.

This foresight process was embedded in the broader strategy process. This integrated approach supported the strong connection with the decision-making involved in strategy formulation. At a more general level, the deployment of the RPM screening method in the Finnish SRA process can be assessed against the backdrop of emerging foresight needs at the international level. First, several analogous processes in other countries may be amenable to similar methodological support, for instance, within European coordination tools that seek to respond to the challenges of vertical coordination of multilayered innovation systems. Second, methodologies such as RPM screening can respond to the challenges of horizontal coordination by permitting the participation of different stakeholders, adopting complementary criteria and varying the interpretations by which the relative importance of these criteria is assigned. Third, the Finnish SRA process is relevant to the management of international foresight activities because its design is scalable and can be adapted to the international context (Könnölä, Salo, Brummer, 2009).

Russia: Nanotechnology Foresight 2020

Aim and scope

The overall goal of the project was to develop a methodology for the National Nanotechnology Foresight Programme for the time horizon of 2015-2020 and to outline the global and national trends in nano-science and nanotechnology. Analytical studies were designed to feed the development of the Russian Nanotech Initiative and to provide inputs to Delphi-survey and scenario development processes. The duration of the project was only 2 months from November to December 2005. The short timeframe was indicated by rather limited resources (€30,000) assigned to the project by the Ministry of Science and Education of the Russian Federation. The exercise was organized by the Russian Institute of Economy, Policy and Law (RIEPL).

The point of departure was the recognition that Russia needed to assess its future from the global perspective, to identify strategic research areas for the next 15-20 years in order to support the competitiveness of the Russian economy and to respond to future social needs and to strengthen future-oriented cross-disciplinary activity inviting all stakeholders to discuss about the future challenges, benefits and threats.

Actors and participation

On the Russian market the project identified 20 nano companies - about 80% of them played on the nano-material's market. All companies were classified as SMEs. Most of these were spin-offs. It was assumed that some companies do not represent themselves as 'nano'. Within the Russian R&D system the project identified 147 R&D organizations in the nano-field. In the foresight process it was decided to involve different stakeholders (companies, researchers, State agencies, and also users) in the Delphi survey. The content for Delphi survey as well for the scenarios was developed at the stakeholder workshops.

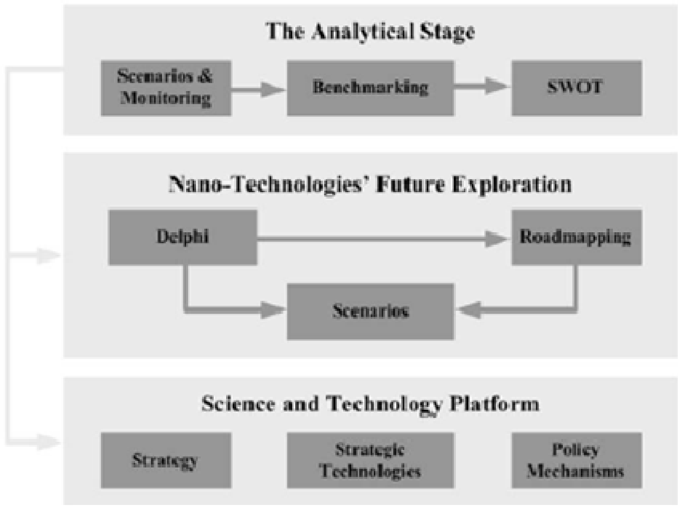
In the Delphi questionnaire, the task of *academic researchers* is to evaluate the nanotechnology impact on the development of other S&T domains, their possible negative impact on population health and environment, to outline the likely scientific and technical barriers and to suggest S&T policy mechanisms as well as to estimate the gap - forestalling or tardiness - of Russian R&D in compression to the world leaders. It was purposed that *companies* should evaluate market demand and barriers, fields of nanotechnology application and the impact of nanotech on the competitiveness of Russian companies as well as to formulate innovation policy mechanisms. The role of *governmental officials* was to estimate public demand, institutional and legislative barriers and to suggest policy mechanisms. At last *potential users* should evaluate future technology in terms of cultural barriers and their importance for the solution of social and environmental issues.

