Paper 7 : Prospective Voluntary Agreement: Escaping Techno-Institutional Lock-in

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Abstract:
The paper looks for co-evolutionary policy responses to techno-institutional lock-in, addressing the coordination role for authorities rather than the corrective optimisation. We analyse experiences from environmental voluntary agreements and foresight activities in relation to the co-evolutionary policy objectives that can facilitate an escape from lock-in. Integrating these approaches by building on foresight's participatory and future-oriented learning process can create common ground for a prospective voluntary agreement. The merit of prospective voluntary agreement lies with the enhancement of collaborative policy culture and inter-sectoral and interdisciplinary stakeholder learning that creates commitment to desired action for escaping lock-in.

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I. INTRODUCTION

This paper addresses the use of future-oriented participatory policy tools to accelerate radical technological changes. This work contributes to the literature by elaborating the notion of Techno-Institutional Complex (TIC) (Unruh 2000; 2002), a concept which builds upon recent efforts at rejoining evolutionary and institutional economics (e.g. Hodgson, 2002; Nelson, 2002). More specifically, we look for policy responses to *techno-institutional lock-in*, a persistent state that creates systemic market and policy barriers to technological alternatives. In policy approaches addressing techno-institutional co-evolution, the main question is not optimisation and equilibrium, but path-dependent change and long-term co-evolution of economic, environmental and social processes (Carrillo, 2004; Llerena and Matt, 1999: 4, Mulder & Van den Bergh, 2001). Thus, the role assigned to authorities is not corrective but *coordinative*, and is more concerned with influencing the process than imposing a particular result (Metcalfe, 1995). The emphasis is on systematic learning and coordination in the combined use of regulatory, economic and voluntary policy tools.

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We examine two corresponding policy tools to initiate facilitated and future-oriented stakeholder processes: *Environmental Voluntary Agreements* (EVA) in the field of environmental policy and *Foresight* activities in the field of innovation policy. EVAs are defined as *"an agreement to facilitate action with a desirable environmental outcome, which is encouraged by government, to be undertaken by the participant based on the participant's self-interest"* (Storey et al., 1997). EVAs are typically negotiated between industry and government as alternatives to environmental regulation in an effort to generate faster environmental results and greater economic efficiency. However, EVAs have been criticized as lacking inclusiveness and having poorly defined targets, resulting in lower environmental standards, unenforceability and ineffectual monitoring (Makuch, 2003). Makuch suggests that an enhanced dialogue *process* between authorities and industry can help identify potential obstacles before an agreement is created.

Stakeholder dialogue process is inherent in the field of innovation policy and technology futures analysis (Technology Futures…, 2003), particularly in technology assessment and *foresight* activities. While technology assessment (Hay & Noonan, 2004) recognises the potential impacts of existing technological choices, foresight emphasises learning and vision-building for creating the desirable and even radically different future. Foresight is typically employed to enhance long-term sectoral, regional or national innovation activities (Salo, Könnölä & Hjelt, 2004). Recently, foresight activities have paid increasing attention to effective communication and extensive stakeholder participation. The High Level Expert Group appointed by the European Commission crystallised these trends by defining foresight as follows (European Commission, 2002): *"A systematic, participatory, future intelligence gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint action"*. At its best, foresight process creates common vision for systemic change towards sustainable development. However, difficulties often arise in transferring vision into action.

Integrating the virtues of EVA and foresight provides opportunities to overcome their individual shortcomings. The implementation of many environmental solutions is prevented by systematic barriers and inertia created by both existing technological infrastructures and existing institutional and organizational arrangements, a condition we term *techno-institutional lock-in.* Overcoming techno-institutional lock-in is therefore a prerequisite for addressing many environmental problems such as global climate change and agricultural-based issues such as water use or impacts on the nitrogen cycle, as well as more localized environmental problems. Foresight offers creative tools for learning and vision-building, and EVA provides insight into how to translate vision into committed action. Integrating these approaches by building on foresight's participatory and future-oriented learning process can create common ground for a voluntary agreement among key stakeholders. Thus, the paper argues that combining the virtues of EVA and foresight methods can help facilitate an escape from techno-institutional lock-in and provide policy resources for addressing lock-in related issues.

