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The purposeful governance of technology discontinuation:

An explorative study on the discontinuation of the incandescent light bulb in the EU

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Abstract

Innovation and technological progress are often associated with the introduction and use of new and emerging technologies. The parallel process of technology discontinuation as a counterforce of innovation is often neglected in literature. In this thesis, the discontinuation of technology is approached as a distinctive part of technological change and innovation. The focus of this thesis is on technology discontinuation as a dedicated way to stimulate innovation. The goal is to conduct an explorative study to contribute to a better understanding of the way the discontinuation policies are used in a purposeful way to govern innovation. A recent example of a discontinuation policy is the phasing-out of the incandescent light bulb (ILB) in the EU. In 2009, an EU regulation was implemented for the gradual discontinuation of ILBs and other inefficient domestic lighting. This discontinuation policy is used as case-study to do an explorative inquiry. This explorative study did a qualitative inquiry on the policy-making process of this policy on the supranational and the Dutch national level. The analysis examined the meanings that were attributed by the involved actors during these policy-making processes the governance of technology discontinuation. This governance perspective was derived from the 'governance of problems' approach of Hoppe (2010). This problem-oriented approach was used to provide an insight in the discontinuation problems that were identified by the involved actors and the way these problems were aimed to be governed. Finally, these findings were used to define a first conceptualization of the discontinuation problem-types, and the attributed governance dimensions to solve these discontinuation problems.

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1. Introduction

Technological innovation is often associated with the embedding of new and emerging technologies. An underexposed part of the innovation process is the discontinuation and termination as a parallel process. In this thesis, the discontinuation of technology is approached as a distinctive part of the broader process for technological change and innovation. Instead of focusing on the new and embedded technologies as the major driver for innovation, the goal of this thesis is to get a better understanding of the way technology discontinuation is used in a dedicated way to govern innovation. The purposeful governance of discontinuation is an underexplored topic of research. A case-study is used to perform an explorative analysis of the constitution of a policy for the discontinuation of a technology. This case-study examines discontinuation issues that were identified by the relevant actors and governance dimensions to solve these issues. Finally, the findings from the analysis are used to define a first conceptualization of the discontinuation issues and trade-offs of the purposeful governance of technology discontinuation.

The phasing out of the incandescent light bulb (ILB) in the EU is a recent example of a policy for the dedicated discontinuation of a technology. Although many new types of energy-efficient light bulbs have entered the market, the ILB is often used for domestic lighting. Although this bulb has proven itself over the years, the bulb is under discussion because of its attributed energy waste. As a result, several policy initiatives for the phasing-out of the energy-inefficient light bulb are introduced all around the globe (Edge & McKeen-Edwards, 2008, pp. 2-7). Also in the different European Member States the discontinuation of the ILB was discussed as a policy issues. Finally in 2009, an EU directive was presented for the gradual phasing-out of household lightning to reduce the greenhouse gas emissions (European Commission, 2009c). A simplified representation of the phasing out of the inefficient light bulbs in the EU can be found in the figure below.

Figure 1: Graph of the phasing-out of inefficient light bulbs (European Commission, 2012)

The European discontinuation policy for the ILB is the subject of the explorative inquiry in this thesis. It focuses on the policy-making trajectory and the meaning that is attributed to the purposeful governance of ILB discontinuation by the involved actors. The research approach includes an interpretative analysis of governance documents related to the policy-making trajectory. These governance documents are used to investigate the different kinds of governance problems that are communicated by the involved actors in relation to the dedicated discontinuation of the ILB. Finally, the analysis of these available accounts of governance problems reflects on the identified discontinuation issues and the way these discontinuation are aimed to be governed.

This lead to the following research question:

Which issues are identified for the discontinuation of the ILB by the relevant governance actors and how are these issues governed?

This research question is developed further in chapter three, after the theoretical framework is discussed in chapter two.

Relevance and contribution of study

As noted before, the discontinuation of the technology is an underexplored topic within transition literature. First of all, the analytical framework that is developed in this chapter positions technology discontinuation within the innovation trajectory as the counterforce of progress. In this way, the analytical framework aims to contribute to a better understanding of the influence of discontinuation of technology on innovation. Secondly, the empirical findings from the case-study on ILB discontinuation aim to contribute to the development of a first concep-

tualization of the purposeful governance of technology discontinuation. The goal of this first conceptualization is to outline the identified problem-types of discontinuation and the governance dimensions to deal with these problems. Finally, although a final policy for the gradual discontinuation of the ILB is constituted in the EU, this phasing-out is still an on-going process. Despite the public awareness for saving energy, the discontinuation is still connected to concerns about the use of efficient lighting. The findings from the case-study also aim to contribute to a better understanding of ILB discontinuation as an on-going policy issue.

Outline of thesis

Following this introductory chapter, in chapter two the theoretical framework that is developed to study technology discontinuation is presented. In this chapter, technology discontinuation is approached as a part of the innovation process and its purposeful governance. In chapter three the research methodology for studying the governance of the ILB is elucidated. This methodology includes the developed research questions and the research design to answer these questions. The actual analysis of the purposeful governance of ILB discontinuation is presented in chapter four up to chapter six. In chapter four, the governance dimensions are outlined that were discussed during the EU policy-making trajectory. Chapter five includes the inquiry of the identified discontinuation issues that were related to the attributed governance dimensions. In chapter six, this supranational analysis is compared and complemented with the analysis of the Dutch policy discussion on the discontinuation of the ILB. Finally, in chapter seven the final conceptualizations of the governance of technology disocntinuation are discussed.

2. Theoretical framework

In this chapter, the theoretical framework is outlined that is developed to study the purposeful governance of technology discontinuation. This framework results in a constructivist analytical approach on the dedicated discontinuation of technology and the governance of its attributed issues by policy-makers. The discussed social constructivist perspective on discontinuation governance is commenced in the first section with an elaboration on the co-evolutionary perspective on socio-technical transitions. As an addition to this co-evolutionary perspective, the discontinuation of technology is underlined as a substantive part of technological innovation. In the second section, the governance of socio-technical transitions by innovation policy is discussed. In this section, the multi-actor and multi-level character of innovation governance is discussed in general and more specifically for the ILB discontinuation policy-making process. In the last section, the analytical framework is presented that aims to incorporate the first and second section, by elaborating on the role of discontinuation as part of socio-technical transitions and the influence of innovation policies. This framework proposes to study technology discontinuation as a dedicated governance task for socio-technical transitions. To investigate this purposeful governance of technology discontinuation, a problem-oriented policy analysis on discontinuation governance is developed. This constructivist approach zooms in on the issues that are attributed to discontinuation by the involved actors and the way the identified issue types are governed by policy-makers.

Innovation in socio-technical systems

Technology and technological innovation are studied and conceptualized from various disciplines. This thesis uses a socio-technical perspective on technology and innovation, which focus on the social embedding of technology. This perspective is widely developed in technology studies, and distinguishes itself from more economic and market oriented views on socio-technical change (Borrás & Edler, 2012, p. 6). The deterministic perspective on technology presents a classical image of technology as a finished product with inevitable characteristics. In this classical image, technology is believed to develop autonomously while creating certain effects on society (Verbeek, 2005, pp. 100-102). Around the 1980s, a social constructivist perspective on technology was introduced that puts much more focus on the social context of technology (Pinch & Bijker, 1987). This perspective argued that technology had no intrinsic properties and that you have to look at the context of use of a technology for an understanding of its functioning (Oudshoorn & Pinch, 2008).

According to this constructivist conceptualization of technology it is emphasized that technologies are embedded in a wider social and economic context (Rip & Kemp, 1998, p. 328). This conceptualization shows that technology should not only be perceived as a material contraption, but is believed to function in relation to human agency and social structures and organizations (Geels, 2004). This co-construction of technology by human agency and social structures is reflected in the occurrence of differentiations of meanings and functions of technology during the various interactions with and contexts of technology (Pinch & Bijker, 1987). From the co-constructive perspective on technology and its functioning in the wider context, technology is explained as a "configuration that works" (Rip, 2005, p. 1). This means that on the one side, the working of a technology links to the achievement of the intended functions of a technology. On the other side, the configuration of a technology links to the technical built up of components bounded together in a system. Due to this understanding of the construction and functioning of technology as a configuration, technology is socially embedded and this embedding is often referred to as the socio-technical system of a technology. Innovation and transitions within these socio-technical systems are not only approached as part of technological development. This socio-technical perspective on technology understands innovation as a development or transition within its whole socio-technical system. So innovation does not only include technological development, but also involves "*changes as user practices, regulation, industrial networks, infrastructure and cultural meaning*" (Geels, 2004, p. 20).

In technology studies, the patterns of change in socio-technical systems and their dynamics of innovation have been studied broadly and have focused on different aspects of transition (Stegmaier, Kuhlmann, & Visser, 2012, p. 2). This literature can be divided in an agency-centered approach, which focuses on change as a agency-based transition by the actors within a socially constructed network, or an institution centered approach, that focuses on the way a institutional set-up influences transitions (Borrás & Edler, 2012, pp. 7-9). This thesis adopts an institutionally-driven evolutionary approach on changes in the socio-technical system, to understand how innovation can alter the socio-technical system from the niche-level to the overall macro-level. A co-evolutionary approach on changes in the socio-technical system identifies three levels of transformation: niches, technological regimes and socio-technical landscape (Ende & Kemp, 1999). Technology as a configuration that works has moved through these levels from the niche to the socio-technical landscape, however many new technologies often do not even leave the niche level. The fact that many technologies do not leave the niche level has put much emphasis on the study of technological regimes and

their bounded rules. Technological regimes are defined as: "*configurations of science, techniques, production routines, institutions, and engineering and social practices that are labelled in terms of a technology*." (Ende & Kemp, 1999, p. 848). Socio-technical changes are embedded in these technological regimes, and part in the wider developments in demand and the advances or constraints of technology-specific characteristics. The transformations of these technological regimes can therefore be triggered in different ways and can lead to different innovation patterns (Poel, 2003). So, a co-evolutionary view on socio-technical change underlines that technological transitions follow a natural trajectory where regimes set boundaries, but also involve a path dependency (Nelson & Winter, 1977, pp. 56-60).

An integrated approach on socio-technical change was presented by Geels (2004), by introducing an evolutionary multi-level framework to incorporate the three levels of transformation and the phases of socio-technical change. This multi-level framework distinguishes four phases of technological transitions. The first phase is the emergence of novelty in existing socio-technical niches. This niche has no coherent set of rules or boundaries and facilitates the start of system innovations. The second phase of innovation is characterized by technical specialization in the niche and the exploration of new functionalities in the existing regimes. During the third phase, a technology is widely diffused and competes with the established regime. Finally, a gradual replacement of the established regimes occurs, which results in a socio-technical landscape transformation. An overview of the dynamics of the multi-level perspective is given by Geels (2004, p. 38) in the figure below:

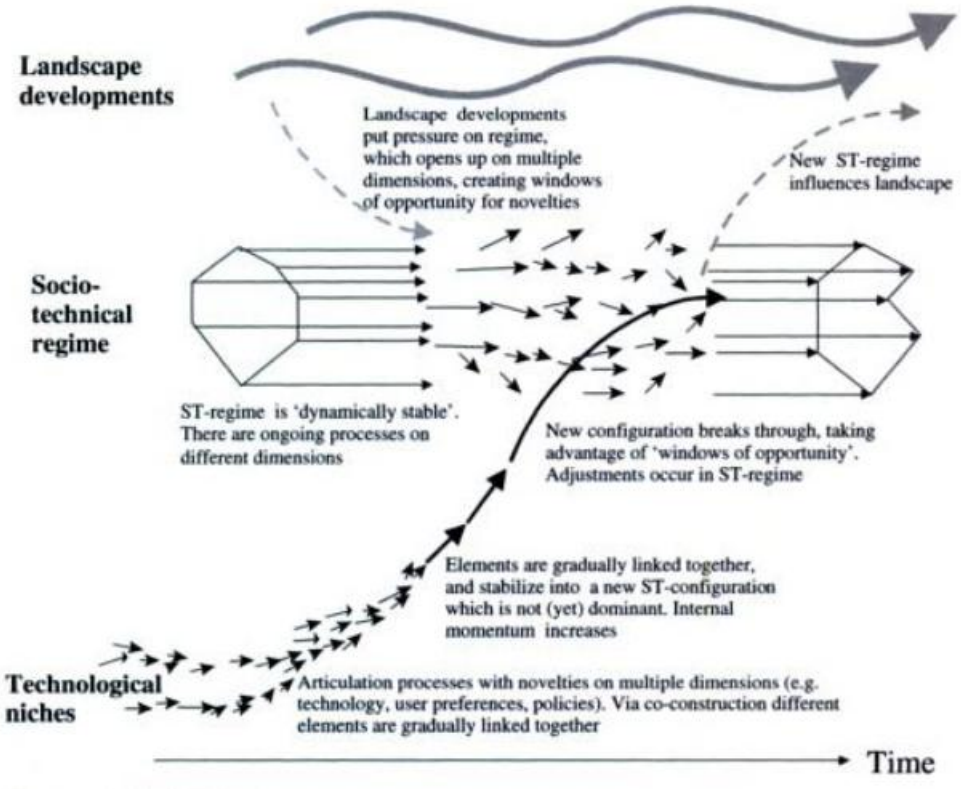

Figure 2: The multi-level dynamics of transitions (Geels, 2004, p. 38)

In this thesis, the evolutionary multi-level perspective on socio-technical transformations is adopted, but puts an additional focus on the discontinuation of technology as a distinctive part of change in a socio-technical regime. The influence of discontinuation on an socio-technical regime appears to be an underexposed part of transition literature (Stegmaier, et al., 2012). It seems that transformations of socio-technical regimes are often only related to progress and technological substitution, but not as the parallel process of the termination and phasing out of an existing socio-technical system. A recent attempt to cover this gap of technology discontinuation in transition literature, is done by Turnheim and Geels (2012) looking at the strategies for the destabilization of existing technological regimes and industries. The authors show that the destabilization of industries operates in a multi-actor environment and different external pressures can be identified that try to influence or trigger this process of destabilization. Their article describes four different strategies for accomplishing destabilization: economic positioning strategies (pressure from the economic environment), innovation/technology strategies (including R&D, knowledge management, and product alliances), political strategies, and socio-cultural strategies. This model shows that when analyzing technology discontinuation, it is important to approach the discontinuation as a purposeful multi-stakeholder concern, which leads to different strategies for the dedicated discontinuation of a socio-technical system by the involved actors.

In the case of the ILB discontinuation, several actors were preparing means to turn the 'continuation' of the ILB into a 'discontinuation', these four different strategies for the destabilization of the ILB, as described by Turnheim and Geels (2012), were clearly present in this empirical case:

- *Innovation/technology strategies:* the industry itself was already preparing a change of lighting by developing new and more energy-efficient lamp types. In this way, industry enabled the use of energy-efficient alternatives for domestic lighting. Subsequently, the industry also proposed a discontinuation regulation/time-line itself just before policy measures were announced by the European Commission (ELC, 2007). This proposal showed that the industry had an interest in the stimulation of the replacement of the old light bulbs as well.
- *Economic positioning strategies:* The transition to the production of efficient lighting entailed different challenges for the industrial actors in the EU, because they mainly produced inefficient lighting. Although the industry had to make a big change in their production and manufacturing they were in favour of a gradual transition towards efficient lighting.
- *Socio-cultural strategies:* the replacement of inefficient lamps was part of the public debate and especially within the sustainability debate. Public awareness was raised by different NGO's and for a small part the inefficient lighting was already terminated by consumers and for a smaller part consumers already terminated inefficient lighting.
- *Political strategies*: In the case of the discontinuation of the ILB, the political strategy was the most present push for the replacement of the ILB. Due to the belief that innovation and public awareness were still lacking, policy-makers aimed to develop a strong push for the replacement of the ILB by regulation.

So, the case under study faced different strategies for the destabilization of the technological regime of the incandescent light bulb. A clear and purposeful push for the final discontinuation of the ILB turned out to be the political strategy for developing a policy to discontinue ILBs. Consequently, the proposed research has been more and more adjusted to the focus of this political strategy, and the way it aims to terminate the use of ILB in a dedicated way by regulation.

So, in this thesis the goal is to contribute to a better understanding of the discontinuation of technology as part of socio-technical transition. The co-evolutionary approach on the socio-technical system presents an integrated understanding of socio-technical change, but

seems to be focused on progress and innovation, instead of the simultaneous termination of socio-technical constellations as counterpart of innovation. In this thesis, the multi-stakeholder approach on discontinuation strategies from Turnheim and Geels (2012) is taken in account and zooms in on the political strategies for discontinuation as a specific part of the innovation process. Before this focus on discontinuation as a dedicated process is specified further and it is explained how technology discontinuation can be positioned as a policy for innovation, the next section elaborates on the governance framework of innovation and socio-technical transitions in general.

Governance of socio-technical innovation

In this section, the relation between socio-technical transitions and innovation governance is discussed: "*Innovation is of social, economic and technological character. It emerges sometimes spontaneously, sometimes as a result of actors' strategic endeavor.*" (Kuhlmann, Shapira, & Smits, 2010, pp. 1-2). In the following paragraphs, the possible strategic character of socio-technical transitions is discussed from a governance perspective and is linked to the case under study. The governance aspect of change in socio-technical systems has been studied in a diffuse way (Borrás & Edler, 2012, pp. 7-9). In this thesis, the governance of socio-technical change is approached from a policy perspective and focuses on the interaction between state actors and societal actors in order to stimulate innovation by policy. Public policies for stimulating innovation play an important role in the economies of industrialized countries by stimulating innovation to increase economic success (Kuhlmann, 2001, p. 954). This has resulted in initiatives to influence innovation patterns of socio-technical systems as a governance task. Before this section zooms in on the policy system of innovation and its governance, the next paragraphs elaborates more on the governance turn in policy-making in general and its multi-level specificities.

In recent times, modern societies experience a destabilization of traditional governing mechanisms. This process of transnationalisation is not only limited to the EU, but is a global phenomenon. Transnationalisation is perceived as the cause of global interconnectedness and the issues that modern states are confronted with (Held, 2006). In policy studies, the governance perspective has replaced the traditional perspective of the government as sovereign power. This governance perspective underlines that "*responsible governments and administrations regularly have to negotiate and cooperate with private actors from the public sector, and that many collectively binding rules are set and implemented beyond the state, in various forms of societal self-regulation*" (Benz, 2006, p.3). An important factor for explaining the

shift to governance is Europeanization (Kersbergen & Waarden, 2004).. The ongoing European integration has changed the authority of member states in the EU. The division between domestic and international politics has turned into a multi-level governance (Hooghe & Marks, 2001).

The multi-level governance in the EU and the member states has three main features (Holzhacker & Albaek, 2007). First of all, actors at different levels share decision-making competencies. Secondly, European collective decision-making leads to a loss of domestic power. Lastly, different policy arenas has turned transnational: "*Political arenas are interconnected, not nested, thus transnational arenas emerge*" (Holzhacker & Albaek, 2007, p. 6). As a result of this Europeanization, many policy arenas have turned into multi-level systems of governance. Four different phase in EU policy-making can be distinguished (Hooghe & Marks, 2001). A first step is policy initiation by putting issues on the agenda. The EU Commission holds the pen of this agenda but is subject to pressures from many different types of actor groups (e.g. European council, European parliament, interest groups). In the case of the ILB, different Member States but also interest groups argued for a discontinuation policy. The second phase is the decision-making process, for which the state sovereignty is in retreat: "*Authoritative competencies in EU are exercised across multiple levels of government. At the European level, national governments and supranational actors share authority, and the institutions in which they operate have intermeshing competencies."* (Hooghe & Marks, 2001, p. 24). The policy-making process of the ILB took place on the EU level and was organized and structured by the EC. Implementation is the third phase and also encompasses multi-level governance: "*The formal division of authority between the Commission, which has sole executive power, and member states, which monopolized policy implementation, no longer holds. National governments have come to monitor the executive powers of the Commission, and the Commission has become involved in day-to-day implementation in a number of policy areas."* (Hooghe & Marks, 2001, p. 25). The last phase is the possible need for adjudication. On the legal order of the different member states, the European Court of Justice decisions have become an accepted influence.