Methodology of the Foresight Programme

The methodology was based on the combination of the following tools: scanning and monitoring, benchmarking, SWOT, Delphi, Scenarios, Technological Roadmapping. It was designed to provide a dialogue between different stakeholders and users of innovation to respond to the specific characteristics of nanotechnology.

Scenarios and monitoring play a special role for the analytical part and for the NNFP as a whole. It were designed to feed the program and to provide inputs to all methods and tools. Based on this assumption the general and specific indicators for the S&M were formulated in the project. *Delphi* plays a key role for the exploration and assessment of coming technologies*.* Its methodology comprises the inclusion of the corporations, academia, governmental officials and innovations' users given the fact that cultural and social issues are of considerable importance to the nanotechnology evolution. These four groups of actors have different knowledge and interests concerning the future of nanotech. Accordingly, it was concluded to develop four questionnaires with common technological statements but different characteristics / indicators.

Since nanotechnology is an interdisciplinary and fast developing domain it was decided to couple Delphi with *a multidisciplinary brainstorming workshop* to outline what kind of scientific breakthroughs with significant impact on economy and social problems' solution could happen in the future. It is expected that this workshop's outputs could serve as one of important inputs to the Delphi questionnaire. Delphi was developed to provide the dialogue between different stakeholders. For this purposes it was suggested in the second round to send the output of the first round calculated for each group of respondents to the members of four respondents' group. This way each group of respondents could learn the expectations of other groups. Corporations, for example, could learn the expectations of innovations' users, governmental officials and scholars and make corrections in their own judgments.



Source: adapted from Gaponenko, 2006a

Figure 4. Foresight methodology sequence in Russia

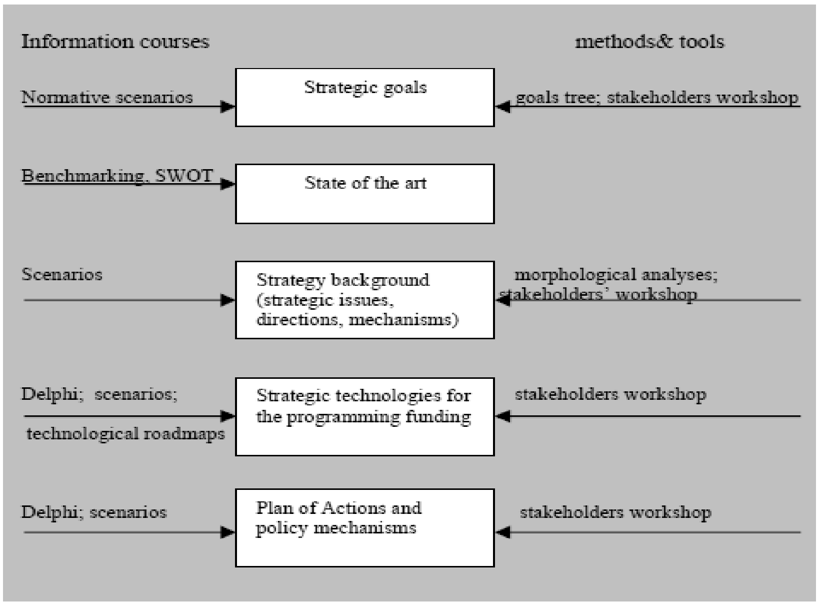
Delphi outputs were proposed to be used for the first round of technology prioritization. For this purposes the methodology suggested using the following approaches:

- Orientation on the consensus between different respondent's groups,
- Realisation of four stages of technology mapping using the criteria of technology importance (in terms of competitiveness at the world market, contribution to the social and environmental issues solution, impact on the other S+T domains' evolution and importance for the national defence sector) and likelihood,
- Evaluation of possibility of technology implementation in different sectors of economy. Delphi-survey outputs serve also as the input for the development of *technological roadmaps*. Roadmaps were built for different nano-fields – nano-materials, nano-bio, nanoelectronic, nano-energy. It is expected that they will be used by policy-makers and scholars and serve as input for the S&T platform development. The roadmap for different sectors of economy is oriented towards the implementation by corporations and as input for scenarios.