The remainder of this paper is structured as follows. In Chapter II, we discuss the dynamics of techno-institutional lock-in and, in Chapter III, elaborate corresponding co-evolutionary policy objectives. In Chapters IV and V, experiences from EVAs and foresight activities are examined and, in Chapter VI, integrated in a new policy tool, named *Prospective Voluntary Agreement* (PVA). Finally, in Chapter VII, the paper discusses implications of the proposed tool on environmental and innovation policy-making.

II. TECHNO-INSTITUTIONAL LOCK-IN

Most of the explanations for failures of the diffusion of environmental technologies tend to focus on barriers to adoption within micro-economic decision-making (e.g. Jaffe, Newell & Stavins, 2000; Lohani & Azimi, 1992) giving limited attention to institutional and macro-level context. However, institutional theorists make clear that macro-level norms and rules constrain micro-level decision making (North, 1981). To understand this broader context, we consider both evolutionary and institutional economics. Evolutionary economics[29] focus largely on the role of technological advance in the economic development, whereas institutional economics emphasises institutional context in which technological decision are taken. Scholars within both disciplines have seen benefits in integrating evolutionary and institutional theory-building (e.g. Hodgson, 2002; Nelson, 2002).

In the domain of environmental sustainability, Unruh (2000, 2002) links evolutionary and institutional economics in an interdisciplinary framework termed a *Techno-Institutional Complex* (TIC), which is used to explain the failed diffusion of carbon free technologies. *Techno-institutional lock-in* is a persistent state that creates systemic market and policy barriers to technological alternatives and occurs through combined interactions among technological systems and governing institutions. Such lock-in arises through path dependent co-evolution driven by economics of increasing returns, which Arthur (1994) has classified as scale economics, learning economics, adaptive economics and network economics. Increasing returns mean that the earlier superiority and emergence of dominant design (Nelson, 1995) is no guarantee of long-term suitability (David, 1989; Cowan, 1990; Nelson, 1994). Apparently inferior designs can become locked in to the production system through a historically dependent process in which circumstantial events in the techno-institutional context can determine the winning alternative (David, 1997).

A techno-institutional complex is a highly co-evolved, self-referential system where the members of the system create rules and practices to guarantee its self-perpetuation. Importantly government ministries and regulatory agencies are part of the techno-institutional complex and are active participants in its perpetuation. Governments become involved in the establishment and extension of technological systems like roadways, electricity grids or telecommunications networks for a variety of reasons including universal service, national security, public safety, etc. Co-evolution among the private owners of technology and regulatory institutions creates a stable system that aims to provide needed services to society. However, as is frequently the case, negative externalities associated with a given technology are belatedly discovered after the system is well established. This is currently the case for many energy, transportation, industrial and agricultural technologies and the basis of many current environmental

[29] Evolutionary approaches depart from the (aggregate) production function used by neoclassical economists (Dosi et al., 1988). Given that uncertainty is intrinsic to the process of technological change, the neoclassical assumption of rational maximizing behaviour is replaced by a search for profit “in the dark” (heuristic search routines); as a result, there is no single welfare maximizing equilibrium, but rather a plurality of possible equilibria: evolution of historical events thus determine which equilibrium is reached or approached at any given time; the structure, including the economic, social and political institutions, is often made explicit in evolutionary approaches (Carrillo, 2004).

challenges. Over coming these problems requires changes to the underlying technological systems. Such change, however, is impeded by techno-institutional lock-in.

The limits of technological change lie generally not with science and technology, which tend to evolve much faster than governing institutions, but with the organisational, social and institutional changes that facilitate or inhibit the diffusion of new technological solutions (Unruh, 2000). Two generic types of technological change can be identified: *continuity changes*, which are incremental, sustaining changes or additions to components that preserve the overall technological architecture, or *discontinuity changes* which seek the complete replacement of the existing system. Historically, environmentally related change has been of the continuity type, such as end-of-pipe technologies that leave the production system basically intact and add pollution control equipment onto the end of the process. These types of changes account for 70 to 90% of environmental technology expenditures. However, it is becoming increasingly clear that some environmental problems cannot be effectively solved through continuity approaches. Dealing with global climate change, for example, will require nearly 90% reductions in carbon dioxide emissions by industrialized countries, something that currently appears to be beyond the scope of continuity approaches in the energy sector.