The previous paragraphs showed how the political system of the EU has increasingly turned into multi-level governance. This changing governance has also moved to the innovation system in Europe. This innovation system encompasses: "*the 'biotope' of all those institutions which are engaged in scientific research. They are responsible for the accumulation and diffusion of knowledge, which educates and trains the working population, develops technology, produces innovative products and processes, and distributes them."* (Kuhlmann &

Edler, 2003, p. 8). Within this innovation system all actors and processes function to structure and stimulate socio-technical innovations. This thesis focuses particularly on the governance actors within this innovation system that use innovation policies in a strategic or dedicated way to stimulate or steer innovation within the whole system. Innovation policies can be defined as: "*the public actions that influence innovation process, i.e. the development and diffusion of (product and process) innovations ... As in any policy, the objectives of innovation policies are determined in a political process and not by researchers.*" (Chaminade & Edquist, 2010, p. 95). Also these innovation policies that aim to govern the socio-technical changes are not exclusively framed within national authorities anymore, but turned into multi-level governance systems. For member states of the EU, innovation policies mostly moved to the transnational framework of the European Union: "*The EU Commission's initiatives fostered considerable transborder European co-operation, although the agenda-setting for most publicly funded research and innovation policy activities remained with the national "arenas" of corporatist actors and policymakers."* (Kuhlmann, 2001, p. 953).

This transnationalization of innovation governance can also be seen in the case under study. The ILB discontinuation case is an example of a public policy that aimed to accomplish a sustainability transitions in the area of domestic lighting: *"Sustainability transitions are long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption.*" (Markard, Raven, & Truffer, 2012, p. 956). In the case of domestic lighting, the policy-making trajectory of the eco-design regulation for the discontinuation of the ILB started with an omnipresent push for the phasing-out of the ILB in order to stimulate the use of energy-efficient light bulbs. The agenda setting of this discontinuation issue had a long history and involved many different actors, like the industry, green NGOs and political parties on multiple levels. The need for a ban or discontinuation of ILBs was pushed bottom-up by different interest groups and was also part of global policy diffusion. An important reason for this policy diffusion was the low-cost of the discontinuation policy and its ease of implementation due the widespread support from industry and environmentalists (Edge & McKeen-Edwards, 2008, pp. 2-7). The need for a policy to oppose ILBs was mainly argued from a sustainable reason. The wide sharing of this reason was reflected in proposal of the European Lamps Companies Federation (ELC) to phase out the ILB before there was any regulation (ELC, 2007). Also several member states had introduced or discussed first policy initiatives to phase out ILBs (European Parliament, 2007c, p. ~)

The policy-making process for a final regulation on the discontinuation of the ILB was mainly facilitated and structured by the European Commission, due to its embedding in the eco-design directive. The eco-design directive (European Union, 2005, 2009) is a framework regulation for improving the environmental performance of energy using products through eco-design requirements. Eco-design requirements aim to set new standards for the design of a product to improve its environmental performances, or improve the supply of information on its environmental aspects. This eco-design framework operates on the supranational level to overcome separate national legislation and preserve the free movement of goods. For domestic lighting, an eco-design regulation was proposed to improve the energy-efficiency performance of lamps and their environmental performances. An overview of the policy-making trajectory of the discontinuation of the ILB can be found in the figure below:

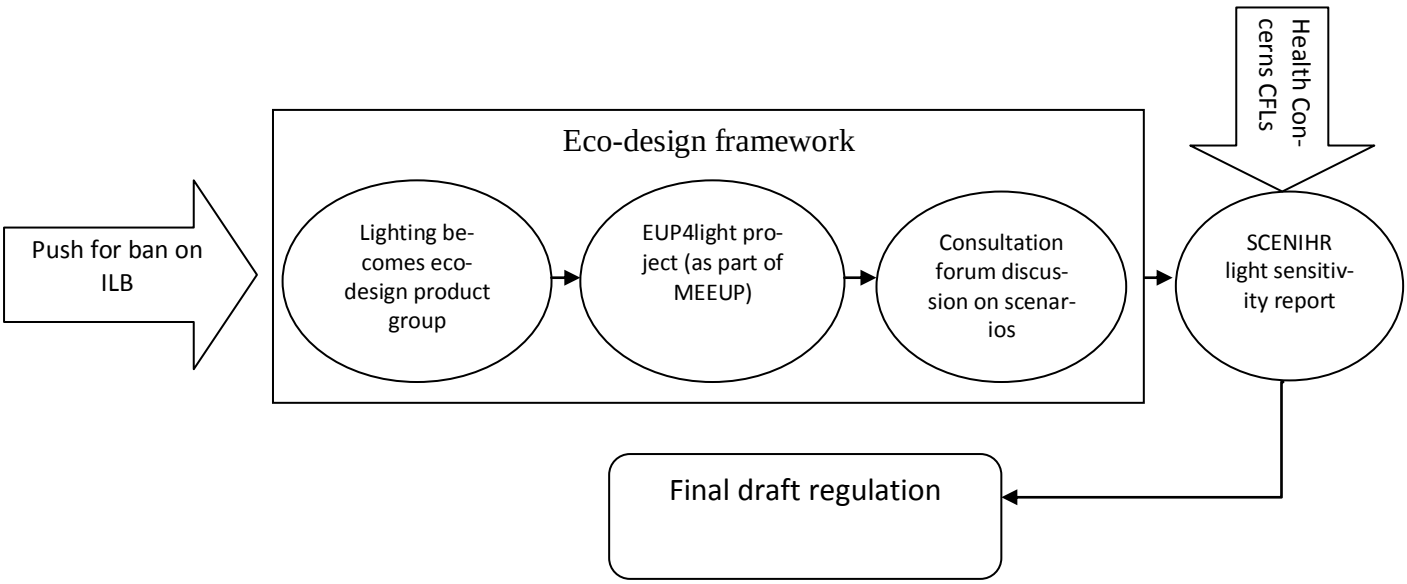

Figure 3: EU policy-making trajectory of the discontinuation of the ILB

The push for discontinuation of the ILB led to the inclusion of domestic lighting as a product group in the eco-design framework. Within the eco-design framework the policy-making process of eco-design requirements was facilitated and pre-structured by the European Commission with the help of fixed approaches and methods during its policy-making trajectory. After domestic lighting was recognized as product group, the second step within the eco-design framework included an open stakeholder project (Vito, 2009b). This project facilitated stakeholders to participate in the development of scenarios for the phasing out of inefficient lighting and set eco-design requirements. To be able to formulate eco-design requirements for domestic lighting, the European Commission installed an EUP4light project, to do a technical,

environmental and improvement analysis of domestic lighting in a fixed format (Vito, 2009a). After the study was done, the Commission proposed different scenarios for the phasing-out of inefficient domestic lighting (European Commission, 2009c). During the third phase of the eco-design trajectory, a closed stakeholder participation project was set up that included experts and representatives of member states to discuss the formulated scenarios. This was called the Consultation Forum and enabled the representatives of member states and invited experts to discuss possible eco-design requirements and propose a final discontinuation scenario (Consultation Forum, 2008a). After these scenarios were discussed in the Consultation Forum, the Commission proposed a draft regulation to the European Parliament. Before this draft regulation could be amended, an additional step had to be introduced in the policy-making trajectory, namely a 'light sensitivity report' (SCENIHR, 2008). This need for this report resulted from the pressure of societal actors that had articulated their concerns about the consequences of using energy-efficient lighting. After this report concluded that the proposed health concerns were mostly ungrounded, the way was free for the Commission to define their draft regulation. After the European Parliament amended this draft regulation the start of the discontinuation of the ILB was introduced and implemented in the member states (European Commission, 2009c).

So, in this section the relation between innovation policies and socio-technical transitions we discussed. As for many other policy fields, the policy-making process for innovation has moved for a large extent to the multi-level governance context of the European Union. This transnationalization was also present in the case under study. This section approached discontinuation of the ILB as a sustainability innovation policy and sketched how it is structured in the EU governance frame. This showed that a study on discontinuation initiatives for the ILB, as part of the broader framework of innovation policy, needs a multi-level and multi-actor perspective. The next section elaborates further on this multi-level policy perspective on technology discontinuation and presents purposeful governance perspective on discontinuation.

Purposeful governance of discontinuation problems

The aim in this section is to integrate both pervious sections and delineate the main theme of this thesis: the purposeful governance of technology discontinuation. In the first section, discontinuation was underlined as part of evolutionary change in the socio-technical regime. In the second section, it was shown how the case on ILB discontinuation is part of the transnational multi-level governance of sustainability oriented innovation policy-making. Finally, in

this section an analytic framework is developed to study the governance of technology discontinuation as a purposeful task: "*One particularity of sustainability transitions is that guidance and governance often play a particular role ... In this case, a transition is purposeful and intended, and a broad range of actors is expected to work together in a coordinated way." (Markard, et al., 2012, pp. 956-957).* As in the case of ILB discontinuation, discontinuation can be a tool to stimulate the innovation of a particular socio-technical regime in a dedicated way and become an important part of innovation policy. This influence of dedicated technology discontinuation on socio-technical innovation has not been studied much before (Stegmaier, et al., 2012).The approach in this thesis aims to contribute to the question how discontinuation is attributed to the practice of socio-technical transformations in a dedicated way and how its constitution is governed and coordinated in the multi-level structure of European innovation policy. Technology discontinuation is approached as a dedicated policy for innovation governance to stimulate and structure change in the socio-technical regime.

Technology discontinuation and the involved policy are conceptualized as a dedicated way to govern the termination of a certain technology in favour of another. The proposed analysis of technology discontinuation focuses on getting a better understanding of the meaning of dedicated discontinuation governance for policy-makers as a problem of action. For policy-makers the purposeful discontinuation of a technology is an intervention on the existing technological regime and the involved barriers, but also has to deal with the barriers of policy termination in general. When a new policy is introduced, the existing policy needs to be terminated as well (van der Graaf & Hoppe, 1996, pp. 221-227). So, besides the termination of a technology, also the termination of the old policy needs effort and coordination (Bauer, 2009; van der Graaf & Hoppe, 1996, pp. 5-7). In the final paragraphs, the specific analytical framework for studying the actual governance of the discontinuation of the ILB and its trade-offs and barriers for policy-makers is discussed.

For the analysis of the purposeful governance of discontinuation, the social-constructivist approach of Hoppe (Hoppe, 2010) is applied. This constructivist approach presents the need for a reflexive account on policy-making as a practice that aims to govern problems that are identified or framed by relevant actors. These actors will construct policy issues through frames in which facts, values and theories and interests are integrated (Rein & Schön, 1993). Because of these constructed multiple social realities that are created by conflicting frames, the participants can disagree both with one another and can also disagree about the nature of their disagreement. Constructivist policy analysis shows that before you can analyze and compare different policy options: "*questions about how problems are defined and framed*

must be addressed to have a basis for evaluating the efficacy, merits or legitimacy of competing social policies." (Jasanoff & Wynne, 1998, p. 5). Policy-making is therefore often perceived as collective puzzling, by recognizing problems and attributing appropriate answers to these problems (Colebatch, 2009, pp. 29-33). The aim is to shed light on the way technology discontinuation is perceived as part of socio-technical change and which issues are identified for its enactment. These perceptions and issue framing are used to develop a heuristic for an understanding of the involved barriers and trade-offs of technology discontinuation and the way these are governed.

The problem-oriented approach used for the analysis is the 'governance of problems' framework that is developed by Hoppe (2010). With it he argues that a shared meaning of a (policy) problem is not given and presents a problem-oriented view on public governance. Instead of only looking at policy from as problem solving perspective, he puts much emphasis on the importance of problem structuring, for political but also for analytical reasons. Problem structuring combines both problem finding and problem solving, by searching and evaluating competing problem representations among involved actors (Hoppe, 2010, p. 27). In the case of discontinuation governance, on the one hand, problem structuring shows that the policy-making of discontinuation has the goal to address a problem of innovation by terminating a certain technology to stimulate another technology (problem solving). On the other hand, it also shows that technology discontinuation is shaped by the issues that are identified by the involved actors as the result of implementing a discontinuation measure (problem finding). By doing so, Hoppe's account presents a clear insight in the way discontinuation governance is the perceived by different problems framings of the involved actors and the way these problems are structured and coordinated by policy-makers.

So, the analytical framework that is defined for studying the discontinuation of the ILB allows for applying a problem-oriented perspective on studying the purposeful governance of discontinuation. In the case of the ILB, the first phase of analysis focuses on the issues that were raised and articulated by the involved actors during the policy-making trajectory for enacting ILB discontinuation. These issues represent the identified barriers that were attributed by the actors for enacting discontinuation. The next step of the analysis concentrates on interpreting these identified issues as different problem types for policy-makers and their attributed governance trade-offs. This part of the analysis is aimed to examine the way the policy-makers govern the different problem types to define a final discontinuation policy. Finally, the analysis uses these empirical findings to develop a more general heuristic that includes ideal-type explanations for the governance of technology discontinuation and its attrib-

uted problems. In the next chapter, the interpretative research methods that naturally spring from this constructivist analytical approach are presented.

3. Research methodology

In this chapter, the research methodology is presented for studying the discontinuation governance of the ILB. The research approach of the policy analysis on technology discontinuation is elaborated in the first section. This policy analysis includes an interpretive research approach in a qualitative and explorative fashion. In the second section, the general research question is specified further in four different research questions. The research design is discussed in the third section. This research design is expounded by its data-sampling process and its data-analysis approach. Finally, in the last part the limitations of the study and its research approach are described.

Research approach

The main research goal is to contribute to a better understanding of the purposeful governance of technology discontinuation. The theoretical framework specified the analytic approach of this thesis on discontinuation governance further, and explained to study the way identified discontinuation issues are governed and which trade-offs are constituted. This governance focus on technology discontinuation acknowledges the wide variety of governance arrangements that the shaping of technology discontinuation can engender. The analysis in this thesis focuses on a specific case-study of the discontinuation governance of the ILB. This case-study design is used to be able to do an extensive and detailed analysis (Bryman, 2004, p. 48) of technology discontinuation. The case-study on the termination of the ILB is used as an exemplifying case to get a better insight in the construction of the governance dedicated to this termination and the way discontinuation issues that arise during this termination are structured by the involved actors. This case-study specifically focuses on the governance of discontinuation issues as it is constituted during the European policy-making trajectory for the ILB. First of all, this focus on the supranational level is the result of the influential role that the EU policy-making frame plays for the actual ILB discontinuation. Secondly, a focus on the policy-making process enabled the attribution of a policy analysis approach on the case and performs a concrete survey on the available policy documents. Consequently, the focus on the ILB case and its governance as the outcome of policy-making does not cover the whole array of different governance arrangements that were present or were possible for ILB discontinuation. However, the focus on the policy-making process enabled this thesis to apply a policy-analysis focus on the discontinuation of the ILB and perform a detailed analysis of the in-

volved policy documents. The approach of the policy-analysis approach is elaborated further in the upcoming paragraphs.

Policy analysis is a field of research that has developed different methodologies over time. A general definition explains that policy analysis is: "*a process of multidisciplinary inquiry designed to create, critically assess, and communicate information that is useful in understanding and improving policies"* (Dunn, 2008, p. 1*)*. There is no single method of policy analysis that is always appropriate and therefore always involves methodological choices. The method of policy analysis that is applied in this thesis is based on an important part of my analytical framework: the governance of problems approach that focuses on the governance of problem structuring. This constructivist approach focus on the issue framing that is attributed to technology discontinuation by the involved actors. This thesis chose to conduct an interpretative analysis of the case in a qualitative research style. Qualitative research aims to understand the social world, as a way to "*actively construct knowledge by inventing tools and instruments to collect and produce data.*" (Sadovnik, 2007, p. 420). In the next section, it is explained further how the interpretative policy analysis is applied. In the subsequent section, the specific qualitative method of this research project, classified as the grounded theory approach, is elaborated

Interpretive policy analysis

Interpretive policy approaches share the assumption that policy-making can only be understood when we grasp the relevant attributed meanings to a policy (Wagenaar, 2007, p. 429). This means that the approach of this thesis have to be sensitive for the meanings that are attached to the discontinuation of the ILB by the relevant actors. An interpretive approach underlines the proposition that the social world we live in can be interpreted in multiple ways (Yanow, 2000). Contrary to a positivistic approach to policy, this method does not aim to make a distinction between facts and values. Interpretive policy analysis presupposes that facts do contain values. The role for the policy analysts is then to put the different value inspired facts of the actors, linked to a certain policy, on the table: "*Interpretive policy analysis explores the contrasts between policy meanings as intended by policymakers—'authored texts'—and the possibly variant and even incommensurable meanings—'constructed' texts—made of them by other policy-relevant groups*" (Yanow, 2000, p. 9). Therefore, policy analysts need to perceive policy statements as intentions, but also need to look at the way these intentions are interpreted in practice. This leads to a pressing question for my case: how is the discontinuation policy framed and understood by the involved actors?

So, interpretive policy analysts aim to examine the different meanings related to a certain policy issue in a qualitative fashion. In order to do this, they need to focus on policy artefacts (language, objects, acts) and their embedded and communicated meanings by the various involved actors. Yanow (2000, p. 22) describes four steps for an interpretive analysis: 1) identify the carriers of meaning for the involved actors, 2) identify relevant communities of meaning, 3) identify the different discourses, and 4) identify the points of conflict that reflect different interpretations. In my research approach, these four steps will not be followed explicitly, but function as important guidelines for my empirical research and resonate in my research questions. The proposed guidelines show that it is important to identify the relevant actor groups for a policy; identify relevant empirical sources of these actor groups that express their problem framings; reconstruct their problem framings by these sources; and finally compare them. The difference between these guidelines and the approach of the analaysis is the leading focus on discourse analysis (Starks & Trinidad, 2007). Within the analytical approach, the value of discourse analysis is underlined as an important source for the interpretation of the meanings that is attributed by the relevant actors to technology discontinuation through the use of language and words. However, due to the lack of empirical research on the governance of technology discontinuation, the analysis does not aim to focus on the use of language in particular. The goal is to do a more broad and explorative search on the meaning of discontinuation governance for the involved actors by their social interactions and discourses. The grounded theory approach is believed to be more suitable explorative research style for the case-study on ILB. A grounded theory helps this project to develop an explanatory framework by studying the social interactions and how they evolve to framings of technology discontinuation and the identified issues. This grounded research approach is explained further in the next section.

Grounded theory approach

The grounded theory approach is a qualitative method that is focused on an inductive style of analysis. The topic of this research project, the discontinuation of technology, is a rather new field and does not fit an existing (monodisciplinairy) research field. Although this thesis starts from a first analytical framework that focuses on purposeful discontinuation governance, the topic itself is a rather new field of research and needs an explorative style of analysis. Instead of explaining the ILB case from a constituted theoretical framework, like in a more deductive style of research, this project applies an inductive research approach. This inductive approach aims to reconstruct the discontinuation process of a specific case of discontinuation govern-

ance and interpret the attributed meanings of the involved actors by the help of qualitative research. The final aim of this inductive approach is to conceptualize the governance of technology discontinuation and its identified discontinuation issues, and constitute and explanatory framework for the governance of the discontinuation of technology.

The grounded theory approach was founded in 1967 by Straus and Glaser, and was introduced in their book "A discovery of grounded theory: Strategies for qualitative research". This grounded approach was developed by these two authors as a reaction on the focus on grand theory building in the social sciences at that time, which removed research further away from social reality: "*With GT [grounded theory], they sought not to make truth statements about reality but, rather, to elicit fresh understandings about patterned relationships among social actors and to explore how these relationships and interactions dynamically construct reality for the actors*." (O'Reilly, Paper, & Marx, 2012, p. 248). Although, different approaches of grounded theory evolved through time, the general goal of this approach is to: "*construct theories in order to understand phenomena. Its main contribution is in generating theory from data in a systematic way—theory grounded in the data. Using the process of analytical induction, grounded theory research examines cases in detail and continues to build theory from the bottom up—based on observation of particular data.*" (Sadovnik, 2007, p. 422).