Scenarios helped to explore how nanotech will be perceived in different contexts - geopolitical, economic, social and cultural. The scenario approach is used for fostering a dialogue between different stakeholders. It is considered a powerful tool for the learning process. Information from all building blocks of the NNFP - S&M, benchmarking, SWOT, Delphi and technological roadmaps - is used as input for scenario building. Special characteristics of the nano-scenario approach were: implementation technological roadmaps – technologies are used as events in scenarios; evaluation of external environment impact on the technological trajectory and adverse impact of technological development on the external environment; delineation of turning points in technological trajectory; analysis of critical uncertainties.

Outputs and results

The outputs of analytical and future studies served as inputs for the development of the national Science and Technology platform (see Figure 5).



Source: Gaponenko, 2006b

Figure 5. Foresight methods and tools to inform National Science and Technology Platform

To sum it up, the developed methodological approach allows: to link science push and demand pull approaches; to provide dialogue and learning process between different stakeholders; to link future studies with policy- making; to collect the judgments of different stakeholders and innovations' users for the providing comprehensive assessment of coming nanotechnology; to select nanotechnology for the programming finding; to formulate policy mechanisms like dialogue between different stakeholders as well as to outline the fields for the public-private partnership; to form the information base for the companies' strategic planning. The design of Foresight programme like a dialogue forms conditions for the building of networks and public-private partnership (Gaponenko, 2006b).

Comparative analysis

This section develops on the benchmarking of the three selected cases in order to find and explain similarities or differences in these areas: aim and scope; method mix applied; participation enhancement, and benefits for SMEs (if applicable).

Aim and scope

In all the selected cases in the Baltic Sea Region, except Finland, the industrial foresight exercises were initiated top-down with the aim of defining priority R&D areas and preparing a national strategy (involving funding instruments) for developing the priority areas. Finish case is different as it also includes an element of supranational coordination – a need of alignment of national goals with the international goals and trends. In Finland, the process of foresight was initiated by the industry actors, and strongly supported by the governmental actors.

Table 3. Aim, scope and approach

Country	Aim	Scope	Time horizon	Top-down vs bottom-up approach
Poland	To provide advice on energy sector R&D priorities (and required public funding)	Energy sector; assessment of new technologies in 8 thematic groups. Technology foresight.	25 years (until 2030)	Top-down (initiated by the Ministry of Economy)
Finland	To define priority areas, to prepare a Vision 2030. A national foresight process was conducted to support the development of the Strategic Research Agenda of the European Forest-Based	Forestry sector. Technology foresight.	25 years (until 2030)	Mixed: both *top-down* (due to supranational coordination of the process of building European technology platform); and *bottom-up* (a national initiative of

Country	Aim	Scope	Time horizon	Top-down vs bottom-up approach
	Sector Technology Platform.			the forestry sector in Finland)
Russia	To prepare the National Nanotechnology Foresight Programme for the time horizon of 2015-2020	Nanotech sector. Technology, economic and societal foresight	15 years (until 2020)	Top-down

On the one hand, the top-down approach in all cases demonstrates strong political will, which is a success factor for foresight exercise as it allows embedding foresight results into the policy development process. On the other hand, mixed approach in the Finnish case that shows strong involvement of industry demonstrates better reflected needs of the industry and therefore better tailored results.

Method mix

In two of the cases, Poland and Russia, the method mixes were quite rich. Both countries had a similar approach to the methodology. The focal point of both exercises was a two-round Delphi survey that was complemented with participative expert workshops / panels that contribute to the scenarios and roadmaps development. In the Finnish case, possibly the shortage of time resources have contributed to the less sophisticated approach – the multi-criteria Internet based assessments and participative workshops were applied.