Given this internally generated stability, breaking the lock-in situation often requires exogenous pressures originating outside of the techno-institutional complex such as major crises or external shocks (March & Olsen, 1989; Hughes, 1987). Some examples of exogenous pressures include technological breakthroughs, social movements or environmental disruptions (Unruh, 2002). However, waiting for exogenous forces to initiate change can be an inefficient way to resolve environmental problems created by techno-institutional lock-in. In fact, our foresight abilities tell us that many of these problems are irreversible, such as massive species extinction or a dramatic abrupt shift in global climate, and that precautionary actions are needed to prevent them. The challenge lies in generating forces for discontinuous change in the TIC. Escaping techno-institutional lock-in in the absence of exogenous shocks requires mutual understanding about future problems and some level of consensus among TIC members about technological alternatives. It is argued here that generating these mutual understandings on actions can be facilitated through PVA.

III. CO-EVOLUTIONARY POLICY OBJECTIVES

In policy approaches addressing techno-institutional co-evolution, the main question is not optimisation and equilibrium, but endogenous path-dependent change and long-term co-evolution of environmental, social and economic processes and complex systems characterised by irreversibility and uncertainty (Carrillo, 2004; Llerena and Matt, 1999: 4, Mulder & Van den Bergh, 2001). The locus of attention moves from the neoclassical market failure (Arrow 1962) towards the improvement in competitive performance and the promotion of structural change (Mowery and Rosenberg, 1989). Thus, the role assigned to authorities is not corrective but *coordinative*, and is more concerned with influencing the process than imposing a particular result (Metcalfe, 1995). This is especially important within a techno-institutional complex where existing government policy is partially responsible for inertia to technological change. In this case an emphasis on mutual learning and coordination in the combined use of regulatory, economic and voluntary policy tools can help to escape lock-in. Additionally, actors from outside the TIC are important in providing new alternatives and motivations and thus play a role in PVA: The ultimate goal is a shift away from public and private policies that reinforce the lock-in conditions, to mutually defined policies that foster an escape from lock-in. Thus, we elaborate three fundamental objectives that can facilitate an escape from lock-in, including the creation of i) radical technological options, ii) vision for the implementation of technological alternatives, and iii) changes in both the physical and social networks themselves.

III.1 Radical Technological Options

Escaping lock-in requires as a starting point a variety of *radical technological options* that meet and shape market needs in ways that correct identified negative externalities. These options are both physical technologies in the form of technological artefacts and infrastructures, and social technologies (Nelson & Sampat, 2001) in particular, search for their creative combination in a systemic innovation process (e.d. integration of technology push and market pull approaches). In addition to ongoing research efforts in environmental technologies, cross-disciplinary and cross-sectoral collaboration is required to expand the variety of options both in supply and demand.

Given bounded rationality and imperfect information it is impossible to identify in advance what technologies and organisational responses are most desirable for society. Technological development should be understood as a process of evolution in which alternative technologies compete with one another and with the dominant technology, resulting in selection of winners and losers, with considerable uncertainty at the outset about their social merits (Nelson and Winter, 1982). Thus, authorities should focus on fostering stakeholder actions to expand the variety of options and respective technological trajectories, and along these processes engage in learning about their social merits. (Carrillo, 2004.)

III.2 Vision for Implementation

Techno-institutional co-evolution is complex, irreversible, and uncertain. The impacts of technology on environment and society are multi-faceted and may be noticed much later than in the emergence of technology, e.g. detrimental impacts of CFCs on the ozone layer. Thus, Unruh (2002) calls for attention of policy makers to take into account and create a flexible policy regime that allows continuous evolution. By initiating processes for creating the foresight and systemic understanding of techno-institutional co-evolution we can begin to formulate pathways to environmentally benign technology arrangements. Vision building entails the creation of future oriented scenarios that envision the new technologies, new systemic interconnections and new institutional arrangements. This vision can then guide the physical and organizational changes needed to escape a lock-in condition.

The co-evolutionary vision-building is crucial, especially because of fragmented sectoral policy-making structures originating, in particular, from the application of positivist social sciences. Typical sectoral policy responses to lock-in are fragmented optimising efforts with command-and-control and market-based instruments, which may lead to inefficient and counterproductive policy actions. This creates uncertainty in the market and hampers the creation of radical systemic changes. Instead of short-term co-optimisation efforts between various policy sectors – which easily escalate to a policy debate characterised by fixed positions and claiming value – we posit that emphases need to be placed on creating value through continuous stakeholder learning and common vision-building for systemic radical changes. Here, we turn our focus in innovation policy and, in particular, foresight practices developed for improving understanding of entire innovation systems and creating common vision for future actions.

III.3 Changes in Physical and Social Networks

The efficient exploitation of technological options and concepts requires a redefinition of stakeholder roles and institutional structures, as well as actual changes in the technological systems of concern. Both policy-makers and other stakeholders tend to shape institutional context through their strategic actions of creating and claiming value (Powell & DiMaggio, 1991), for example by building new coalitions. These new social networks and agreements, in turn, open up possibilities for lock-in breaking innovations spurring typically from new technology-based start-up companies within distinct value networks from those of incumbent industry. In line with this approach, in the rigid energy sector, companies such as Shell and BP have set up spin-offs and subsidiaries to develop renewables and hydrogen technology. This type of responses to lock-in can be seen as strategic actions to anticipated market changes, but also to improve corporate image.

Whereas collaborative action can create new physical and social networks for disruptive radical innovations, it can also be used for enforcing TIC (Beder, 1998). Thus, authorities need to initiate facilitated processes that direct possibly counter-productive stakeholder actions towards collaboration, persuading industry to engage in learning processes, reassess their value networks and commit to desired action. Here, experiences on EVAs provide insight how to commit industry to desired action by building on incentives and collaboration, without ruling out regulatory actions in case of non-compliance.

We examine EVAs and Foresight activities in relation to the above three objectives. Both EVA and Foresight are participatory collaborative policy tools, which represent distinct viewpoints; EVAs are designed to curb negative impacts of technology and polluting industrial activities, whereas Foresight activities focus traditionally on technological advance improving economic competitiveness. Here, we consider these distinctions as opportunities for elaborating PVA by combining EVA and Foresight to overcome their individual shortcomings.

IV. ENVIRONMENTAL VOLUNTARY AGREEMENTS

EVAs, are typically designed as alternatives to environmental regulation in an effort to generate faster environmental results and greater economic efficiency. Normally, EVAs are seen as alternatives for regulation to correct market failures. Thus, research on EVAs tends to focus on environmental *results* and economic efficiency within a specific institutional context (OECD, 2000). Furthermore, collaborative mechanism of EVA can also be conducive for the development of innovative solutions, which authorities and companies would have been unlikely to develop alone (Delmas & Terlaak, 2001a). OECD (2000) has classified *Environmental Voluntary Agreements* (EVA) in three categories, including i) unilateral agreements initiated among industry, ii) public voluntary programmes devised by regulators and i) negotiated agreements drafted between regulators and industry. Next, we follow this triadic categorisation and discuss experiences from each of them in relation to the co-evolutionary policy objectives.

IV.1 Unilateral Agreement

Unilateral agreements are commitments by industry to reduce pollution. Thus, these commitments do not necessitate the evolvement of authorities (OECD, 2000). Typically unilateral agreements emerge as a response to stakeholder pressures to gain legitimacy and to avoid stricter regulation, for example, the Responsible Care Program in the chemical industry (Howard et al., 2000) and the Declaration on Global Warming Prevention adopted in 1996 by German industry and trade. The former represents intensive collaboration in a specific sector facing growing stakeholder pressures, where as the latter a loose coalition among different sectors to avoid the implementation of an energy tax.

Thus, unilateral agreements tend to induce only incremental and sustaining advances in physical and social networks disregarding the creation of radical technological options and vision for their implementation. Though, the inclusion of civil society and scientific community in drafting an agreement may in some cases generate vision for implementation of technological alternatives.

IV.2 Public Voluntary Programme

Public voluntary programmes are devised by authorities, which establish the frame for the programmes and define basic requirements for participation. These programmes usually provide technical assistance and positive public recognition to participating companies (OECD, 2000). Most of EVAs in U.S. are Public Voluntary Programmes, as these programmes do not necessitate sectoral industry coalitions or agreement negotiations with authorities.

For example, through Design for Environment Program (DfE), U.S. Environment Protection Agency (EPA) developed and provided companies with information how to incorporate environmental issues into the design of products, processes and management systems (Delmas & Terlaak, 2001a). The programme emphasised information dissemination and coordination of research and technology development (RTD) efforts. This industry-research collaboration may create radical technological options and changes in social networks among participants, but does not enforce their application, as it does not contain environmental targets or sanctions. For example, in the case of EPA’s Climate Wise Programme, most corporate level targets do not require radical technological change, but can be achieved through improved housekeeping (Delmas & Terlaak, 2001b). Furthermore, as public voluntary programmes tend to be designed by authorities with limited stakeholder interaction, visions for implementation of technological alternatives remains fragmented.

IV.3 Negotiated Agreement

Negotiated agreements differ from unilateral agreements and public voluntary programmes because they require negotiation between industry and authorities (OECD, 2000). Thus, the success of negotiated agreements to prompt changes in physical and social networks relies largely on credible regulatory commitment, which may be diminished by the fragmentation of decision-making power among different authorities and the open access of stakeholders in negotiations (Delmas & Terlaak, 2001b). When stakeholders are included, transaction costs may become excessive. For example, in U.S. EPA’s Project XL (excellence and Leadership), stakeholder involvement entailed lengthy and costly negotiations (Blackman & Mazurek, 2000).

Negotiated agreements may promote radical technological options and changes in social networks. For example, the French End-of-Life-Vehicle Agreement spurred from too complex problem to be handled by a single firm or industry. Collaboration was needed to create coordination mechanism, which promotes learning and exploratory action. Furthermore, the targets of the agreement asked for changes in technological trajectories and learning and mutual knowledge formation between firms. (Delmas & Terlaak, 2001a.). However, in negotiated agreements limited attention is paid to vision-building for implementation of technological alternatives, and wider stakeholder engagement is seen as a burden rather than a learning opportunity.

V. FORESIGHT ACTIVITIES

In recent years, national, regional and sectoral foresight studies have been conducted in many countries, in order to define research priorities, look at the future from a broad range of complementary viewpoints and create common vision for RTD activities (Gavigan, 2002; Hjelt *et al.*, 2001). The locus of foresight activities has tended to shift from positivist and rationalist technology-focused approaches towards the recognition of broader concerns that encompass the entire innovation system, including the challenge of sustainable development (Gavigan, 2002; Schomberg, 2002). Along this development, increasing attention has been paid to communication and stakeholder engagement, which is inherent in the definition of foresight given in the introduction of the paper.

Salo and Salmenkaita (2004) categorise Foresight activities in three traits, including i) emergent foresight driven by stakeholder interests to align RTD activities, ii) embedded foresight conducted within instruments of S&T policy and iii) explicit foresight initiated by policy-makers to align S&T policy actions. Subsequently, we discuss these practices in relation to the co-evolutionary policy objectives.

V.1 Emergent Foresight

Salo and Salmenkaita (2004) define emergent foresight as collective and competitive processes through which future-oriented analyses are iteratively produced, revised and evaluated, in response to a recognized need to align interdependent RTD agendas with opportunities that are perceived and shaped by stakeholders who share overlapping interests. Emergent foresights emerge typically within industry clusters with no necessary involvement of authorities. For example, the work of the Wireless World Research Forum (WWRF) – which sought to promote the conception, development and diffusion of wireless communication technologies – evolved from the establishment of a think-thank into a forum consisting of open calls for proposals, open meetings and workshops.

In this kind of networking process, through iterative discussions, participants synthesise their competing and complementary views into increasingly comprehensive visions of the future that may accelerate changes in physical and social networks and the development of even radical technological options for shaping future markets. Because emergent foresight is often initiated around existing industry coalitions, claiming value and power plays are typical features, in which inducing needed structural policy and institutional changes for implementation of radical technological alternatives receive limited attention.

V.2 Embedded Foresight

Embedded foresight refers to individual and collaborative processes through which prospective information about relevant technological, commercial and societal developments is acquired, produced, refined or communicated within RTD programmes, in order to generate shared vision for RTD activities (Salo and Salmenkaita, 2002). For example, foresight activities embedded in Finnish RTD programmes in electronics and telecommunication have been considered highly relevant, especially because the sectors are characterised by rapid technological advance (Salo and Salmenkaita, 2002). Foresight activities embedded in steering group meetings and project reviews induce changes in social networks among the funding agencies, the recipients of RTD funding and the consulted experts and, thus, also accelerate the development of new technological options. However, embedded foresight often is limited to the areas of existing RTD activities in terms of a time horizon and vision-building and, thus also in terms of the scope of limited changes in physical and social networks.

V.3 Explicit Foresight

Explicit foresight exercises in support of S&T policy-making exhibit considerable variety within the used methods. Salo and Salmenkaita (2004) consider explicitly managed foresight projects where (i) the setting of research priorities is among the key agenda items, (ii) the work is intensively systematic and analytic, and (iii) participants are consulted mainly due to their expertise in specific fields. Often, such exercises are run by appointing parallel expert panels, for example The UK Technology Foresight Programme 1994-1995 depended crucially on 15 sector panels (Keenan, 2003). Even though the process itself may not ensure that steps towards the implementation of recommendations are taken, the results can be used to justify changes in S&T priorities, which in turn may create changes in physical and social networks and influence on the development of radical technological options. For example, the UK Technology Foresight lead to the launch of several new LINK (academic-industrial collaborative RTD) programmes, e.g. waste minimisation through recycling, reuse and recovery in industry (Georghiou, Loveridge & Street, 1998).

In explicit foresight, sustainable development is generally viewed as a key future need to which science and technology should be directed. However, explicit foresights tend to emphasise opportunities and to neglect threats related to technological advance (Hjelt et al., 2001), thus disregarding the viewpoint inherent in environmental technology assessment (Hay & Noonan, 2004). As a promising exception, an explicit foresight initiated by the Dutch Ministry of Housing, Physical Planning (Borub, 2003) discussed future technologies[30] as opportunities for systemic changes but also as potential sources for new environmental problems. In explicit foresight, especially the selection of participants plays an important role in order to induce creative discussion and challenge the existing TIC.

VI. PROSPECTIVE VOLUNTARY AGREEMENT

[30] Examples of the identified technological systems are: Advanced separation; Cultivation of biological raw materials; Coal gasification; New generation of photovoltaics cells; Hydrogen for driving vehicles; Intermodal goods transport; Domestic communication systems; Novel protein foods; Optimisation of horticulture behind glass; Industrial waste as building material.

Interestingly, the identified three categories both in EVA and Foresight activities correspond in terms of the level of authorities' engagement. Unilateral agreement and emergent foresight are both industry lead activities in which authorities have limited access and possibilities to assure desired actions. Public voluntary programme and embedded foresight are initiated by authorities but with limited control on the direction and outcomes of the process. In negotiated agreement and explicit foresight, authorities, in turn, have a major role in the design and management of the process. Thus, these triadic categorisations from the viewpoint of the role of authorities own a promise for integrating EVAs and respective Foresight activities.

As the co-evolutionary policy approach calls for authorities to actively engage in the coordination of stakeholder processes, we focus on negotiated agreement and explicit foresight:

- Negotiated agreement between industry and authorities, at best, creates commitment to efficient environmental improvements. However, negotiation process may become a political debate of claiming value limited by current institutional pressures. As EVA focuses on environmental protection and costs, it often neglects other policy areas, limiting possibilities for systemic techno-institutional changes. Fundamentally, it may suffer from regulatory capture and free-riding, because of lack of learning, creation of alternatives and long-term vision-building. Thus, also goals may remain incremental improvements with no radical elements sufficient for escaping lock-in.
- Explicit foresight owns a promise of a creative and participatory process to create alternative futures and build common vision for action to escape lock-in. However, delivering into action consensus driven abstractions of identified solutions, may become difficult because of lack of commitment and policy measures available for decision-makers.

Combining negotiated agreement and explicit foresight provides opportunities to overcome their individual shortcomings. Thus, we propose development of a new integrated policy tool, *Prospective Voluntary Agreement* (PVA). Based on the definitions on EVA and Foresight, PVA may be crystallised as

> a systematic, participatory, future intelligence gathering and medium-to-long-term vision-building process aimed at creating an agreement between authorities and industry to facilitate desired action.

Recognising the challenge of integrating two different straits of practice, here, we limit our elaborations on the management of stakeholder learning process that supports the drafting a PVA, thus, giving limited attention to post-negotiation activities such as monitoring. In Table 1, we present the main determinants of archetypal negotiated agreement and explicit foresight and their respective combined determinants for archetypal PVA. PVA builds on extensive stakeholder learning process creating ground for the negotiation of an agreement between key stakeholders. Instead of fixing issues at the out-set of the process, divergence of views on future challenges are looked for and elaborated through a learning and vision-building process. Then, key issues are converged for the negotiations to create the commitment for desired action among key stakeholders. Correspondingly, the activities of project coordinators evolve from facilitation to mediation.

Dimensions:	*Archetypal Negotiated Agreement:*	*Archetypal Explicit Foresight:*	*Archetypal PVA:*
Collaboration	Negotiation and Decision-making	Learning and support for decision-making	Learning followed by negotiation and decision-making
Stakeholder engagement	Limited to industry and authorities	Inclusion of industry, research, and other stakeholders	Different levels of stakeholder engagement
Issues	Defined and limited in number at the out-set	Evolve through divergence and convergence	Evolve through divergence and convergence
Outcomes	Commitment to action	Vision	Vision and commitment to action
Process management	Mediation	Facilitation	Facilitation followed by mediation

Table 1 Determinants for archetypal negotiated agreement, explicit foresight and prospective voluntary agreement.

VI.1 Structured Stakeholder Engagement

A shift away from public and private policies that reinforce the lock-in conditions to mutually defined policies that foster an escape from lock-in calls for attention to avoiding regulatory capture. Thereat, wide stakeholder participation engaging actors also from outside the TIC can bring in external monitoring (Timmer, 1997) as well as new alternatives and motivations. However, experiences both from negotiated agreement and explicit foresight address that wide stakeholder engagement may become too complex and controversial to manage increasing transaction costs and, thus, also free-riding, as various stakeholders bring in the process too many issues to be resolved, unclear interests, fundamental value differences, threat of leakage of competitive and proprietary information and power struggle through media actions (Hjelt et *al*., 2001; Weber & Khademian, 1997).

Therefore, stakeholder engagement arrangements need to balance between *extensiveness* (e.g., which stakeholders are placed into contact with each other in the different phases of the process, in one way or another?) and *intensiveness* (e.g., how intensely are these contacts enacted in terms of information exchanges and common vision-building) (Barré, 2002). Based on the experiences from structured stakeholder engagement in a foresight study for the Finnish food and drink industries (Salo, Könnölä & Hjelt, 2004), we elaborate three levels of stakeholder engagement in PVA process with respective objectives:

- *Low engagement*: Stakeholders exchange ideas and perceptions on future challenges in seminars and individual interviews and comment on deliverables, thus contributing inputs to the process which, however, does not necessarily lead to notable changes in their value networks.
- *Medium engagement*: Stakeholders participate also in workshops and meetings engaging in collaborative learning processes and proactive development of radical technological options which also create shifts in participants' value networks (this, however, do not necessarily lead to participation in the agreement).

- *High engagement*: Stakeholders are intensively involved in the collaborative management of the whole process that aim at the creation of the agreement.

Figure 1 illustrates the above three levels of intensiveness in relation to extensiveness in stakeholder engagement. Within high engagement, key stakeholders – namely authorities and industry representatives who demonstrate interest in searching for a common ground for a PVA – design and manage together the prospective learning and vision-building process. They invite extensively stakeholders in low and medium engagement for learning and vision-building. This responds to avoiding regulatory capture and the self-perpetuation of the TIC. High engagement, in turn, creates commitment among the key stakeholders minimising the transaction costs of the agreement and, thus, also likelihood of free-riding.

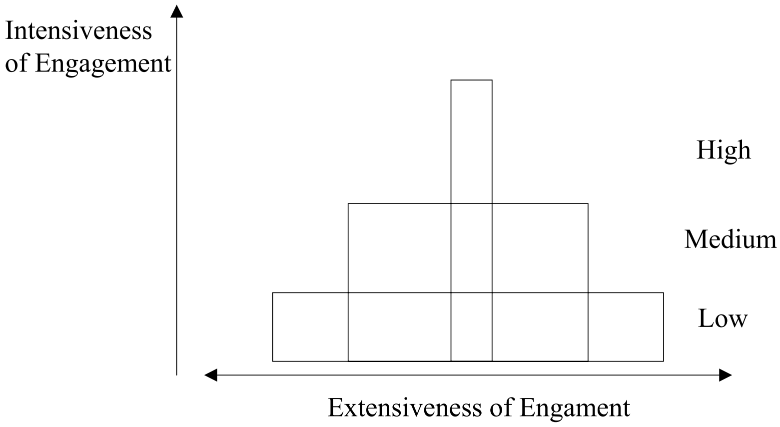

Figure 1 Three levels of intensiveness in relation to extensiveness in stakeholder engagement.

VI.2 Responsiveness in PVA Process Management

The design of creative learning process that allows extensive and intensive stakeholder engagement calls for authorities to take an active role by bringing in the process their bargaining power and by providing needed infrastructure for conducting such a process. This asks for combined use of foresight and negotiation methods to balance analytic (i.e., production of factual future-oriented statements) and communicative (i.e., facilitation of dialogue processes among the stakeholders) approaches (Salo, Könnölä & Hjelt, 2004). Yet, the selection of these approaches and ensuing methodological choices is not an easy task, given that the different methods (e.g., Delphi-survey, critical technologies, expert panels, see, e.g. Porter et al., 1991) have their specific advantages and disadvantages. Thus, in the management of the PVA process, coordinators need to pay attention to *responsiveness* – by which Salo, Könnölä and Hjelt (2004) define as *purposely designed managerial controls for making warranted mid-course adaptations to objectives and implementation plans* – that depends on the envisaged role that is ascribed to a specific activity in an evolving innovation environment. In effect, responsiveness requires *receptivity* vis-à-vis the interests and expectations of participating stakeholders, and *flexibility* in planning and implementation (Salo, Könnölä & Hjelt, 2004).

In this setting, the defining feature of the responsive PVA process is that key stakeholders collaborate with the stakeholders from different societal sectors and scientific disciplines, in order to implement process cycles which, by design, contribute to the creation of radical technological options, vision for the implementation of technological alternatives, and changes in both the physical and social networks themselves. This process culminates into a drafting of a PVA among key stakeholders committing them to desired action. The drafted agreement itself, however, is no more than a formal point in a process of governance within a specific type of cooperative arrangement. Thus, the agreement should be seen as a confirmation and reinforcement of the value of the emerged cooperation.

VII. DISCUSSION

In this paper, we elaborated co-evolutionary policy responses to techno-institutional lock-in, addressing the coordination role for authorities rather than the corrective optimisation. Within a techno-institutional complex existing government policy is partially responsible for inertia to technological change. Thus, escaping techno-institutional lock-in in the absence of exogenous shocks requires continuous learning among stakeholders and the inclusion of actors also from outside the TIC. Thereat, we identified the need for authorities to initiate future-oriented stakeholder learning processes to facilitate an escape from techno-institutional lock-in and provide policy resources for addressing lock-in related issues.

We examined EVAs and Foresight activities in order to identify their individual shortcomings and to sketch a new integrated policy tool, PVA, in which authorities can use the threat of environmental regulatory actions as well as innovation oriented economic incentives to connect even confrontational stakeholders into a mutually beneficial learning process and commit them to desired action. The merit of PVA process lies with the enhancement of collaborative policy culture and inter-sectoral and interdisciplinary stakeholder learning. Thus, in the application of PVA in a specific policy context, particular attention should be paid to the creation of a new collaborative arrangement that builds on the existing institutional structures without disregarding the key role of actors outside the TIC and the plurality of viewpoints for technological alternatives. At best, PVA process helps participants to position themselves in relation to TIC, allowing them to take informed decisions for the creation of radical technological options and changes in physical and social networks. It also helps consolidate a shared vision for implementation of technological alternatives that supports the development of joint actions plans, in particular, synchronising policy efforts between authorities responsible for environmental and innovation policies.

Even though we focused on integrating the virtues of explicit foresight and negotiated agreement, we consider also combining the virtues of unilateral agreement and emergent foresight as well as public voluntary programme and embedded foresight as relevant areas for future work. By identifying suitable themes, PVA process may well provide needed impetus to initiate such exercises.

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Presentation 7 :

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Background

- Climate change politics and conceptualising ***Techno-Institutional Lock-in***
- Diffusion of environmental technologies and the ***coordination*** role for Gov't agencies
- Study on environmental ***voluntary agreements***
- Experiences from a ***foresight*** exercise in the Finnish food and drink industry

2

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Escaping Techno-Institutional Lock-in

"Persistant state that creates systemic market and policy barriers to technological alternatives"

- Learning processes for
  - radical technological options
  - vision for implementation
  - changes in physical and social networks
- Engaging also external stakeholders

3

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Participatory Policy Practices

- Environmental Voluntary Agreements
  - Threat of regulatory actions
  - → Commitment to action
    - lack of learning and vision
- Foresight Activities
  - Systemic learning and vision-building
  - → Common vision for systemic changes
    - lack of commitment

4

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Corresponding Categories

Environmental Voluntary Agreements:	**Foresight Activities:**
Unilateral Agreements	Emergent Foresight
Public Voluntary Programmes	Embedded Foresight
Negotiated Agreement	*Explicit Foresight*

5

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Prospective Voluntary Agreement

"a systematic, participatory, future intelligence gathering and medium-to-long-term vision-building process...

... aimed at creating an agreement between authorities and industry to facilitate desired action"

6