This thesis used the grounded theory approach as described by Corbin & Strauss (1990, pp. 419-423). An important aspect of this approach is the interwoven process of data collection and analysis. At the start of the analysis, the research field was entered with some predefined questions and hypotheses. However, from the start it was important to incorporate and capture all seemingly relevant issues in the next data samples in a systematic order. This involved the constant revision of the research questions and hypotheses during the analysis. The second step of the analysis of the data started with applying codes on the identified discontinuation issues, which enabled the structuring of the data from a from a bottom-up approach. This coding process functioned as the first step to transcend the descriptive level of the data to the conceptual level and the systematization of ideas. As a result, these codes eventually evolved into concepts, which included issue topics and the involved governance dimensions. These concepts were the basic units of analysis and needed to be specified further with the help of additional data collection. In a later stage, these concepts were grouped in overarching categories for understanding discontinuation governance. Finally, these categories were used to build a first heuristic for the understanding of technology discontinuation. As an

additional part of the process, during all these steps of analysis, theoretical memos were used as container for ideas on theory-building.

When working with the grounded theory approach, researchers need to be aware not to use the approach "a la carte manner" (O'Reilly, et al., 2012). A first important condition of the grounded theory approach is the constant comparative approach for the simultaneous collection, coding and analysis of data. During the analysis, this constant comparison of data analysis and collection really helped to improve coding and the quantity and quality of the data samples. This is process is often called "theoretical samplings" and is the key for finding new relevant data samples. Secondly, the data samples are examined in a systematic order to see whether they fitted constituted codes and categories. This was necessary to move from the identification of discontinuation issues, to the identification of their issue categories, and finally to the conceptualization of the core dimensions of the governance of technology discontinuation. Thirdly, the process of analysing and data collection developed until the point of theoretical saturation. This saturation occurred when new data did not provide any new information for the refining of categories. This saturation was an important verification for the wrap up of the grounded approach. Finally, during the process of coding and data collection you needed to be aware of your theoretical sensitivity. Before entering the research field, it was necessary to have some predetermined ideas and hypotheses, as defined in the theoretical framework. This theoretical understanding of the phenomenon was used to be able to develop a heuristic for the understanding of discontinuation governance, but as a researcher you should remain sensitive to new theoretical inputs from the data as well. In the next section the predefined research questions and the research design of the study are further developed in the upcoming sections.

Research questions

The research questions for this thesis project focused on the analysis of the governance of a specific case of technology discontinuation: the discontinuation of the ILB. As part of the grounded theory approach, this has led to the predefined research questions to study the purposeful discontinuation governance of the ILB and more specifically the way discontinuation issues were governed. This has resulted in the following research question: *Which issues are identified for the discontinuation of the ILB by the relevant governance actors and how are these issues governed?*

This overall research question can be divided in the following research questions:

a.) *Which actor groups were involved and/or contributed to the constitution of the discontinuation policy for the ILB?*

This first question was the starting point of the grounded approach. This question aimed to provide an overview of the involved actors and the relevant data samples in case of the discontinuation of the ILB. The outcome of this question is reflected in the section on the theoretical sampling process of the grounded theory approach, which is discussed in the next section.

b.) *What (type of) discontinuation issues did the involved actor groups identify?*

This question included the first part of the data analysis. It aimed to interpret the array of discontinuation issues that were identified and framed by the involved actors that were found in question (a.). These identified issues were structured into problem types for the discontinuation of the ILB.

c.) *How were the discontinuation problems governed and what trade-offs in the policy design have been incorporated to deal with these problems?*

This question represented the second part of the data analysis and focused on the further conceptualization of the dimensions of discontinuation governance that were constituted as a way to overcome the identified discontinuation problems.

d.) *How could the empirical findings of the discontinuation of the ILB define a first conceptualization of the discontinuation governance of technology in general?*

As a final step of the grounded theory approach, this question focused on the final conceptualization of technology discontinuation and its governance of problems. This final conceptualization presents ideal-type explanations for the governance of discontinuation of technology and its problems.

A first response on the formulated research could note the descriptive character of the research questions. The descriptive character of these questions was the result of the applied interpretive and explorative analysis. The developed analytical framework and the research questions functioned as a first start and delineation for the empirical inquiry. Due to the fact that the research questions were not too predefined (and the research field neither), the research still had the opportunity to explore the field of technology discontinuation from a 'governance of problems' perspective and finally make a conceptualization of the governance of problems of technology discontinuation more in general. During the empirical inquiry, the researcher went back and forth between the data and the conceptualizations in an inductive

manner to see how they could complement each other and adjust the research questions to it. In the next section, the organization of this inductive research method is explained further.

Research design

The discontinuation of the ILB had the interest of multiple stakeholders. The different levels of these actors with interest in the discontinuation and their initiatives for governance arrangements for the discontinuation of the ILB were not all included in the empirical study. As explained in the theoretical framework chapter, the analysis mainly focused on the governance of the discontinuation of the ILB within the context of the formal policy-making process of the European Commission. Therefore the analysis examined the eco-design policy-making process as research site. The main unit of analysis of this research site consisted of a document analysis. This document analysis concentrated on the governance documents that were publicly available from the research site. These documents formed an important part of the discursive construction of the ILB discontinuation, namely the mediation and framing of policy-making (issues) by communication between the relevant actor groups. The analysis of these documents was done by examining how the discontinuation of the incandescent light bulb was framed or structured by the relevant actors and which governance dimensions were discussed. Besides using these documents as units of analysis, the documents also enabled the search for other relevant documents by identifying the involved actors. In this way, the document analysis was also used to build up the criteria for relevant actors and other governance documents as part of the theoretical sampling process. These criteria were revised during the process of research as well and narrowed the sample of governance documents further down. The upcoming section presents an overview of the steps that were taken in the process of data sampling. The second section explains more about the actual process of interpreting and coding the data.

Data sampling process

The data sampling process focused on public available governance documents. The data samples were collected with the help of an internet survey for governance documents. The first step in data sampling was taken with a general internet search for a possible ban on the ILB and developed as shown in the figure below:

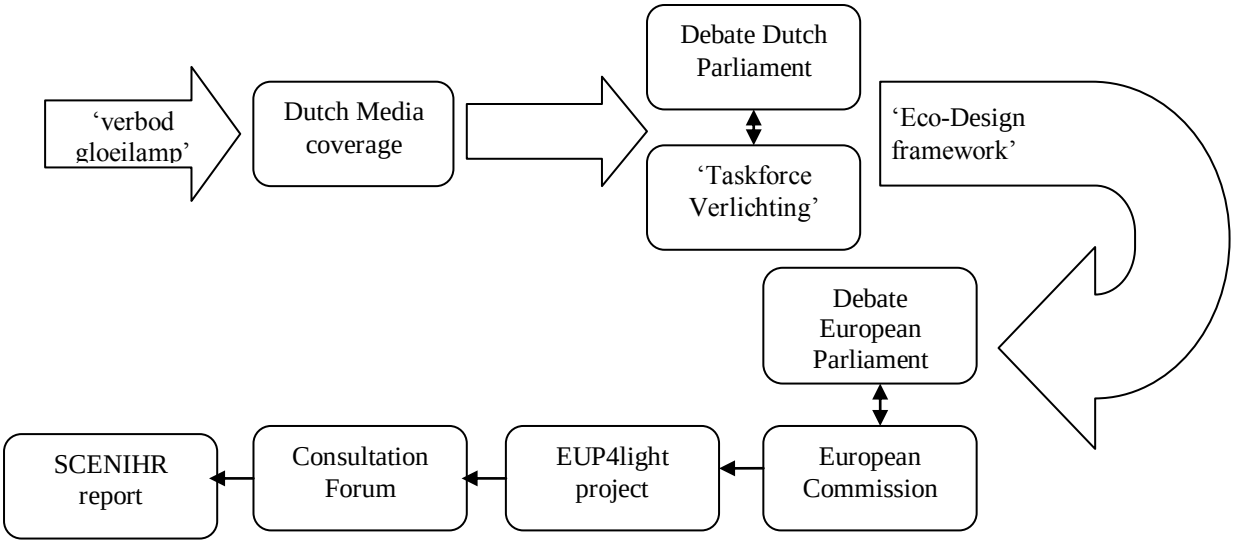

Figure 4: Data-sampling pathway

The first search on a possible ban of the ILB, resulted in various websites that covered the discussion on a possible ban in the Netherlands. These sources underlined the public debate on the discontinuation of the ILB and reflected on discontinuation as a policy issue for the Dutch government. In 2007, the Dutch government had installed a stakeholder project called 'Taskforce Verlichting' to discuss and develop policy measures for improving the use of lighting in the future. Also the debates in the Dutch Parliament turned out to be a first interesting source for studying the attributed meanings for an ILB discontinuation measure. In the beginning of 2007, a vote was passed on the ban of the incandescent light bulb in the Dutch parliament (Elsevier, 2009). From this moment, the discontinuation of the ILB was identified as a policy issue and was discussed at several debates in parliament (Tweede Kamer, 2007a, pp. 2457-2458). The online database of the Dutch government could be used to sample parliamentary documents on discussions of the ILB, by searching for 'gloeilamp'. The selected documents showed that the level of the actual policy-making of discontinuation was a reoccurring subject of debate. Although there were some national initiatives brought up, the responsible Dutch minister explained that she focused and preferred the framework of supranational policy-making for banning the ILB. She argued that she took the effort to put the issue on the EU agenda and would strive for a European policy (Tweede Kamer, 2007a, pp. 2457-2458). These findings showed that the policy-making process on the discontinuation of the ILB in the Netherlands was mainly embedded in the multi-level context of EU, and more specifically the Eco-Design framework. Analytically, this was also an important indicator to move my analysis of the discontinuation governance of the ILB to the supranational level of EU policy-making.

A search on 'Eco-Design Directive' showed that the policy-making process Eco-Design regulations was mainly facilitated and structured on the level of the European Commission. The European Commission had the mandate from the European Parliament and the Council of Member States to implement eco-design requirements for domestic lighting (European Commission, 2009a). The policy-making process of eco-design requirements was facilitated and prestructured by the European Commission with the help of fixed approaches and methods. This formal and pre-structured policy-making trajectory can be found back in the data-sampling overview. First of all, the website of the European Commission was used to select the document they published in relation to the implementation of the ILB discontinuation. Before any eco-design regulation could be formulated, a study for the setting of eco-design requirements had to be performed. This led to the selection of the documents of the EUP4light project. A second step in the decision-making process of establishing eco-design requirements was a meeting with the Consultation Forum. This Forum entailed a stakeholder meeting that represent experts and EU member states and was also added to the data sample. Thirdly, as a reaction on the wide spread concerns about the health issues of the use of energy efficient lighting, a SCENIHR study was executed. This report was also added to the data sample. And finally, the discontinuation of the ILB was also a highly debated policy issues in the European Parliament. Although the Parliament did not have a big say during the policy-making trajectory, the debates in parliament were approached as an important discourse arena for the discussion on the governance of the ILB discontinuation.

So, the most important research site for the governance of the ILB was the formal and pre-structured policy-making trajectory of the EC. Different actor constellations were involved during the formal policy-making process of the Eco-design regulation on domestic lighting. However, the EC pre-structured the approaches for stakeholder involvement and expert opinions, and had the responsibility to write the final regulation. Appendix A presents a more detailed overview of the different sources that were distinguished to select governance documents for analysis. In the next section, the process of analyzing the selected governance documents is discussed.

Data analysis

Selecting quotes for analysis and applying codes on these data samples enabled this researcher to structure the grounded data that was selected. Besides structuring the data with codes, applying codes also is a necessary step to conceptualize the selected data, by stepping from the descriptive level to the conceptual level and developing a heuristic for the understanding of

technology discontinuation. During analysis, a merely inductive style of coding was applied, by the use of open-coding. This type of coding analytically breaks down data in order to gain new insights from the data: "*In open coding, event/action/interaction, and so forth, are compared against others for similarities and differences; they are also conceptually labeled. In this way, conceptually similar ones are grouped together to form categories and their subcategories."* (Corbin & Strauss, 1990, p. 423). This process of coding was organized with the help of the coding software "Atlas.ti". The use and the values of this analytical software for the presented analysis is explained in the next paragraphs

Atlas.ti is one of the available tools you can use for data-analysis that is referred to as Computer-Assisted Qualitative Data Analysis Software (CAQDAS). Using CAQDAS enabled the study to organize data samples and perform a qualitative analysis of the data by applying codes and categories. On a conceptual level, Atlas.ti was used to select documents, select quotations and link codes or memos to it. After some rounds of coding, the program was a really useful tool to start conceptualizing the data. First of all, this was done by structuring the attributed codes in the code list and by developing codes categories. This enabled the study to sort and structure codes that were close to the data to a more conceptual level (Friese, 2012, p. 123). Secondly, besides this easy handling of data samples and codes, another strong point for using CAQDAs is its ability to record the steps you take while analysing (Bringer, Johnston, & Brackenridge, 2006, pp. 246-247). This recording of steps helped the analysis to reconstruct the qualitative journey was taken through the data and to open up the analysis for co-coders. Thirdly, this program also enabled this research to record the conceptual steps by applying memos in a systematic way as containers for ideas. Memos were used in to develop theoretical memos or make notes for literature; to develop research question memos to bloom the interpretation of data and the scope of research; and memos were linked to codes or quotations to add additional information.

Lastly, it is important to note the importance for coding your data in a systematic and consistent order. A first important task was to keep reflecting on the functioning of the codes and the code list. At several stages, the code-list was sorted and structured to see whether there were any codes that flawed. Also, the quotations were systematically checked whether they still hold. Last but not least, the coding evolved in multiple rounds, so the data was coded over again. Because Atlas.Ti was used to organize the data analysis in a qualitative fashion, it enabled this researcher to stay close to the data and recorded the conceptual steps. In this way, the supervisors were able to check the coding process and act as a co-coder by checking the reliability of my coding within the timeframe of this thesis project.

Limitations of study

In this last section, the limitations of the presented research methodology are discussed. These limitations can be divided in two types: limitations related to the scope of research and those related to the grounded research method. First of all, the limitations of the scope of the research are discussed. As explained earlier, the empirical study on the governance of technology discontinuation mainly focused on the formal decision making process of the discontinuation of the ILB on the EU level. This involved several limitations for my interpretation of discontinuation governance in general.

First of all, the discontinuation case of the ILB was an explicit and recent case of the purposeful discontinuation of technology. Due to its embedding in a formal but public policy-making trajectory, this case could be studied in detail by its governance documents. However, this policy-making trajectory was most specific for the case of the ILB. In this way, the empirical findings did not reflect all the facets of technology discontinuation governance. On the one hand, the socio-technical system of domestic lighting had its own characteristics and dynamics that influence its governance. On the other hand, the ILB case had a specific policy context and was structured within the eco-design framework. Therefore, the governance processes that were studied are likely to differ in other cases. Secondly, due to the focus on the formal policy-making process of discontinuation, my analysis missed many other important governance initiatives that shaped the path dependency of the final EU regulation. The agenda setting of this discontinuation issue had a long history of public debate and had involved many different actors on different levels. These different discontinuation governance arrangements were missing in the analysis. The implementation of the discontinuation regulation by the Member States was missing as well. After the regulation was introduced, the functioning of the policy was not clear yet. The phasing out of the ILB evolved in steps and upcoming summer the last step is taken. So, in this way the discontinuation can still become rather controversial when its final effect hits consumers. Finally, for the analysis public policy documents were used to interpret the discontinuation governance of the ILB. However, these documents did not represent or cover all the governance interactions among the involved actors during the policy-making trajectory. An inevitable result is the limited understanding of the whole policy-making process of the ILB discontinuation by only doing a document study. The missing data could have been complemented with additional interviews or questionnaires. However, within the time frame of this thesis project, it was not possible to perform these extra surveys.

Another important limitation of the analysis is related to the use of the interpretative and explorative research approach. The analysis uses a grounded theory approach, because technology discontinuation is a rather unexplored field of research and the grounded theory is really applicable to sample and analyze data in an interpretive manner. Although the grounded theory had an important value for the explorative study, also some limitations need to be noted. First of all, the grounded theory approach is performed in a qualitative fashion. A qualitative analysis takes a lot of time to execute and to present in a usable manner. Secondly, while using the grounded theory it is important to reach theoretical saturation and include all relevant data samples in the analysis for a good understanding. It is not always easy to define this point of saturation and it is also important not to get trapped in your concentration site (O'Reilly, et al., 2012, pp. 257-258). Finally, an important part of qualitative analysis is its reliability and validity. Therefore it is important to work in a systematic way and record the steps of your analysis and conceptualizations. The software program Atlas.Ti was used as tool for organizing and recording the data analysis. This recording of the analytical steps in the software program was needed to secure and reflect on the inter-coder reliability of the analysis. In this way my supervisors or other interested researcher could act as co-coders and check the reliability of my coding.

4. Analysis: Dimensions of discontinuation governance

In the following three chapters, the empirical findings of the study on ILB discontinuation are presented and discussed. In chapter four and five, the focus is on the analysis of the attributed meanings of discontinuation governance as discussed during the EU policy-making trajectory. In Chapter, the discussed governance dimensions and the involved trade-offs for constituting an ILB discontinuation policy are outlined. In chapter five, an overview is presented of the problem-types for ILB discontinuation and the related discontinuation issues that were identified by the involved actors. Next to the display and discussion of the governance dimensions and discontinuation problem-types, chapter five also presents an overview of the relations between these dimensions and problem-types for the case under study. This overview shows how the identified discontinuation issues were aimed to be solved by the attribution of the different governance dimensions. Finally, in chapter six the analysis of the debate in the Dutch parliament on ILB discontinuation is discussed. This analysis presents the identified discontinuation problems and related governance dimensions that were debated on the national level. Finally, these findings from the national level are used to compare and complement the findings from the EU level.

This chapter entails the first part of the analysis of the discontinuation governance of the ILB on the supranational level and discusses the attributed governance dimensions for discontinuation. The table below presents an overview of the governance dimensions of ILB discontinuation that were proposed and discussed during the EU policy-making trajectory. These governance dimensions represent the policy choices that were considered by the involved actors for the design of a discontinuation policy. In the table, a schematic overview is given of the discussed governance dimensions and the involved trade-offs.

Governance dimensions of discontinuation	**Dimensions' trade-offs**
Policy instruments	Efficacy requirements vs. Additional requirements
Implementation	Immediate ban vs. Gradual transition
Strictness	Exceptions for use vs. No exceptions for use
Monitoring	Business as usual vs. Additional regulations
Policy level	National vs. Supranational

Table 1: The governance dimensions and the trade-offs on EU level

The identified governance dimensions are elaborated in the following sections. The presented order of these governance dimensions is based on the relevance of these dimensions in the discourses that were analysed.

Policy instruments

The discussion on the discontinuation of inefficient lighting in a dedicated way was notably focused on the use of appropriate policy instruments. An important policy instrument that was debated among the actors was the introduction of efficacy requirements for domestic lighting. The ELC was one of the first parties that presented a plan for the termination of the ILB by setting efficacy requirements: "*For each phase, there would be minimum efficiency specifications based on an energy efficiency classification (see table 1), and on luminous efficacy or lumens per watt (see table 2).*" (ELC, 2007, p. 1). Subsequently, efficacy requirements for domestic lighting were also an important part of the eco-design framework. The aim of the eco-design framework was to set a new standard for the production of light bulbs, which eventually would lead to the termination of inefficient lighting like ILBs. The EUP4light project did a comparison of the different eco-design scenarios for phasing out inefficient domestic lighting. These eco-design scenarios were mainly based on raising the energy efficiency classes of lighting with subsequent phases, so the inefficient lamps that could not satisfy these efficiencies would have to be phased out or need to be improved: "*In the tables presenting the scenarios (except for the BAU), minimum requirements (i.e. minimum energy class) are set for each tier. In order to analyse these scenarios, a specific lamp technology is used as replacement lamp [as a way to reach the requirements]"* (Vito, 2009a, p. 242).