All cases demonstrate priority to the semi-quantitative methods (multi-criteria analysis, Delphi, roadmapping) and qualitative methods (expert panels, SWOT, STEEP, benchmarking). The fact that quantitative methods (modelling, simulation, forecasting and similar) were used to much lower extent (in Polish case – energy consumption forecast; in the Finnish case – computer based simulation) can be related to:

1. firstly, the European trends of participative foresight as described in Table 1;
2. the need to mobilize the community (the value chain) around the industrial sector or certain technology and to build public-private partnerships. The latter reason is most obvious for the Central and Eastern European countries such as Russia and Poland where public- private partnerships are still underdeveloped.

The methods mix in all cases strongly supports expertise and evidence, and is least related to creativity and interaction, according to the Popper's 'diamond' (2008). On the one hand, this can be related to the aims and scope of the foresight exercises and the fact that most of the exercises were initiated by the public sector. On the other hand, especially in Russia's and Poland's case lack of creative and interactive methods can be associated with the formal and legalistic administrative culture.

Table 4. Methodological approach

Country	Delphi	Scenarios	Roadmap	Expert panels	Benchmarking	STEEP, SWOT	Other
Poland	Yes; the focal point of the study	Yes	Yes	Yes, two rounds of panels	-	Yes	Yes; cross-impact analysis; energy consumption forecast
Finland	-	-	-	Five participatory workshops under different themes with the members of the value chain working groups	-	-	Robust Portfolio Modelling (RPM) screening methodology, which consisted of the Internet-based solicitation and assessment of research themes
Russia	Yes, the focal point of the methodology; four questionnaires tailored for different target groups	Yes	Yes	Yes; multidisciplinary participatory workshop	Yes	Yes	Yes; scanning and monitoring

Participation

It has to be noted that participation and involvement of different stakeholders was at the focal point of all three cases and specific attention was devoted for involving different target groups into the exercise. In most cases, participation was enhanced by organizing expert panels and participative workshops. In Finland, participation was enhanced both at national and *international* levels: by establishing national support groups that acted as “mirror groups” of the European FTP and also by establishing national value chain working groups. The national support groups consisted of representatives of industrial firms, research organizations and funding agencies with interests in the forest-based sector.

In the Russian case, 4 groups of stakeholders were formulated (companies, researchers, State agencies, and also users), and separate Delphi questionnaires for each group were formulated. This approach provided opportunity to make a comprehensive assessment of nanotech, to accumulate knowledge of different stakeholders and potential users and to link science push and demand pull approaches.

Table 5. Involvement of the target groups

Country/ Stakeholder and level of involvement	Public officials	Research institutes	Companies	Experts	NGOs, associations, other
Poland	Delphi, expert panels	Study was implemented by consortium of research institutes	Delphi, expert panels	Delphi, expert panels	N/A
Finland	Invited at participatory workshops	Experts invited to participatory workshops; took part at Internet based evaluations of research themes	-//-	-//-	-//-
Russia	Delphi, participatory workshop	Delphi, participatory workshop	Delphi, participatory workshop	Delphi, participatory workshop	N/A

Role and benefits for SMEs

Data on the role (if any) of SMEs in industry level foresight exercises and the benefits (if any) for SMEs in being involved in these exercises is scarce. It could be the focus of another research. However, from the data that is available it could be concluded that in all cases SMEs were to a certain extent involved in the foresight exercises. Possibly, the strongest involvement of SMEs was in Russia due to the specificity of the nanotech sector, were all the nanotech companies are small and medium sized.

Table 6. Involvement of the target groups

Country	Involvement SMEs	Success factors	Weaknesses
Poland	Delphi/ expert panels	Multi-method approach	The process was dominated by the public sector (Ministry and research institutes)
Finland	Experts from some forestry-based SMEs were involved in the Internet-based evaluation of research themes and participatory workshops	Partial application of the bottom-up approach and lead by the industry; Involvement of full value chain	The process was too short; involvement of SMEs limited.
Russia	All of Russian nanotech companies are SMEs; they were involved in the Delphi survey and some in the participatory workshop	Multi-method approach	Process dominated by public sector

However, the main weakness of the Russia's and Poland's foresight exercises is that both of these foresight programmes were controlled and dominated by the public sector - governmental research institutes and governmental agencies. It can be associated with the fact that the highest proportion of the governmental funding for technological development in the related areas (energy and nanotech) in these countries is provided for the public sector research organizations. Stronger involvement of the industry actors, including SMEs, in the public debate about the directions of sector's development as well as the public policy development, should be enhanced.