Within the final eco-design regulation, minimum efficiency requirements were a central aspect for the phasing out of inefficient lighting. The EC underlined: "*efficiency requirements should be set at levels that would lead in practice to a phase out of traditional incandescent bulbs (GLS) used for general lighting purposes*." (European Commission, 2008, p. ~). However, besides energy efficiency, the EC also addressed the need of additional requirements for lamp functionalities and product information for the replacing lamp types: "*requirements are also set on the functionalities of the concerned lamp types ... and on the product information to be displayed to allow the consumers to better select the appropriate lamps for a given purpose among the alternatives to conventional incandescent lamps*." (European Commission, 2009a, p. 17).

So, raising energy efficiency requirements for domestic lighting formed an important part of the policy instruments for the dedicated discontinue of ILBs by setting new standards

for domestic lighting. Besides the discussion on the appropriate efficacy requirements for a discontinuation policy, also additional requirements were raised. These additional requirements for the phasing out of the ILB were discussed to overcome certain consequences of a phasing out and to establish an appropriate discontinuation trajectory.

Implementation

The previous section showed that the main focus of the discontinuation policy was to phase out ILBs and other inefficient lighting by setting energy-efficiency requirements. However, the pace of this phasing out was highly debated as a distinctive part of the policy. From the start, a gradual discontinuation was preferred for an immediate ban. The EC explained that a ban would have an advantage for energy savings, but would mitigate impact on industry and supply: "*Staged introduction of requirements (in particular banning incandescent bulbs in several stages) would affect accumulated savings up to 2020 but mitigate impacts on industry and should avoid risk of supply shortage; the annual savings as from 2020 would remain more or less unchanged*." (European Commission, 2009d, p. 56). Although there was consensus about the advantages of a gradual replacement of lighting, there was discussion about the timing and ambition of this replacement: "*All the examined options lead to a total phase out of traditional incandescent bulbs (GLS) used for general lighting purposes ... The main questions for debate are the level of ambition beyond phasing out GLS and timing"* (Consultation Forum, 2008a, p. 2).

The decision on the pace of discontinuation was argued to be influenced by the level of ambition of the setting of the eco-design requirements and the timing for the setting of these requirements. The Consultation Forum members divided two types of timing: ambitious and cautious timing (Consultation Forum, 2008a, pp. 9-10). The ambitious times was proposed during the EUP4light project: a phase-out of 3 stages in 5 years (Vito, 2009a). The lighting industry (ELC and CELMA) proposed a phase-out of 5 stages in 9 years (CELMA, 2008). Besides the ambition of timing, also the ambition of the requirements for these stages was discussed among the stakeholders. The EUP4light discussed several options and proposed three of them to the EC and the Consultation forum (Consultation Forum, 2008a, pp. 7-8). Option 1 contained a final minimum energy efficiency requirement of level A: only efficient CFLs allowed. Option 2 had a final minimum energy efficiency requirement of level A with some exemption in level B+ and B: this would allow improved incandescent light bulbs in some cases. And the least ambitious option 3 that put the energy efficiency requirement on level C: phases out all ILBs, but leaves some options for halogen lamps.

So, besides defining the appropriate policy instruments for a discontinuation policy, also the implementation of the policy was widely discussed. A major part of the actors appeared to be in favour for a gradual termination of inefficient lighting. However, the ambition and timing of the implementation of the proposed requirements were highly debated. Several different scenarios were developed and discussed, but the EC and the Consultation Forum had the final say.

Strictness

The plans to phase out the use of inefficient domestic lighting also led to a discussion about room for exceptional use of the discontinued lamp types. In the EUP4light project the need for the use of the discontinued lamps in specific circumstances was explicitly mentioned: "*Banning of products or technology from the market based on its 'efficacy' could therefore cause serious negative side effects for other light source applications*." (Vito, 2009a, p. 298). Examples of the application of special purpose lamps were summed up by the ELC: "*In the domestic market: Oven lamps, Fridge lamps and other appliance lighting ... Other applications that would be severally impacted ... would be Theatre, Stage, studio & the entertainment industry. Also indicator lamps, airfield & aircraft lamps.*" (Vito, 2009b, p. 90). Exceptional use of discontinued lamps was also requested for people that are sensitive for light: "*Following the precautionary principle, there is also a need to keep alternatives to CFL lamps for some patients with alleged health issues. This means leaving certain transparent halogen lamps on the market"* (European Commission, 2009d, p. 55). A solution for these issues of special uses of inefficient lighting was proposed by the ELC by lowering the efficacy requirements of 25 Watt lamps: "*The majority of the lamps under 25W ... have a lower environmental impact due to their power ... frequency of use ... and their market size ... Furthermore, cost-effective, energy efficient alternatives for many of these lamps are not yet available on the market*." (ELC, 2008, p. 4).

In the final regulation, the EC left room for the use of less energy-efficient lamps in two ways. First of all, they left the option open to allow the production and use of improved incandescent light bulbs: "*current-day compact fluorescent lamps and light emitting diodes cannot provide the same type of light as the conventional incandescent lamps ... improved incandescent bulbs with halogen technology do, and consumers who are keen on conventional incandescent light quality for aesthetics or health reasons should have access to it.*" (European Commission, 2009a, p. 9). And secondly, they made exceptions for special purpose lamps in their final regulation: "*the following information shall be clearly and prominently*

indicated on their packaging and in all forms of product information ... :(a) their intended purpose; and (b) that they are not suitable for household room illumination." (European Commission, 2009c, p. 76/76)

So, the phasing out of inefficient lighting also stirred up the debate on the need for exceptional use of the discontinued technology. It was argued that for some occasions use of energy-efficient lighting was not appropriate or feasible. This opened the debate about the room to lower the strictness of the governance of discontinuation for some cases. In the final regulation, the EC chose to allow the improved incandescent light bulbs temporarily and give special purpose lamps a formal exception for the efficacy requirements.

Monitoring

Besides the constitution of a discontinuation policy for inefficient domestic lighting, also the monitoring of this policy was discussed by the involved actors. The enforcement of the policy by market surveillance was often remarked as an important condition for the enforcement of a fair competition. The ELC argued that effective Member State enforcement for market surveillance was needed for a successful outcome of the legislation: "*Without this [effective Member State enforcement], ELC fears that illegal free riders will undermine the potential benefits of the legislation, to the detriment of consumers, companies making genuinely conforming lamps, and ultimately well-intentioned legislators*." (ELC, 2005, p. 1). Also during the Consultation Forum the issue of effective market surveillance by Member States was noted (Consultation Forum, 2008c, p. 6). However, it was believed that there was no additional regulation needed to improve this market surveillance for the enforcement of the discontinuation policy. A member of the EC (Oettinger) explained: "*The role of the Commission is to provide (where appropriate) opinions on the decisions taken by the Member States in the framework of their market surveillance activities, and to keep the other Member States informed of the decisions taken by a particular Member State."(European Commission, 2010, p. ~).* This showed that the monitoring of the discontinuation policy was mainly perceived as part of the framework of the market surveillance activities of the member states.

Another part for the monitoring of the discontinuation policy that was discussed was the evaluation of the regulation through time. The EC explained that monitoring not only includes market surveillance, but also the monitoring of the appropriateness of the policy through time: "*The appropriateness of scope, definitions and concepts will be monitored by the ongoing dialogue with stakeholders and Member States. A review of the measure should be planned taking into account market evolution and in particular the development of LED*

technology." (European Commission, 2009d, p. 17). Although there did not seem to be a concrete deadline for the revision of the eco-design regulation, the policy-makers assured that the appropriateness of the policy is monitored as well.

So, the monitoring of the established policy was discussed from two perspectives. First of all, market surveillance was perceived to be needed to monitor the enforcement of the discontinuation policy. However, no additional policy measures were discussed, because the existing framework of market surveillance was argued to be effective enough. Secondly, the evaluation of the appropriateness of the discontinuation policy was also seen as an important part of policy monitoring. This evaluation was especially linked to innovations in the field of lighting.

Policy level

The level of policy-making for the ILB discontinuation was not highly debated by the involved actors during the formal policy-making trajectory. The important legitimization for this supranational approach was the subsidiary principle. A member of the EC (Piebalgs) explained a supranational policy will discontinue inefficient lighting in a harmonised way: "*The subsidiarity principle is respected, as diverging national requirements on products ... would have posed obstacles to the free movement of goods within the Community*." (European Commission, 2009b, p. ~). Also the costs for different national legislation were mentioned as an important reason to choose for a supranational policy: *"The form of the proposed legislation is a regulation which is directly applicable in all Member States. This ensures no costs for national administrations for transposition of the implementing legislation into national legislation."* (European Commission, 2009d, p. 43). In this way, the supranational level of the policy-making was perceived to be beneficial because of the standardization in the different Member States.

However, not all actors agreed that a supranational legislation on the EU level would fulfil the needs of a discontinuation policy. On the one hand, in a petition, several MPs wrote a declaration for the need of international discontinuation: "*Urges the Commission to use the proposal for a new international energy efficiency Agreement to launch a global ban on the use of incandescent bulbs.*"(European Parliament, 2007a, p. 2). On the other hand, MP Nuttall doubted the democratic legitimacy of the banning of the ILB, due to its underhand and undemocratic procedur: "*The initial directive handed implementing measures to the European Commission which, in effect, meant that the regulation was allowed to pass without the consent of this farce of an Assembly or of my real parliament at Westminster." (European Par-*

liament, 2009a, p. ~). This showed that some of the opponents of the supranational level wanted to transcend the standardization to an international level. While other opponents argued that a supranational level had overruled the policy initiatives on the national level and was not democratic legitimate.

So, the choice for the level of the discontinuation policy did stir up some debate about the legitimization of the supranational level a discontinuation policy. Within the EU policy-making trajectory the level of policy was not really debated. It appeared that among the involved actors the legitimization of the supranational policy was mainly argued from its output as a harmonized regulation that counts for all member states and the internal market.

To conclude, in this chapter the first outline was presented of the discussed and considered governance dimensions for ILB discontinuation on the supranational level. These governance dimensions represented different trade-offs for constituting a discontinuation trajectory for inefficient lighting by setting new technical standards for domestic lighting. Five dimensions have been distinguished in this chapter. These dimension showed that there were different choices considered to constitute a discontinuation policy. Not only energy-efficiency requirements were considered, also other policy means were discussed. The involved policy choices functioned as a way to overcome certain discontinuation issues. In the next chapter the identified discontinuation issues are discussed.

5. Analysis: Discontinuation problems in light of the identified issues

The analysis in this chapter presents the findings of the study on the discontinuation issues that were attributed by the actors during the EU policy-making trajectory. These attributed discontinuation issues are interpreted into different discontinuation problem-types. The table below presents an overview of these problem-types and the related discontinuation issues.

Discontinuation problem-types	**Identified discontinuation issues**
Burdens of replacing technology	Performance issues
	Impact of production and use of resources
	Recycling
	Health issues
	Need for improvement
Burdens of/for users	Awareness raising for need of discontinuation
	Need of knowledge for replacement
	Comparison of light output of new lamp types
	Image-issues
	Change of use (rebound effects)
	Stockpiling ILBs
	Costs of discontinuation
Burdens of infrastructure	Retrofitting
	Harmonic interference
	Dim installation
	Need for new eco-labelling
Challenges for industry	Costs of discontinuation
	Capacity for new production
	Production loss due to discontinuation
	Circumvention of industry
Existing regulations	National level
	Supranational level
	International level

Table 2: The discontinuation problem-types and the related issues on EU level

In the following sections an elaboration on these discontinuation issues is discussed. The order of the presentation of the discontinuation problem-types and the related issues is based on the relevance of these issues in the analysed discourses. After the presentation and discussion

of the discontinuation problems, in the final part an overview is given of the relations between these identified problems and the attributed governance dimensions in table 3. This table shows which governance dimensions were attributed to deal with the discontinuation issues that were raised by the involved actors.

Burdens of replacing technology

The discontinuation of ILBs and other inefficient lighting resulted in a new standard for domestic lighting. Although the energy-efficient lamps were already available on the market, after the phasing-out only these efficient lamps will be available for domestic lighting. In this section, the discontinuation issues are discussed that are related to the use and functionality of these efficient lamps that replace the old type of lamps.

Performance issues:

An important part of the burdens of the discontinuation of the ILB that are discussed relate to the performance issues of the energy-efficiency lamp types. Most of these issues refer to functionality and performance of CFLs in comparison with ILBs:

- Design of lamp

The deviant physical exterior of efficient lighting was a discussed burden for the replacement of ILBs: "*Most existing luminaires in the home are designed for incandescent lamps. Use of a CFLi in a luminaire dedicated to incandescent lamps might reduce the visual appearance (e.g. by losses in light output and/or glare).*" (Vito, 2009a, p. 115). Besides the shape of the new lamps, also its influence of its design on the diffusion of the emitted light was a point of concern: "*Bright point like light sources create nice-looking reflections on shiny objects ... which cannot be generated with CFLs. ... the integrated ballast or transformer shields a certain angle of the light coming from the lamp."* (European Commission, 2009d, p. 47). This issue was not only seen as an aesthetic issues, but also as an functionality issue. However, the ELC noted that these design issues of efficient lighting would be solved by innovations in efficient lighting: "*The latest generations of CFLi's offered by the major manufacturers are no longer very large. In some cases they are slightly smaller than their GLS equivalent and with the new classic shapes, also look almost the same as GLS lamps.*" (ELC, 2008, p. 8). So, although the design of the energy-efficient lamps involved issues, no policy measures were attributed to solve this issue.

- Performance/quality of light output

A large part of the discussion on the use of energy efficient lighting, focused on the visual perception of the emitted light: "*The quality of the light and its perception by end-users is an important issue.*" (Consultation Forum, 2008c, p. 4). It was explained that the output is often perceived as lower quality lighting: "*CFLs tend to emit most of their light output at certain wavelengths and almost nothing at others. This may cause a subtle difference in the perception of the light they produce (more "artificial" than filament lamp light), but it also leads to a poorer colour rendering (meaning how well the colour of the different objects lit is rendered).*" (European Commission, 2009d, p. 48). Besides the colour rendering issues, the colour temperature of efficient lighting was also mentioned as an influence on the quality of lighting: "*fluorescent lamps are sometimes perceived as providing cold light. In fact, their colour temperatures can range from 2700 K equivalent to incandescent lamps up to 5000K and beyond, which correspond to cold white light. While the colour temperature of incandescent lamps at full light output is always 2700K, CFLs can have a variety of colour temperatures, which is actually an advantage*" (European Commission, 2009d, p. 48). So, the visual quality of the efficient lamps was noted as an issue, but was believed to improve over time through innovation.

- Start-up time

Also the warm-up time of efficient lighting was identified as a limit for its functionality: "*Starting delay is an issue where instant light output is required (e.g. lamps used for signalling), longer warm-up times may cause people to perceive CFLs as providing insufficient light*." (European Commission, 2009d, p. 47). To solve this issue, the discontinuation regulation had set requirements for start-up time: "*the regulation introduces minimum requirements on switch-on and warm-up times. Switching on a compact fluorescent lamp shall not take more than 2 seconds, and it should reach 60% of its full light output within one minute*." (European Commission, 2009a, p. 23). Although the issue of start-up time cannot be solved for CFLs, an additional requirement for start-up time was included in the regulation.

- Switching

The amount of switching cycles for CFLs was also identified as an issue for the use of energy-efficient lighting. It was argued that the switching frequency for CFLs are limited, which can affect its functionality and lifetime. The EC explained that an average use of CFLs would not affect its lifetime. But they did explain that: "*if such a CFL is installed in a location where it is switched on/off more often ... it can substantially reduce its life time.*" (European Commission, 2009d, p. 48). Additionally to this issue, the ELC added that the lifetime of current CFLs are no longer affected by switching (ELC, 2008, p. 8). In this way, the switching issue of effi-

cient lighting and the effects on its lifetime had been falsified and was not a point of discussion anymore.

- Performance issues during use

There were also performance issues identified that related to the use of CFLs. Some argued that the lifetime of CFLs was often shorter than the 5000 hours that was promised on the label (European Parliament, 2009b). Also, the sensitivity of the functioning of CFLs for the external temperature was also seen as a drawback of this type of lamp:"*incandescent lamps and halogen lamps offer the same performance at any ambient temperature, however fluorescent lamps are often optimised for a rather narrow range (e.g. room temperature), and their light output decreases at other temperatures."* (European Commission, 2009d, pp. 47-48). This hinders the use of CLFs outdoors or in closed luminaries. However, these drawbacks of the use of efficient lighting were not incorporated in the policy.

- Benefits of discontinued technology

Besides identifying the disadvantages of efficient lighting, also the benefits of the use of ILBs over other lamp types were discussed. A benefit of ILBs that was often noted was its function as source of heating. It was argued that this source of heat compensated for the inefficiency of ILBs: "*In some particular cases (e.g. winter season) this 'energy waste' [of ILBs] is recovered as space heating and this could be considered as a useful interactive effect with the space heating needs.*" (Vito, 2009a, p. 104). However, the EC argued that this heating is still a waste of energy, because it is not an efficient way to regulate indoor temperature: "*The location on the ceiling is inefficient ..., the heating is unnecessary in the summer period and may even result in increased cooling needs, and not all rooms needing lighting need also heating."*(European Commission, 2009a, p. 29). In the end, the proposed benefits of the discontinued and inefficient lamps were not seen as a decisive reason to change the discontinuation policy.

Impact of production and use of resources

Beside the energy that is saved by using efficient lighting, it was also argued that these savings are outweighed by the environmental impact of the production and disposal of efficient lamps. First of all, the ELC showed that the production of energy efficient lamps costs much more energy to produce than traditional lamps: "*the amount of energy needed for the production of one CFLi is comparable to the production of between 6 to 15 GLS lamps – hence the saving over the lifecycle of the product is much higher*." (ELC, 2008, p. 7). And secondly, also the environmental impact of the use of mercury in CFLs was debated. The EC explained:

"*It is established that the decrease of mercury emissions resulting from energy savings over-weigh the need for mercury in the lamps. The mercury content in CFL lamps remains to some extent a risk factor to the user and to the environment*" (European Commission, 2009d, p. 7). These risks and environmental impact of mercury were related to the waste in landfills and its environmentally damaging mining methods for the production of efficient lamps (European Parliament, 2007d, 2009e). Although there were no additional measures planned to overcome this issue, the final regulation did refer to an existing directive that focuses on the use of mercury in electrical products: "*Although the mercury content of compact fluorescent lamps is considered to be a significant environmental aspect, it is appropriate to regulate it under Directive 2002/95/EC*" (European Commission, 2009c, p. 76/74).

Despite the existing directive on the use of mercury, some actors claimed that this will not solve the issue. They argued that there still is an issue with the negative externality related to the use of mercury content: "*Market forces have little impact on product environmental improvements not accompanied by cost savings over the product's life cycle, such as reducing their mercury content. This is a negative externality as environmental costs are not accounted for"* (European Commission, 2009d, p. 26). This means that there will be no market incentives to decrease the use of mercury during the production. To conclude, the environmental impact of the production of efficient lighting could be argued to oppose effects of the discontinuation of the ILB. The EC showed that there is additional regulation for this issue, but other actors do not believe that there will be enough incentives to solve the issue.

Recycling

In contrast to ILBs, efficient lamps were familiar for the content of hazardous substances that need to be recycled, like mercury or other heavy metals: "*Although the mercury content in CFLi's is restricted to 5mg and EU lamp manufacturers supply lamps down to 1 mg, mercury remains an hazardous substance and the release to the environment has to be avoided anywhere in the society*." (Vito, 2009a, p. 105). The recycling of these lamps and their mercury content was put down in a general directive: "*Under the Waste Electronic and Electric Equipment (WEEE) Directive, the collection and recycling of WEEE, including energy saving lamps, is being organised in all Member States*." (European Commission, 2009b, p. ~). However, it appeared that the return rate of efficient lamps was low and the recycling of efficient lamps turned problematic. The EC argued that an important way to overcome this issue entailed awareness-raising for recycling: "*CFL recycling schemes under the WEEE Directive are in an early stage of development in most Member States, and the majority of the general*

public is not aware that CFLs are supposed to be recycled. The situation will hopefully improve in the future" (European Commission, 2009d, p. 50).

So, the recycling issue of efficient lamps was identified as a discontinuation issue. Beside policy initiatives to raise awareness, recycling was believed to be solved with an existing directive for product recycling. However, the issues was also downplayed by EC member Piebalgs and his attempt to put the recycling issues in perspective: "*Even in the worst possible case that a CFL goes to the landfill, during its lifetime it will have saved more mercury emissions ... than is contained in the CFL itself"* (European Commission, 2009a, pp. 28-29). This showed that the debate on the recycling issue of efficient lighting did not have a high priority as governance task.

Health issues

The use of mercury in efficient lighting was also related to health risks during use. Lamp breakage was seen as an important hazard and it lead to the discussion on the need for the safe use of CFLs. The ELC advised a soft handling of CFLs: "*No mercury is released when the lamps are in use ... However, CFLis are made of glass tubing and can break if dropped or roughly handled. Care should be taken when removing the lamp from its packaging, installing it, or replacing it."* (ELC, 2008, p. 11). EC member Piebalgs argued that this health risk was diminishing with the new type of CFL lamps: "*CFLs with an outer non-breakable lamp envelope are also commonly available on the market that largely mitigate any risk of mercury leakage in case of accidental lamp breakage.*" (EUropean Parliament, 2009c, p. ~).

Another health issue was related to the effects of the light output from efficient lighting for light sensitive people and patients. Under pressures of several stakeholder groups, much attentions had been put on the negative effects of efficient lighting on light sensitive people:"*Some associations of patients suffering from various diseases have reported to the preparatory study consultants that their symptoms are aggravated in the presence of CFLs and also sometimes of other energy saving lamps"* (Consultation Forum, 2008a, p. 13). As a reaction, the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) executed a light sensitivity report on the effects of efficient light for several diseases. They explained that they focused mainly on the aggravation of symptoms of diseases: "*citizens' associations ... claim that the symptoms of the following diseases are or could be aggravated in the presence of energy saving lamps (mainly compact fluorescent lamps): xeroderma pigmentosum, lupus, migraine, epilepsy, myalgic encephalomyelitis ..., Irlen-Meares ..., fibromyalgia, electro-sensitivity, HIV/AIDS, dyspraxia and autism/aspergers syndrome.*"

(SCENIHR, 2008, p. 8). In their research, SCENIHR focused on three concerned properties of energy saving bulbs: flicker, electromagnetic field radiation, and UV and blue light emissions (SCENIHR, 2008, p. 27). In their final report they concluded:

> "*There are a number of individuals across Europe who suffer from a variety of disorders which renders them exceptionally sensitive to UV/blue light radiation. The prevalence of these conditions is extremely low ... The prevalence of only polymorphic light eruption represents a sizable portion (up to 20%) of the general population. However, due to the nature of the condition, the likelihood of patients with polymorphic light eruption to be affected by CFL is rather low. The number of all patients in Europe, who might be at risk from the increased levels of UV/blue light radiation generated by CFL, is estimated at around 250,000 individuals. Hypersensitive patients are constantly at risk of exposure to much higher levels of UV/blue light radiation from sources other than CFL. Therefore, those patients are usually closely monitored and provided advice by health care professionals. The committee notes that the use of double envelope energy saving bulbs or similar technology in the dwellings of such individuals would largely or entirely mitigate this increased risk.*" (SCENIHR, 2008, p. 29).

In general, the SCENIHR report showed that for specific patients the use of efficient lighting can cause health issues. However, for the general population these health issues are not underlined. Despite this report, health issues were constantly related to the discontinuation of ILB and the use of efficient lighting. The report was a policy initiative to settle this discussion, but there were no additional regulations announced to attribute health issues.

Need for improvement

Although there seemed to be a large consensus on the benefits of the discontinuation of the ILB, the need for improving efficient lighting still turned out to be a point of debate. The improvement of CFLs often involved its efficacy, lifetime, amount of mercury, start-up time and dimmability (Vito, 2009a, pp. 177-188). Also, the improvements for halogen lamps, like the improved ILB, did mainly involve the enhancement of its efficacy (Vito, 2009a, pp. 188-192). Also the LED lamp was seen as an important lamp type to replace the CFL in the future that is still in development: "*LEDs are a rapidly emerging mercury-free technology, meeting or even surpassing compact fluorescent lamps in efficiency. However, at this stage they are not yet commercially and technically valid alternatives to the full range of household incandescent*

bulbs" (European Parliament, 2009d, p. ~). So, the issues that related to the improvement of the existing efficient lighting mainly put its focus on its capacity of innovation.

Burdens of/for user

In this section, the issues are included that were related to discontinuation and the influence of users on this process. This problem-type includes both the issues that were identified as result of the use of efficient lighting, and the issues that were identified for using efficient lighting.

Awareness raising for need of discontinuation

The ELC showed that the communication efforts in favour of discontinuation are extensive: "*We are in dialogue with retailers and media to inform the EU's 500 million citizens about the recent EU decision and seek a progressive switch in their homes by 2012."* (ELC, 2008, p. 4). The ELC added that the authorities also needed to: *"run their own communication effort to inform citizens of the new rules.*" (ELC, 2008, p. 4). These information campaigns were not only seen as an important measure to inform consumers about the upcoming discontinuation policy. It was also seen as a measure to raise awareness of the economic and environmental advantages of efficient lighting to: " *maximize existing legislation to facilitate the phasing out of incandescent bulbs.*" (European Parliament, 2007a, p. 2). This showed that awareness raising for the need of discontinuation was seen as an important part for the societal support of discontinuation.

Need of knowledge for replacement

Besides awareness-raising, consumers were also believed to be needed to get informed about the proper way to replace old lighting: "*A very broad range of lamps for domestic application did become available on the market in the last decades ... A one to one comparison with the familiar GLS is not always straightforward and could create a user barrier*" (Vito, 2009a, p. 109). To overcome the burdens of replacement, they recommend: "*launch advanced public information campaigns on phase out (e.g. announce timely a phase out and allow people to stock spare lamps if needed for existing luminaries)*" (Vito, 2009a, p. 296). The EC explained that this form of consumer education was the concern of national organization, which can focus on local needs (European Commission, 2009a, p. 17). So, the need of consumer education was shared to overcome problems of replacement, and it seemed that this responsibility for consumer education was transferred to the local level.

Comparison of light output of new lamp types

The traditional comparison of light output of ILBs by wattage was discussed as consumer burden when ILBs are replaced by efficient lighting: "*The user should know how to replace incandescent lamps by CFLi's giving the same amount of light (lumen). Unfortunately, the manufacturers generally do not give correct information about this replacement*" (Vito, 2009a, p. 112). This could lead to confusing situations for consumers, because the wattage of ILBs and halogen lamps do not match with the wattage of CFLs: "*This already causes confusion that manufacturers try to solve by giving equivalence with incandescent bulbs such as "this 15W energy saving lamp is equivalent to a 60W lamp." (European Commission, 2009a, p. 16).* Therefore it was shared among the actors that the output of level of light produced by lamps needs to be standardized. In the final regulation, this issue was addressed: "*The draft regulation also requires that the quantity of light provided by any lamp (expressed in lumens) should be displayed in a font twice as large as the indication of the power of the lamp in watts."* (European Parliament, 2009b, p. ~). So, for this issue, policy measures were applied to harmonize the light output of lamps by displaying it in lumen instead of wattage.

Image-issues

The image of consumers of CFLs is not as good as it could be, which was perceived as an obstacle for the proper discontinuation of ILBs. This image issue was related to the poor quality of the first generation of CFLs: "*with cold light colour, poor colour rendering, fairly heavy weight and large dimensions ... the bad experience of CFLi's can damage the image of higher quality products and can make people afraid of buying CFLi's again.*" (Vito, 2009a, p. 111). Besides these bad experiences, it was also explained that the small differences in functionality can disappoint consumers about the performance of efficient lighting: *"Consumers are likely to be disappointed by the CFL if its functionalities differ substantially from the incandescent lamp it is meant to replace (colour rendering, warm-up times, dimmability…), or if it does not perform well due to some installation related condition."* (European Commission, 2009d, p. 27). The ELC added that proper market surveillance was also important to overcome image issues: "*The ELC urges the market surveillance authorities in the EU Member States to protect the consumer from lamps that are inferior and do not meet these standards."* (ELC, 2008, p. 7). So, it was believed that public information for replacement could solve the image issues of efficient lighting, and that market surveillance is an important measure overcome issues with quality in the future.

Change of use (rebound effects)

Besides the discontinuation and the supply of new and efficient lighting, also users were believed to have a large impact on the effect of discontinuation. A phenomenon that was discussed is the change of use of lighting by consumers, which can cause a rebound effect on discontinuation: "*Availability of more efficient and flexible light sources has over centuries triggered off new applications, increased illumination or comfort levels. Attention should be paid to an 'inflation of illumination levels ... the result is an increase of energy consumption*." (Vito, 2009a, p. 294). But also the Jevons paradox was mentioned: "*in the longer term energy-saving bulbs will not cut energy consumption, but may on the contrary increase it. This thus confirms the so-called Jevons paradox: that innovations that produce energy savings result in the long run in higher energy use."* (European Parliament, 2010a, p. ~). So, although discontinuation of inefficient lamps was aimed to cut energy waste, this effect could be undone by changes in use of lighting. The actors were aware of this phenomenon, but did not propose any policy measures to overcome this rebound effect.

Stockpiling ILBs

Another phenomenon that could harm the effect of discontinuation is the stocking of ILB lamps by consumers. This stockpiling was described as an effect after the announcement of ILB discontinuation that could weaken the impact of discontinuation: "*Communication to consumers about available equivalent alternatives to conventional incandescent bulbs (such as improved halogen bulbs) could help prevent much of the stocking of bulbs. Consumers will realise in the end that the alternatives provide substantial savings and have equivalent light quality*" (European Commission, 2009a, p. 16). This stockpiling was believed to be overcome by informing consumers about the benefits of efficient lamps and the availability of improved ILBs.

Costs of discontinuation: Replacement costs vs. life cycle costs

Finally, a burden for consumers that was often discussed is the costs and affordability of discontinuation. Although the life cycle costs are much lower than for ILBs, the purchase costs of efficient lamps was seen as an economic obstacle that tend to discourage replacement of lamps: "*we would estimate that the price to the customers will be 5 to 7 times higher than at present, in many cases the additional costs would not drive economic savings so consequently the majority of the cost burden for these changes would be picked up by the consumer."* (Vito, 2009b, p. 90). The purchase costs were often seen as a psychological barrier for consumers

(European Commission, 2009a, p. 10). Therefore the focus of consumers needed to be changed towards the long term effect of using efficient lighting by changing the asymmetric information: "*Purchasing price is visible at first sight while information on cost savings/running costs is not explicit.*" (European Commission, 2009d, p. 26). This showed that the actors agreed that discontinuation involved costs, however the actors wanted to approach these costs as investment for savings in the future.

Burdens of infrastructure

This problem-type relates to the discontinuation issues that were identified as the result of the changing infrastructure of domestic lighting. Due to the change to new lamp types, the existing infrastructure needs to be adapted to this new technology. This section discussed the identified issues that refer to the existing infrastructure and system of domestic lighting.

Retrofitting

When replacing a traditional light bulb with an energy-efficient bulb, it was noted that problems can arise due to the size and shape of existing luminaires: "*Issues of compatibility of the new lamp types: The issue here is not how well the lamp will perform ..., but whether it will fit at all and provide the expected minimum level of service." (European Commission, 2009d, p. 24).* An example of the consequence of discontinuation that was discussed was the luminary socket and space lock-in effect: "*Some luminaires do not accept an energy efficient retrofit lamp due to the available space and/or socket types." (Vito, 2009a, p. 109).* To solve this issue of retrofitting, the EC argued that the availability of improved ILBs was the solution: "*Compact fluorescent lamps exist today in many sizes and shapes to replace conventional incandescent bulbs. Where there is indeed too little room for any compact fluorescent lamp to fit in, improved incandescent bulbs with halogen technology could be used*" (European Commission, 2009a, p. 183). So, the efficacy requirements for improved incandescent light bulbs were lowered to overcome the issue of retrofitting.

Harmonic interference

CFLs are known for their possible influence on the power grid when they are used, like harmonic interference: "*CFLi's are ... giving a little harmonic interference and some energy suppliers have discussed or claimed that the manufacturers should introduce an electronic compensation system in the CFLi's.*"(Vito, 2009b, p. 116). Also, the EC identified issues with the power factor of CFLs: "*compact fluorescent lamps has [sic] an influence on the electricity*

grid on which they are operated. This is characterised by their power factor and results in quantifiable extra energy needed to power a grid operating with such lamps." (European Commission, 2009d, p. 41). However, it was argued that this issue may be solved by the improvement of (the quality of) CFLs (Consultation Forum, 2008c). However, there were no policy measures introduced to deal with these issues.

Dim installation

Another identified issue related to the incompatibility of efficient lamps with existing dim installations. As a consequence, consumers should be careful with using them on efficient lighting: "*Common to both dimmers and many electronic switches, is that ordinary CFLi's should not be operated on them. Lamp manufacturers warn against doing so with any CFLi, which is not specifically designed and certified for this use." (Vito, 2009a, p. 183)*. This burden of the old infrastructure for the use of efficient light bulbs was aimed to be solved over time. It was argued, that nowadays, special dimmable CFLs are introduced on the market, or otherwise improved ILBs could be used in old dim installations as temporary solution (European Commission, 2009a, p. 24).

Need for new eco-labelling

The eco-labbeling system had been introduced for retailers and users to classify the energy-efficiency of different lamp types: "*Lamps have had to display an A-G scale energy label on their packaging since 1998 (Commission Directive 98/11/EC).*" (European Commission, 2009a, p. 34). However, it was argued that the traditional labeling of the efficacy of lamps does not function properly anymore for the new types of energy efficient lamps. The participants of the EUP4light project argued that the existing labelling of the efficacy of lamps needs to be revised and straightened (Vito, 2009a, p. 290). For example, they noted that the gap between 'level B' and 'A' had become too large and they also pleaded for a more ambitious 'A level'. Additionally, after the discontinuation the 'levels D-G' were aimed to be phased out immediately and the highest rank would become 'A+++' (Consultation Forum, 2008a, p. 4).

Challenges for industry

The eco-design regulation for the discontinuation of the ILB did not only have an effect on the use of domestic lighting, but also on its production. This resulted in the need of manufacturing changes for the industrial actors to change their production and start producing more

energy-efficient lamps (ELC, 2008, p. 6). The next section elaborates on these identified issues and challenges for the industry.

Costs of discontinuation

A consequence of the discontinuation of ILBs for industry that was often discussed, were the costs involved to change their supply chain: "*Compliance with the proposed ecodesign requirements can be achieved by applying readily available non-proprietary technologies, and no risks for shortages in the supply chain, ... leading possibly to unforeseen cost increases have been flagged by the stakeholders.*" (European Commission, 2009d, p. 41). Also, there were re-design costs involved due to discontinuation: "*products not complying with ecodesign requirements need to be re-designed, which, in general, implies the need for re-assessing conformity with further requirements. The costs for assessing conformity are estimated to be in the order of several thousand Euros*." (European Commission, 2009d, p. 43). ELC added the costs for the innovation of CFLs: "*We will also invest in research and development to develop a wider range of CFLs, halogens and new generation lamps that will fit most luminaire models while remaining low energy consumption.*" (ELC, 2008, p. 4). Besides these costs, the discontinuation was also seen as an opportunity to gain money, by an increase of turnover. The EC argued: "*the switch from incandescent lamps is due to take place largely towards already existing more efficient products with higher added value accompanied with higher profit margin (such as compact fluorescent lamps) ... the lamp manufacturing industry should ultimately experience a substantial increase in its turnover.*" (European Commission, 2009d, p. 41). So, there was no consensus on the total of costs of discontinuation for the industry. However, these costs were not seen as a governance task.

Capacity for new production

Many actors were concerned about the manufacturing capacity for new production for a proper discontinuation transition. These concerns emphasized the risk of empty shelves, due to an increasing demand of efficient lighting. MP Batten questioned how after the discontinuation the demand of efficient lamps could be met: "*Demand would require about 300 new production lines - that is about 75 new production lines for each one of Europe's four main lamp manufacturers. None of them currently has more than ten production lines."* (European Parliament, 2007b, p. ~). The MP argued that the consequence will be that efficient lamps have to be imported from China. Besides this production problem, the ELC added: "*On top of the volume problems, there will be a considerable impact on the supply chain to manage a*

whole technology change of this type in the short term" (Vito, 2009b, p. 90). Subsequently, it was also argued that the capacity issues of the industry for efficient lighting should be viewed from the international market perspective: "*even if we delay the introduction of measures phasing out incandescent bulbs in order to tackle the capacity issue, major third countries could be adopting legislation at the same time which could again raise capacity problems of an equivalent order of magnitude*." (Consultation Forum, 2008c, p. 3). Finally, it was shown that the production capacity also have to deal with peak demands, due to discontinuation: "*After the first wave of CFLs are sold after the GLS phase out, the newly installed production lines may have to slow down, as the lifetime of CFLs is much longer than GLS lifetimes."* (Consultation Forum, 2008a, p. 12). The main solution for solving this issue of production capacity was the need for gradual implementation of the discontinuation policy (ELC, 2008, p. 6).

Production loss due to discontinuation

Another consequence of ILB discontinuation that was mentioned for industry is the production loss of traditional bulbs: "*A strong reduction of GLS lamps sales will appear in all the proposed scenarios ... These lamps are mainly produced in ... [the EU] and these production facilities would have to close down or should shift [to producing other types of lamps]"* (Vito, 2009a, p. 300). This showed that the problem for the European industry is that efficient lighting is especially produced outside the EU, and the EU production is still ILBs. The EC explained that this can have an impact on job losses in the EU: *Overall, about 2-3000 jobs (out of the 50.000 people producing lamps in the EU) are estimated to be at stake as a consequence of the incandescent lamp phase-out."* (European Commission, 2009d, p. 8). But the EC continued by stating that this will also lead to benefits for the economic: *"Any job losses should be counterbalanced by the macro-economic benefits of reinjecting 5 billion euros / year into the EU economy through the energy savings realised in each household*." The EC explained that the gradual discontinuation of the final regulation could solve the issues of production loss:

> "*The calendar of the phase-out in the regulation has been developed in a way to ensure that lamp manufacturers have the time to convert their conventional incandescent bulb production lines to the production of improved incandescent bulbs (with halogen technology) ... There is no specific European support measure accompanying the Regulation to help companies carry out this conversion. The lighting industry will also benefit of the increase of sales of energy saving bulbs. However, existing support pro-*

> *grammes could be used in case the conversion is eligible for such support in the region where the company is located*." (European Commission, 2009a, p. 15).

The discussion on the production loss for industry showed that the loss of production is believed to be counterbalanced by the improvement of the demand of energy-efficient lighting. However, to overcome manufacturing problems and job losses, the industry and the EC underlined the importance of a gradual discontinuation.

Circumvention of industry

Lastly, the issue of circumvention of discontinuation by the industry was mentioned. MP Reul articulated the rumours that some manufacturers tried to bypass the regulation: "*is there any truth in the rumours that, following the bans on traditional 100-watt and 75-watt light bulbs, third countries have begun producing 99-watt and 74-watt versions?*" (European Parliament, 2010b, p. ~). Member of EC Oettinger explained that the EC was not aware of this phenomenon. However, they did not see any problems with this bypass, as long it fitted within the phasing-out requirements (European Parliament, 2010b, p. ~). So, the circumvention of industry was noticed as an issue for an effective discontinuation, but there no serious threats were found that would harm the outcome of the regulation.