Designing sector foresight in Lithuania

This section provides an example on how foresight methodology could be applied to develop proposals for sector's development and funding priorities in one industry sector in Lithuania. For this Report, the Lithuanian energy sector is selected as a suitable example. The reasons why national foresight is a viable option in Lithuanian energy sector's case are outlined in chapter 2 of this paper. The proposals for the industrial foresight methodology are provided below in this section and are based on the results of the comparative analysis of selected foresight programmes in the other Baltic Sea Region countries. Moreover, it is considered that there could be potential benefits and synergies in coordinating the foresight process with the process of developing national technology platforms related to the energy sector in Lithuania, as it was done in forestry sector's case in Finland.

Conclusions based on comparative analysis

There cannot be one "best" methodological approach to foresight exercise. However, the data available allows bringing up several conclusions. The conclusions, based on the results of benchmarking the three industrial foresight cases, are structured around these questions:

1. What are the similarities and differences in the methodological approach, how can these be explained?
2. What are the success factors and weaknesses of industry level foresight in the Baltic Sea Region?

First of all, it seems that the difference in the approach to the methodology and process of organizing a foresight exercise is defined by the *aim*s of the given exercise, its *status* at the political agenda (high/low) and the level of *political will*, and the *resource*s (including the time resources) available. The higher is the importance of the foresight exercise on the political agenda (i.e. if it is related to the development of the medium to long term strategy with concrete funding priorities) and the larger the resources available for the project, the more sophisticated and more interaction based the methodology will be chosen.

Secondly, the selected methodology in all cases was strongly based on qualitative or semi-qualitative methods, but the methods mix was based on expertise and evidence (less on creativity and interaction). However, all cases involved a strong participation element (value chain working groups, participative workshops, expert panels). However, one of the weaknesses was that different stakeholders in some cases were involved to a different extent (i.e. involvement of the research institutes in Russia and Poland was possibly higher than of the companies). The Finnish case is a good practice example in this case, as it involved all main stakeholders along the value chain.

Much more detailed analysis to examine the success factors and weaknesses would be required as the ex post surveys or evaluations of the selected foresight programmes are not available. The survey of the participants of the foresight exercises on their satisfaction with the process, the methodology and the results achieved, as well as on the extent to which the results were later implemented, would provide important data that could help answering the questions raised in this Report. It could be the subject of other research projects.

Suggested aim and scope of energy foresight in Lithuania

Based on the current needs outlined in chapter 2, the aim of the foresight programme for the energy sector in Lithuania could be to develop strategic vision for the sector's development as well as the long-term development objectives for the sub-sectors (electricity, natural gas, renewable energy and oil sector). The complementing objective would be to define State funding priorities (including the R&D funding priorities) for the 2014-2020 and later periods. Based on the experience of other countries, the suggested time scope would be at least 25 years; i.e. given the foresight process starts in 2012 and ends in 2013-2014, the recommended time horizon is until 2040.

Given other countries' experience, the important preconditions for the beginning of the foresight process are: (a) ensuring substantial political will and support and active involvement of decision makers; (b) ensuring compatibility and coordination with the existing strategic documents.

Suggested methodological approach

Popper (2008) pointed out four essential phases of the foresight process: the pre-foresight or *scoping* phase, the recruitment phase, the *generation* phase, and the action or *renewal* phase. In the suggested foresight process design these three phases are seriously considered.