Burdens of existing regulations

During the policy-making trajectory, the different policy levels for a discontinuation policy were discussed. For the different levels, existing legislation and policy initiatives were noted that could interfere with the eco-design regulation on the supranational level. Also, possible additional regulations for these levels were mentioned.

National level

Different Member States had prepared plans for national legislation to support the use of efficient lighting. In the UK, they introduced an implemented voluntary phase out of the ILB: "*The UK government announced in September 2007 a voluntary initiative that is being led by a number of retailers in the UK to phase out incandescent (GLS) lamps over the period to 2011. The government has proposed, as an illustrative schedule for the phase out of inefficient lamps that retailers might want to follow"* (European Commission, 2009d, p. 24). However, this initiative never was a formal agreement or commitment for retailers, but it was believed that this phasing out would be followed within their competitive climate. For the other

Member States, member of EC Piebalgs explained that they analysed the different national regulations for the discontinuation of the ILB.

> "*The Commission conducted research in 2006 on "Residential Lighting Consumption and Saving Potential in the Enlarged EU", including an in-depth review of existing policies and programmes at national level in half of all Member States. The vast majority of Member States have launched in actions, mostly consisting of promotional campaigns addressed to consumers and involving different market actors, aimed at spreading the use of energy-saving compact fluorescent lamps replacing conventional incandescent lamps*." (European Parliament, 2007c, p. ~).

This analysis showed the EC never found an obstacle for a supranational discontinuation policy in the EU.

Supranational

Besides the eco-design framework, in which the discontinuation policy for domestic lighting is embedded, there are also other EU directives that have embedded this policy. There were various EU directives and regulations that needed to be taken care of by the final policy-making. These regulations consisted of environmental directives, efficiency directives and voluntary agreements on the EU level (Vito, 2009b). These directives were: Directive on the Energy Labelling of Household Lamps (98/11/EC) ; Regulation on voluntary eco-labelling of light bulbs (2002/747/EC); Energy Performance of Buildings Directive (2002/91/EC); Energy End-use Efficiency and Energy Services Directive (2006/32/EC); Directive on the Restriction of Hazardous Substances (2002/95/EC); and Directive on Waste Electric and Electronic Equipement (WEEE, 2002/96/EC) (European Commission, 2009d, pp. 21-23). During the policy-making trajectory these supranational directives were taken in account and some also functioned as additional regulation for the discontinuation policy.

International level

The global diffusion of the discontinuation of ILBs also reached the EU policy-making discussion. These bans did not have a direct influence on the policy-making of the final regulation, but appeared to be an important legitimization for a regulation on ILBs. In 2007, a petition for a ban on ILB was submitted by some MPs (European Parliament, 2007a). In this document they referred to the ILB can in Cuba (may 2006), Venezuela (November 2006), California (February 2007), Australia (February 2007) and Ontario (February 2007). The ELC was also aware of this international discontinuation diffusion:

> "*the setting of minimum energy performance standards is something that is generally considered important. Several governments worldwide have also recently announced plans to put legislation in place to eliminate the least efficient domestic lamps, including energy inefficient incandescent lamps, from the market over time. However, geographic and cultural differences have to be taken into account."* (ELC, 2008, p. 5)

So, the policy initiatives on the discontinuation of the ILB did not influence the policy-making of a policy in the EU, but it they were as used as an additional legitimization for a final regulation.

Integration of discontinuation issues and attributed governance dimensions

The analysis of the EU policy-making presented separate overviews of the discussed discontinuation governance dimensions and the identified discontinuation problems for the case under study. In this final section of the analysis, the actual relations are explained between the identified issues and the way they were attributed by the governance dimensions to be solved. Table 3 presents the integrated overview of the governance dimensions and the related discontinuation issues for the discontinuation of the ILB.

Governance dimensions	**Problem-types**	**Discontinuation issues**
Policy instruments	Burdens of replacing tech.	Performance issues
		Impact of production and use of resources
		Recycling
		Health issues
	Burdens of/for users	Awareness raising for need of discontinuation
		Need of knowledge for replacement
		Comparison of light output of new lamps
		Image-issues
		Stockpiling of ILBs
		Costs of discontinuation
	Burdens of infrastructure	Need for new eco-labelling
Implementation	Challenges for industry	Capacity for new production
		Production loss due to discontinuation
Strictness	Burdens of replacing tech.	Performance issues
	Burdens of infrastructure	Retrofitting
		Dim-installation

Monitoring	Burdens of replacing tech.	Recycling
		Health issues
	Burdens of/for users	Image-issues
	Challenges for industry	Circumvention of industry
Policy Level	Existing regulations	National level
		Supranational level
		International level

Table 3: The governance dimensions and the related problems on EU level

The table is the result of the structuration of the governance dimensions that were attributed to the different discontinuation problems. However, some issues were not identified by the involved actors as a governance task, as explained in the first part of this chapter, and others were aimed to be solved with more than one governance dimension. The 'performance issues' (burdens of replacing technology) and the 'image issues' (burdens of/for users) are mentioned twice, because they were attributed with two different governance dimensions. Absent are the 'need for improvement (burdens of replacing technology), 'change of use' (burdens of/for users), 'retrofitting' (burdens of infrastructure), and 'costs of discontinuation' (challenges for industry) because there were not perceived as issues that should be solved as a governance task. In the following paragraphs, the distribution of the discontinuation issues in the table is discussed per governance problem-type.

- *Burdens of replacing technology*

The issues that related to the new and efficient lamps, which needed to replace the discontinued lamps, were attributed by several policy instruments. First of all, the attribution of additional requirements was an important policy instrument for governing the issues of the new technology. For some of the performance issues, additional requirements were introduced to force the industry to improve specific functionalities of efficient lamps. Both the environmental impact of the production of energy-efficient lighting and the need for recycling were regulated by additional directives. The health issues that were related to the use of efficient lighting also entailed an additional policy instrument, namely the examination by health reports. Besides policy instruments, the strictness of the policy was also lowered to allow the use of improved ILBs to overcome performance issues. Subsequently, effective monitoring of the consequences of the recycling and health issues was also seen as important governance tasks. Finally, the need for improvement of energy-efficient lamps was not perceived as a governance task, but was believed to be solved by innovations over time.

- *Burdens of/for users*

The issues related to the use of efficient lighting were mainly aimed to be solved by the improvement of consumer education and the raising of awareness. Policy instruments for the stimulation of information to consumers were proposed for the issues of awareness, need of knowledge for replacement, and image issues. The costs of discontinuation were also aimed to be solved by more provision of information about the improved life cycle costs of efficient lighting. A more specific policy instrument was attributed to the issue of light output comparison. This issue needed a standardization of the output level that is presented on the packaging. Lastly, the rebound effects discontinuation as the result of the changing behaviour or the stockpiling of ILBs was not seen as a governance task.

- *Burdens of infrastructure*

The burdens of the existing infrastructure involved different discontinuation issues to govern. The issue of retrofitting and the inapplicable dim installations for efficient lighting were solved by lowering the strictness of the efficacy requirements temporarily to allow the use of improved ILBs. Besides the use of improved ILBs, no governance tasks were attributed to solve the issue of harmonic interference. Ultimately, the issue of the outdated eco-labelling system was solved by introducing a new and update system as an additional policy measure for discontinuation policy.

- *Challenges for industry*

The discontinuation issues that were faced by the industry, we mainly attributed by the implementation of the discontinuation policy. The issues of new production capacity and production loss were attributed by discussing the pace and timing of the phasing out of the ILB. It was often argued that the manufacturing changes needed a considered implementation pace. Another challenge for industry, the circumvention of discontinuation requirements by other industrial actors, was mostly tackled as monitoring task.

- *Exiting regulations*

The possible burdens of existing regulations for a discontinuation policy were mainly discussed in relation to appropriate policy level of discontinuation governance. The suprnational policy level for the discontinuation regulation was not highly debated during the policy-making trajectory. However, the issues of existing policy initiatives or legislation were often argued to be solved by a supranational policy.

To conclude, in the previous two chapters the analysis was presented of the purposeful governance of the ILB discontinuation on the supranational level. This analysis presented a conceptualization of the different governance dimensions for ILB discontinuation and the identified discontinuation issues to govern. To contrast and complement this analysis of the purposeful governance of ILB on the supranational level, in the next chapter the analysis is moved to the Dutch national level.

6. Comparison: Discontinuation issues and attributed governance dimensions on the national level

In the previous chapters, the governance dimensions for ILB discontinuation and the related discontinuation issues within the EU policy-making trajectory were analysed. The focus of this chapter is on the identified ILB discontinuation issues and its governance dimensions on the level of EU Member States. More specifically, the analysis in this chapter examines the Dutch debate between the parliament and government about a dedicated discontinuation policy for the ILB. This discussion was initiated before the start of the EU policy-making process and also continued afterwards. In the upcoming sections, the first considerations for a discontinuation policy in the Dutch parliament are examing. These findings on the national level are used for a comparison of the discussed discontinuation issues and the governance dimensions on the supranational level.

In the first section of this chapter, the discontinuation governance problems are discussed that were discussed in the Dutch parliament. For this purpose, the public proceedings of the Dutch parliament on the ILB discontinuation as policy issue were sampled and interpreted. The proceedings included written questions or questions asked by members of parliament during debates as well as the responses from the government. The analysis of the debate in parliament resulted in the finding of six types of governance problems that were discussed in the making of a discontinuation policy for the Netherlands. In the second section, the described governance problems are analysed further to see which discontinuation problems and governance dimensions they included, like described in chapter four. These findings on the national level are compared with the findings of discontinuation governance on the supranational level. The goal in this last section is to show what differences can be found between the discussion on the constitution of an ILB discontinuation policy on these two different levels; and the way they can contribute to each other in order to present a more complete picture of the purposeful governance of ILB discontinuation in the EU.

Identified discontinuation issues on national level

From the analysis, six different types of governance problems were distinguished in the Dutch parliamentary debate. An overview of these different governance problems can be found in the table below:

Discontinuation governance problems
D1: Exiting strategy: Stimulation vs. Ban
D2: Costs of discontinuation: Price policy vs. Return of investment
D3: Old infrastructure: Issue of retrofitting
D4: Quick transition in favour of innovation vs. Slow transition in favour of innovation
D5: Burdens of replacing technology: Need for exceptions of use vs. No exceptions
D6: National policy vs. Existing supranational policy

Table 4: The governance problems on the national level

This overview of discontinuation governance problems is derived from the paper of Stegmaier, Kuhlmann and Visser (2012, pp. 5-7). In this paper, the authors analysed the various governance problems and strategies of ILB discontinuation that were attributed in the Dutch parliamentary debate. These governance problems are elaborated in the following paragraphs. In these paragraphs not only aim the discussed governance problems are described, but also the identified discontinuation issues and the attributed governance dimensions to deal with these discontinuation problems. These findings are used in the next section to present an overview of the attributed governance dimensions and the related discontinuation problems for the Dutch level of policy-making.

D1: Exiting strategy: Stimulation vs. Ban

On the national level, there was an on-going discussion about the choice for stimulating the use of efficient lighting or banning inefficient lighting. From the start, the responsible minister of VROM (Dutch ministry of Housing, Spatial Planning and Environment) was clear about her goal to ban ILBs. However, various members of the Dutch parliament (MP) disagreed on a ban and argued in favour of discontinuation by stimulation of the use of energy-efficient lighting (Tweede Kamer, 2007c, pp. 3763-3765). The critique on a ban was the high degree of choice containment of consumers in favour of the collective interests. Although the ministry acknowledged that a ban is a 'steering measure'(Ministry VROM, 2010, p. 12), the minister believed that there are enough alternatives, so there will be a low degree of choice containment (Tweede Kamer, 2007c, pp. 3763-3765).

The analysis showed that on the level of the Dutch parliament, there was no disagreement that energy-efficient lighting should become the norm. However, there was a discussion on the way this norm needed to be established. Stimulating the use of efficient lighting would contain positive sanctioning, and banning inefficient lighting would include negative sanctioning. This discussion showed that the choice for an exiting strategy involves an important decision on the type of policy instrument you use for discontinuation. This exiting strategy for discontinuation did not appear as an issue on the supranational level. On the supranational

level, the eco-design framework already prescribed the ban on the design of particular inefficient lighting by setting norms. On the Dutch national level, the responsible minister was in favour of a ban, despite the argumentation of some of the MPs that this strategy would have too much impact on the choice containment of consumers

D2: Costs of discontinuation: Price policy vs. Return of investment

On both the national and the supranational level, the costs of discontinuation due to replacement of lamps were a topic of discussion. Also on the national level a possible intervention on the high prices of bulbs was discussed. The purchase costs were seen by some of the MPs as a major burden for users to replace ILBs for energy-efficient lighting. To overcome the high purchase costs of energy-efficient lighting, MPs asked for measures from the government. A first measure that was discussed is the stop on import levy on energy-efficient lighting (Tweede Kamer, 2008a, p. 8). The government agreed on this measure and explained that they would try to deal with this on EU level. Another measure that was asked from the government is a VAT reduction on efficient lighting (Tweede Kamer, 2009a, pp. 361-362; 2009b, pp. 8355-8356). In both documents, MPs asked the minister of VROM whether she wanted to install a VAT reduction. The minister replied that the return of investment speaks for itself, and that she believed that the growing demand for efficient lighting will let the manufactures innovate and lower the prices automatically (Tweede Kamer, 2009a, pp. 361-362; 2010, p. 2).

So, while some of the MPs asked to come up with policy measure for the economic effects of discontinuation of ILB, the minister replied that these costs can be regulated through innovation. The minister of VROM agreed that these high prices could raise a threshold for discontinuation (Tweede Kamer, 2009b, p. 8356). However, she did not want to put an effort in eliminating this threshold, because she argued that the total return of investment is far more than the purchase costs, the lamps use less energy and have a better durability. So, there was an agreement in parliament that the purchase costs of discontinuation can be an economic obstacle. To deal with this situation, instead of focusing on fixing this economic obstacle, she focused on the return of investment of the efficient bulbs as a major driver for ILB discontinuation.

D3: Old infrastructure: Issue of retrofitting

On the national level, the old infrastructure of domestic lighting was discussed as issues for discontinuation. An important disadvantage of energy-efficient lighting is that these bulbs do not always fit the used lamps. This is a result of the different shapes of the new bulbs in com-

parison with the old bulbs. Consequently, there is a chance that new bulbs do not fit in the old armatures of lamps (Tweede Kamer, 2007c, pp. 3763-3764; 2008a, p. 8). To overcome this burden of the old infrastructure, and additional transition period was proposed. However, the responsible minister was not in favour of a slower implementation phase for these infrastructural problems and adjustments (Tweede Kamer, 2007c, pp. 3763-3764). She argued that when retrofitting will become a problem, manufactures will be forced to solve this issue. So, the minister did not believe that the design obstacles of the discontinuation of the ILB had a need to be solved by an adjusted implementation as governance dimension, but a total ban would force the manufactures to solve this obstacle automatically.

D4: Quick transition in favour of innovation vs. Slow transition in favour of innovation

Another discussed burden of the new light bulbs was the need for the stimulation of innovation for improving the new technology. While the phasing out of the ILB was taking its first step, the discussion about the feasibility of the discontinuation reoccurred. In particular, the practicability of the energy-efficient lighting on the market was openly questioned, due to the slow pace of innovation. An MP asked the minister of VROM whether there was a possibility to make exceptions for the use of certain ILBs and slow the implementation of the discontinuation down as a reaction on the slow innovation of energy-efficient lighting (Tweede Kamer, 2009b, pp. 8375-8378). However, the minister underlined that making exceptions for the use of the discontinued technology should stimulate innovation. She argued that manufactures need to innovate, therefore exceptions will not be necessary and innovation will be forced upon them. So, while a MP perceived the technological development of efficient-lighting as a feasibility problem for a total ban of the ILB, the minister wanted to improve the feasibility by sticking to the ban. This shows that in the case of a need for improvement to overcome the burden of the new technology, the pace of the implementation of discontinuation can be used in two ways in favour of innovation.

D5: Burdens of replacing technology: Need for exceptions of use vs. No exceptions

As a reaction on the raised performance issues and need for improvement of efficient lighting, the strictness of discontinuation was also a topic of discussion in the Dutch parliament. The ILB has a broad spectrum of light and is believed to produce more natural light. Energy efficient lighting is often accused of producing artificial or ugly light. As a result, the discontinuation of the ILB was believed to harm light sensitive people. Therefore, a MP asked to leave room in the discontinuation policy for exceptions of use of ILBs (Tweede Kamer,

2009b, pp. 8357-8358). However, the minister did not want to leave room for the use of ILB in specific cases. She argued that exceptions will not be needed when you force the manufactures to innovate and overcome these exceptions with the help of a total ban (Tweede Kamer, 2009b, pp. 8357-8358). Additionally, the Minister explained that the improved Halogen light bulb can act as a temporal solution for these types of problems (Tweede Kamer, 2007c, p. 3765). So, the governance dimension of strictness was discussed as a way to overcome the burdens of the replacing technology. However, exceptions of use were not perceived by the responsible minister as a way to find a solution for these burdens of new light bulbs. The minister believed that a strict regulation would be most effective for overcoming these burdens.

D6: National policy vs. Existing supranational policy

Also on the national level, the level of the proposed discontinuation policy was an omnipresent issue. From the beginning the focus of the government was in favour of supranational regulation. In a first reaction on the written questions about a possible ban on the ILB, the minister of Economic Affairs and the state secretary of VROM at that time explained that they focused on an European approach for ILB discontinuation (Tweede Kamer, 2007b, p. 1933). In a subsequent round of written questions from the same MP, the same minister and state secretary explained that they could not initiate a national policy, because this topic was already discussed on the supranational level for the making of an eco-design directive (Tweede Kamer, 2007a, pp. 2457-2458). The new installed minister of VROM also made it clear that she strived for a European approach as well (Tweede Kamer, 2007c, pp. 3763-3765). In one document, the ministry of VROM acknowledged that supranational policy in relation to the environment is often more efficient and effective in comparison with national policy. However, due to the specific characteristics of individual countries, they thought it could be justified to develop a national policy as well (Tweede Kamer, 2008b, pp. 1-3).

Although in the parliamentary discussion, the supranational focus had not been contested much, the minister wanted to underline that the Dutch delegation had much influence on the issue and the manner of phasing out (Tweede Kamer, 2008a, p. 31). In general, the responsible ministers and state secretaries—besides those from VROM also those from the ministry of Economic Affairs and the after 2010 to the new ministry of Infrastructure and Environment—explained that the Dutch government was not able to develop a national regulation due to the existing European policy-making on the same topic. However, they assured to put much effort in a supranational policy instead. Although they left space open for specific national policy, the legitimacy of supranational policy appeared not to be a point of discussion.

Overview and comparison of issues and governance dimensions

In the first part of this section, an overview is presented of the discontinuation issues that were identified on the national level. In the second part, these issues are related to the different governance dimensions that were discussed by the involved actors. Although the Dutch government did not have the authority to constitute a national policy on discontinuation, several governance dimensions were considered in the parliamentary debate. Finally, the last part presents a comparison of the discussed governance dimensions and the related discontinuation issues on the national and supranational level. The findings on both levels are compared and complemented for a better understanding of the purposeful governance of discontinuation on both levels.

The following table presents an overview of the discontinuation issues that were identified by the actors in the previous section. In the table below, the described governance problems are structured by the related discontinuation issues. This structuration of the considered governance problems on the national level results in the table below:

Discontinuation problem-types	**Identified discontinuation issues**
Burdens of replacing technology	Performance issues
	Need for improvement
Burdens of/for users	Costs of discontinuation
Burdens of infrastructure	Retrofitting
Existing regulations	Supranational level
Exiting strategy	Positive vs. Negative sanctions

Table 5: The discontinuation problem-types and the related issues on national level

The following subsections elaborate on the abstracted discontinuation issues that could be identified in the described governance problems. In addition to these issues, also the governance dimensions that were considered in the Dutch debate to solve these issues are noted in the subsections below.

- *Burdens of replacing technology*

It was argued in the parliament that there was a need for the improvement of the available efficient lamps for a proper discontinuation of the ILB. Both the parliament and the government explained that the improvement could be stimulated by the pace of the implementation of a discontinuation regulation. The parliament wanted a slow implementation to solve the issues of the efficient lamps. The government argued that a policy needed to be implemented in a fast pace, because this would be an incentive for the industry to improve their lamps.

- *Burdens of/for users*

Also on the national level, the purchase prices of efficient lamps were seen as an economic obstacle for the use of these lamps. The parliament was in favour of different policy instruments to lower these prices, by cutting the import levy or add a VAT reduction. Finally, the minister did not agree on any policy measures. She argued that consumers should focus on the return of investment of an efficient lamp or that these purchase costs had to be regulated by the market through innovation.

- *Burdens of old infrastructure*

In the Dutch debate, retrofitting was also mentioned as a discontinuation issue due to deviant designs of efficient lamps. The parliament discussed the need of an additional transition period for the implementation of discontinuation to overcome this issue. However, the responsible minister argued that when retrofitting becomes an issue after discontinuation, this issue will be solved by the market through innovation.

- *Existing regulations*

National initiatives for the discontinuation of ILB discontinuation were not possible due to the policy plans on the supranational level. Some of the parliament members approached this as an issue, but the government claimed to be in favour of a supranational policy. They argued that a supranational policy is more efficient and effective than national policies. Besides that, the minister underlined that she had access to influence this supranational policy and could account Dutch concerns as well.

- *Exiting strategy*

Finally, the Dutch debate also introduced an additional problem-type to the analysis of the constitution of a discontinuation policy. Although there was no discussion on the need of more efficient lighting in the parliament, there was a discussion about the strategy to establish a discontinuation. The government preferred a negative sanction by banning inefficient lighting. Other members of the parliament argued in favour of stimulating discontinuation in order to preserve the choice containment of consumers. The government acknowledged that a ban is a steering measure, but it won't be so steering because they presumed that there were alternative lamps options available.

The next table presents a structured overview of the identified discontinuation issues and their relations with the considered governance dimensions, as discussed in the previous subsections.

Governance dimensions	**Problem types**	**Discontinuation issues**
Policy instruments	Burdens of/for users	Costs of discontinuation
	Exiting strategy	Positive vs. Negative sanctions
Implementation	Burden replacing tech.	Need for improvement
	Burdens of infra.	Retro-fitting
Strictness	Burden replacing tech.	Performance issues
		Need for improvement
Level of policy	Existing regulations	Supranational level

Table 6: The governance dimensions and the related problems on national level

In the final part of this chapter, comparison is drawn between the discussed governance dimensions and the related discontinuation problems on the national (table 6) and the supranational level (table 3).

A first look at both tables shows that many of the distinguished governance dimensions have been discussed on both levels. From five dimensions on the supranational level, four dimensions had been related to the discussed discontinuation problems on the national level. Only the governance dimension of monitoring did not occur explicitly in the Dutch debate. This can be explained as the result of the supranational approach for the final regulation. The final regulation on the ILB discontinuation was framed within the EU governance frame, and automatically made its monitoring an issue of supranational market surveillance. Another explanation relates to the on-going phasing out of the ILB. At the moment, the ILB is not yet completely phased out and the monitoring of the last step of the phasing out can still become an issue on the national level.

Secondly, the table of the supranational level includes many more discontinuation issues than the national level. This shows that the discontinuation governance on the supranational level included a wider pallet of discontinuation issues that were identified by the involved actors. An explanation for this difference in quantity of discussed issues could be result of the multi-actor constellation in the EU policy-making trajectory. Another explanation could be the more in-depth discussions on the supranational level that resulted from the responsibility to define a final discontinuation regulation.

Finally, an integration of these tables shows the overlap of these two tables. The bold issues correspond on both levels and the underlined issues were not present at the supranational level.

Governance dimensions	**Problem-types**	**Discontinuation issues**
Policy instruments	Burdens of replacing tech.	Performance issues
		Impact of production and use of resources
		Recycling
		Health issues
	Burdens of/for users	Awareness raising for need of discontinuation
		Need of knowledge for replacement
		Comparison of light output of new lamps
		Image-issues
		Stockpiling of ILBs
		Costs of discontinuation
	Burdens of infrastructure	Need for new eco-labelling
	Exiting strategy	**Positive vs. Negative sanctions**
Implementation	Challenges for industry	Capacity for new production
		Production loss due to discontinuation
	Burdens of replacing tech	**Need for improvement**
	Burdens of infrastructure	**Retrofitting**
Strictness	**Burdens of replacing tech**.	**Performance issues**
		Need for improvement
	Burdens of infrastructure	Retrofitting
		Dim-installation
Monitoring	Burdens of replacing tech.	Recycling
		Health issues
	Burdens of/for users	Image-issues
	Challenges for industry	Circumvention of industry
Policy Level	**Existing regulations**	National level
		Supranational level
		International level

Table 7: An integration of the issues on both levels

The table shows that the national level complemented the table of the supranational level on many parts. First of all, the analysis of the national introduced an additional problem-type, namely the exiting strategy of a discontinuation policy. In the Dutch parliament this problem-type was a highly debated point of interest, although this issue was not mentioned on the supranational level. The exit strategy appeared to be an important problem-type before any pol-

icy was defined. However, when the supranational policy-making started, the discontinuation was already positioned within the eco-design framework. As a result, this framework pre-structured the regulation by setting eco-design requirements, which involved negative sanctioning from the start. Secondly, besides the additional problem-type of 'exiting strategy', the table shows that unlike the supranational level, the implementation of a discontinuation policy was perceived as an important governance dimension. On the national level, this governance dimension was perceived as a way to overcome issues with retrofitting and the need for improvement of efficient lighting by a gradual implementation of a regulation.

7. Conclusion & Discussion

The conducted analysis of the phasing-out of the ILB in the EU focused on the purposeful governance of discontinuation and the related discontinuation problems. In this final chapter, the developed problem-types and governance dimensions that were found and conceptualized for the case under study are evaluated. The goal in this chapter is to show how these conceptualizations can contribute to a better understanding of technology discontinuation, but also to reflect what the limitations of these findings are. In the first section, it is discussed how the case under study has provided an insight in the way technology discontinuation can be understood as part of a socio-technical transition and its governance. In the second section, the developed conceptualization of discontinuation problems and the discontinuation governance dimensions are summarized and discussed in the general context of technology discontinuation. Finally, in the last section the limitations of the presented study are explicated and provides hints for further research.

Discontinuation as part of innovation and its governance

From the start of this thesis, the need to approach discontinuation technology as part of the broader process of technological innovation was underlined. A large part on the socio-technical transition literature approaches technological innovations from the perspective of the new and upcoming technology. These new technologies are believed to replace the 'old technology' in favour of technological progress. The case of the ILB showed how this replacement of inefficient lamps with efficient lamps did not occur to be a straightforward process, despite the availability of new and efficient lighting alternatives on the market. Many actors believed that this technology transition had to be stimulated and put it on the political agenda. Different policy initiatives were attributed to domestic lighting in order to stimulate the replacement of inefficient lamps by putting restrictions on the use of inefficient lighting. These policy initiatives on the national and supranational showed that the transitions in domestic lighting cannot be understood without analyzing these efforts for discontinuation. So, this project showed that it is important as well to get a better understanding of the forces and counter-forces for technology discontinuation from the perspective of the replaced technology.

Besides the emphasis on discontinuation as part of socio-technical transitions, the analysis focused on the purposeful means to discontinue a technology. In the case of the dis-

continuation of the ILB, multiple actors tried to influence the push for replacement by different means. The analysis did not examine the whole spectrum of discontinuation strategies to govern discontinuation, but focused on the discussion and constitution of a discontinuation policy on the national and supranational level. From the start, initiators for an ILB discontinuation policy on both levels perceived the need to push the termination of efficient lighting for inefficient lighting. The analysis focused mainly on the policy-making trajectory for constituting a discontinuation policy. This policy-making trajectory involved the introduction of a final EU regulation on the ILB. Although this policy-making process was pre-structured by the European Commission, it involved many different stakeholders that could contribute to the debate about the different discontinuation problems and governance dimensions that were needed to solve these problems. In the upcoming section, a summary is presented of these problems and governance dimensions, and it discusses how these findings can be transcended to the governance of technology discontinuation in general.

Governing discontinuation issues

In the analysis, the governance of problems approach was used to examine the different discontinuation issues that had to be assigned as a result of a phasing-out of the ILB. These different identified issues were structured into discontinuation problem-types. These problem-types are summed up in the next subsections and are linked to technology discontinuation in general.

- Burdens of replacing technology: The discontinuation of a technology involves the replacement of this technology with an alternative technology. Different issues can be attributed to this replacement that questions the appropriateness of the alternative technology in comparison with the discontinued technology.
- Burdens of/for users: Another problem-type of discontinuation focuses on the burdens for using a replacing technology and the way this replacing technology is used. This problem-type is broad up when a replacing technology involves a change in use. This new way of use can be a burden for a user, but also for the use of the replacing technology. Burdens of users can include need of information for its new use or it can lead to an aversion to this new way of use.
- Burdens of infrastructure: When an established technology has to be replaced by an alternative technology, the implementation of an alternative technology can be hindered by the existing infrastructure. These burdens of infrastructure of the discontinued technology can relate to different aspects of its socio-technical system.

- Challenges for industry: Not only users have to deal with the discontinuation of a technology, also manufacturers need to change their production as a result of new norms or requirements.
- Existing regulations: When a new discontinuation policy is implemented, the existing legislative framework needs to be taken in account. This legislative framework can possibly set burdens for new policies or involve the need to revise existing regulations.
- Exiting strategy: The discontinuation of a technology can be achieved by different strategies, which both can lead to different issues. The choice for a ban involves negative sanctioning and can lead to resistance for a discontinuation. However, stimulating discontinuation by positive sanctioning can lead to disappointing discontinuation results.

In the case under study, these discontinuation problem-types were attributed by different governance dimensions. In the next subsections an overview is presented of these governance dimensions that were distinguished for the purposeful governance of technology discontinuation.

- Policy instruments: The instruments for a discontinuation policy comprehend the means that are defined for setting a discontinuation goal. These instruments often comprehend the new technical standards or requirements that are introduced for stimulating or demanding innovation. However, in the case of the ILB not only technical standards were introduced for lighting, also additional requirements were believed to be needed for a proper discontinuation. These additional requirements can be proposed in case: alternative technologies are not perceived to be sufficient, additional infrastructural changes are needed, when industries need stimulation for change, and/or to overcome rebound effects of use.
- Implementation: The pace of the effectuation of discontinuation also turned out to be a substantive part of the discontinuation regulation. The timing and ambition of a discontinuation can have several degrees, varying between an immediate ban and a transition. The decision for the right pace of discontinuation can be dependent on the support from industry and society for a discontinuation, the need to enforce innovation, additional costs, and/or the room for the communication of discontinuation.
- Strictness: The level of strictness of a regulation decides whether there is space for exceptions or no exceptions. These exceptions for the use of the discontinued technology can be perceived to be based on: the purpose of use, purpose of use for certain user-groups,

availability of alternative technology, the ambition for innovation, room to make comprises to tackle resistance.

- Policy level: A discontinuation policy can be introduced and effectuated on different levels, from local to national or supranational level. The choice for the appropriate level of discontinuation can be highly debated by the actors due to the different advantages or legitimizations of these levels. Considerations for a particular level of discontinuation can be: cost savings, subsidiarity, uniformity in favour of market surveillance, exiting legislative framework, and/or international appointments.
- Monitoring: Finally, when a discontinuation policy is introduced, this new regulation needs to be monitored to maintain its proposed effects. This monitoring can include the aftercare of a discontinued technology, the proper use of the replacing technology, and the sanctioning of the circumvention of the regulation.

To conclude, the empirical study on ILB discontinuation did not only provide a first conceptualization of the issues and governance dimensions for technology discontinuation. The analysis also showed how the different issues were attributed by the different governance dimensions to govern these problems. This means that for every case of discontinuation governance different issues and governance dimensions can be identified, but that also their relations can have a different structure.

Further research

In this section, recommendations for further research are discussed. The data-sampling of the policy-making trajectory on the supranational level and the debate on the Dutch national provided extensive empirical data for analysis. Although this data was useful for a first conceptualization, a wider selection of discontinuation cases is needed to develop this conceptualization further. The discontinuation pathways of additional cases provide additional insights to verify or expand this first conceptualization. Examples of additional cases are the recent political commitments for the phasing-out of nuclear energy, the worldwide ban on synthetic pesticides, and the initiatives to stimulate the phasing-out of the combustion engine for cars (Stegmaier, et al., 2012, pp. 8-10). Another important empirical contribution to the conceptualization of discontinuation would be to broaden the perspective on discontinuation as a governance task. The analysis of the ILB case focused on the political strategies for the discontinuation of the ILB. However, there are more strategies that can be distinguished for the de-

stabilization of a socio-technical system, like economic, technological or socio-cultural strategies for discontinuation (Turnheim & Geels, 2012, p. 5).

Secondly, an important analytical tool for the further research on the conceptualization of the discontinuation problem-types is problem structuring. Hoppe (2010) distinguishes two dimensions for problems: consensus on relevant norms and on knowledge of a certain policy problem. This results in a fourfold typology for problem structures. When there is consensus on the relevant norms and knowledge of problem, this is called a structured problem. When this consensus for both dimensions is lost, a structured problem can turn into an unstructured problem. When the consensus is lost for one dimension, this results in a moderately structured problem. Additional research on the structuration of the identified problem-types, can get a better understanding of the influences of this structuration on the attributed governance dimensions to solve this problem.

Another task for further research on the conceptualized governance dimensions includes the attribution of relevant literature. Literature is important to contextualize the grounded concepts and relate them to existing knowledge on these concepts. The governance dimension that relates to policy instruments showed that the actors discussed different design options for the governance of discontinuation. However, Voss (2007, pp. 19-26) shows that this design perspective on governance is contested by a governance perspective that approaches governance as the outcome of social dynamics. Also the implementation process of policy is approached differently in literature. Colebatch (2009, pp. 50-53) explains that a goal-oriented perspective on policy implementation approaches implementation as reaching goals, however it is also argued that implementation is influenced by interpretation and negotiation. These different perspectives show that there is not one shared conceptualization of the process of policy implementation. Also for the policy level dimensions, there are still theoretical and public debates about the appropriateness of a policy level within the multi-level system of the EU (de Winter, Swyngedouw, & Goeminne, 2009). This concise record of some of the governance dimensions and their embedding in policy studies literature shows how further literature research can contribute to the further development of these grounded concepts.

9. Bibliography

Bauer, M. W. (2009). The policy termination approach: Critique and conceptual perspectives. *Lehrstuhl Politik und Verwaltung: Working paper series* Retrieved November 11, 2011, from http://www.sowi.hu-berlin.de/lehrbereiche/politikundverwaltung/wps/working-paper-1

Borrás, S., & Edler, J. (2012). *The governance of change in socio-technical and innovation systems: Some pillars for theory-building*.

Bringer, J. D., Johnston, L. H., & Brackenridge, C. H. (2006). Using computer-assisted qualitative analysis software to develop a grounded theory project. *Field Methods, 18*(3), 245-266.

Bryman, A. (2004). *Social research methods* (Second ed.). Oxford: Oxford University Press.

CELMA. (2008). CELMA comments on the Commission's documents on possible ecodesign requirements for general lighting equipment. Retrieved April 22, 2012, from http://www.celma.org/archives/temp/20080320_CELMA_Comments_on_the_COM_documents_for_general_lighting_equipment_FINAL.pdf

Chaminade, C., & Edquist, C. (2010). Rationales for public policy intervention in the innovation process: Systems of innovation approach. In R. E. Smits, S. Kuhlmann & P. Shapira (Eds.), *The theory and practice of innovation policy: An international research handbook.* (pp. 95-114). Cheltenham: Edward Elgar Publishing.

Colebatch, H. K. (2009). *Policy* (Third ed.). New York: Open University Press.

Consultation Forum. (2008a). Annex 2: Working document on possible ecodesign requirements for general lighting equipment. Retrieved April 21, 2012, from http://ec.europa.eu/energy/efficiency/ecodesign/doc/forum/2008-03-28.zip

Consultation Forum. (2008b). Annex 3: Possible ecodesign requirements for general lighting equipment part 1. Retrieved April 21, 2012, from http://ec.europa.eu/energy/efficiency/ecodesign/doc/forum/2008-03-28.zip

Consultation Forum. (2008c). Minutes of the meeting of the eco-design consultation forum held on 28 March 2008. Retrieved April 21, 2012, from http://ec.europa.eu/energy/efficiency/ecodesign/doc/forum/2008-03-28.zip

Corbin, J., & Strauss, A. (1990). Grounded theory research: procedures, canons and evaulative criteria. *Zeitschrift für Soziologie, 19*(6), 418-427.

de Winter, L., Swyngedouw, M., & Goeminne, B. (2009). The level of decision making: The preferences of the citizens after enlargement. In J. Thomassen (Ed.), *The legitimacy of the European Union after enlargement* (pp. 117-141). Oxford: Oxford University Press.

Dunn, W. N. (2008). *Public policy analysis: An introduction* (Fourth ed.). Upper Saddle River: Prentice Hall.

Edge, J., & McKeen-Edwards, H. (2008). *Light bulbs and bright ideas?: the global diffusion of a ban on incandescent light bulbs*. Paper presented at the 80th Annual Conference of the Canadian Political Science Association, University of British Colombia. http://www.cpsa-acsp.ca/papers-2008/Edge-McKeen-Edwards.pdf

ELC. (2005). Comments on the Council Common Position on the Framework Directive on Energy Using Products. Retrieved April 23, 2012, from http://www.elcfed.org/documents/050126_ELC%20EUP%20Position%20Paper.pdf

ELC. (2007). The ELCs proposal for domestic lighting. Retrieved April 23, 2012, from http://www.elcfed.org/documents/2.%20Phase-out%20proposal.pdf

ELC. (2008). The European lamp industry's strategy for domestic lighting: Frequently asked questions & answers on energy efficient lamps. Retrieved April 23, 2012, from

http://www.elcfed.org/documents/080613_ELC%20FAQ%20domestic%20lighting_external.pdf

Elsevier. (2009, August 25). CDA en D66 hebben spijt van gloeilampverbod. Retrieved January 10, 2012, from http://www.elsevier.nl/web/Nieuws/Politiek/244283/CDA-en-D66-hebben-spijt-van-gloeilampverbod.htm

Ende, J. v. d., & Kemp, R. (1999). Technological transformations in history: how the computer regime grew out of existing computing regimes. *Research policy*, *28*, 833-851.