In Lithuania, the knowledge on participation and consensus based strategy development methods, such as foresight or technology analysis methods, is scarce. The political will related to the usage of the participation based discussion processes is rather low. Therefore, the *scoping* and *recruitment* phases of the new foresight process are of particular importance. Key attention should be devoted to:

- Creating the awareness and building the political will to support the process;
- Enrolling key individuals and stakeholders who can contribute with their knowledge and expertise on particular issues and promote the research process within their own networks;
- Ensuring the sufficient (time and funding) resources to ensure the quality of the programme and rich methodological mix.

The *generation* phase is the ''heart'' of a foresight process, given that here is where prospective knowledge and shared visions are generated. It is therefore the phase in which ''codified knowledge'' is fused, analysed and synthesised; ''tacit knowledge'' is gathered and contrasted with codified knowledge; and (hopefully) ''new knowledge'' is generated, such as shared visions and images of the future (Popper, 2008). In the Lithuanian energy sector foresight case, given other countries' experience, it is suggested to apply a well developed methods mix under these three dimensions:

1. Exploration – methods like scanning or brainstorming could be used to identify and understand important issues, trends and drivers; this could be done by the Project team (consortium) and then discussed at the expert panels;
2. Analysis –methods like expert panels, extrapolation or SWOT could be used to understand how the context and main issues, trends and drivers influence one another. It is proposed to apply the method of expert panels (at least 5 different panels are suggested) quite intensively in this exercise with the aim not only to collect tacit knowledge and generate new knowledge related to the topic, but also to build new networks. Recommendations based on consensus building methodologies will also guarantee more effective implementation.
3. Anticipation – methods like scenarios or Delphi could be used to anticipate possible futures or suggest desirable ones. In the energy sector exercise in Lithuania it is suggested to apply both scenarios and Delphi methods.

Given the other countries experience in the Baltic Sea Region, it is suggested that the methods mix selected for this foresight programme should be based on at least three corners of the 'Foresight Diamond': *evidence* (i.e. analyses should be based on official data, such as Eurostat, national monitoring data, and the meta-analyses of previous studies); *expertise* (i.e. gathering and synthesising the knowledge of well known experts and individuals along the value chain in the process of Delphi survey and expert panels); and *interaction* (via expert panels). This methods mix would suggest that in the proposed methodology the qualitative and semi-qualitative methods would dominate over the quantitative methods.

The proposed sequence of methods usage is presented briefly in the Figure 6.

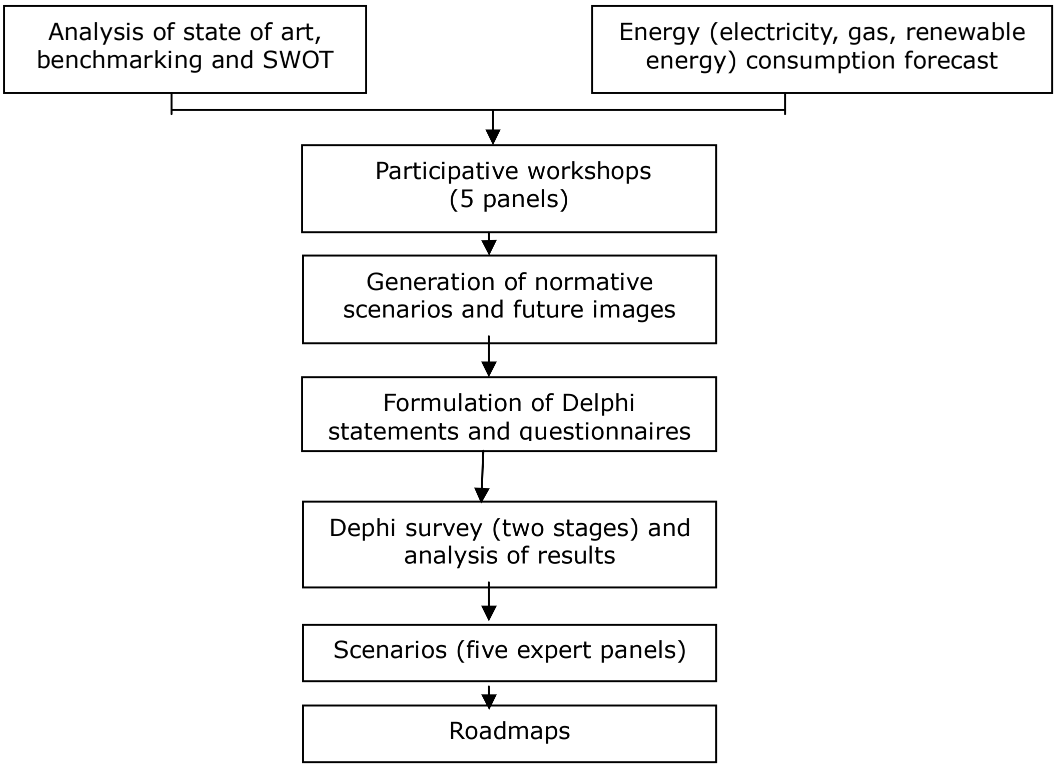


Figure 6. Proposals for the methodological sequence

The *action* and *renewal* phases are heavily influenced by the type, quantity, quality, relevance, usability and timely production of codified (and process-related) outputs, among others. Action is about reaching commitment from key players who are ready to embark on the ‘‘business of transforming and shaping the future’’ through the implementation of the policies and decisions produced in the generation phase (Popper, 2008). At this phase, the foresight process should link with traditional strategic planning processes in order to define realistic medium-to-long-term action plans. It is suggested that this bridge between foresight and planning could be achieved by using the integrative method of *roadmapping*.

Renewal is a mixture of intelligence and wisdom. It is about gaining knowledge and understanding of the opportunities and threats identified in the codified outputs and the process itself. This phase requires the use of evaluative approaches and, in particular, of traditional social research methods like interviews and opinion surveys. It is suggested that a set of monitoring indicators is developed to evaluate the extent to which the outputs and results developed by foresight are implemented. The Monitoring Board composed of elected representatives of main stakeholders could be set up to review the progress time after time. After 5-7 years the ex post evaluation study could be carried out. Based on the results, it would be decided whether the renewal of the strategic documents and other strategic outputs is required.

Participation enhancement

Participation scale refers to the level of openness of a study, but openness is not necessarily well captured by simply looking at the scale of participation given that its scope is more important (Popper, 2008). It is suggested that building networks and enhancing interaction of stakeholders in the energy foresight programme in Lithuania becomes one of the objectives. Enhancing participation is expected to contribute to enhancing transparency in the decision making processes in this rather closed industry sector in Lithuania, and would also foster new players coming into the field (e.g. in the renewable energy sub-sector).

The fundamental element of the recruitment phase is selection of the target groups. Eight categories are to be considered: government agencies and departments, research community, firms, trade bodies and industrial federations, NGOs, intermediary organisations, trades unions and ‘‘other audiences‟ (Popper, 2008). In the suggested energy sector methodology in Lithuania, it is proposed to follow the experience of the Finnish forest sector foresight, and to involve wider stakeholders along the supply chain (i.e. not only the governmental agencies, research institutes and main producers, but also suppliers and SMEs etc.). It is proposed to build (where applicable) the working groups / discussion panels based on the existing networks in the national technology platforms. Preliminary suggestions for the discussion panels are: (1) electricity sub-sector; (2) natural gas sub-sector; (3) oil sub-sector; (4) renewable energy sub-sector (wind power, biomass, biofuels and waste utilization energy), which could be broken to small discussion panels if necessary; and (5) energy usage efficiency.

Different target groups would be involved in the exercise not only via the participative workshops (expert panels), but also via the Delphi survey. It is recommended, given the Russian case experience, to develop different questions set for different target groups (public officials, research institutes, companies). It is expected that a large part of companies in the energy sector and especially the sub-sector of renewable energy are SMEs. Involvement of SMEs (not only producers, but also suppliers and other members along the value chain) should be ensured.

Moreover, it is recommended to ensure the links with the relevant European technology platforms and well known experts in the field. Involvement of the global / European experts into the expert panels would help overcoming certain knowledge stumbling blocks / bottlenecks.

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