European Commission. (2008). H-0508/08: Question no 94 by Ivo Belet. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getDoc.do?type=CRE&reference=20080710&secondRef=ANN-01&language=EN&detail=H-2008-0508&query=QUESTION

European Commission. (2009a). MEMO/09/368 FAQ: Phasing out conventional incandescent bulbs. Retrieved April 22, 2012, from http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/368&format=PDF&aged=1&language=EN&guiLanguage=nl

European Commission. (2009b). P-0146/09EN: Written question to the Commission. Retrieved April 24, 2012, from http://www.europarl.europa.eu/RegData/questions/reponses_qe/2009/0146/P6_RE(2009)0146_EN.doc

European Commission. (2009c). Regulation 244/2009: Implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional household lamps. Retrieved February 14, 2012, from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:en:PDF

European Commission. (2009d). SEC(2009)328: Full impact assessment. Retrieved April 22, 2012, from http://ec.europa.eu/energy/efficiency/ecodesign/doc/legislation/sec_2009_327_impact_assesment_en.pdf

European Commission. (2010). E-1482/10EN: Answer given by Mr Oettinger on behalf of the Commission. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getAllAnswers.do?reference=E-2010-1482&language=EN

European Commission. (2012). Changes - bulbs and packaging Retrieved July 3, 2012, from http://ec.europa.eu/energy/lumen/overview/whatchanges/index_en.htm

European Parliament. (2007a). DCL(2007)0029: on introducing a prohibition on the sale of incandescent light bulbs in the European Union. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+WDECL+P6-DCL-2007-0029+0+DOC+PDF+V0//EN&language=EN

European Parliament. (2007b). Debate: 16. One-minute speeches on matters of political importance. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-%2f%2fEP%2f%2fTEXT%2bCRE%2b20070312%2bITEM-016%2bDOC%2bXML%2bV0%2f%2fEN&language=EN

European Parliament. (2007c). E-1184/07: Written Question. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+WQ+E-2007-1184+0+DOC+XML+V0//EN

European Parliament. (2007d). E-3378/07: written question. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getDoc.do?type=WQ&reference=E-2007-3378&language=EN

European Parliament. (2009a). Debates: 18. One-minute speeches on matters of political importance. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-%2f%2fEP%2f%2fTEXT%2bCRE%2b20091007%2bITEM-018%2bDOC%2bXML%2bV0%2f%2fEN&language=EN

European Parliament. (2009b). E-0103/09: written question. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+WQ+E-2009-0103+0+DOC+XML+V0//EN

European Parliament. (2009c). E-1088/09: Written question. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getAllAnswers.do?reference=E-2009-1088&language=EN

European Parliament. (2009d). E-1090/09EN: written question. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getAllAnswers.do?reference=E-2009-1090&language=EN

European Parliament. (2009e). E-3802/09: written question. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+WQ+E-2009-3802+0+DOC+XML+V0//EN

European Parliament. (2010a). E-8356/2010: Written question Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getAllAnswers.do?reference=E-2010-8356&language=PL

European Parliament. (2010b). E-011180/2010: Written question. Retrieved April 24, 2012, from http://www.europarl.europa.eu/sides/getDoc.do?type=WQ&reference=E-2010-011180&language=EN

European Union. (2005). Directive 2005/32/EC for establishing a framework for the setting of ecodesign requirements for energy-using products. Retrieved February 14, 2012, from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0029:0029:EN:PDF

European Union. (2009). Directive 2009/125/EC for establishing a framework for the setting of ecodesign requirements for energy-related products (recast). Retrieved February 14, 2012, from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:en:PDF

Friese, S. (2012). *Qualitative data analysis with ATLAS.ti*. Thousand Oaks (CA): Sage Publications.

Geels, F. (2004). Understanding systems innovations: A critical literature review and a conceptual analysis. In B. Elzen, F. Geels & K. Green (Eds.), *System innovation and the transition to sustainability: Theory, evidence and policy* (pp. 19-47). Cheltenham: Edward Elgar.

Held, D. (2006). Models of Democracy (Third ed., pp. 290-331). Cambridge: Polity Press.

Holzhacker, R., & Albaek, E. (2007). Introduction. *Democratic governance and European integration* (pp. 1-22). Cheltenham: Edward Elgar.

Hooghe, L., & Marks, G. (2001). Multi-level governance and European integration (pp. 1-28). Oxford: Rowman and Littlefield.

Hoppe, R. (2010). *The governance of problems: puzzling, powering and participation*. Bristol: The policy press.

Jasanoff, S., & Wynne, B. (1998). Science and decision making. In S. Rayner & E. Malone (Eds.), *Human choice and climate change.* (Vol. 1). Columbus, Ohio: Battle Press.

Kersbergen, K. v., & Waarden, F. v. (2004). 'Governance' as a bridge between disciplines: Cross-disciplinary inspiration regarding shifts in governance and problems of governability, accountability and legitimacy. *European Journal of Political Research, 43*, 143-171.

Kuhlmann, S. (2001). Future governance of innovation policy in Europe: Three scenarios. *Research policy, 30*, 953-976.

Kuhlmann, S., & Edler, J. (2003). Changing governance in European research and technology policy: Possible trajectories and the European Research Area. In J. Edler, S. Kuhlmann & M. Behrens (Eds.), *Changing governance of research and technology policy: The European Research Area.* Cheltenham: Edward Elgar Publishing.

Kuhlmann, S., Shapira, P., & Smits, R. E. (2010). Introduction. A systemic perspective: The innovation policy dance. In R. E. Smits, S. Kuhlmann & P. Shapira (Eds.), *The theory and practice of innovation policy: An international research handbook.* (pp. 1-24). Cheltenham: Edward Elgar Publishing.

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy, 41*, 955-967.

Ministry VROM. (2010). Energiegedrag in de woning: Aanknopingspunten voor de vermindering van het energieverbruik in de woningvoorraad. Retrieved January 19, 2012, from http://ikregeer.nl/documenten/blg-55502

Nelson, R. R., & Winter, S. G. (1977). In search of useful theory of innovation. *Research Policy, 6*, 36-76.

O'Reilly, K., Paper, D., & Marx, S. (2012). Demystifying grounded theory for business research. *Organizational Research Methods, 15*(2), 247-262.

Oudshoorn, N., & Pinch, T. J. (2008). User-technology relationships: Some recent developments. In E. J. Hackett, O. Amsterdamska, M. Lynch & J. Wajcman (Eds.), *The handbook of science and technology studies.* (Third ed., pp. 541-566). Cambridge: MIT Press.

Pinch, T. J., & Bijker, W. E. (1987). The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit from each other. *Social Studies of Science, 14*(3), 399-441.

Poel, I. v. d. (2003). The transformation of technological regimes. *Research Policy, 32*, 49-68.

Rein, m., & Schön, D. (1993). Reframing policy discourse. In f. Fischer & j. Forester (Eds.), *The argumentative turn in policy analysis and planning* (pp. 145-166). Durham: Duke University Press.

Rip, A. (2005). *Technology as configurations that work: An overview of perspectives on technology (Unpublished work).*

Rip, A., & Kemp, R. (1998). Technological change. In S. Rayner & L. Malone (Eds.), *Human choice and climate change* (pp. 327-399). Washington D.C.: Batelle Press.

Sadovnik, A. R. (2007). Qualitative Research and public policy. In F. Fischer, G. J. Miller & M. S. Sidney (Eds.), *Handbook for public policy analysis: Theory, politics, and methods.* (pp. 417-427). New York: CRC Press.

SCENIHR. (2008). Light Sensitivity. Retrieved April 23, 2012, from http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_019.pdf

Starks, H., & Trinidad, S. B. (2007). Choose your method: A comparison of phenomenology, discourse analysis, and grounded theory. *Qualitative Health Research, 17*(10), 1372-1380.

Stegmaier, P., Kuhlmann, S., & Visser, V. R. (2012). *Governance of discontinuation of socio-technical systems.* Jean Monnet Conference, Copenhagen Business School, Denmark, 1-2 March 2012. (Unpublished work).

Turnheim, B., & Geels, F. (2012). *Industry destabilisation in socio-technical transitions: Lessons from the history of the British coal industry (1913-1997)*. Paper for Energy Policy, special issue on 'Past and prospective transitions: Insights from history'.

Tweede Kamer. (2007a). Aanhangsel van de handelingen 1158 Retrieved January 17, 2012, from https://zoek.officielebekendmakingen.nl/ah-tk-20062007-1158.html

Tweede Kamer. (2007b). Aanhangsel van Handelingen 903: 1933 Retrieved Januari 17, 2012, from https://zoek.officielebekendmakingen.nl/ah-tk-20062007-903.html
Tweede Kamer. (2007c). Vragenuur 70: 3764 Retrieved January 17, 2012, from https://zoek.officielebekendmakingen.nl/h-tk-20062007-3763-3765.html
Tweede Kamer. (2008a). 31 209, nr 62, Schoon en zuinig: verslag van een notaoverleg Retrieved January 17, 2012, from https://zoek.officielebekendmakingen.nl/kst-31209-62.html
Tweede Kamer. (2008b). 31 700 XI, nr. 5, Vaststelling begroting Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer (XI) en Waddenfonds 2009 Retrieved January 17, 2012, from https://zoek.officielebekendmakingen.nl/kst-31700-XI-5.html
Tweede Kamer. (2009a). Aanhangsel van de handelingen, 170 Retrieved January 17, 2012, from https://zoek.officielebekendmakingen.nl/ah-tk-20092010-170.html
Tweede Kamer. (2009b). Vragenuur 104:8355-8358 Retrieved January 17, 2012, from https://zoek.officielebekendmakingen.nl/h-30397.html
Tweede Kamer. (2010). Aanhangsel van de handelingen, 1626 Retrieved January 19, 2012, from https://zoek.officielebekendmakingen.nl/ah-tk-20092010-1626.html
van der Graaf, H., & Hoppe, R. (1996). *Beleid en Politiek: Een inleiding tot de beleidswetenschap en de beleidskunde*. Bussum: Coutinho.
Verbeek, P. (2005). *What things do: Philosophical reflections on technology, agency, and design.* Pennsylvania: Pennsylvania State University Press.
Vito. (2009a). Preparatory Studies for Eco-design Requirements of EuPs: Final report Lot 19: Domestic lighting. Retrieved February 22, 2012, from http://www.eup4light.net/assets/pdffiles/Final_part1_2/EuP_Domestic_Part1en2_V11.pdf
Vito. (2009b). Preparatory Studies for Eco-design Requirements of EuPs: Project Report Lot 19: Domestic lighting. Retrieved March 6, 2012, from http://www.eup4light.net/assets/pdffiles/Final_part1_2/EuP_Domestic_Project_report_V10.pdf
Voss, J. (2007). *Designs on governance: Development of policy instruments and dynamics in governance*. Enschede: Printpartners Ipskamp.
Wagenaar, H. (2007). Interpretation and intention in policy analysis. In f. Fischer, F. Miller & M. Sidney (Eds.), *Handbook of public policy analysis: Theory, politics and methods* (pp. 429-441). New York: CRC Press.
Yanow, D. (2000). *Conducting interpretive policy analysis*. Thousand Oaks (CA): Sage.

10. Appendix A

Below you can find a more detailed overview of the distinguished actor groups and the related sources that were used to select governance documents for the analysis.

- *'Taskforce Verlichting'*

After a general search on the internet with the search term 'verbod op gloeilamp', I found different news articles on the discussion in the Dutch parliament for a possible ban of the ILB. This was the first confirmation for me, that this topic was an explicit theme in parliament.
During my general search, I also came across the first governance document that really dealt with policy for discontinuation of inefficient lighting: the final report of 'Taskforce Verlichting'[1]. This stakeholder committee was installed in 2007 to examine ways to realize the use of more efficient lighting. This document was a first important document to get an insight in the different issues that were discussed among the stakeholders about the discontinuation of the ILB and the ways stakeholders were involved.

- *Dutch parliament*

To get a quick overview of any relevant parliamentary documents on the ban of the ILB, I used the easy-to-handle database from 'Ikregeer.nl'[2] to search for parliamentary documents on the discontinuation of the ILB. This website is set up by an independent organization and has the goal to make public information from the Dutch government more easily accessible. I searched this database with the search term 'gloeilamp', which seemed to be a rather effective term because it is a common Dutch word for ILB. After I found relevant documents and got familiar with the different types of policy documents, I applied a wider search on the official database of the government[3] with the same search term. I selected the documents that specifically were linked to the proposed ban on the ILB. Besides these public parliamentary documents, I couldn't find any available policy documents on website of Ministry that dealt with the topic of discontinuation of ILB.

- *European Commission*

[1] http://www.agentschapnl.nl/nl/programmas-regelingen/taskforce-verlichting
[2] http://www.ikregeer.nl
[3] https://www.officielebekendmakingen.nl/

My study of the Dutch discussion on the discontinuation of the ILB, showed that proposals for a discontinuation policy were not developed on the national level, but at the supranational level. At first I looked for the official regulation document on the discontinuation of the ILB, and this led me to the European Commission. The European Commission (EC) is a central actor in the policy-making process of the discontinuation of the ILB. The EC had a mandate from the EP and the Council of Member States to implement measures for inefficient domestic lighting (as part of the eco-design directive):

> *"the Commission is implementing the specific mandate from the European Parliament and the Council of Member States as originally laid down in the Ecodesign Directive (2005/32/EC, see point II.3 of this FAQ). In its Article 16, the Directive specifically requested the Commission to introduce implementing measures on lighting in the domestic sector through this procedure.The importance of this measure was underlined by the Spring European Council of 2007, which invited the Commission to "rapidly submit proposals to enable increased energy efficiency requirements (...) on incandescent lamps and other forms of lighting in private households by 2009" and by the Parliament itself in its resolution of 31 January 2008 on the Action Plan for Energy Efficiency, where the European Parliament stressed " the importance of the Commission's keeping to the proposed timetable for the withdrawal of the most inefficient light bulbs from the market" (European Commission, 2009a, p. 11)*

For the sample of the governance documents that relate to the EC, I selected the documents they published in relation to the implementation of the discontinuation of the ILB:

+ The impact assessment they executed for the regulation (European Commission, 2009d)
+ The final directive for eco-design requirements for non-directional household lamps (European Commission, 2009c)
+ The publication of a FAQ in which they announce the regulation to a broad audience, but also discuss the governance issues of this regulation (European Commission, 2009a)

- *EUP4light project*

Before an eco-design regulation for the discontinuation of the ILB could be formulated, a study for setting eco-design requirements for domestic lighting had to be performed. This study was conducted by VITO (the Flemish institute for technological research) with BIO Intelligence Service (an environment and sustainable development consultancy) and Energy Piano consultancy as partners and Kreios engineering for general support. Besides these profes-

sionals, the project comprised multi-stakeholder consultation (organized by self-involvement) on the preliminary drafts of the study reports. Although the study was mostly done by independent researchers and stakeholders, the focus and approach was shaped by a mandatory methodology: 'Methodology Study Eco-design of Energy-using Products' (MEEUP). This MEEUP methodology was developed in 2005 and contains the general methodology that is used for performing life-cycle assessments for product groups within the eco-design framework.

For my analysis, I selected two documents from this project that were published on their website, to examine how the discontinuation is proposed and which governance problems are discussed:

+ The final report of the study (Vito, 2009a)

+ The final project report of the study, which includes the minutes from the stakeholder meetings as well (Vito, 2009b)

- *Consultation Forum*

Another part of the decision-making process for establishing eco-design measurements is the Consultation Forum. This Forum entails a stakeholder meeting, which is organized by the EC to discuss working documents on eco-design regulations. The EC explain on their website:

> *"Directive 2009/125/EC (Article 18) establishes a group of experts called "Consultation Forum" which will allow stakeholders to be informed and provide their contribution on the implementation of the Directive. The task of the group of experts is to contribute in particular to the definition and review of the implementing measures, to monitoring the efficiency of the established market surveillance mechanisms and to the assessment of voluntary agreements and other self-regulatory measures taken in the context of the Directive"*[4]

So, the participants are invited by the EC and are allowed to discuss the regulation, also in the case of the eco-design regulation for domestic lighting.

In my analysis, I will use the documents from the meeting of the Consultation Forum to investigate how this stakeholder meeting discusses the discontinuation governance of the ILB.

- 6th meeting (march 28, 2008): They put 'Working documents on possible Eco-Design requirements for general lighting equipment ("Domestic lighting part 1") (for opinions)' on the agenda and discussed it (Consultation Forum, 2008a, 2008b, 2008c)

[4] http://ec.europa.eu/energy/efficiency/ecodesign/forum_en.htm

- *European Parliament*

Although the EP, may not have voted or had the power to take initiative for a regulation on the discontinuation of the ILB, I approached the EP as an important discourse arena for the discontinuation governance. In several databases I looked for documents from debates in parliament or reports, to examine how discontinuation is discussed among the MPs. I did not find any plenary debate about the regulation from the Commission (at the time not explained as controversial?), but I did found questions that were asked by MPs to Committee members about the regulation.

First of all, I looked at the legislative observatory of the EU parl, to see if there was a codecision procedure (ordinary legislative procedure) for the regulation between the parliament and the Council[5]. The decision-making process for the general eco-design framework can be found. But, in this database, no references to the regulation can be found or the key-words 'domestic lamps' or 'incandescent', '2009/244/EC'. So, it seems that that for the specific eco-design requirements, there was no codecision procedure, but the Commission is in charge of proposing these eco-design requirements, and the parliament can keep them accountable.

Secondly, I looked into the website of the EP and the section 'plenary sitting' - to find out whether the discontinuation of the incandescent light bulb is publicly debated or discussed in the parliament. I looked at several databases and selected by hand-picking the documents that related to the actual discontinuation of the ILB:

+ Reports[6] - Key-words in text: 'domestic lamp*' (no results), 'incandescent' (no results)

+ Motions for resolutions[7] - Key-words in text: 'domestic lamp*' (no results), 'incandescent' (no results), '244/2009' (no results)

- Minutes[8] - Key-words in text: 'incandescent' (2004-2009: 1 result, 0 relevant; 2009-2014: 0 results), 'domestic lamp*' (no results), '244/2009' (no results)

+ Debates[9] - Key-words in text: 'domestic lamp*' (no results), "244/2009' (no results). But for the key-word 'incandescent', the database had hits. For the period 2009-2014, I had 5 hits, and selected 3 files. For the period 2002-2009, I had 10 hits and selected 5 files. Because these files are only digitally available, I collected them in one document for coding.

[5] http://www.europarl.europa.eu/oeil/home/home.do
[6] http://www.europarl.europa.eu/plenary/en/reports.html
[7] http://www.europarl.europa.eu/plenary/en/motions-for-resolutions.html
[8] http://www.europarl.europa.eu/plenary/en/minutes.html
[9] http://www.europarl.europa.eu/plenary/en/debates.html

Thirdly, the 'public document register' was used to do a broader search in a database of published minutes and documents from the EP[10]. Via 'simple search', many new and relevant documents were found.

+ "Household lamp*": This search term presented two hits. I selected two documents; a petition and a question from a MEP.

+ '244/2009': This search term delivered 26 results. From these results;18 new questions from MEPs were selected, and one new petition.

+ 'incandescent': This search term provided the most hits: 140. From these results; 4 communication documents and 29 new questions from MEPs were selected.

Note: In Atlas, a memo gives an overview of the precise documents that are selected per search term.

- *SCENIHR research*

The last data sample that is added to my analysis, is the light sensitivity report that is published by Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR, 2008). In 2008, As a reaction on the wide spread use of new energy efficient lamps due to possible phase out of the ILB, this committee performed a study on the symptoms of several disease that may be cause by these new lamps:

> "*The European Commission has requested SCENIHR to determine whether the claims of the "light sensitive" citizens' associations that their symptoms are aggravated by energy saving lamps are justified and, if any of the claims is valid, to determine which lamp characteristics (e.g. light wavelength, lamp frequency, electromagnetic fields emitted, etc.) are responsible as well as to estimate the size of the population affected." (SCENIHR, 2008, p. 7)*

[10] http://www.europarl.europa.eu/RegistreWeb/search/simple.htm?language=EN

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CAQDAS: Computer Assisted Qualitative Data Analysis Software
CFL: Compact Fluorescent Lamp
CFLi: Compact Fluorescent Lamp with integrated ballast
EC: European Commission
ELC: European Lamp Companies Federation
EP: European Parliament
EU: European Union
FAQ: Frequently Asked Questions
GLS: General Lighting Service
GT: Grounded Theory
ILB: Incandescent Light Bulb
LED: Light-Emitting Diode
MEP: Member of European Parliament
MP: Member of Parliament
SCENIHR: Scientific Committee on Emerging and Newly Identified Health Risks
UV: Ultraviolet
VAT: Value Added Tax
VROM: Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer