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The Light Industry as Actor and Factor in the EU Discontinuation of the Incandescent Light Bulb

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Abstract

Offering an inquiry into the discontinuation of a socio-technical system as being an integral part of innovation, which is an under-developed concept in innovation theory, this thesis aims at deepening the understanding of the rather new research field of purposeful governance of discontinuation. The focus of the investigation is on the role of industry as governing change in a socio-technical system. The policy-making context establishing the EU Eco-Design Framework that regulated the gradual phase-out of incandescent light bulbs was chosen as exemplifying case while also acknowledging a global policy trajectory. The theoretical framework predominantly relies on the account that incumbent firms are embedded in economic, and socio-political environment, as well as in internal industry regimes. This thesis further employs a concept of governance of change in a socio-technical system which helps to find answers to the questions *who* is driving change and *how* it is done. In a qualitative interpretative style, the adopted grounded theory approach allows for an interwoven collection and analysis of relevant public policy and industry documents which helps to continuously improve the understanding of the investigated research problem. Special attention is hereby given to reconstructing the discourses on barriers to discontinuation, and the way they are governed, from the specific industry viewpoint. The empirical findings point to four different sets of strategies that are employed by incumbents to manage the ILB discontinuation issues. These are economic positioning, corporate political strategy, shaping cultural environment and corporate social responsibility. Besides, the empirical insights suggest that in the ILB case industry actors entered the policy-making sphere in order to tentatively take advantage of the regulatory power of the European Commission. Thus, the EU Eco-Design Directive supplemented the industry's mainly market and discursive instruments – facilitating market transformation towards energy efficient lighting and enforcing the phase-out ILBs.

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List of Abbreviations

ADEME:	French Environment and Energy Management Agency
BEUC:	Bureau Européen des Unions de Consommateurs [The European Consumer Organisation]
CAQDAS:	Computer-Assisted Qualitative Data Analysis Software
CDM:	Clean Development Mechanisms
CE:	Conformité Européenne [European Conformity]
CELMA:	National Manufacturers Association for Luminaires and Electrotechnical Components for Luminaires
CER:	Certified Emission Reduction
CFL:	Compact Fluorescent Lamp
CFLi:	Compact Fluorescent Lamp with integrated Ballast
CIRCAB:	Communication and Information Resource Centre for Administration, Businesses and Citizens
CO_2:	Carbon Dioxide
DEA:	Danish Energy Agency
DG:	Directorate General
DSM:	Demand Side Management
ECAS:	European Commission Authentication Service
ECCP:	European Climate Change Programme
EC:	European Commission
ECEEE:	European Council for an Energy Efficient Economy
EEL:	Energy Efficient Lighting
ELC:	European Light Companies Federation
EMF:	Electro Magnetic Fields
EU:	European Union
EuP:	Energy-using Products
GEF:	Global Environment Facility
GHG:	Green House Gases
GLS:	General Lighting Service
HG:	Mercury
IEA:	International Energy Agency
ILB:	Incandescent Light Bulb
IM:	Implementing Measures
IPCC:	International Panel on Climate Change
LED:	Light-Emitting Diode
MEEuP:	Methodology Study for Ecodesign of Energy-using Products
MNC:	Multi-National Company
NGO:	Non-Governmental Organisation
OECD:	Organisation for Economic Co-operation and Development
PLDA:	Professional Lighting Designers' Association
RoHS:	Restrictions of Hazardous Substances
RoMS:	Roll-Out Member States Programme
SCENIHR:	Scientific Committee on Emerging and Newly Identified Health Risks
TEF:	Triple Embeddedness Framework
UK:	United Kingdom

UN:	United Nations
UNEP:	United Nations Environmental Programme
UNFCCC:	United Nations Framework Convention on Climate Change
UV:	Ultra Violet
VAT:	Value Added Tax
WEEE:	Waste Electrical and Electronic Equipment
WTO:	World Trade Organisation
WWF:	Word Wildlife Fund for Nature

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1. Introduction

1.1 Background

This thesis is offering an inquiry into the discontinuation of a technology as being an integral part of innovation and technological change mechanisms. However, innovation is predominantly being observed as a phenomenon going hand in hand with the embedding and implementation of emerging technologies. Therefore, this study is taking a perspective that acknowledges the discontinuation of technology as another substantial part of innovation, which is a rather underdeveloped concept within recent innovation literature. Moreover, this study aims at deepening the understanding of how the discontinuation of a technology is employed by particular actors, in this case industry actors, to drive innovation, hence adding to the rather new and fragmentarily explored research field of purposeful governance of discontinuation. Making use of a case-study format, this investigation seeks to identify which specific issues within the discontinuation process have constituted problems for the industry and how they have been solved by means of strategies of actions.

An exemplifying case is the Eco-Design Framework Directive (2009/125/EC)[1] as it implemented minimum efficiency requirements which led to the gradual phase-out of the incandescent light bulb (ILB) technology. Throughout this decision-making procedure, relevant industry actors were in an advisory capacity to the European Commission (EC) which is the EU institution that initiates, structures and leads the policy-making process. Therefore, this case was considered to be suitable in order to investigate the role of the industry within technology discontinuation procedures.

The ILB technology, the 'normal' light bulb, was dominating the domestic lighting market for decade after decade, even though more efficient lighting has been available at least since the 1940's when the fluorescent technology was introduced (Waide, 2010, p. 15). Nevertheless, this emerging technology had to undergo several improvements and enhancements to finally arrive at a more consumer-friendly technology, namely the compact fluorescent lamp (CFL). Even though this new technology was energy efficient and the lighting industry has put a lot of efforts in promoting the uptake of these lamp types, and although it increasingly won market shares on a large scale, consumers still favoured the old technology. However, in the context of climate change, the Kyoto protocol was signed to address the threat of global warming by significantly cutting greenhouse gas emissions and policy initiatives by legislators all over the world have been implemented to reach the set goals. The phase-out of the inefficient lighting technology was also seen as suitable approach to save energy and emissions, so that global policy diffusion took place (Edge & McKeen-Edwards, 2008, pp. 4-5). That means that in the long run consumers could no longer opt for the ILB technology as preferred option to illuminate their residential homes.

As already indicated, this investigation seeks to improve the understanding of the industry's role within the EU ILB discontinuation process by means of explorative research. Building upon qualitative and interpretative approaches, the research focuses on the analysis of industry and policy documents while identifying the meanings that were attributed to the purposeful ILB discontinuation governance especially by industry actors. Moreover the author wanted to know which discontinuation governance problems were addressed by the lighting industry, how solutions to these problems were communicated in the industry discourse and which factors or actors facilitated

[1] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products; see http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32009L0125

or constrained the industry's strategies of addressing the problems. For this purpose, the reconstruction of the findings is grounded in and developed from the textual data (policy documents from industry, EU, and interest groups) that was sampled for the case study.

The following research question was introduced:

Which issues of the discontinuation of the ILB constituted barriers for the lighting industry and how were these issues managed according to relevant industry and policy discourse?

Further elaboration on this question is presented in the methodology chapter of this study.

1.2. Relevance of this Study

First of all, it has to be mentioned that this thesis is intended to contribute to the project 'Governance of Discontinuation of Sociotechnical Systems' (DiscGo)[2] which is collectively undertaken by an international team of researchers. This project aims at conceptualizing the notion of 'discontinuation governance', analysing four exemplary cases – one of them is the discontinuation of the ILB and deriving a heuristic from those explorative case analyses. Furthermore the re-interpretation of relevant models within this field of research, offering an outlook for further scientific inquiry and introducing a new policy perspective are further aims of the project. All in all, 'discontinuation governance' is considered to constitute a strategic challenge for the analysts who seek to understand this phenomenon (Stegmaier, Kuhlmann & Visser, 2014).

As already noted before, the literature on discontinuation and especially the purposeful discontinuation of technology is an underdeveloped field within innovation studies. The analytical framework used in this piece of research considers discontinuation as an integral part of the innovation process. Therefore, this study is contributing to an improved understanding of the technology discontinuation's impact on innovation in general. In addition, the empirical insights achieved by means of the case-study on the industry's role on ILB discontinuation will add to the broad conceptualization of purposeful governance of technology discontinuation as introduced by Visser (2012) by now offering the particular industry perspective. According to Shapira et al. (2010), this is one of major flaws within the innovation system approach and so this thesis furthermore adds to the *"[…] underdeveloped insight in the role of actors at the micro level, how they are framed by the system and – in turn – impact on the system and the consequences for policy in terms of concepts, strategies and instruments"* (Shapira, Smits & Kuhlmann, 2010, p. 458). Hence, after reconstructing the major lines along which the lighting industry actors oriented their actions, a first conceptualization of the identified types of discontinuation barriers and the executed strategies of action of the industry to address these issues will be given.

1.3. Thesis Outline

Following this introductory chapter, chapter two presents the theoretical framework that evolved throughout the interwoven process of data collection and analysis. This specific process is adopted due to the characteristic of the chosen research method which follows the logic of abduction as will be explained in detail in chapter three. Chapter two will first elaborate on the general discussion about innovation in socio-technical systems and its governance, then present the industry's role in the discontinuation process from a general theoretical angle, and lastly focus on the interrelatedness of industry actors and the policy making process. In chapter three, the author discusses the applied research approach, introduces the questions of research and elaborates on the specific research

[2] For further information on DiscGo project please visit: www.discontinuation-governance.net

design while acknowledging limitations to this study. Chapter four contains the first part of the analysis that portrays the identified issues of discontinuation as experienced by the industry actors and integrates them into various types of discontinuation barriers. In chapter five the strategies of actions that were employed by the lighting industry to address the particular issues of discontinuation are presented. The final chapter six discusses the findings on the industry's role within the ILB discontinuation process and gives an outlook on further research.

2. Theoretical Framework

The development of the theoretical framework of this thesis is relying on concepts from diverse scientific disciplines, as innovation in the technological sphere has hitherto been analysed and conceptualised from the angle of evolutionary economics, neo-institutional theory as well as economic sociology. In order to introduce the reader to the central underlying theoretical notions of this piece of research, the first section of this part of the thesis will develop an understanding of technology (and its innovation) that cannot be seen as a stand-alone conception but rather as being socially embedded within a wider context of social organization and structures which is referred to as a socio-technical system. This socio-technical approach on technological systems and regimes and innovation within these entities is widely prevalent in technology studies while setting itself apart from strictly market oriented and economic perspectives on change of socio-technical systems (Borrás & Edler, 2014). Furthermore, a multi-level approach on transition of innovative technologies from the 'niche' to the overall socio-technical system level will be introduced while referring to the empirical findings of this case study.

The next section of the theoretical framework focuses on the governance aspect within socio-technical regimes and systems exploring the industry's role in the purposeful governance of these entities, e.g. by drawing on the empirical findings of the ILB case. As Borrás and Edler (2014, p. 12) highlighted, innovation literature so far approached the governance of change in socio-technical systems only implicitly and indirectly. Thus, the authors stress the intentionality in interactions between state and societal actors in order to drive change in the respective systems (Borrás & Edler, 2014, p. 14). In this respect, a further central conceptual acknowledgement is that discontinuation is considered as integral part of purposeful governance of change within an innovation system (Stegmaier, Kuhlmann & Visser, 2014). To better grasp the co-evolution of industries and the embedding of incumbent firms in various environments such as political, economic, social and cultural, this sub-part presents the inter-disciplinary 'triple embeddedness framework' (TEF) introduced by Geels (2014). This will help to understand that a single company like Philips is interrelated on the one hand with the broader socio-political as well as environmental/market environments and on the other hand with its very own intra-lighting-industry environment (relations to competitors, national and EU-wide associations, etc.). Next to this, Borrás' and Edler's (2014) conceptual framework of the governance of change in socio-technical and innovation systems will be introduced and tailored to the context of the ILB case. The authors' consideration that specific social agents drive change in socio-technical regimes by means of their capabilities and resources by employing opportunity structures and various forms of governance instruments is especially useful with regards to identifying the most influential (industry) actors that pushed the diffusion of energy efficient lighting by implementing the legal discontinuation of the ILBs. Moreover, Borrás and Edler's notion will help to detect which instruments the lighting industry actors employed to set through their goals and to solve problematic situations on their way. Like most of the literature concerned with the governance of change in socio-technical and innovation systems (Borrás and Elder, 2014, pp.

7-8), this study will include both theoretical dimensions, on the one hand socio-cultural and market-oriented contexts, and on the other hand agency and institutions discussion. However, due to the fact that this investigation aims to understand the role of actors, mainly industry actors, in the context of the discontinuation of the incandescent light bulb technology, it focuses on an agency-driven approach relying on the one presented by Borrás & Edler (2014). Nevertheless, possible interactions between agency and institution will not be categorically excluded with regard to the empirical case at hand.

However, both presented theoretical concepts do not acknowledge the global interacting character of multinational companies (MNC) which also influences change in socio-technical regimes. In the case of the discontinuation of the ILB, the empirical findings point towards a supranational EU-wide trajectory that was also considerably pre-structured on a global level. Here, nation-states do not have much influence on companies' abidance by laws and regulations, and authority is mainly executed e.g. by means of international governmental organizations (International Energy Agency[3] [IEA], United Nations Framework Convention on Climate Change[4] [UNFCCC], etc.) and initiatives (En.lighten – cooperation with lighting associations from all over the world, etc.) or the self-regulation of multinational firms. Hence, this section will add on globally enacted corporate political/social activities of multinational companies.

To give this developed analytical framework the final sharpening, the last section of this theory part will explore the rather general instruments and manners of how interest groups (the focus here is on industries, but also other actors like NGOs will be briefly discussed) influence the European policy making landscape by agenda-setting, framing a topic with their bounded rationality and so forth. Moreover, literature on lobbying and especially on firms lobbying the EU institutions will be revisited. In this context, relevant examples explored in the ILB case will be highlighted and thus contribute to a detailed view on how the lighting industry has pushed change forward in the domestic lighting system in form of the discontinuation of incandescent lamps.

2.1. Innovation in Socio-Technical Systems

As already indicated above, technology and its innovation have been analysed and conceptualised by diverse scientific disciplines. An economy and market-driven approach allows drawing a classical picture of technology. Here, technology is seen as a finished 'artefact' or 'tool' coming from the outside of society like a 'cannonball' (Rip & Kemp, 1998, p.330). Verbeek (2005, p. 101) introduces a view on technology which assigns inevitable characteristics to a technological product and argues that the development of technology occurs autonomously while affecting society in a way that it has to adapt accordingly. Nevertheless, this deterministic view on technology does not account for the social embedding and hence the reciprocal interactions between society and technological innovation. Moreover, technology can also be considered as a 'configuration that works' (Rip & Kemp, 1998, p. 330) while focusing on the 'artefact' and the innovator introducing novelty and taking the role of an entrepreneur. In relation to this view, Schumpeter (1934) acknowledged technological innovation as 'creative destruction'. By crossing boundaries, 'new combinations' of technologies, knowledge domains, seemingly divergent ideas, or markets are discovered by the innovator and applied accordingly. However, this approach is not flawless as it might unsatisfactorily conceptualize the social environment a novel technology is introduced to (Rip & Kemp, 1998, p. 338). More attention needs to be centred on the consideration that technology is socially embedded and

[3] For further information see: http://www.iea.org
[4] For further information see: http://newsroom.unfccc.int/

therefore the employment of a socio-technical approach on technological systems and innovation within this piece of work is central.

According to Pinch & Bijker (1987), a social-constructivist view on technology has developed during the 1980s focusing increasingly on the social context. This approach objected the view on technology having intrinsic properties but believed that for a better understanding of the functioning of technology one has to closely examine the context of its use (Oudshoorn & Pinch, 2008). The emphasis of the constructivist perspective on technology is that this *"account of science and technology seeks to understand the role of human agency and cognition, cultural discourses and practices, and social goals and norms in the making of scientific knowledge and technological products"* (Jasanoff and Wynne, 1998, p. 17). Rip & Kemp (1998) argue that technology should not only be seen as an exogenous factor as in the classical image but treated as an endogenous factor being *"part of the world and its dynamics, suggesting that it may be a malleable aspect of social life"* (Rip & Kemp, 1998, p. 329). Geels (2004a) believes that the functioning of a technology has to be understood in relation to social structures and organizations, as well as human agency. This co-constructive view on technology is also visible in Pinch' and Bijker's (1987) approach as they state that differentiations of the functioning and meaning of a technology occur throughout a technology's interaction in its wider contexts. In other words, the development and use of a technology is deeply embedded in social organization and does not occur in a vacuum (Borrás & Edler, 2014, p. 26). Therefore, a novel technology is shaped by the own dynamics of its social environment and it has to function in its concrete social contexts. This is especially the case when big complex systems are being designed (Rip & Kemp, 1998, p. 331). According to this understanding the social embeddedness is referred to as the socio-technical system of technology (Rip & Kemp, 1998, ibid). In the context of the socio-technical approach on technology, innovation is understood as a development or change in the totality of the socio-technical system. A formal definition of socio-technical and innovation system is offered by Borrás and Edler (2014, p. 11) as they describe it as *"articulated ensembles of social and technical elements which interact with each other in distinct ways, are distinguishable from their environment, have developed specific forms of collective knowledge production, knowledge utilization and innovation, and which are oriented towards specific purposes in society and economy."*

As a next step, a multi-level approach developed from transition theory will be exploited which enriches the understanding of socio-technical discontinuities (Berkhout, Smith & Stirling, 2003, p. 6). The model identifies three distinct levels of transformation namely niches, technological regimes and socio-technical landscape. Niches are protected spheres for promising technologies which are still 'in the pipeline' and in need of learning process about its desirability, as well as enhancement of further developments and the applicability of the technological novelty (Kemp et al. 1998, p. 186). The level of 'technological regime' (Kemp et al., 1994; Van den Ende & Kemp, 1999) functions as meso-level or intermediate position (Berkhout, Smith & Stirling, 2003, p. 6) and is the complex of engineering practices, scientific knowledge, product characteristics, production process technologies, skills and procedures, user practices, and infrastructures and institutions that put together the entirety of a technology (Rip & Kemp, 1998, p. 338; Kuhlmann et al., 2010, p. 2). The final transition level are socio-technical landscapes which are background variables (political culture, social values, paradigms, etc.) channelling transitional processes and changing themselves in an incremental and autonomous way (Kemp & Rotmans, 2001, p. 7). Thus, a successful transformation or innovation of a technology can be described as a technology moving in a trajectory from the micro 'niche' level to the macro 'landscape' level (Berkhout, Smith & Stirling, 2003, p. 7).

Building on the earlier mentioned notions as well as on Geels' (2004b) multi-level framework of socio-technical change, it can be stated that the CFL and the LED technology went through the four phases of socio-technical regime transition. Both technologies were novelties in the socio-technical regime and created thus a technological niche. After gradually developing these technologies further – so that specific quality and end-user friendliness requirements were met as in the case of CFLs, or the novelty could be used for domestic lighting purposes which was the case with LEDs – the new configurations were introduced to the until then stable socio-technical regime. They now competed with and incrementally replaced the dominant ILB technology (Waide, 2006, p. 183) by means of a 'window of opportunity' (Geels, 2004b, p. 914). This window of opportunity in this specific case can be considered to be the pressures related to the phenomenon of climate change which led to the implementation of legally binding minimum efficiency requirements for domestic lighting regulated under the Eco-Design Directive and leading to a gradual phase-out of the incandescent lighting technology. Hence, the EU legislation was supporting the diffusion of the lighting novelties by discontinuing the supply of reportedly inefficient ILB technology which strengthened the establishment of a new technological regime of energy efficient lighting in the socio-technical domestic lighting landscape.

The next section will shed light on the purposeful governance of change in socio-technical systems while focusing on the industry's role as a 'capable agent' (Borrás & Edler, 2014) being embedded in different environments as portrayed by the triple embeddedness framework by Geels (2014).

2.2. Industry's Role in the Discontinuation of a Socio-Technical System

Within this section, the industry's role as an actor and factor in the purposeful discontinuation of a socio-technical system will be employed in depth, hence a close-up on the micro level of individual actors with their own knowledge and learning problems as well as governance practices (Stegmaier, Kuhlmann & Visser, 2014, p. 4) will be emphasised. This will be done by means of employing the main relevant theoretical concepts relying on the triple embeddedness framework (Geels, 2014), and the industry perspective approach developed by Borrás and Edler (2014).

As Kuhlmann, Shapira & Smits (2010, pp. 1-2) put it, *"innovation is of social, economic and technological character. It emerges sometimes spontaneously, sometimes as a result of actors' strategic endeavor"*. This paragraph emphasises the underlying assumption that industries and their actors, being socially embedded in different environments, may have significant influences on the socio-technical transitions and the governing of innovation by strategically driving for change. In the context of the ILB case, transitions and innovation is related to discontinuation. The governance perspective of changing socio-technical systems has been studied from different angles (Borrás & Edler, 2014). This thesis aims at a specific industry perspective approach analysing the governance of socio-technical change. Following the innovations system view, the analysis of a single company, a single field of knowledge and technology, or a single policy is not favourable, as the scope has to be widened (Kuhlmann, Shapira & Smits, 2010, p. 2). Dankbaar and Vissers (2010, p. 51) claim that *"the firm is the place where decisions are made, initiatives are taken and inventiveness is turned into real products sold for profit"*, hence the company is considered as a main actor in and as a place of the decision making procedures of innovation. Special focus is put on large enterprises as they are often frontrunners in technological change and innovation (Dankbaar & Vissers, 2010, p. 53). Even Schumpeter's early work acknowledged this special role of large companies due to the fact that he – viewing profits as precondition for innovation – claims that only these large enterprises, being in a dominant position in their markets, could afford to spend their considerable profits in R&D measures

which might enable them to innovate. Hence, *"it pays to be big and dominate your market"* (Dankbaar & Vissers, 2010, p. 54). Furthermore, the authors state that the limited amount of big companies competing with one another in oligopolistic markets tended to enable a preferable environment for both the incentives and resources for innovation (Dankbaar & Vissers, 2010, p. 55). During the 1980s the occurrence of strategic alliances between competitor firms increased steadily with the aim to decrease costs and splitting risks of R&D (Dankbaar & Vissers, 2010, p. 61).

Within this thesis the discontinuation of a socio-technical system (although represented by a relatively small and low-tech device, the incandescent light bulb) is a central aspect and needs special attention as a specific kind of governance of change in a socio-technical regime. However, in transition literature, the influence of discontinuation on socio-technical regimes seems to be almost poorly employed (Stegmaier et al. 2012), as transformations in these regimes often only refer to progress as well as technological substitution instead of the parallel occurrence of the phasing-out and termination of an incumbent socio-technical system. The purposeful discontinuation governance is specified as *"the deliberate, dedicated endeavour to discontinue established socio-technical systems and their associated regimes as purposeful coordinated and interactive governance action sui generis"* (Stegmaier et al. 2012, p. 26). The deficiency in the literature, as claimed by Stegmaier et al. (2012), is countervailed by the multi-dimensional conceptualisation of regime destabilisation of Turnheim and Geels (2013) and Geels (2014) that offers a triple embeddedness framework TEF, which is useful in particular for large, scale-intensive and politically powerful industries (Turnheim & Geels, 2013, p. 1750) which is the case in the discontinuation of the ILB. According to information from 2008 (which were then relevant in the context of the Eco-Design directive policy procedure), the seven members of the European Lamp Companies Federation (ELC)[5] collectively employed 50.000 people within Europe and had an annual turnover of €5 billion (ELC & CELMA, 2008a, p. 3).

The underlying assumption is that regime destabilisation entails three main processes, namely *"accumulation of external pressures, response strategies to performance problems, [and] weakening commitment to regime elements"* (Turnheim & Geels, 2013, p. 1750). The strength of this model is that it employs useful insights from very distinct disciplines, which are evolutionary economics, industrial economics, neo-institutional theory, as well as management studies. Industries are defined as "populations of firms", being embedded in an organisational setting that can be differentiated by an economic environment as well as a socio-political environment. The TEF furthermore offers a structuration of industry actors by an 'industry regime' that entails four main elements, namely a) mindsets and cognitive frames, b) identity, norms and mission, c) capabilities and technical knowledge and d) formal-regulatory institutions (Turnheim & Geels, 2013, p. 1752). The authors further suggest that industry actors are not only exposed to influences by external pressures but also act strategically in response to their environments while employing economic positioning strategies, political strategies, innovation/technology strategies, and socio-cultural strategies (Turnheim & Geels, 2012; Geels, 2014). Economic positioning refers to the position of certain industries in the economic environment and entails operations and supply chain management, as well as marketing and sales. Moreover, knowledge management, R&D, and product development alliances are seen as innovation and technology strategies. Relating to government policies, political strategies comprise lobbying, litigation, organized pressure strategies, financial support of political parties and lastly non-compliance strategies. The last set of strategies, the socio-cultural ones that are connected with

[5] The ELC's most prominent member companies were Philips, Osram and General Electric. However, it has to be stated that nowadays the ELC does not exist in its original form but is now represented by 'LightingEurope' the newly found European lighting industry association. For further information see this study p. 16 or visit: http://www.lightingeurope.org

public opinion and social discourses, include public relations, framing strategies, advertising and campaigns (Turnheim & Geels, 2012, pp. 37-38; Geels, 2014, pp. 269-270). Figure 1 gives an overview of the three kinds of the embeddedness and relations of industries.

Two ways of an industry's embedding relates to horizontal interactions between firms-in-industries with actors from on the one hand the economic environment and on the other hand the socio-political environment. The third embeddedness which is described as vertical describes the relations and ties between the companies and their industry regime (Geels, 2014, p. 267).

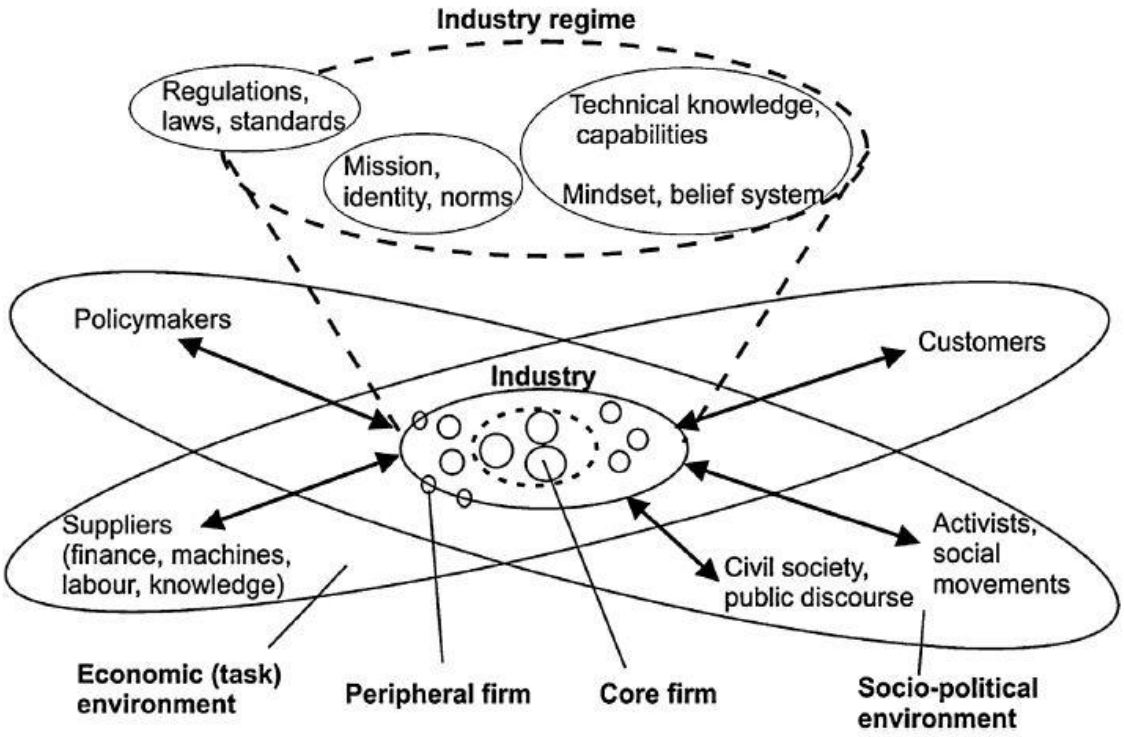

Figure 1 Triple Embeddedness Framework of Industries (Geels, 2014, p. 266)

As already indicated by Visser (2012, p. 13) all four core sets of strategies mentioned above have been clearly visible in the context of the discontinuation of the ILB. However, this thesis will mainly focus on the industry's way of (strategic) behaviour towards their environments in which they are embedded.

Besides these externally oriented strategies, Geels (2014, p. 270) introduces two internally-oriented strategies which are the behavioural and cognitive learning processes. By merging these processes into a single approach, Geels tries to tackle the flaws of each and offers a *'mixed behavioural-cognitive perspective on strategic reorientation'* (Geels, 2014, p. 271). The combined concept now acknowledges intentionality in combination with cognition, as well as considers corporate strategy not only as having dynamic capabilities but rather as using them respectively which implies the business' ability to make sense of those capabilities in an interpretative way. However, Geels' proposition *'that strategic reorientation progresses through four stages in which increasing pressures and performance problems stimulate actors to overcome lock-in mechanisms and question increasingly more foundational regime elements'* (Geels, 2014, p. 271) does not completely fit the specific case of the ILB discontinuation, as will be shown in more detail in the analysis in chapter four.

Nevertheless, the TEF approach will be employed as an eye-opener and adjusted to the ILB case reality.

The conceptual elaboration on the socio-cultural and economic context has already been employed above, so the focus should now be put on literature dealing with the agency/institution controversy. Agency here means individuals and organizations being 'agents of action' in innovation in socio-technical systems, whereas institutions refer to the informal or formal 'rules-of-the-game' enabling and inhibiting actors of innovation and socio-technical processes (Borrás & Edler, 2014, p. 7).

In the context of this thesis two of the three pillars building a concept of governance of change in socio-technical and innovation systems put forward by Borrás and Edler (2014) seem promising in enriching the understanding of the role of industry actors in the discontinuation of the ILB. The first pillar is concerned with the main question of who and what is a driving (f)actor of change by examining opportunity structures and capable agents (Borrás & Edler, 2014, pp. 26-27). Opportunity structures are defined as a particular technology/new knowledge which is embedded into specific social institutions while the role of agents is crucial here that enable governance of change by applying opportunity structures (Borrás & Edler, ibid). As governance is considered to be employed by bargaining and negotiation between state and non-state agents (Smith, Stirling et al. 2005, p. 1498), *"the exercise of relational power among interdependent agents of change in the process of generating guiding visions, framing problems and motivating other actors towards change"* (Borrás & Edler, 2014, p. 28) is a significant discursive/deliberative approach which has to be acknowledged. Besides, the differentiation between 'elite visionary agency' and 'everyday users'[6] (Smith and Stirling, 2010) is relevant, as the former tends to be prevailing in the governance process of change, enjoying substantial political authority which enables them to introduce even greater changes in comparison to everyday users. Hence, the authors claim that change is governed by capable agents who are acting intentionally and strategically and also acting as 'policy entrepreneurs' (Borrás & Edler, 2014, p. 28). Ambiguity is also of importance in this context as institutions as well as agents' experiences are viewed as ambiguous and leave room for the different organization and interpretation of social institutions by the agents. The second pillar which is relevant in the context of industry actors analyses the instruments employed in the governance of technological change while acknowledging the mechanisms used by agents to drive change enabling them to actually design and mould change (Borrás & Edler, 2014, p. 31). Governance instruments are split up into policy instruments employed by state agents and social agent's instruments which are designed by non-state actors while the underlying rationales for the intervention of the state are a) correcting market failure, b) correcting system failures and c) achieve certain goals/missions. These rationales should address problems related to insufficient investment incentives, specific deficiencies or problems of the prevailing system (Smits & Kuhlmann, 2004) as well as to the achievement of certain particular goals or grand social challenges such as climate change or the quality of life (Borrás & Edler, 2014, pp. 32-33). In line with the achievement of these goals it is relevant to mention the growing trend in innovation literature. This is the increasing emphasis on sustainability (cf. Elzen et al., 2004; Murphy, 2007) influencing innovation in a way that focus is put on developing low-carbon but high-value products. Due to the rise of grand social problems, such as sustainability, as well as the challenge of international competition, policy makers feel the need to adopt policies which enable an environment facilitating companies' innovative capabilities and taking a leading position in facing societal challenges (Shapira, Smits & Kuhlmann, 2010, pp. 455-456). In addition, social agents'

[6] Elite visionary agents refer to firms, policy entrepreneurs, inventors, researchers, and so forth while everyday users refer to lead consumers, civil-society organizations, NGOs, etc. (cf. Borrás & Edler, 2014, p. 28).

designed instruments refer to stakeholder participation, the discourse on alternative futures, technology assessment presenting its opportunities and risks, as well as non-binding voluntary agreements which are considered as a soft kind of accountability. In the context of technology assessment the constructive technology assessment (Schot and Rip, 1997) is especially relevant as it *"mobilises input and feedback on technologies in early design states and for re-design of technologies from all interested parties (end users, technical experts), thus not only assessing technologies, but influencing and governing the process of change in the socio-technical system"* (Borrás & Edler, 2014, p. 33). The third pillar of the authors' conceptual framework deals with the conceptualization of legitimacy in terms of a legitimate process of the government of change in socio-technical systems, and the public support and social acceptance of a (novel) socio-technical system (Borrás & Edler, 2014, pp. 34-35). However, this aspect of the approach will not be discussed in detail at this point as it will go beyond the scope of this study. Nevertheless, the author will refer to it in chapter six where further research approaches are recommended.

In order to have a theoretical fundament which helps explain how lighting industry actors influenced other relevant actors (especially policy makers, but also consumers, other industry actors, NGOs etc.) of the domestic lighting landscape in order to lobby for a transitional change of technologies, the next section will elaborate on an understanding of the interaction between industry and the policy-making sphere.

2.3. Industry in the Policy-Making Sphere and Implications for the ILB Case

This part of the thesis is meant to give a general overlook on the conceptualisation of different ways in which actors – here the emphasis is on industry actors – have an opportunity to influence policy formulation and policy-making processes. Hence, these analytical aspects contribute to the understanding of how actors governed the discontinuation of the incandescent technology.

In this respect, lobbying is a major way to influence policy-making and the respective legislation. The construct of the European Union (EU) offers manifold channels for industry actors to stipulate decision-making. Due to the fact that decision-making procedures are complex and executed in multi-level arenas involving numerable EU institutions like the European Commission – the initiating and guiding institution in terms of policy making – with its various Directorates-Generals (DG) and working groups, the European Parliament, the Council of the European Union, and so on, industry groups find numerous channels to approach EU officials. In the 1990s corporate political activities exploded, and as a response lobbying became competitive and crowded in such a way that corporatists developed new lobbying strategies to make use of those multi-level opportunities (Coen, 2009, p. 145).

According to van Schendelen (2010, pp. 157-158), a very effective manner is to invite responsible EU bureaucrats to, for instance, a free diner and thus have an informal and quiet conversation in which relevant topics are discussed and the industry's perspective is conveyed. Nevertheless, a more formal and official lobbying approach may be preferred by lobbyists depending on the specific situation at hand. At this point it has to be mentioned that considering and analysing the informal lobbying channels in the context of the Eco-Design Directive is on the one hand difficult to observe (in-depth interviews with top-managers of the industry and its federations, as well as EU officials that worked in the context of the Eco-Design Directive would address that problem) and on the other hand goes beyond the scope of this thesis. Due to the fact that it surely is an important lobbying channel, it will be further stressed in the part that gives an outlook on further research in this field.

The focus in the context of the policy-making procedure for the Eco-Design Directive is on the direct lobbying measures executed by the corporations in the arenas of the Commission, as this institution is the most popular 'venue shopping' channel (Coen, 2009, p. 147) which is also reflected in the analysed industry documents. As the Chief Market Leader of Philips, Ronald de Jong, puts it in a speech at Tilburg University, the Philips European Affairs Office in Brussels with its cultural diversity *"enables us to navigate with diplomacy with all the different levels of engagements we have from Commissioners and Heads of State, via Director-Generals, Directors and technical expert levels [and] looks for opportunities to influence policy to support our business objectives […]"* (Philips, 2013, pp. 4-5). Besides the Commission itself, this study puts emphasis on the Commission Consultation Forum, as well as the most important studies that have been done in order to prepare the Eco-Design Directive which are the methodology and preparatory study. However, the single company is not the only entity seeking to influence decision-making. In order to compete with other business groups for putting their topics high on the policy-makers agenda, the number of business associations visible in the Brussels policy environment increased considerably in the 1990s. Thus, collective action has evolved as a further lobbying tactic and is a suitable, powerful approach for corporations, especially for the big ones (Coen, 2009, p. 156). In this particular case, the sector-specific European Lamp Companies Federation (ELC) and the Federation of National Manufactures Association for Luminaires and Electrotechnical Components for Luminaires in the European Union (CELMA) play important roles in keeping close relations with the Commission and its officials and employ their collective action influence. The close cooperation between these industry associations is perfectly reflected in their merger into a single European lighting association 'LightingEurope'[7] that was founded in December 2012. Thus, the collective action of the lighting industry has been intensified and centralised by giving the lamp and luminaire manufacturers one voice in Europe. Moreover, collective activities improve the businesses chance to be permitted access to the policy making arenas as they are creating political mass as well as a viable political voice in the policy environment. These cooperative actions can have an ad-hoc as well as a permanent long-term character (Coen, 2009, p. 163). In the Eco-Design context, one example needs to be mentioned here, as three European federations – representing the European electricity industry, the European retail, wholesale and international trade sectors, as well as the leading lamp manufacturers in Europe – signed a common 'Agreement on the Promotion of Efficient Lighting' in 2008 in the presence of the European Commission (EURELECTRIC, EuroCommerce & ELC, 2008). Another point which creates a great channel of opportunity for business interests is the fact, that the Commission heavily relies on technical expertise and information from businesses of the respective industry sectors in order to discuss policy options in the various policy fora and develop adequate legislation. Van Schendelen (2010, p. 206) highlights the Commission has plenty of political expertise but lacks technical expertise and thus, the EU bureaucrats *"have to insource the latter via expert committees or inter-groups or by inviting experts to come along."* In the discontinuation of the ILB this happened mainly within the Consultation Forum, where different stakeholders negotiated about the phase-out of inefficient lighting.

Now that an overview of the different channels and approaches of how to lobby the European Union decision-making process that are relevant in the context of the Eco-Design Directive have been given, the following part introduces theoretical concepts that further add to the understanding of how business influence groups act within the EU policy making sphere.

[7] For further information see: http://www.lightingeurope.org

To begin with, the model of policy cultures offers a realistic outlook on how policy is formulated reflecting the interactions between politics and a broader range of actors. The model assumes that there co-exist four central policy cultures – civic, economic, bureaucratic and academic – competing for resources and influence in knowledge production and its transfer into policy making (Jasanoff & Wynne, 1998, p. 14). These cultures have their very own underlying assumptions, images and ideals of science which – through mutual conflict and interaction – form a distinct policy framework, such as the 'green and sustainable policy framework' of the ILB case which balanced the various views of the policy cultures. The policy culture is based on a particular ideology focusing on values, following specific subjective interests while making use of opportunistic tools such as bargaining and negotiation. In contrast to this, the academic culture is concerned with objective facts, being neutral and not following particular interests while applying standardized methodological tools in order to find 'the truth'. Next to this, the economic culture may have an outstanding role as it mainly focus on cost-benefit matters in order to frame specific policy problems and can become dominant in the interactions of the different cultures, hence significantly influencing the adopted policy framework (Jasanoff & Wynne, 1998). The policy culture model can be related to social embedding of technology in general, and it may constitute a very overall, and initial conceptualisation of the industry's (in this sense the economic culture) embeddedness in different kinds of environments.

However, as the literature on global corporate (political) activities suggests, the lines between the economic and the political 'culture' are blurring on a global level so that nation-states can hardly control the multinationals' abidance by regulations when it comes e.g. to labour rights or environment protection, as *"a significant part of global production has been shifted to locations that lack democratic control and where there is no rule of law"* (Scherer & Palazzo, 2011, p. 902). Moreover, market actors sometimes commission their own research (cf. Waide, 2006; 2010) which means a merger of two different cultures where economic reasoning is likely to be dominant. In this context, the 'knowledge constitutive' perspective introduced by Habermas (1972) also acknowledges opportunities for certain actors to feed 'their' knowledge into policy formulation processes, which can be seen as influencing the outcome of a (discontinuation) policy. This notion on knowledge interest describes three centric rationalities: Instrumental, strategic, and communicative rationality. Within the instrumental rationality, control is a central aspect aiming at maximizing the own interests. Next to this, strategic rationality tries to understand and control, which means maximizing your own profits while understanding the behavioural strategies of other actors. The third type of rationality assessed by Habermas is the communicative one having the central goal of authentic mutual understanding and full self-transparency in order to establish a public interest which is free of any power context. The best developed argument which is agreed on then becomes dominant and influences policy formation (Habermas, 1972). If industry agents adopt the instrumental or strategic rationality in social interactions, their main goal is the maximization of their very own interests and influencing policy formulation by means of the specific knowledge produced which is opposed to the power-free context of the communicative action. In the light of the decision-making procedure on the Eco-Design Directive, the Commission depended on the specific input and expertise from the lighting industry actors throughout the creation of a methodology for energy-using products, the selection of suitable product groups (EC, 2005b, Appendix III, p. 1), and the decision on implementing measures of the Eco-Design Directive in the context of the Consultation Forum (Consultation Forum, 2008b; 2008c). Thus, industry was involved in the preparation of the phase-out from the very beginning and throughout different levels and stages of the Eco-Design decision making framework.

Furthermore when it comes to lighting companies 'feeding' the decision-making process with their own evidence, the conception of competing rationalities as introduced by Lin (2003) is relevant; it shows that evidence based policy is a difficult achievement (Lin, 2003, p. 14). The key notion here is that there are three main competing rationalities – cultural, political and technical. The crucial claim is that successful policies can only be realized when adequately balancing the competing rationalities – or respectively policy cultures following Jasanoff and Wynne's notion. In reality, as already stated above, there can be an unbalance between different rationalities, while the dominating one may impose evidence which is considered to be the true one, even though it may be false, irrelevant or unreliable. Banning the ILB technology was claimed on argumentation and evidence that were mostly created and diffused by international economic fora of countries, such as the Organisation for Economic Co-operation and Development (OECD)[8] (cf. OECD, 2008), or IEA (cf. Waide, 2006; Lefèvre et al., 2006; Waide, 2010), as well as single companies (Philips, Osram, etc.) which introduced their technical expertise into the policy-making process of the Eco-Design Directive.

The discourse analysis is in this investigation used as the key methodology to look into how policy makers rely or have to rely on available scientific findings. It is based on Hajer's (1995) account *"that actors and institutions are shaped by their own discourses, which delimit their moral identity, and their cognitive horizons, shaping in effect what they care to know"* (Jasanoff & Wynne, 1998, p. 15). Discourses are here defined as *"ways of enacting socially significant identities and associated practices in society through language […] and ways of acting, interacting, valuing, knowing, believing and using thins, tools, and technologies at appropriate times and places"* (Gee, 2011, pp. 108- 109). Thus, even though the same scientific knowledge might be available for different policy makers, differences in their discourses influence the way they consider something as fact, evidence or good science (Jasanoff & Wynne, 1998, p. 15). In the ILB discontinuation case several opportunities for industry actors were given, as already highlighted above, to incorporate their discourses into the policy-making process (EC, 2005b, Appendix III, p. 1; Consultation Forum, 2008b; 2008c).

As Tannen (1993, p. 4) highlighted *"[…] the concept of framing provides a fruitful theoretical foundation for the discourse analysis […]"*. Therefore, to understand the different ways of communicative 'meaning-making', varying accordingly to the different discourses applied, the different conceptualisations of framing are also inevitable to the analytical framework, as the various frames, especially those employed by industry actors trying to influence the decision-making process, will be analysed.

The way industry actors frame specific topics, such as the discontinuation of the ILBs as a 'triple win situation for the environment, consumers, and policy makers' (ELC & CELMA, 2008a, p. 9) creates another area of influence for interest groups and is also coloured by the prevailing discourse. According to Rein and Schön (1993) framing *'is a way of selecting, organizing, interpreting, and making sense of a complex reality to provide guideposts for knowing, analyzing, persuading, and acting'* (Rein & Schön, 1993, p. 146). Frames convey meanings and values rather than facts to make sense of problematic situations and hence to take action. The authors identified three interrelated levels of framing namely personal life, the scholarly or scientific inquiry and policy making and further claim that framing leads to different views of reality as there are various angles from which the 'worldmaking' takes place (Rein & Schön, 1993, p. 146). Due to the fact that different frames of the world exist, there arise policy controversies deriving from these conflicting views. This concept can again be related to the already mentioned competing rationalities and the unbalances within co-

[8] For further information see: http://www.oecd.org/about/

existing policy cultures. The empirical part of this study detects profound ambiguity in the lighting industry's introduced frames, facts and evidence, which countervails the assumption that CFLs are beneficial for the environment, consumers or the European economy, as, for instance, remarkable job losses in Europe (Die Presse, 2014) or poisoned workers in Chinese CFL factories (Sheridan, 2009a; Sheridan, 2009b; Profil, 2009) have been reported. Minsky (1975) introduced a hierarchical frame system of related frames in which the highest level in this hierarchy consists of 'thematic superframes' that provide broad and general information (Minsky, 1975, p. 236). Below this category, there are 'top-level' frames adding some more information but in a rather stereotypical way. The lowest level of frames is the 'subframes' one which contains the most details about the concerned topic (Minsky, 1975, p. 223).

As Rein and Schön state, the extreme positivist view on frame controversies supposes that facts and logic are able to settle meaningful controversies, whereas extreme relativism claims that all framings of an issue are equally valid (Rein & Schön, 1993, p. 150). Nevertheless, a third approach is offered that lies between these extreme perspectives; empirical epistemology, which seems more favourable in the industry context as it offers a less extreme view on policy controversies. This approach focuses first on the questions of how a shift in framing of a policy issue can change over time and second it encompasses a frame-reflective discourse analysis which is concerned with a detailed analysis of the particular frames in order to learn across these conflicting framings (Rein & Schön, 1993, p. 150). Moreover, the role of science is depicted in more depth. As policy controversies heavily rely on the meanings of a frame which precede evidence and facts and only make sense when related to the purposes underlying different frames, *"there is an increasing doubt about the neutrality of science as an agent in debates over the framing of policy issues"* (Rein & Schön, 1993, p. 160). Furthermore Lakoff (2006) argues that frames of a certain policy issue often rely on false facts and that reframing that issue to come up with the truth or more reliable facts needs a lot of time, effort and money and has to be done in a diligent, sensible and morally right way because you have to detect and refute an antagonistic myth (Lakoff, 2006, p. 4). This notion can be related to the lighting industry as 'capable agent' spending a lot of resources (time, money, etc.) to establish and maintain the discourse and framing of the ILB technology as inefficient and simultaneously claiming the promising advantages of the more energy efficient novelties for mainly policy-makers but also end-users and NGOs (education, information campaigns, etc.), while it reflects on the indispensable efforts which are needed to reverse that industry frame. In the ILB case the MEEuP is an example for a piece of research which creates a methodology that at some points raises concerns about its neutrality. For instance, there are concerns about the way toxicity is determined and about the neglected CO_2 emissions resulting from the transport of products coming from outside EU borders, such as the majority of CFLs do (VITO, 2009b, pp. 145-146). These concerns will be further elaborated in subsection three of chapter five.

Due to the fact that this study aims at analysing the relevant 'capable agents' being visible and influential in the decision-making process of the discontinuation of the ILB and which interest groups were neglected throughout that process, the following theoretical account is also of relevance for this analytical framework. According to policy analysis literature (Colebatch, 2002, p. 36), it is not only relevant to analyse 'who makes policy' but also 'who participates in the policy process'. The emphasis made here, is that not every actor who has an interest in settling a policy problem will necessarily be involved, and moreover, the involved stakeholders may not always have an equal say in the process. Colebatch also states that participation in policymaking is not neutral, as different stakeholders tend to have different perspectives on the policy problem and are thus shaping what

the issue is. Therefore, *"the problem and the participants are 'mutually constitutive': the one reinforces the other. Neither who the 'decision-makers' are nor what problem they are addressing are self-evident phenomena: they are constituted in the policy process"* (Colebatch, 2002, p. 36). Within the decision-making process leading to the ILB ban, various interest groups from business, culture, societal, and environmental background have been involved in the Consultation Forum of the Eco-Design Directive. However, organizations and actors from the 'economic culture' dominated this forum, as out of 30 stakeholders being involved, about two-thirds fall under the industry actor category while only three organisations represented consumer interests and only two stakeholder groups had an environmental background (Consultation Forum, 2014). Thus, it can be assumed that economic and market interests also prevailed within this process and influenced the outcome considerably. Colebatch (2002) does also give a nice definition of 'advocacy coalitions' within policy communities, which is, in the struggle for power, participants seeking support of other stakeholders being close to them. This in turn, will provoke the creation of a counteracting force of actors (Colebatch, 2002, p. 35). Thus, this policy analysis perspective nicely reflects that (industry) actors inhibit a more influential role in policy formulation processes than other stakeholders, framing the issue at hand in their very own view and even forming powerful advocacy coalitions in order to enforce their strategy, which was the case in the discontinuation of the ILB policy making process.

All in all, this study adopts an approach that mainly borrows from Geels' TEF approach (2014) and Borrás and Edler's work (2014), but at the same time adjusts these conceptions to the particular case at hand. In order to reconstruct the lighting industry's role in the discontinuation of the incandescent light bulb, incumbent firms such as Philips and Osram will be analysed in their broader embedded contexts of their respective industry regime on the one hand and their relations to their economic as well as socio-political environments on the other hand. As far as the embedding of the lighting industry into its' socio-political as well as economic environment is concerned, Borrás and Edler's capable agents and opportunity structure approaches complement the TEF by asking for the driving (f)actors of the discontinuation of the ILB. Furthermore, the 'elite visionary' and 'every day user' concepts add to the TEF, too, in order to detect prevailing interests. The employed industry strategies as introduced by Geels (2014) are analysed while combining externally oriented corporate activities, which are the political, economic, normative and cultural ones, with the internal adjustment strategies and finally adjust this approach to the ILB case. This perspective will be improved by incorporating the various governance instruments highlighted by Borrás and Edler (2014).

The presented theoretical frame is employed as the fundamental groundwork for the analysis of this thesis while the initial versions of this frame have also been subject to amendments caused by deeper insights gained throughout the analysis itself. This can be described as a flexible, iterative-recursive relation between theory and data and will be highlighted in chapter three, where the major research approach of qualitative interpretive analysis will be discussed.

3. Research Methodology

This chapter of the thesis presents the particular research methods chosen for studying the industry's role within the ILB discontinuation process. In the first part the interpretative approach will be elaborated in detail introducing the two central applied methods and a single approach that was employed as a guideline for this inquiry. In a next step, the main research question as well as various sub-questions that enabled the analyst to answer the central question will be presented. The third part of this methodology chapter is aimed at portraying the specific data collection and analysing

steps that have been executed throughout the inquiry. Finally, limitations of this study will be discussed in the last section.

3.1. Research Approach

The major research aim of this thesis is contributing to a better understanding of the role of the light industry in the governance of discontinuation of the ILB technology. The theoretical framework developed above defines this thesis' analytic approach on the industry's role in the discontinuation governance and illustrated the importance to analyse industries' in their triple embeddedness context as well as view them as capable agents making use of opportunity structures in order to drive technological discontinuation. Special focus should hereby be given to the different types of discontinuation problems and the specific issues encountered by the industry actors. This approach puts furthermore emphasis on the broad set of various strategies of action that have been formulated and employed by industry agents in order to position themselves as influential actors in the discontinuation governance process. The central corpse of this thesis, namely the analysis, will focus on the specific case-study of the discontinuation process of the ILB. Following Bryman's notion (2004, p. 48), the case-study design enables the researcher to execute a complex and in-depth analysis, in this case on the termination of the ILB technology. The case study of the phase-out of the ILB has been adopted due to its exemplifying character enabling a more detailed understanding of industry agents' behaviour within the governance of this specific discontinuation. As Visser (2012) already emphasized the governance of discontinuation issues in general, this case study at hand will focus on the embedded interactions between the industry, policy-makers and other involved stakeholders, such as NGOs, which structured the process of termination, acknowledging the various forms of embeddedness and the strategies and actions employed by industry. Due to the fact that the policy which led to the phase-out of the ILB technology in the EU was formulated and adopted within the European policy-making trajectory, the focus is on the supranational level. However, the context of the global actions on the ILB termination and its relevance for the EU legislation will be briefly discussed within the analysis part as well. Moreover, as the policy-making sphere will be analysed in detail while zooming in on the micro-level with industry agents as potential determinant actors, the policy analysis approach will be helpful in examining available, relevant policy documents in-depth.

Within the wide field of policy analysis, various approaches developed in the course of time. A general statement given by Dunn (2008, p. 1) defines policy analysis as *"a process of multidisciplinary inquiry designed to create, critically access, and communicate information that is useful in understanding and improving policies"*. Choices on methodology have to be made anew for every piece of research analysing policies, as there is no ubiquitous single policy analysis method which can be employed that is universally valid. The major method that is used in this thesis is the interpretive analysis as e.g. portrayed by Schwartz-Shea and Yanow (2012). This style of analysis is based on the most relevant parts of the analytical frame developed above, as it puts emphasis on the various kinds of embedding of agents being involved in policymaking, as well as acknowledging that therefore different actors have different understandings and make different meanings of policy issues at hand (Yanow, 2000, p. 9). As Sadovnik (2007, p. 420) puts it, qualitative research methods aim at understanding the social world by means of an active construction of knowledge at which the invention of instruments and tools to gather and generate data plays a significant role.

It has already been highlighted that the discontinuation of technology, as well as the even more specific approach of the purposeful governance of discontinuation viewed through the lens of

industry actors, as proposed in this thesis, is under-evaluated in the literature. Thus, an explorative mode of analysis will be adopted within this project. Even though the relevant literature of discontinuation governance and related sciences allow for this thesis to initially offer an analytical framework, it is not considered to completely satisfy research methods based on a deductive style of inquiry. Deduction is a way of reasoning *"that begins with theories, which lead to hypotheses, from which testable concepts are generated and then tested against a set of observations"* (Schwartz-Shea & Yanow, 2012, p. 27). Following from this deficiency, approaching and explaining the case study of the ILB by relying on an already existing and well-defined body of theoretical conceptualisations, is not possible. That is why this thesis opts for the introduction of the 'abduction'-inspired character of interpretive analysis that is meant to mediate between induction and deduction styles of research and will be discussed in detail in the following. Besides the interpretive analysis, the grounded theory approach will also be central to the methodology of this study as it is a profound method to investigate a phenomenon without applying pre-fixed theories and hypotheses and creates theories about 'social reality' from the analysed data at hand.

Interpretative research design

The primary focus of interpretative research is in 'meaning-making', as analysts aim at knowledge that portrays how various kinds of people, including the researcher itself, make sense of their specific worlds, individually as well as collectively. According to the authors, *"human beings are understood not as objects, but as agents […] actively and collaboratively constructing (and deconstructing, meaning both critically assessing and changing) their polities, societies, and cultures – along with institutions, organizations, practices, and […] concepts that populate these"* (Schwartz-Shea & Yanow, 2012, p. 46). Nevertheless, these social and political contexts simultaneously frame the actions, discourses and thoughts of these actors. Interpretative analysis therefore acknowledges that the expression and communication of meaning to others or oneself leaves space for multiple interpretations. In relation to policy analysis, Wagenaar (2007, p. 429) claims that it is inevitable to identify the attributed meanings being relevant to a particular policy in order to understand the policy-making process adequately. According to Yanow (1996, pp. 10-11), *"all language, objects, and acts [the so-called cultural artifacts] are potential carriers of meaning, open to interpretation by legislators, implementors, clients or policy 'targets', concerned publics, and other stakeholders. At the same time, they are tools for the recreation of those meanings and for the creation of new meanings. […] We communicate, in other words, through artifactual interaction, interpreting the more concrete symbolic representations […] that embody our and others' values, beliefs, feelings, and meanings."* The interpretation of such symbols enables the analyst to understand the related meanings as well as their cognitive (value), moral (belief), and affective (feeling) properties (Yanow, 1996, p. 11). So for the case of this study it is important to ask for how industry actors frame the discontinuation process and the related barriers as well as how the lighting industry is embedded into its' wider context. According to Schwartz-Shea and Yanow (2012, p. 82) it is essential in interpretative analysis to seek multiple 'truths' as being conceived by the different actors, being aware of potentially contradictory or conflicting 'truths'.

Problem discourse tracing

As already highlighted, this study aims at zooming in on the lighting industry's purposeful governance of discontinuation of the ILB by reconstructing the industry discourses related to problem perceptions and problem solving approaches while also considering the discourses of NGOs or other relevant actors in the context of the Eco-Design framework. Therefore the discourse tracing

approach is adopted as a central method with a special focus on industry problem discourses. In this respect, it has to be stressed that perspective and perception is mainly one-dimensional as the author approached the investigation through the 'lighting industry lens' in order to reconstruct the 'meaning-making' of what constitutes problems to industry actors and how they addressed those problems. However, the author also gives an overview of relevant discourses that are in conflict with those of the industry and challenge them and their related 'meaning-making'. Discourse tracing developed within the critical-interpretative research field and it perfectly suits this investigation as it *"moves beyond the number of utterances, items or classifications present, and moves toward asking* how *and* why *such issues came into being and how various levels of discourse play a role in their creation and transformation over time"* (LeGreco & Tracy, 2009, p. 1522). The major aspects of the four phases of discourse tracing (research design, data management, data analysis and evaluation) is reflected in this study as data is gathered from various forms of sources that involve macro, meso and micro levels of discourse and then ordered in a chronological way (LeGreco & Tracy, 2009, p. 1523) which has been considered in the methods of this study.

Grounded theory approach

The grounded theory approach is a classical, theory developing, qualitative method (Brüsemeister, 2008, p. 151) which was founded and introduced by Strauss and Glaser in 1967 and has been further developed in the course of time being an integral part of the 'family' of interpretative research approaches. Glaser and Strauss developed this methodology as an opposing response to extreme positivism prevailing in most social research in that time due to the fact they rejected the positivist view that natural and social sciences are concerned with the same kind of subject matter. More specifically they challenged the notion of 'grand theory' which assigns the uncovering of pre-existing and ubiquitous explanations of social conduct as the purpose of social research (Suddaby, 2006, p. 633). "*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). Furthermore, this approach offers a *"[…] systematic data collection [procedure, which] could be used to develop theories that address the interpretive realities of actors in social settings"* (Suddaby, 2006, p. 634). Sadovnik (2007, p. 422) highlights that *"its main contribution is generating theory from data in a systematic way – theory grounded in the data [while] grounded theory research examines cases in detail and continues to build theory from bottom up – based on observation of particular data."* These observed data comprises a broad variety of various forms of data such as transcripts of meetings, interviews, court proceedings, as well as field observations or documents like letters and diaries, census statistics, et cetera (Brüsemeister, 2008, p. 151).

Corbin and Strauss (1990, p. 5) stress that *"the procedures of grounded theory are designed to develop a well integrated set of concepts that provide a thorough theoretical explanation of social phenomena under study."* Due to these characteristics of grounded theory, the method is considered to suit the purpose of this rather new research field of the discontinuation of sociotechnical system. The reconstruction of the particular case of ILB discontinuation and the related governance efforts made by the lighting industry while identifying and interpreting the actors' attributed meanings is a central aspect of this study. Furthermore, this project is aiming at a conceptualization of the lighting industry's role in the discontinuation of a socio-technical system. This is been done by building categories, in the sense of the grounded theory approach, that typify the discontinuation barriers

and the respective strategies of action addressing these barriers as being presented in the traced industry discourses.

Moreover, another essential aspect of this research method is theoretical sampling. This is a process where the researcher enters the field of investigation without having a predetermined theoretical framework. The investigation rather begins with a partial framework acknowledging some principal features of the structure of the social phenomena the author will study (Glaser & Strauss, 1967, p. 45). In this research project, the already existing literature on technology discontinuation and its' purposeful governance has been assessed in order to get a first overview of concepts as discussed in the theory chapter. Thus, having a first starting point, the researcher collects first samples of data on the case and starts coding and analysing it which subsequently leads to emerging theory from the data which then influences the decision on the following data collection procedure (Glaser & Strauss, 1967, pp. 45-46). Subsequent steps involve e.g. decisions about which data to be collected next and which groups of actors to be focused on. Another claim made by the authors is that the fact that the categories are directly emerging from the data and that they are constantly being redefined by the data which then leads to strong confidence in the identified categories (Glaser & Strauss, 1967, p. 76).

The very first version of grounded theory (Glaser & Strauss, 1967) is related to an inductive way of research but was further developed e.g. by Corbin & Strauss (1990) which described a method of research which uses abduction. Interpretative methods, as applied in this study and as already mentioned above, also describe an abductive sort of research which will be central in this study. This means the analyst initiates research by finding a puzzling or tensed situation trying to identify circumstances that give a less perplexing explanation of the initial puzzle. Furthermore this research approach is characterized by an iterative-recursive style of inquiry in which the researcher goes back and forth between the puzzling situation and possible explanations by means of investigating different field situations, e.g. other documents or observations, or related theoretical literature. Hence, abduction follows a rather circular-spiral pattern, having no clear starting point, however, allowing the analyst to continuously aim at a richer and deeper understanding of the investigated topic by going back and forth between theory and data in order to learn about issues being confronted with by analysing more data samples (Schwartz-Shea & Yanow, 2012, pp. 27-33). The intertwining of data collection might also lead to an elaboration of choices with regard to research design and questions, as was the case in this study which will be discussed in detail in subchapter two of chapter three. Another central characteristic is contextuality as interpretative analysts seek for explaining their research findings or generated theory about their subject of research in context of the analysed scenery. Hence, such a 'thick description' would contain the 'whys' and 'hows' of the historical, economic, cultural, demographic, etc. background being relevant and enabling a better understanding of the investigated 'puzzle' (Schwartz-Shea & Yanow, 2012, p. 48). In this respect it has to be stressed that interpretative policy analysis considers the stakeholders of a policy to be active agents hence challenging the prominent view of being a passive recipient of the meaning of a policy (Yanow, 1996, p. 26).

Revisiting the most important features of the discourse tracing, grounded theory and interpretative analysis methods, which altogether are guiding the analyst towards the generation of adequate research questions for this specific case study, the following steps in research are followed. As a first step the identification of relevant lighting industry actors involved in the ILB discontinuation policy process is inevitable, and then empirical sources have to be collected where these actors formulate

their problem framings. Next to this, a reconstruction of the various meanings, hence the industry actors' frames applied on the policy problem has to be conducted. Within this process, the problem framings which can be 'conflicting truths' or 'supporting truths' of other actor groups will also be central as they give another opportunity to show interactions of the industry and make the description of the analysed social phenomenon 'thicker'. Moreover the embeddedness of the lighting industry is also of importance will also improve the thick description. The following parts will present a more detailed discussion of the initial research questions and the specific research design of this study.

3.2. Research Questions

As already presented in the research approach above, the qualitative interpretative research style of this thesis is done in an abductive style which is formulating initial research questions by means of the researcher's prior knowledge of the case in focus. These questions function as a departure point for the researcher to initiate the first steps of research, giving a guide on which data to analyse and what to look for within these data. It has to be highlighted, that abduction means that the research questions are not seen to be fixed and that they preferably should alter throughout the investigation process. In case the researcher gets to know more about the phenomenon she is studying, she may decide to collect new data and theoretical input which suit her research goal more adequate and bring new (theoretical) insights. Having achieved new knowledge about the case means that the researcher should check in-between if the initial questions still incorporate her research goals properly as these can change over time as well. In this specific case of the industry's endeavour within the discontinuation governance of the ILB, the research questions have changed significantly throughout the whole process due to a shift in research perspective. Therefore, only the latest set of research questions will be presented here in detail. The first collection of research questions were preoccupied with the specific level of influence and power the lighting industry executed in order to influence policy makers and achieve particular industry objectives. However, as until now little research has been done in this specific case and in purposeful discontinuation governance in general, the researcher, doing explorative investigations, shifted her initial research focus to portraying a more general overview of the lighting industry's governance of discontinuation and the issues related to it. Even though there was a shift to a more general perspective, the research was executed in an in-depth style of gathering knowledge from the analysed data and interpreting it respectively. With the aim to give a 'thick description' of the lighting industry's role in the discontinuation of the ILB the following main research questions has been employed:

RQ: Which issues of the discontinuation of the ILB constituted barriers for the lighting industry and how were these issues managed according to relevant industry and policy discourse?

In order to give an adequate answer to this general research question, the following sub-questions have been generated:

> *SQ1: Which light industry and non-industry actors were involved and/or contributed to the adoption of the EU ILB discontinuation policy?*
>
> This initial question can be considered as the point of departure leading the researcher into the specific field of inquiry by giving a first overview on relevant industry and non-industry actors and leading to a first set of data samples. The theoretical sampling procedure of the grounded theory, as discussed in the following section, gives an answer to this question.

SQ2: What type of discontinuation barriers and specific issues did the involved industry actors identify?

The first part of the analysis of this study is aiming at identifying and interpreting the particular discontinuation issues framed by relevant industry actors as well as integrating them into various types of barriers. These analytical steps are considered to find an adequate response to this sub-question.

SQ3: How were the discontinuation barriers governed by the lighting industry?

Within the second part of the analysis this question is being answered by conceptualizing the industry's efforts of discontinuation governance that aimed at effectively addressing the identified barriers of discontinuation.

SQ4: How could the empirical insights of the discontinuation of the ILB define a first conceptualization of the discontinuation governance of technology for industry actors?

Due to the fact that grounded theory seeks to generate a preliminary theoretical conceptualization, in this case of the discontinuation of a particular technology and the related governance of problems, this study will present initial explanations about the industry's role in the governance of technology discontinuation.

3.3. Corner Stones of the Actual Research Process

As Visser (2012) already investigated the general governance of discontinuation, this research project is focusing on the role of the lighting industry in the ILB discontinuation process. However, as already indicated, if the analyst acknowledges other actors of having a stake in confronting or supporting the industry's position and actions throughout the process, they were also incorporated within the analysis in order to give a 'thick description' of the analysed situation. The dominant method of qualitative and interpretative analysis was a document analysis of policy and industry documents. These documents were collected by accessing the publicly available archives of the relevant industry actors as well as relevant EU institutions, where a range of policy documents of the process leading to the Eco-design Directive were found. The different ways of framing and meaning-making of industry and non-industry actors were identified by means of these documents which therefore built an important base for the analysis of the industry's discursive properties of the ILB discontinuation. Moreover they enabled the researcher to detect the different strategies of actions adopted by the industry to overcome the perceived discontinuation barriers. On the one hand the documents functioned as repository of the units of analysis, namely the various codes established by the analyst. However, on the other hand they also acted as a guide to the researcher due to the fact that they led to new insights and hence the analyst knew which documents to collect as a subsequent step, which actors to analyse next or even which theoretical concepts to review in order to improve the research process. The following parts will elaborate on the data collection and the analysis of data.

Data collection process

In general, the data sampling of this study focused on documents from internet sources that are open to the public and thus easily accessible. However, there was only a single case where access was limited, as will be portrayed in the following.

The initial step of the data collection was to search the online archives of the European Lamp Companies Federation, as the study was intended to zoom in on the lighting industry's role within the ILB discontinuation process, which was considered to be mainly structured on a European

trajectory. The focus was on finding different types of documentation about the Eco-Design Directive of the European Union, the general topic of an ILB phase-out (without special reference to the Eco-Design legislation) and the promotion of CFLs as replacing technology for ILBs. After revisiting the first set of documents, the analyst decided to also search for similar documentation within the online archives of some single members of the ELC, namely Philips and Sylvania[9], as well as the federation of luminaire and electro technical components manufacturers CELMA. This should help to broaden the range of documents and to see how the bundled representations of the manufacturers on EU level as well as single companies handled and which meanings they attributed to the ILB discontinuation topic. The variety of documents ranges from press releases, industry statements, summaries or memos of meetings, correspondence with EU institutions, to annual and quarterly reports.

Despite these first hand industry document, the analyst was also interested in documents from the policy making process of the EU for the ILB phase-out in order to analyse communication between the different policy making actors and industry. In this context, it has to be mentioned that access to a set of EU policy documents of the ILB discontinuation database of the DiscGo project was given. As already outlined by Visser (2012, p. 30) the whole decision making procedure was structured. Therefore, the documentation came from the EuP4light project, which defined an initial set of eco-design requirements, and from the Consultation Forum, in which several stakeholders, such as experts, members of consumer and environmental organizations and representatives of the EU member states discussed and elaborated on the proposed eco-design requirement. In the specific context of the Consultation Forum it has to be mentioned, that the researcher was granted access to the Communication and Information Resource Centre for Administration, Businesses and Citizens[10] of the European Commission which contained even more detailed documentation about the Consultation Forum meetings. However, the publicly access was limited in a way as one has to create an account, stating one's background as employee of an EU institution, an external expert or a citizen using the information system, and wait for being granted access to these resource platform by the European Commission Authentication Service (ECAS)[11]. After having been granted access, the analyser could select documents from the stakeholders mentioned above which have been submitted before and after the meeting of the Consultation Forum. The third source of the data sampling from the EU policy making sphere was the SCENIHR report, the outcome of a study which was executed as a reaction to health concerns about the use of energy efficient lighting, especially CFLs which arose throughout the Consultation Forum.

Throughout the iterative-recursive process of data collection and analysis it became apparent that the ILB discontinuation was also structured on an international or rather global level. For instance awareness arose from a joint workshop held by the OECD in September 2007 at which Philips gave an important presentation about energy saving lighting (Philips, 2007a) as well as from a joint IEA and European Commission workshop also held in 2007 where the quality of CFLs and the phase-out strategies of ILBs were discussed. Hence the analyst decided to also sample most relevant data from databases of relevant organizations such as the UNFCCC, the International Energy Agency and the OECD. Moreover, at several points throughout the analysis, some newspaper articles have also been added to the data sample in order to shed more light on specific issues and make meaning of them.

[9] Due to the fact that the homepage of Sylvania did not present adequate information being related to the research topic, the analyst contacted the press office of the company to ask for additional information but got a negative answer about related press releases.

[10] CIRCAB, more information available via: https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp

[11] ECAS, more information available via: https://webgate.ec.europa.eu/cas/wayf?loginRequestId=ECAS_LR-2010463-zg0ry5zssQtYizQKzsJFPcuF3JjFtjoNCXrdfMfQ2GHXSOwBpOAxXMM4xSxA5JxjkpBc1zmkDHgQBhqWYj1bFPG-PHslUMVSXYCaH46bSwEPAC-PndE9qzuq7wyuqhY63vQl7Gy45F6CqIRJP3DKzTNKus0&caller=%2Fcas%2Flogin

Analysis of data

Again, it has to be highlighted that even though the analyst also made use of the initial version of grounded theory introduced by Glaser and Strauss in 1967 which described an inductive way of analysis, this study adopts an abductive way of analysis as employed by the evolved grounded theory (Corbin & Strauss, 1990) and by the interpretative qualitative research approach.

The structuration of the data followed the steps of searching for relevant incidents in the selected data which contain important aspects of the analysed topic of the industry's role within the ILB discontinuation. Quoting these passages, thinking about the selected incidents and interpreting them, and then applying a certain code on these incidents describes the subsequent steps of structuring data within this study. As the coding procedure goes on, certain codes have been found being equipped with certain properties such as causal, conditional and consequential mechanism giving more details on the analysed topic. This process is named 'open coding' and described by Corbin and Strauss (1990, p. 12) as follows: *"In open coding, events/actions/interactions are compared with others for similarities and differences. They are also given conceptual labels. In this way, conceptually similar events/actions/interactions are grouped together to form categories and subcategories."* Within open coding, the generation of new questions guiding the researcher to new insights as well as the constant comparison of concepts and their properties to make sure they still suit the data are inevitable to execute a sound analysis. This has been the case in this study, as the analyst, being inexperienced within this qualitative interpretative field almost ended up in a 'code swamp' (Friese, 2012, pp. 117-118; 122-123) which describes a situation where you are applying too many codes and almost losing sight of the focus of your study. Hence, an extensive reconsideration and re-structuring of the almost applied codes to the selected incidents found in the documents has been executed by merging codes which describe similar incidents or actions, erasing irrelevant ones and building new subcategories/properties where needed.

As a next step *'axial coding'* was done by the analyst. *"In axial coding, categories are related to their subcategories, and the relationships tested against data. Also, further development of categories takes place and one continues to look for indications of them"* (Corbin & Strauss, 1990, p. 13). Hence, the analysis was taken to a higher conceptual level as the subcategories of contexts, conditions, strategies of action and consequences were related to a specific category. In the context of this study it means that if an incident of discontinuation was being identified that established a problem for the lighting industry, scrutinizing the data to determine which pre-conditions facilitated or enabled these issues, the context in which they appear, the strategies of action to be taken to address them and finally their consequences is necessary for axial coding. The last step of coding is *'selective coding'* which describes the procedure of unifying all categories around a particular core category which represents the major phenomenon of this study (Corbin & Strauss, 1990, p. 14). It means that all other categories can be related to the core category either as pre-conditions, strategies of action or consequences. An overview of the outcome of the last step of selective coding will be presented within the analysis part by means of a conditional matrix which will portray the interrelations between categories.

The use of the qualitative data analysis and research software Atlas.ti[12], which is a powerful tool to handle e.g. large bodies of texts, enabled the analyst to adequately organize the collected data and execute an interpretative qualitative analysis by interpreting incidents, applying codes as well as categories. Instead of reading printed texts and applying coding schemes manually, this software

[12] Atlas.ti is an example of Computer-Assisted Qualitative Data Analysis Software (CAQDAS).

facilitated the quick browsing of documents, selecting already established quotations and codes and thus finding specific incidents, examples of a code within the extensive data sample of documents. It furthermore supported the conceptualization of the data as the analyst was able to structure applied codes by means of a code list and also building categories of codes. In addition, the tool allowed for constantly generating memos and also linking them to a certain phrase within a document which is helpful e.g. for reminding the researcher of reading additional literature about a certain aspect to deepen the theoretical knowledge. These memos could also contain first ideas about (changes in) research questions or the establishment of theoretical concepts grounded in the data (Friese, 2012, pp. 141-142).

Due to the interwoven process of data collection and analysis, the coding process developed throughout multiple rounds and it was regularly checked if the built codes and categories are still suiting the newly added data. Therefore, the systematic and consistent coding is highly significant and again, the use of Atlas.ti considerably facilitated this process by allowing the analyst to stay as close as possible to the data and recording the executed steps of the analysis of data (Friese, 2012, p. 136). Holding record also improved reliability of the research project, as fellow researchers, in this case the supervisors were able to screen the coding procedures and reconstruct the decisions made by the analyst.

According to the discourse tracing approach that is adopted in this study, the following table will offer an overview on the various macro, meso and micro data sources that were analysed within this research project. It presents the different backgrounds of the documents, gives information about the size and publication date, and shows if the data was analysed by means of CAQDAS (Atlas.ti) or in a traditional way so without the assistance of computer programmes.

Level of Analysis	Data Type	Data Sources	Pages	CAQDAS / Traditional
Macro	Legislation/ Formal Texts	Joint Research Centre	~50	Traditional
		European Commission 2003	~58	CAQDAS
		European Commission 2005 a+b	~300	CAQDAS
		European Commission 2009	~85	CAQDAS
		USAID 2009	~50	Traditional
	Intergovernmental Organisations	IPCC Second Assessment 1995	~70	Traditional
		International Energy Agency 1996, 1998a+b; Waide 2006, 2010 (for IEA)	~835	Traditional
		IEA & OECD 2006 (Lefèvre et al.)	~35	Traditional
		OECD 2008	~100	Traditional
	Firms-in-industries Texts	Philips 2007 a+d	~20	CAQDAS
	Media Sources	The Sunday Times & The Australian (Sheridan, 2009 a+b)	~3	Traditional
Meso	Formal Texts	Consultation Forum 2008b+c, 2014	~28	CAQDAS
		Vito 2009 a+b	~1100	CAQDAS
		SCENIHR 2008	~30	CAQDAS
	Industry Federation Texts	ELC 2005a+b, 2007a-c, 2008a-g, 2009	~140	CAQDAS
		ELC & CELMA 2008 a-c	~19	CAQDAS
		CELMA 2008	~4	CAQDAS
		EURELECTRIC, EuroCommerce &ELC	~16	CAQDAS
	Firm-in-industry Texts	Philips 2007b,	~2	CAQDAS
		Philips 2013	~16	Traditional
	Industry-related Texts	ECEEE 2008	~2	CAQDAS
	Member States	Danish Energy Agency 2008	~1	CAQDAS
		Italy (Consultation Forum, 2008a)	~8	CAQDAS
		Belgium (Federale Overheidsdienst, 2008)	~3	CAQDAS
	NGO Supplementing Texts	Greenpeace 2008	~2	CAQDAS
		Havas (2008)	~11	CAQDAS
Micro	Firms-in-industries Texts	Philips 2005, 2006a-d, 2007c+e, 2008, 2009a+b	~375	CAQDAS
	Supplementing Texts	Krivošík & Attali 2014	~45	Traditional
		Öko Institut (Matthes et al. 2010)	~40	Traditional
	Media Sources	Die Presse 2009 & 2014	~5	Traditional
		Health & Safety Executive 2010	~3	Traditional

Table 1 Discourse Tracing Data
(cf. LeGroco & Tancy, 2009, p. 1527)

3.4. Limitations to This Study

Some readers might identify a deficiency of this thesis in relation to issues of reliability and validity. However, researchers unexperienced with the approach of grounded theory and interpretative qualitative research methods have to acknowledge that the criteria applied to evaluate quantitative, positivist research are not necessarily adequate for the evaluation of the approaches used within this study (Perry, 1998, p. 95; cf. Guba, 1981, Kirk & Miller, 1986).

Especially discourse tracing is considered to provide new methodological means to gather and analyse data concerning case study formats that elaborate on issues of change (LeGreco & Tansy, 2009, p. 1522) and is therefore highly suitable in the context of studying purposeful governance of change. This method furthermore *"provides in-depth, thick descriptions of contextual and personal experience […and…] can result in rigorous naturalistic generalization"* (LeGreco & Tansy, 2009, ibid.)

In relation to validity a possible limitation can be derived from the data that has been collected for the analysis. Due to the fact that this study focused on the analysis of data found in relevant documents, adding multiple sources of data could strengthen the methodology (Kirk and Miller, 1986), such as executing interviews with representatives from parties that were involved in the ILB discontinuation process, such as industry actors, most favourably from the ELC and one of the most important incumbent lighting companies such as Philips or Osram, or policy-makers. However, as the amount of data being investigated was already considerable, doing interviews would have gone beyond the scope of this thesis design.
In addition, the collection and analysis of key policy documents within the Eco-Design policy-making process, while being close to the data, allows the researcher to reconstruct the communicated industry discursive strategies and detect discourses that challenge those strategies. Relying on this reconstruction of the different 'meaning-making' approaches then contributes to a highly detailed picture of the investigated research problem of the role of the lighting industry in the discontinuation of the ILB. It further explores new empirical insights that add to the understanding and conceptualisation of purposeful governance of discontinuation in general.

When it comes to reliability, another limitation to this study might be that the researcher was inexperienced in qualitative interpretative research methods prior to this project. However, as claimed by Flick (2008, p. 386), an increase in reliability can be achieved in relation to the interpretation of data by *"training and reflexive exchange about the interpretative procedures and about the methods of coding".* This was the case with this project, as the researcher of this study received education and constructive criticism in terms of qualitative research and especially about coding mechanisms by her supervisor who has competent expertise in qualitative research methods.

Furthermore, it could be criticized that despite the data samples being collected from the European federation of manufactures, mainly documentation from Philips as representing a single company within the ILB discontinuation process has been analysed within this study. It is obvious that documents from other dominant lamp companies such as General Electric (GE) or Osram would have enhanced the research. However, it should be acknowledged that the data samples had to be analysed in a feasible manner in the context of a master thesis project. Besides that, it can be argued that the efforts of playing a role in the ILB discontinuation process of the single companies were channelled by the ELC as being a dominant actor within the discontinuation process, which was anyway mostly structured on the European policy making trajectory. Hence, the strategies of action of single members of the ELC were adequately reflected within the position of the federation.

4. Analysis: Industry's Discontinuation Problem-Types and Identified Issues

This part of the thesis portrays the findings of the analysis of this study with regards to reconstructing discontinuation issues encountered by the industry actors which are then categorized and interpreted into different problem-types of discontinuation. The table below gives an outlook on the various problems categories and related issues which will be presented in more detail in this first analysis chapter. In the following analysis chapter the reader gets to know about the particular industry strategies that were employed as problem solving measures, which in turn created further problems for industry as well as other actors.

It has to be stressed that the perspective on the various barrier types and the respective discontinuation issues is highly one-dimensional and should not be misunderstood or seen away

from its context as I try to reconstruct the particular subjective industry perception on the ILB discontinuation from the specific economic angle. Therefore, aspects that constitute barriers and issues for industry actors do not simultaneously pose problems to other policy actors, such as NGOs or policy-makers and should be born in mind by the reader.

Discontinuation barrier-types[13]	**Identified discontinuation issues**
Financial barriers	Initial costs EEL
Market (organization) barriers	Limited availability of high-quality, low cost EEL replacements
	Inefficient technology still prevalent
	Production capacity of EEL
Information & awareness barriers	Lack of awareness of disadvantages of ILBs & benefits of EEL
	Lack of knowledge & skills: public, commercial, residential, industrial
	Poor understanding of Eco-labelling
Regulatory institutional barriers	Lack of policies & laws encouraging EEL
	Lack of policy restricting supply of inefficient lamps
	Lack of guidelines ensuring international CFL quality standards
Technical barriers	Low quality & low suitability of EEL
	Lack of testing facilities to monitor, verify compliance with standards
Environmental & health risk perception barriers	Misperception of Hg amount in CFLs compared to emissions using inefficient lighting
	Concerns over mercury and other heavy metals content in CFLs in relation to health and the environment

Table 2 Industry's Discontinuation Barrier-Types and Related Issues

Table 2 gives a summary of the different forms of issues or problematic situations that create barriers to the industry's efforts to switch from incandescent lighting to more energy efficient lighting technology and are classified into various barrier-types. I will shortly explain the logic of this table to the reader in the following. For instance the fact that incandescent light bulbs are still available on the market is perceived as an issue hindering the discontinuation of that technology and thus creates a barrier that can be considered to be caused by the organization of the market. Moreover, consumers' and other actors' concerns about the content of mercury and other heavy metals in CFLs – the most important replacing technology for ILBs – is constituting another problematic situation for industry actors as problem solving efforts are needed to overcome concerns and get consumers to buy the more energy efficient CFLs. So from the corporatists view, this issue belongs to the discontinuation barrier category that keeps costumers from buying energy efficient products due to environmental and health risk perception reasons.

4.1. Financial Barriers

Initial costs EEL

The high initial costs of energy efficient lighting compared to inefficient technology are commonly seen as one of the most inhibiting factors of the slow uptake of energy efficient lighting solutions. Consumers making a rational choice when purchasing a new lamp will therefore tend to buy incandescent lamps instead of CFLs. The European Lighting Companies Federation explains this financial barrier as follows: *"Behavioural change is difficult to influence; people have complex and*

[13] Even though other authors referred to the barrier-types as problem-types (Visser, 2012, p. 41), I use the term of 'barrier' due to the fact that this term is visible in plenty of industry documents (IPCC, 1995; IEA, 1998; Waide, 2006) and has thus been created 'in vivo' from the analysed data as an ex post research finding.

unpredictable tastes and don't always react as you'd expect. Behavioural attitudes to lighting are no exception to this rule. Despite the significant reductions in price that have already occurred and the availability of new high performing energy efficient lamps, particularly over the past 2-3 years, all the behavioural evidence available points to the differential in the initial purchase price being the main factor which influences purchasers. This is true of individual consumers, public administrations and private companies despite the clear evidence that total cost of ownership of an energy efficient lamp is many times lower than its traditional equivalent (up to 15 times longer depending on the lamp)" (ELC, 2007a, p. 5). A Philips Lighting manager moreover claimed in a presentation held at an OECD workshop in Berlin in 2007, that consumers do not understand 'the overall but long-term benefits', which are the 'total costs of ownership benefits' (Philips, 2007a, p. 7) and therefore attach more value to the initial purchase price than to long-terms savings when taking a decision about which lamp to buy.

Furthermore the federation states that a lack of feeling responsible for saving energy by switching to more efficient lamps is another aspect of this barrier as *"[m]any private and commercial users (people in rented accommodation, offices, small companies) do not pay directly for the buildings' energy use therefore [have] no sense of responsibility"* (ELC, 2008a, p. 12).

"Due to the nature of the higher efficiency products these inevitably are considerably more expensive, 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, 2009a, p. 90). This comment made by the ELC in the context of the Consultation Forum perfectly indicates that consumers do not only benefit from the switch to energy efficient lighting as the higher price can be seen as a burden.

According to the IEA, *"Incandescent lamps are very cheap to manufacture and purchase but are extremely energy inefficient […] and hence are expensive to operate. A typical 60W GLS lamp may only cost USD 0.3 to purchase […]"* (Waide, 2010, p. 15). Furthermore the IEA states that *"prices have also fallen substantially over the preceding decade such that high-quality CFLs now cost slightly over USD 1 at factory gate prices in China but can retail at much higher prices in the shops"* (Waide, 2010, p. 17). What becomes obvious from these statements is that the initial purchase price for the consumer is higher in case of the CFL compared to the traditional lamps and constitutes a huge barrier for consumers to switch to energy efficient lighting. When taking the viewpoint of a manufacturer of CFLs, one can state that the profit margin of CFLs seem to be much higher compared to that of ILBs which points to the industry's interest in pushing forward market transformation towards energy efficient lighting.

4.2. Market (Organization) Barriers

Within this part issues resulting from market failures or the need of newly organizing the lighting market in order to discontinue the incumbent technology of ILBs and further stimulate the uptake of energy efficient solutions are portrayed from the industry actors' point of view. These are the limited availability of proper replacements, the dominance of inefficient technology as well as CFL production capacity issues.

Limited availability of high-quality, low cost EEL replacements

The discontinuation of the incumbent technology of ILBs means that alternative replacements that show adequate levels of quality as well as a proper purchase price have to be made available to satisfy consumer needs, however the lighting industry states that this constitutes another issue as portrayed in the following ELC statement. *"This is particularly challenging as many of the 'energy*

efficient' lighting products on the European market are not only non-compliant with basic safety, functionality and CE performance standards; they also have very low lifetimes. Consumers regularly feel 'let down' by low quality products as a result of poor market surveillance" (ELC, 2007a, p. 5).
After revisiting the VITO[14] study, the ELC stated its special concerns about a too ambitious timing of a phase out which will possibly result in *"a shortage of adequate light sources for a large range of applications and luminaires in the EU"* so that the limited availability of alternatives might lead to 'empty shelves' for the European consumers (ELC, 2008b, p. 11).

The technology of LEDs was still lagging behind and not yet marketable when the discontinuation of ILBs was discussed, as the price was still utterly high, and also problems with the light output had to be solved. Hence, this technology could not act as an adequate substitute for ILBs in the short-term. Philips reported on the future of LEDs but also existing shortcomings as follows:
"LED technology will also have a big future impact in the home. We already have decorative LED light bulbs for the home, which can replace incandescent light bulbs where only a decorative effect is required both indoor and outdoor. These don't just use less energy; they slot into existing light fittings and also provide the consumer with a new lighting experience, using colors. I should stress however, that the light output of these current LED light bulbs is not yet comparable to an incandescent lamp" (Philips, 2006a, So what has Philips been doing to encourage this switch?, para. 14).

Inefficient technology still prevalent

The European lamp manufacturers state that another discontinuation issue is related to the prevailing ILB technology which is still being offered and purchased within the European market. *"The lighting market is also one of the few markets where although new efficient technology exists, old and/or inefficient technology is still readily available on the market"* (ELC, road map, 2007, p. 5). Moreover the percentage of inefficient lamps used in Europe's domestic lighting is huge as stated by the ELC: *"Approximately 85% of lamps currently in EU homes are energy inefficient"* (ELC, 2008a, p. 10).

A Philips representative also highlighted the issues related to the inefficient technology that is still being dominant and calls for untacking the potential of energy efficient solutions. *"There is also a striking unbalance between the amount of electricity used by incandescent bulbs, their sales volumes and the work they actually perform: Incandescent bulbs consume 25 % of all electricity used for lighting in the world, but they only produce 4 % of all electric light. This is despite the fact that they represent 2/3 of all global lamp sales!*

Huge savings can thus be made in the way we are lighting our offices, roads, shops and factories. It would be a real shame, if we let our nostalgia for a century-old, inefficient bulb, obscure the need to switch to more energy efficient technologies" (Philips, 2007b, para. 11-12).

Production capacity of EEL

The European lamp manufacturers were concerned about their production capacity meeting the demand for energy efficient replacements due to a proposed phase-out of inefficient technologies. *"A switch to more efficient domestic lighting will require significant manufacturing changes within the ELC Member companies. Lamp manufacturers currently produce 8 times more "traditional" lamps than the more energy-efficient equivalents. This is why we have proposed a time-phased approach in*

[14] Vito is an independent research and technology organisation which was commissioned by the European Commission to compile the preparatory study for energy-using products focused on domestic lighting as a product group. For further information see: www.vito.be/en

order to manage this process in a suitable timescale, in order to safeguard the interests of employees, supply chain and consumers" (ELC, 2007b, n.p.).
Especially concerning the proposed ambitious timing of a gradual phase-out of ILBs, ELC questions whether the capacity of the market will be able to provide energy savers within that time-frame (ELC, 2008b, p. 11).

Throughout the Consultation Forum it was further discussed that *"the capacity issue was to be looked at also in a global market perspective – e.g. developments in India and China need to be taken into consideration. For instance, 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). However, *"ELC explained that all ELC members are global players and that there are ongoing discussions in Australia, China and the US on phasing out inefficient products. Even without the IM in the EU there was large growth in the use of CFLs. ELC stated that it is difficult to predict how a future ban in India and China would affect the industry. […] ELC believes that no plan is completely resistant to movements in other parts of the world but that their proposal took those potential risks into account and therefore is the most sustainable in terms of availability and avoidance of empty shelves"* (Consultation Forum, 2008c, p. 3).

The doubts about a production capacity meeting European needs properly made by ELC were not supported by research undergone by Greenpeace as the NGO stated: *"The threat of empty shelves as a result of an early phase-out of inefficient bulbs appears to be coming only from companies represented by the European Light Companies Federation. These companies have significant investments in traditional lamp production and may prefer to have the burden of switching technologies eased by a slower transition. Manufacturers that have come into the market exclusively producing energy efficient products such as Megaman are keen to realise the full potential of their business as quickly as possible and are already planning ahead by designing facilities that can increase production as demand increases"* (Greenpeace, Cons For, 2008, n.p.).

4.3. Information and Awareness Barriers

Lack of awareness of disadvantages of ILBs and benefits of EEL

From the specific industry perspective, the end-users' lack of awareness that the prevailing technology of ILBs is very inefficient as it wastes most of the consumed energy as heat output and not light output and therefore leads to a waste of money spent on electricity bills by the consumer as well as unnecessarily producing CO_2 emissions. The International Energy Agency further stresses that *"[t]he comparatively high running costs of incandescent bulbs are poorly understood or may be dismissed because of the relatively small sums of money involved, at least for each lamp. Also, most consumers receive electricity bills infrequently and have no way of understanding which part of the bill is accounted for by lighting"* (Waide, 2006, p. 184).
Industry actors also consider the low level of public awareness of the benefits of energy efficient lighting as a barrier to the successful switch in lighting technologies. The IEA and OECD (Levèfre et al., 2006, p. 12) stated that consumers are in general sceptical about the claimed added value of any new technology and in this special case doubt that CFLs show a convincing performance and reliability. Thus, having had a bad experience, end-users are likely to be shy of the new technology, even if early problems have been minimized remarkably as portrayed in the following excerpt: *"The image of CFLi's is not as good as it could be. This is mainly due to the experience with the first generation of CFLi's that came on the market twenty years ago with cold light colour, poor colour*

rendering, fairly heavy weight and large dimensions. In the mean time, most of these disadvantages are eliminated […]. Anyway nowadays some people also have bad experiences with CFLi's of poor quality e.g. the light output is not enough, the lifetime is less than claimed etc. Although the quality of an incandescent lamps is often also not good enough, 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, 2009b, p. 111). Harry Verhaar, Senior Director Energy & Climate Change at Philips Lighting and heading the global Energy Efficiency programme puts it as follows: *"However, a number of people remain uncomfortable with the idea [of switching to energy efficient lighting]. Resistance is generally based on the notion that the only alternative to the incandescent light bulb is the CFL energy saving bulb and a number of supposed (negative) issues associated with this light source are then listed and multiplied. This picture however is misleading"* (Philips, 2007b, para. 3). Moreover, the lighting industry claims that there is a significant *"lack of awareness of the cost-effective savings potential of energy efficient lighting technology"* (ELC, 2008a, p. 12) which is also holding back consumers from buying CFLs.

Lack of knowledge & skills: public, commercial, residential, industrial

Another information and awareness problem is the lack of knowledge and skills in the commercial, residential, industrial and public sphere as policymakers, light designers, maintainers and operators of lighting systems as well as suppliers need specific know-how on energy efficient solutions once the traditional lights are phased-out. The ELC is addressing this issue by *"[p]roviding support to our own lighting 'value chain' so that they too have the information required to mobilise their own customers to purchase energy efficient lighting technology"* and also *"[e]nsuring that architects, designers, contractors, real estate professionals, and other businesses and organizations involved in sustainable design, building & development have the right information about energy efficient lighting - alternatives, functionality and savings potentials"* (ELC, 2007a, p. 10).

Poor understanding of EU Energy Label

The EU Energy Label classifies the energy consumption of domestic lighting lamps according to their carbon footprint. *"The carbon footprint of a lamp (i.e. the total amount of carbon dioxide or CO_2 and other greenhouse gases emitted over the full life cycle of a lamp) differs considerably to that of other products, particularly those which require energy or electricity to function. Whereas for most products, the greatest environmental impact occurs during resource use, production, transport and disposal phase, lamps create most of their greenhouse gas emissions (up 90% depending on the lamp type) during their use phase, i.e. when they are switched on or illuminated. […] Lamps marked with A have the lowest carbon footprint, lamps labelled G have the highest carbon footprint"* (ELC, 2007a, p. 9-10).This label is therefore acknowledged to be an adequate tool to optimize consumers' choices towards more energy efficient lighting and related greenhouse gas emissions. Nevertheless, the industry claims that the understanding of the labelling scheme is lacking and hence it is necessary to promote and improve the understanding significantly (ELC, 2007a, p. 9).

4.4. Regulatory Institutional Barriers

According to a Philips Lighting Development Manager (Philips, 2007a, p. 5) efficient lighting solutions are already offered by the market (especially CFLs) and even more efficient solutions are in the pipeline (LED, OLED) and would be available for domestic lighting soon. However, the market transformation rate is too slow, neglecting the significant factor of growth of the energy efficient lighting market (Philips, 2007a, ibid.). In relation to this situation, another set of barriers encountered

by the lighting industry are missing policies, regulations and legislation that limit the supply of the incumbent inefficient technology such as ILBs and promote and push the demand for energy efficient lighting solutions.

Lack of policy restricting supply of inefficient lamps

A missing EU regulation limiting the most inefficient lighting technologies has been considered to inhibit the uptake of energy efficient lamps by the lighting industry, therefore *"Philips has been pursuing for years, that governments stimulate demand for energy saving light bulbs,[…] by […] restricting availability of high energy consuming products, e.g. a ban on incandescent light bulbs"* (OECD, 2008, p. 35). Furthermore, *"Philips Lighting is interested in participating, to the extent possible, in the development of regulation. When regulation is proposed, Philips Lighting, through industry associations, tries to influence it, in particular the implementation measures under EU regulation"* (OECD, 2008, p. 85). These implementation measures lead to minimum efficiency requirements that phase-out the ILB technology.

Lack of policies & laws stimulating EEL

The European Lighting Companies Federation further stressed that *"[i]n addition to legislative tools setting mandatory efficiency standards for lamps, we are working on policies and measures that focus on encouraging the most efficient lighting products at European, national, regional and local levels. These include: awareness raising campaigns, the use of updated building codes, green procurement and the use of appropriate fiscal instruments"* (ELC, 2007a, p. 9). This shows that the lack of these policies stimulating demand of energy efficient lighting technologies has been considered as an issue for discontinuation by the industry actors. Besides, the ELC members also *"[…] want to ensure that fiscal instruments, ranging from reduced VAT rates or subsidy mechanisms, are used to […] to overcome the barriers to much greater uptake of energy efficient lamps. […]To strengthen awareness campaigns and energy labelling, positive fiscal measures, such as reduced rates of VAT on the most efficient products […] could provide a potential incentive for consumers to switch quickly to the best options. However, these measures should be applied in a co-ordinated way across the EU in order to avoid distortions to the Internal Market and unnecessary additional administrative costs on the supply chain"* (ELC, 2007a, p. 11-12).

Lack of guidelines ensuring international CFL quality standards

A further problem related to the discontinuation of the ILB technology was considered to be a lack of international guidelines regulating CFL quality standards. This deficiency is especially relevant when one takes into account that the European incumbent lighting industry would depend on imports of CFLs from especially China and India and fears sub-standard products on the European market, which would further inhibit consumers' uptake of the efficient lamps. Hence, *"working with our international colleagues on a global harmonization of energy efficient lamp criteria for CFLis in order to increase consumer confidence and harmonise performance"* (ELC, 2007a, p. 10) is presented as one priority of the industry.

4.5. Technical Barriers

In the following, the issues that constitute problems for industry actors to phase-out ILBs and replace them appropriately with energy efficient lightings and purely relate to technical and technological matters will be discussed.

Low quality & low suitability of EEL

The lighting industry highlighted that the low quality and suitability of energy efficient solutions, despite lowering consumers' confidence with that technology, constitute another purely technical obstacle to a successful discontinuation which needs to be tackled. *"We do not believe there are enough quality CFLs available on the market to replace the GLS lamps that will be removed from the market. Our concern is not just volumes (production capacity) but also the quality of the lamps. We need to ensure quality lamps are used such that the final luminaire/lamp system quality is maintained. We do not want to take the risk of bad quality products"* (CELMA, 2008, p. 1). In a joint paper, the IEA and OECD addressed also this specific barrier by stating *"With most residential light fittings having been designed over many decades to fit the highly standardised dimensions of incandescent bulbs, the additional length and bulk of CFLs acted as a significant disincentive for residential buyers. CFLs have also had a number of quality and suitability issues to address. The first CFLs had limited colour ranges and tended to only be available in the higher cooler-light values. CFLs using magnetic ballasts were also prone to delayed starts and long warm-up times and could suffer from flicker"* (Levèfre et al., 2006, p. 11).

Poor power factor and bad quality of CFLs

Another aspect is that a poor power factor, which is typical for CFLs, influences the efficacies of the energy savers in a way that the calculated energy saving potential seems to be much lower (Federale Overheidsdienst, 2008, Efficacy Requirements, para. 1). The Professional Lighting Designers' Association (PLDA) sees problems in particular for people using micro generation in their homes due to an inappropriate power factor of CFLs. Under these conditions the lamps will need almost twice the capacity of the indicated wattage (Vito, 2009a, p.73). Besides, bad quality CFLs, imported mostly from Asia, show sensitivity to ambient temperatures (EC, 2009, pp. 76-77), need long warm-up times until they deliver their full light potential and have a shorter life time when switching frequencies are high (Danish Energy Agency, 2008, Other comments, para. 1). Having taken these issues into consideration, financial savings from decreased energy costs would not withstand which weakens the industry's argumentation further.

Retrofitting and dimmable lamps

Some actors also pointed to problems related to retrofitting and the consumers' wish of dimmable lamps. *"Some luminaires do not accept an energy efficient retrofit lamp due to the available space and/or socket types. […] In most cases a luminaire replacement should be recommended"* (Vito, 2009b, p. 109). Moreover, when CFLs are put in certain luminaires they appear to be too big and are not considered to be aesthetic by the consumers (Vito, 2009b, p. 115).

"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, 2009b, p. 183). Furthermore dimmable CFLs *"[…] contain significantly more electronics than ordinary CFLi's, and are consequently also more expensive to the user"* (Vito, 2009b, p. 184). *"When CFLi's are dimmed the colour temperature increases slightly […and] special dimmable CFLs cost 20€"* (Vito, 2009b, p. 185).

Lack of testing facilities to monitor, verify compliance with standards

The lamp manufacturers do also state that the missing facilities monitoring the compliance of quality standards of lamps entering the European market is another discontinuation issue as sub-standard products might threaten the environmental benefits of energy efficient lighting. The ELC highlights this specific issue in its' Road Map as follows: *"For this approach to be fully effective, we believe that Europe's market surveillance systems need to be strengthened to ensure that this ambitious legislation does not result in market distortion and incentives to free-ride the legal requirements. Huge numbers of low quality products enter freely into the European marketplace each year from unscrupulous manufacturers who exploit poor market surveillance systems. For lamps, this problem is particularly dangerous. Many of the 'energy efficient' lamps on the European market are not only non-compliant with basic safety, functionality and CE performance standards but they also have very low life times and are threatening to undermine consumer confidence in energy efficient lighting technology as a whole. We will be working with national governments and market surveillance authorities to make sure effective and timely market surveillance systems are implemented in Europe"* (ELC, 2007a, p. 7).

4.6. Environmental and Health Risk Perception Barriers

Within this subsection, the industry's perspective on barriers hindering the discontinuation of ILBs caused by other actors' (consumers, policy-makers) perception on risk factors that may have negative impacts on health or the environment are discussed.

Misperception of HG amount in CFLs compared to emissions using inefficient lighting

Due to the fact that there were concerns about the mercury content in CFLs from especially consumer organisations raised throughout the Consultation Forum, the industry was eager to show that this is a misperceived picture. Hence, the misperception is seen as another issue hindering discontinuation and needs to be addressed.

Concerns over mercury and other heavy metals content in CFLs in relation to health and the environment

According to the mercury content of CFLs, there were worries about consequences to health, especially in case of lamp breakage, constituting a further barrier to the diffusion of energy efficient lighting. The industry stressed that the public is unaware about the fact that there is no necessity for special precautions for the domestic use of CFLs as they are safe and pose no danger when handled properly. However, information about what to do in case of lamp breakage has to be spread broadly, as mercury will be released here and people are still unaware of how they should clean up adequately (Consultation Forum, 2008b, p. 13).

Throughout the Consultation Forum of the Vito preparatory studies, several concerns from various stakeholders about potential health risks of the use of energy efficient lighting, especially affecting light sensitive people and patients: "s*ome 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, 2008b, p. 13).

Besides, the collection and recycling infrastructure for CFLs, being covered by the WEEE[15] Directive of the EU, was not working properly when the discontinuation of the ILBs was discussed which posed another issue for industry. Due to the fact that CFLs contain a maximum level of 5mg[16] of mercury and the electronics of the lamps do also include hazardous substances, the EU regulates the waste of these lamps by means of the WEEE Directive in order to protect the health of European citizens and the environment. All manufacturers producing electrics and electronics are obliged to take back exhausted products in order to get them recycled. However, in terms of CFLs the collection and recycling system is very poor and its implementation is still lagging behind, especially in the domestic sector. Most of the consumers are not aware of the Hg content of CFLs or rather that they have to be recycled and should not end in the household waste (Vito, 2009b, p. 108). According to Vito that gathered information about recycling from different Member States throughout their preparatory studies, 80% of CFLs are not recycled which is a significantly high amount as the contained mercury is emitted to the environment (Vito, 2009b, p. 158). However, due to the life cycle approach, Vito states that these emissions only play a negligible role at the end-of-life, as the Hg emissions during the use phase of CFLs shows the most significant effect (Vito, 2009b, ibid.). Nevertheless, the malfunction of the collections and recycling infrastructure constituted a problem to the industry as well as the fact that people are still unaware about the recycling of CFLs and that these lamps should not be disposed in domestic bins to prevent the mercury from going to the landfills, which is another issue that has to be addressed (ELC, 2008c, p. 2).

5. Analysis: Industry Strategies of Action and Opposing Strategies

In order to give the reader at this point a general understanding of how and at which points the industry actors are involved in the decision making process which ultimately leads to the Eco-Design Directive, a general summary of the process is introduced. In the following, this chapter depicts an outlook on the various industry strategies of action and explicit examples that have been examined throughout the data analysis. The proposed strategic categories are derived from the theoretical approaches of Geels (2014) and Borrás & Edler (2014) that have already been theoretically conceptualised in the theoretical chapter of this paper. In a next step, it will be reconstructed which specific strategic actions have been applied to address the different types of discontinuation problems which have been introduced in the chapter above. Finally this chapter will finish with employing opposing strategies and argumentations that heavily disagree with the industry's lines of reasoning and problematization of discontinuation issues and draw a different picture of how discontinuation problems and issues are perceived by other actors. For instance the job losses in Europe due to production outsourcing as well as costly market surveillance measures, as demanded by industry actors, are discussed.

5.1. The Eco-Design Decision Making Process in Context

In the context of the Kyoto Protocol the European Union (EU) has committed to fight climate change by reducing its' greenhouse gas emissions by 20% compared to the levels of 1990 by aiming at the European economy to become highly energy-efficient and low carbon. The EU leaders have made this commitment a top priority in terms of the Europe 2020 growth strategy putting great effort in the implementation of a bundle of binding legislation.

[15] EU legislation regulating the waste related to electrical and electronic equipment. For further information see http://ec.europa.eu/environment/waste/weee/legis_en.htm

[16] EU legislation restricting the use of hazardous substances in electric and electronic products. For further information see http://ec.europa.eu/environment/waste/rohs_eee/index_en.htm

There are some hints that point to the fact that the implementation of minimum efficiency requirements as a policy option has already been initially taken into consideration within the preparations for the Kyoto Protocol as executed by the International Panel on Climate Change (IPCC) that . Back in 1995, the IPCC's Second Assessment Report (IPCC, 1995) states that GHG emission reductions are *"technically possible and can be economically feasible. These reductions can be achieved by utilizing an extensive array of technologies and policy measures that accelerate technology development, diffusion and transfer in all sectors, including the energy, industry, transportation, residential/commercial and agricultural/forestry sectors"* (IPCC, 1995, p. 12).
Moreover, it is highlighted that initiatives are needed *"to counter lack of information and overcome cultural, institutional, legal, financial and economic barriers which can hinder diffusion of technology or behavioural changes"* (IPCC, 1995, p. 12). Those initiatives also influence and determine the level of the technical potential as well as the cost-effectiveness that can be realized.
The IPCC also clarifies that initial support is needed in a lot of cases to facilitate the market entry of innovative technologies so that they *"reach sufficient volume to lower costs to become competitive"* (IPCC, 1995, p. 13). To modify patterns of (end-user) consumption and to support the diffusion of low-carbon technical novelties, it is anticipated that a number of policies have to be decided on by single countries or by various countries internationally. Those policies are supposed to involve *"institutional and structural frameworks, […] utility demand-side programmes, regulatory programmes including minimum-efficiency standards […], market pull and demonstration programmes that stimulate the development and application of advanced technologies"* (IPCC, 1995, p. 42), as well as education, training, advisory and information measures.
At this point it has to be explained why energy utilities are interested in demand side management measures that will promote the diffusion of energy efficient (lighting) technologies that will result in decreased sales and hence cut their revenues. The IEA 'Assessment on Benefits, Costs and Impacts of Demand Side Management' (1996, p. 44) states that it is *"a common feature in utility regulation […] that utility rates should be adjusted as needed to cover all utility costs. In other words, the utility is allowed to recover all revenue losses that result from the DSM programme."* The assessment document furthermore reflects that *"a disadvantage if this representation is that the lost revenue is actually a benefit (through bill savings) to the programme participants, which can male this more a question of distribution of costs and benefits between parties rather than efficiency"* (IEA, 1996, pp. 44-45). To put it bluntly, if utilities take demand side activities, such as the promotion of CFLs by means of e.g. give-aways, the energy that is saved and hence leads to revenue losses for the utility will be recovered by the increased tariffs consumers have to pay. This means, the distribution of the costs and benefits of the DSM programme is therefore heavily relying on the consumers as they pay the price and the utilities still benefit. What is even more interesting is the fact that *"large power customers prefer to see the cost of DSM removed from their tariff"* (IEA, 1996, p. 72), hence industry actors that use huge quantities of electricity, such as manufacturers of products, will not be affected by the raised tariffs, but normal citizens will definitely. Another reason for utilities being active in DSM activities is that regulators in some countries certify the energy savings achieved by the utility in form of so-called 'white certificates'. This white certificate scheme works similar to the EU emission trading scheme, as the utility *"is then free to trade on an open market with other utilities subject to the same obligations"* (Waide, 2006, p. 307). In this respect, Clean Development Mechanisms (CDM) as defined by the Kyoto protocol, are projects with the aim of emission reduction which in turn make available Certified Emission Reduction (CER) units that can also be traded in the mentioned emission trading scheme. For instance, Osram and RWE, the biggest German electricity producer, executed a project in parts of India, where CFLs were given to approximately 700.000 households and which

generated tradable certifications for the industry actors (Osram, 2008). That those tradable emission certificates are worth the efforts of introducing such projects is reflected in the outcomes of the analysis of the Institute for Applied Ecology (Öko-Institut e.V.) which is commissioned by the German department of the Wild Wildlife Fund for Nature (WWF). The study analysed the additional revenues of certain industry actors earned within the context of the EU emission trading system in the time span of the years 2005-2012. The estimated amount of Euros additionally earned as revenue by RWE are 9.6 billion, in which the taxation for nuclear fuel is already deducted (Matthes et al., 2010, p. 3).
Hence, a market transformation towards a low carbon economy is in this report presented as an initiative that earns money for the economic sectors being involved in case various barriers are reduced or overcome by means of, inter alia, public policies such as the minimum efficiency requirements of the Eco Design Directive.

The IPCC Report further stresses the 'negative to zero net costs' at which energy efficiency aims are possible for each of the sectors mentioned above, also among the residential lighting and appliances sector (IPCC, 1995, p. 12) which will even be much higher *"with longer time horizons, which allow a more complete turnover of capital stocks and which give research, development and demonstration, and market transformation policies a chance to impact multiple replacement cycles"* (IPCC, 1995, p. 16). Here it has to be stated that negative costs equals economic benefits.
The International Energy Agency (IEA) in its Annual Report on the Demand Side Programme (IEA, 1998a) states that the *"Kyoto Protocol strongly emphasises the necessity of energy efficiency and acknowledges that it is a demand side issue"* (IEA, 1998a, p. 8). Hence, the European Union and 15 other countries signed the Implementing Agreement on Demand-side Management Technologies and Programmes and set up *"a form of participation with countries via the World Bank […] under a Memorandum of Understanding"* (IEA, 1998a, p. 7). The participants of this programme collaborate to establish demand side management activities that should support the penetration of energy efficient technologies so that they achieve full market potential (IEA, 1998a, p. 7).
In relation to market potential of low carbon technologies, the IEA launched initial in-depth analyses about particular technologies, inter alia, lighting, in order to learn about the market acceptance process by means of pilot projects (IEA, 1998b, p. 39). A detailed and in-depth analysis about the (market) potential of energy efficient lighting and the optional policies to promote it is offered by the IEA in 2006 (Waide, 2006). Among other policy options, minimum efficiency requirements are deployed while the phase-out of incandescent lights is discussed as a favourable step (Waide, 2006, p. 299; 501).
Facing now the targets of the Kyoto Protocol on the European level, the European Commission set up the European Climate Change Programme (ECCP) in June 2000 to determine and develop strategies requiring the member states to reduce their emissions. Focusing on sustainability, energy demand management and renewable energy the ECCP was meeting ground for multiple stakeholders such as members of the Commission's different Directorates-General (DG), industry and national experts as well as representatives of environmental NGOs. Due to the fact that the programme is a consultative process, expertise from different societal actors is essential to reach consensus and thus enabling an effective implementation of the decided policies and instruments. Within the framework of the first ECCP from 200 to 2004, eleven working groups have been established that analysed a broad variety of policy sectors and measures in terms of potential reductions of greenhouse gas emissions. The options and instruments for cutting emissions identified by the working groups are based on cost-effectiveness. This brief background note on the ECCP becomes important in relation to the Eco-Design framework as the European Lamp Companies Federation (ELC) as well as the European

Federation representing National Manufacturers Associations for Luminaires and Electrotechnical Components for Luminaires (CELMA) were both actively engaged. Within the ECCP Joint Sub Working Group (JSWG) on Energy Efficiency in End-Use Equipment and Industrial Processes the domestic lighting sector – among others – was identified as being promising for energy savings and cutting European CO^2 emissions (Joint Research Centre, 2001, p. 25). Furthermore the JSWG suggested policy actions to the European Commission such as *"[t]he adoption of a new Framework Directive for Efficiency Requirement of Electrical and Electronic End-Use Equipment to facilitate and accelerate the achievement of ambitious energy efficiency targets to be implemented through minimum efficiency requirements and/or voluntary agreements"* (Joint Research Centre, 2001, p. 24). There was also an agreement with the lamp manufacturers to extensively scale up sales volumes of CFLs by 2005 and 2010 and to promote the Green Light Programme (Joint Research Centre, 2001, p. 25).

The outcomes of this programme had an impact on the very first draft Directive proposal 'On establishing a framework for the setting of Eco-design requirements for Energy-Using Products and amending Council Directive 92/42/EEC' which has been drafted in August 2003. The draft proposal directly refers to the findings of the ECCP and the suggested equipment sectors where energy savings and the reduction in CO_2 emissions are most prominent (European Commission, 2003, pp. 25-26).

Before the draft of the eco-design directive entered into force, the Commission presented the Methodology Study for Ecodesign of Energy-using Products (MEEuP)[17]. This study was meant to facilitate the creation of methodological approaches evaluating the suitability of different energy using products for being considered within the context of the Eco-design framework directive and thus becoming subject of legal obligations (implementing measures) in terms of environmental aspects. The MEEuP will then be applied to the range of relevant products already identified by certain criteria, such as domestic lighting.

By adopting the eco-design directive, domestic lighting was recognized as a relevant product group and the step following on the agenda of the framework directive was an open and transparent stakeholder project called EUP4light[18]. At this forum stakeholders had the opportunity to actively take part in the creation of various options specifying the phasing out of the incandescent light bulb by introducing eco-design requirements. In the context of the EUP4light the Commission entrusted VITO and partners (BIOS, Energy Piano and Kreios) with executing an environmental, technical and improvement analysis on the domestic lighting product group facilitating a formulation of eco-design requirements (Vito, 2009b). Building on this preparatory study, the European Commission presented different elaborated scenarios for the phase-out of domestic lighting products not meeting the established eco-design requirements. The so-called Consultation Forum constituted another phase within the eco-design framework due to the fact that on this platform a closed stakeholder consultative project took place. Invited experts and representatives of the EU member states examined the presented scenarios with regard to draft implementing measures, impact assessments and eco-design requirements and gave their opinion on the phasing-out options (Consultation Forum, 2008b). On basis of the suggestions made by the Consultation Forum and after the impact assessment was completed (European Commission, 2009), the Commission discussed the measure within an internal Interservice Consultation and notified the World Trade Organization. After deliberation, the Regulatory Committee consisting of Member State representatives voted on the eco-design regulation and so the draft regulation was presented to the European Parliament. Due to

[17] For more information see: http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm
[18] For more information see: www.eup4light.net

great concerns coming from societal actors being afraid of impacts on health when being exposed to energy-efficient lighting, a 'light sensitivity report' (SCENIHR, 2008) had to be executed before the regulation could be finally amended. The conclusion of this report considered the expressed health concerns to be mostly unsubstantiated and after amendment by the European Parliament could be implemented within the Member States which meant the start of the phase-out of the ILB.

All in all, increased international competition in the lighting market due to emerging markets in developing countries, as well as low profit margins generated within the ILB technology branch (Waide, 2006, p. 502), the lighting industry and its' various kind of actors seek to become governance actors. By doing so, the switch to energy efficient lighting solutions should be promoted more proactively and by means of implementing EU legislation restricting the supply of ILBs. The original plan to switch to more innovative products by just letting the forces of the market and competition between the rivalling products work failed and was not quick enough to diffuse energy efficient lighting and thus create larger margins. More drastic approaches are needed. Here, the context of the Kyoto protocol efforts to cut greenhouse gas emissions, as well as the advocacy coalition between environmentalist NGOs (e.g. Greenpeace) and lighting industry and the overall prevailing public opinion to fight global warming played significant and facilitating roles for the industry. Firms and their associations presented ILBs as energy wasting devices, and thus created a great 'window of opportunity' to be actively involved and shape the Eco-Design decision making process which will be discussed in more detail in the following. A major step in this strategic process was to put domestic lighting in the focus and make it become considered as an official product group within the jurisdiction of the Eco Design Directive. This has been done through various market analyses – where industry actors have been involved – that verified the emission saving potential by switching from old 'inefficient' technologies to low carbon energy efficient ones (i.e. Waide, 2006; Lefèvre et al., 2006).

5.2. Industry's Strategies of Action in Discontinuation Governance

As already mentioned different changes in the economic as well as the socio-political environment of the lighting industry offered an opportunity structure (Borrás & Edler, 2014) to speed up the market transformation from traditional incandescent light bulbs – leaving the industry with low margins – to more energy efficient and also more profitable (Waide, 2006, p. 502) lighting technologies. The CFL was planned as main intermediary technology to shorten the transitional time span for making the LED technology marketable for domestic lighting purposes. Even though Geels (2014) assumes that changes within the external environments the incumbent firms are embedded in are putting pressures on the industry actors, it does not hold true to the grand societal challenge of climate change in the ILB case. It rather seems that the international and European CO_2 emission and energy consumption reduction plans established in the aftermath of the Kyoto Protocol as well as the common public opinion to fight climate change by cutting CO_2 emissions rather facilitated the industry's access to the EU policy making sphere considerably; however, the market developments leading to increased energy efficient lighting sales and no longer profitable production and sales of conventional bulbs indeed put pressure on lighting industries to abandon the light bulb technology and production infrastructure. For instance a market scenario presented by the IEA (Waide, 2006) assumed that by replacing ILBs with CFLs from 2008 onwards, the CFL technology would double its share of delivered light in 2030 compared to a scenario which does take a replacement of ILBs by CFLs into consideration (Waide, 2006, p. 413). So from a purely industry perspective the minimum efficiency requirements that phased-out incandescent light bulbs as regulated under the Eco Design Directive was an appropriate policy tool to compensate for the market failures that could not been

handled by market and competition activities solely. Hence the diffusion of energy efficient lighting technologies is boosted considerably.

This section of the chapter will reflect on the particular strategies of action that have been applied by the industry actors in the ILB discontinuation process while relying on the TEF approach introduced by Geels (2014) which are the various strategies that are summarized into economic positioning, corporate political activities, shaping the cultural environment, public debate and discourses as well as the corporate social responsibility strategies.

Economic positioning strategies

In the light of Geels (2014, pp. 269-270) economic positioning here means that the lighting industry executed particular activities related to marketing and sales, operations management, innovation strategy and supply chain management which combined should strengthen the single company's or industry actors' position within the economy. One of these economic positioning strategies employed by the industry to overcome certain discontinuation problems was the elimination of the bad quality of the 'first generation' energy efficient lighting, especially CFLs, by offering advanced innovated versions. The European federations of the lamp as well as the luminaire and fixtures manufacturers claimed to work in collaboration aiming at "*a guarantee of life duration, energy performance and lighting quality in compliance with the EcoProfile on CFLi lamps"* (EURELECTRIC, EuroCommerce & ELC, 2008, p. 3)

Industry's *innovation strategies* furthermore aimed at offering a broader range of products to the end-user in order to satisfy needs and wants related to retrofitting, aesthetics, dimmability, and different light colours as well as achieve a competitive advantage in the market.

"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 to replace conventional incandescent bulbs. Other factors such as a dimmer or other lighting controls may also prevent the use of standard compact fluorescent lamps, in which case a dimmable compact fluorescent lamp or improved incandescent bulbs with halogen technology could be installed. In any case, more efficient alternatives will remain available for all domestic lighting installations, even for those currently using the conventional halogen lamps that are also going to be phased out" (EC, 2009a, p. 24).

Philips also claims that *"the shape and design of the latest generation of energy savers has improved and can easily fit any luminaire"* (Philips, 2009a, Increased performance of CFLi energy-saving lighting solutions, para. 1).

In relation to the future most efficient lighting technology, the LEDs, Philips claim that they strengthened their *"[…] position as the leader in solid-state lighting and are the only company covering the whole value chain from LED components via modules to luminaires and systems. Over the past few years we have invested nearly EUR 4 billion in acquiring high-growth businesses in the areas of solid-state lighting and luminaires"* (Philips, 2007c, p. 85). Hence, high R&D expenditures improving LEDs and making them available for the mass market is also a promising addition to the range of products which is another *economic positioning strategy*.

Another economic positioning strategy is the *marketing and sales strategy*. Awareness rising efforts are undertaken in order to let public and private consumers as well as policy makers and the whole supply chain and industry partners know about in how far they can benefit from switching to energy efficient lighting solutions.

In this respect, a report executed by the International Energy Agency (1998b) highlights that manufacturers and/or retailers will only be interested in selling energy efficient products if those products offer *"a larger commercial margin"* (IEA, 1998b, p. 120) which they obviously do, as stated within another IEA report (Waide, 2006, p. 502). When it comes to the purchasing process of energy efficient products to the end-user the distribution chain is arranging for the product to be taken from the manufacturers to the point-of-sale. Here, the retailer's role is significant as by means of advising and informing the consumer about energy efficiency aspects of particular products he is actively involved in the customer decision process. Therefore, it is vital to train and educate retailers to gain expertise about energy efficiency which *"increases the confidence of their own clients and through it, their sales"* (IEA, 1998b, p. 121). In the ILB case, the close cooperation between the different actors of the distribution chain is perfectly reflected by the 'Agreement on the Promotion of Efficient Lighting' that was signed by the three European federations representing the European electricity industry, the European retail, wholesale and international trade sectors, as well as the leading lamp manufacturers in Europe in 2008 in the presence of the European Commission (EURELECTRIC, EuroCommerce & ELC, 2008). Hence marketing and sales efforts have to be executed throughout the whole distribution chain.

Raising consumer awareness as well as educating the end-user is classified as an economic positioning strategy in the ILB case and can be seen as a *marketing* tactic as the industry sees great need in teaching the benefits of switching to more energy efficient lighting and phasing out incandescent light bulbs.

For instance, in the context of the 'asimpleswitch' brand campaign, Philips highlighted that *"visitors will be invited to record a personal 'simple switch' pledge. Philips will track these collective pledges to change to energy efficient lighting and calculate the resulting energy and costs savings on the asimpleswitch.com website"* (Philips, 2006b, para. 11). This example shows that the industry is also keen on helping the end-user to calculate their economic savings from using 'energy savers' which can be seen as a marketing and sales strategy.

The use of recognizable 'green' logos is another way to help consumers make decisions to buy energy efficient lighting as *"the Philips Green logo to identify an increasing number of our Green Products"* (Philips, 2009b, p. 43) and is thus recognized as a helpful tool to educate end-users.

Besides, ELC does also stress the promotion and improvement of the consumers' understanding of labelling in general as being central to educate the consumer in a way that enables him/her to identify the most efficient product and make an informed choice.

The introduction of the voluntary certification and labelling can be seen as a marketing strategy being employed to 'nudge' (Thaler & Sunstein, 2009) the consumer into buying the energy efficient product. *"The EU Energy Label rates domestic lamps from A to G. In all EU Member States, the label must be shown on all domestic lamp packaging. The EU energy label also gives the most accurate indication of the carbon footprint of a lamp. The carbon footprint of a lamp (i.e. the total amount of carbon dioxide or CO_2 and other greenhouse gases emitted over the full life cycle of a lamp) differs considerably to that of other products, particularly those which require energy or electricity to function. Whereas for most products, the greatest environmental impact occurs during resource use, production, transport and disposal phase, lamps create most of their greenhouse gas emissions (up 90% depending on the lamp type) during their use phase, i.e. when they are switched on or illuminated"* (ELC, 2007a, pp. 9-10).

In achieving a competitive advantage compared to competitors from outside the EU, technology transfer mechanism can be seen as another set of economic positioning strategies deployed by the lighting industry.
In this context the transfer of technology means mechanisms such as bundling R&D efforts, building joint ventures or doing foreign direct investments among different industry actors and among countries, in order to further develop energy efficient lighting technologies, especially LEDs by encouraging the exchange of know-how. The outsourcing of production is another part of this industry transfer strategy.

In relation to continuously working on the improvement of LEDs in order to make them marketable, different strategic alliances were formed. For example Philips noted that they *"started Philips Lighting Lumileds as a joint venture with HP and we have now acquired full ownership. But we are also active in Organic LEDs. We formed a research consortium, under our initial leadership, together with companies like BASF, and OSRAM, and we aim for a European lead in this field as well"* (Philips, 2006a, So what has Philips been doing to encourage this switch?, para. 14). Philips also emphasizes that *"In China, the division is also increasing its investment in research and development, tapping into the country's substantial innovation resources to create products for both the Chinese market and other regions"* (Philips, 2006c, p. 74). Hence, technology transfer mechanisms facilitate the management of the increased demand for energy efficient lighting after the ban of ILBs.

Moreover industry actors worked on saving costs by the outsourcing of European production lines to low labour countries outside the EU, such as India or China. Even in the MEEuP it is acknowledged that outsourcing seems inevitable as it is stated: *"Furthermore, the method should take into account that –through rationalisation of the production, outsourcing to low-labour-cost countries, etc.— production costs in most sectors are continuously being reduced […]"* (EC, 2005a , p. 137). So the basic methodology of the Eco Design process suggests the outsourcing of the production of products, in this case lighting products, from the EU to low labour countries to save costs which would then lead to considerable job losses as depicted below.
In 2006, Philips reallocated parts of its fabric in Weert, the Netherlands to 'low-cost areas' (Philips, 2006c, p. 36) namely China and Poland.

Corporate political strategies

The following lines will highlight different kinds of corporate political strategies, such as feeding industry-specific information into the policy-making process, employing direct lobbying efforts, executing organized pressures, collective action as well as confrontational strategies.

According to Philips, awareness rising measures that can be considered as an example of *information strategy*, are inevitable in order to speed-up the dissemination of energy efficient lighting: *"Last October we launched an awareness raising initiative to highlight the untapped environmental and financial potential of new energy efficient lighting systems. We are providing information to European municipalities and companies on this important issue. Municipalities, financial institutions and political leaders have an important role to play in actively encouraging, promoting and engaging Europe to accelerate the adoption of these energy saving and CO_2 reducing technologies"* (Philips, 2006d, The Energy Challenge, para. 6).
That is why the company has "*a range of activities in place. Our communications programs aim to raise awareness of the triple win situation. You may have seen our current TV advertising campaign linking energy efficient lighting with the struggle against climate change. In addition, we have*

developed the Philips Lighting Academy, which offers courses in local languages in all major European countries with energy efficiency as a key theme" (Philips, 2006a, So what has Philips been doing to encourage this switch?, para. 3-4).

One of the main arguments for switching to energy saving alternatives to ILBs is the claim made by the lighting industry that by doing so significant reductions in CO_2 emissions can be achieved which therefore helps to meet Kyoto targets and to fight climate change.
Within numerous documents like position papers, press releases, fact sheets, etc. the lighting industry presented itself as a proactive advocate of the environment, fighting climate change and giving a hand to politicians which have to fulfil the Kyoto targets, by offering energy saving alternatives which significantly reduce greenhouse gas emissions (e.g. Philips, 2006a; ELC, 2008d, p. 2). The following chart, introduced by the ELC within their proposal for a phase-out of ILBs in domestic lighting (ELC, 2007c, p. 2), presents the potential savings estimated by industry experts.

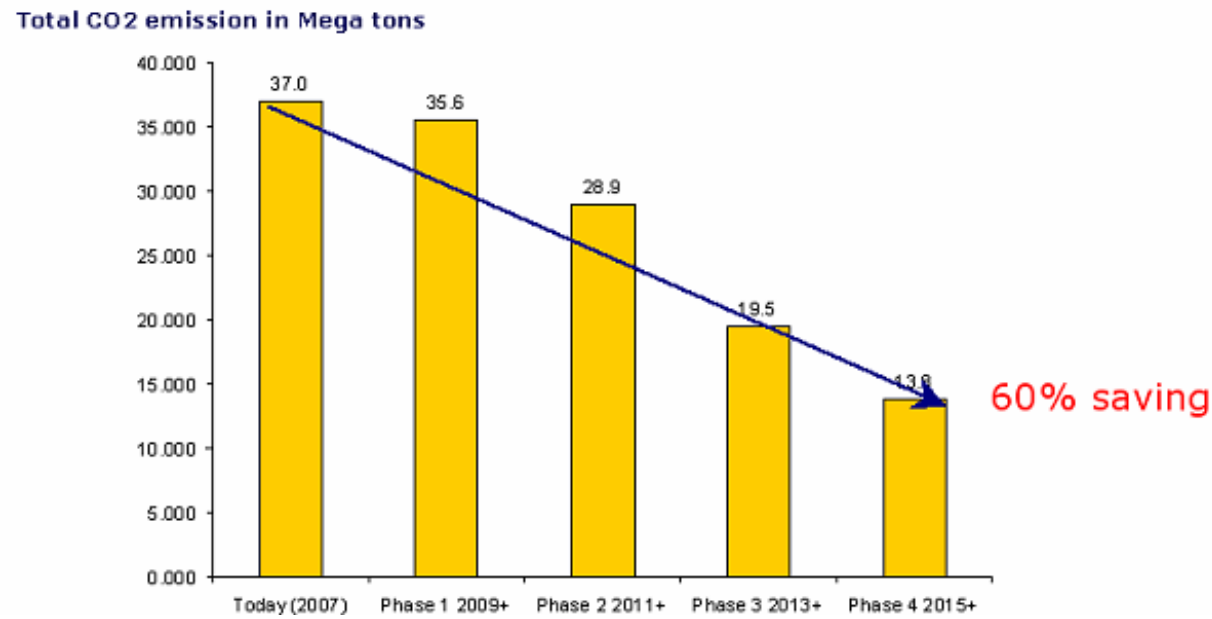

Figure 2 CO_2 Saving Potential Through Efficient Lighting in the Home
(See: ELC, 2007c, p. 2)

So by releasing expert information to mainly policy makers, but also consumers, the lighting manufacturer association here tries to push for decision making that supports the diffusion of energy efficient lighting and limits the supply of incandescent technologies.

Furthermore, scientific knowledge was developed to inform consumers that CFLs are safe to use by pointing to the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) which was assigned to execute a light sensitivity report to analyse the impacts of efficient lighting on various diseases. While focusing on the flicker, electromagnetic field emissions, and UV and blue light radiation of CFLs (SCENIHR, 2008, p. 27), SCENIHR mainly focused on the aggravation of symptoms of the following diseases: *"xeroderma pigmentosum, lupus, migraine, epilepsy, myalgic encephalomyelitis (also known as chronic fatigue syndrome), Irlen-Meares (also known as scotopic syndrome), fibromyalgia, electro-sensitivity, HIV/AIDS, dyspraxia and autism/aspergers Syndrome"* (SCENIHR, 2008, p. 8). The Committee concluded that even though flicker and/or UV and blue light

emissions are not being emitted by lamps can aggravate the symptoms of particular diseases such as epilepsy, migraine, retinal diseases, et cetera. However, they found that there is no evidence which point to the fact that the use of energy saving lamps does so (SCENIHR, 2008, p. 31). Moreover it was mentioned that *"[o]f all CFL properties, only UV/blue light radiation was identified as a potential risk factor for the aggravation of the light-sensitive symptoms in some patients with such diseases as chronic actinic dermatitis and solar urticaria. No evidence was found that would indicate that either EMF or flicker could be a significant contributor"* (SCENIHR, 2008, p. 31).
Industry actors highlighted that CFLs are safe to use and do not have any health impacts on consumers by pointing to the outcomes of the SCENIHR report: *"SCENIHR experts reviewed scientific data related to flicker, electromagnetic fields (EMF), UV and blue light radiation. No evidence was found that would indicate that either EMF or flicker from fluorescent lamps posed a risk for consumers, including people with light sensitivity diseases. Only UV/blue light radiation was identified by the experts as a potential risk factor in aggravating light-sensitive symptoms in some cases and they recommended using double-envelope lamps"* (ELC & CELMA, 2008b, p. 1). The federation furthermore stressed that *"EMF emitted by energy saving lamps are well within safety limits [and] UV emitted by energy saving lamps pose no risk"* (ELC & CELMA, 2008b, p. 1). Even though the SCENIHR report was not set up by industry actors, but by the European Commission, it was used by the lighting industry as a further *information strategy* to convince consumers that CFLs are safe even though there are some minor health issues.

Another *information strategy* can be detected in the case of the various market analyses and strategic knowledge that has been created or commissioned by industry actors. Exemplifying cases are the IEA and OECD reports on energy efficient lighting (Waide, 2006; Lefévre et al., 2006) which gave an outlook on the global market of efficient lighting especially in case of phasing out least efficient products such as the ILB. Moreover, the early reports of the IPCC (IPCC 1995) and IEA (1998a; 1998b) can be seen as strategic knowledge production pre-structuring and facilitating the way for the international diffusion of energy efficient products in the market place by means of public policy, as already highlighted above. Besides, industry-in firms or their European associations, in this specific case Philips and ELC, were directly involved into the creation of a Europe-wide methodology (MEEuP) for detecting energy-using product groups, such as domestic lighting, that offer huge saving opportunities and should therefore be regulated under the Eco Design Directive (EC, 2005b, Appendix III, p. 1).

In the following section *direct lobbying strategies* of the industry actors are introduced which were visible in the context of the discontinuation of the ILB.

ELC and CELMA introduced the Roll-Out Member States Programme (ROMS) which is an example for taking lobbying channels on a European as well as national level.
By means of this programme, they claim to:

- *"Support European Governments*
    - *to develop policy and other measures that deliver CO_2 emission reductions through energy efficient lighting.*
    - *to meet their National and European targets in a quick, practical and cost effective way.*
- *Help to identify the barriers to becoming energy efficient.*

- *Work with a range of stakeholders (our value chain AIE, EUEW, PLDA, CELMA, NGOs & retailers etc) to develop and communicate user friendly information to end consumers"* (ELC & CELMA, 2008a, p. 4)
- *"Provide technical information about energy efficient lighting alternatives, savings potentials, procurement guidelines, etc*
- *Provide information and best practice examples from our colleagues in Europe and share information on key developments"* (ELC & CELMA, 2008a, p. 11)

Obviously, the ROMS Programme is a prime example of massive lobbying efforts which is undertaken by ELC and CELMA, as one can see that industry information and technical advice directly flow into the working group structure in Brussels and from there to national working groups which transmit it further to e.g. National Governments and NGOs.
The detailed structure of the ROMS Programme is depicted in the following picture.

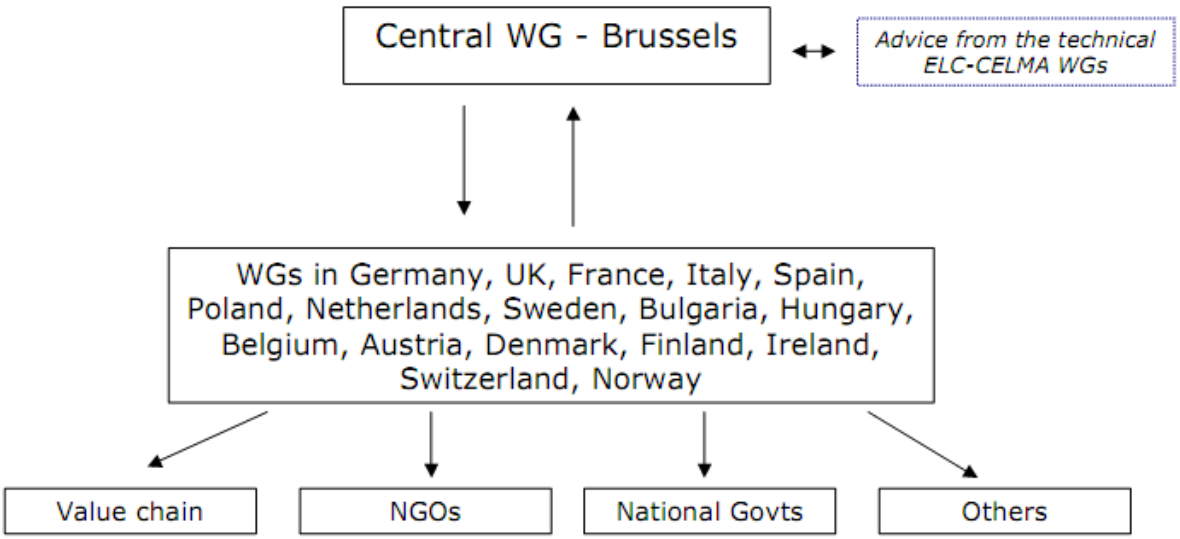

Figure 3 Structure of ROMS Programme
(See: ELC & CELMA, 2008a, p.6)

Philips stresses the fact that *"It's time to take a more business-like approach where there is a clear win-win: value creation for communities and corporations. Certainly governments should play a facilitating role. And as we've seen in our pilot projects, new types of partnerships are essential"* (Philips, 2006d, Role of corporations in sustainable development, para. 5).

Furthermore, *"A major contribution could be made in the home sector. In line with clear signals from the market as well as governments, we think the time has come to collectively take up responsibility to contribute to a significant reduction of CO_2 emission, in light of climate change.*

Today we announce that we are calling for a joint action to replace incandescent light bulbs in Europe with energy efficient alternatives within ten years. The action is to tackle this issue collectively, with the lighting industry, NGO's, energy suppliers and governments. A successful switch will help reach Kyoto commitments.

We believe the mechanism and forum to achieve this switch over within the EU is already in place, namely the eco design directive for energy using products" (Philips, 2006a, So what has Philips been doing to encourage this switch?, para. 5-7).

Here, Philips directly refers to the situation that the market is ready for being transformed into a more energy efficient one which will produce value, or rather financial value, for corporations and that the next step to take is now to implement the mechanism (minimum efficiency requirements) by means of the Eco Design legislation tool.

Another telling statement which has to be mentioned in the context of cooperation between ELC and CELMA is the following: *"CELMA, the European Federation for National Manufacturers Associations for Luminaires and Electrotechnical Components for Luminaires, welcomes the initiatives of the ELC with regard to the coming EuP Directive. CELMA, having itself deployed several initiatives on energy efficiency, is convinced of the positive effect of the market transformations that would result from ELC suggestions being applied in practice. CELMA will assist the ELC at all stages of the discussions and actions"* (ELC, 2005a, p. 1). ELC and CELMA furthermore stressed the fact that they are committed to support the creation of Implementing Measures under the Eco-Design Framework by means of providing their technical expertise (ELC & CELMA, 2008c, p. 2).
This citation shows that the industry associations are directly involved in the EU decision making process at various stages and can thus influence the outcome in a way that (economic) benefits can be expected by the legislation that is being implemented by giving their expertise as input for the Eco Design Directive.

There exists a direct connection in the context of the Eco-Design Directive between the European Commission and the ELC, as ELC states: *"We have committed to work with the European Commission, who commenced its own study for an Implementing Measure on domestic lighting in the home in June 2007, to develop ambitious minimum energy performance requirements for domestic lighting"* (ELC, 2007b). Furthermore, *"Several expert-meetings were organised in close cooperation with the European Commission and the expert groups representing the sector organisations ELC and CELMA"* (Vito, 2009a, p. 7).
"To this end, ELC monitors, advises and co-operates with legislative bodies in developing European Directives and Regulations relevant to the European lamp industry" (ELC, 2007b). Moreover, the association is *"working with regulators to develop legislative tools under the EU's Eco-Design of Energy-using Products Directive (EUP) that set mandatory efficiency standards for lighting products. These standards will lead to the phase-out (or a restriction of supply) of the least efficient products from the European market over the coming years"* (ELC, 2007a, p. 4).

The European lamp companies federations specifies their lobbying efforts as follows: *"We are working with European and national regulators to develop lighting specific 'implementing measures' under the EU's Eco-Design of Energy-using Products Directive (EUP). By as early as 2009, these pre-market measures will ensure that all new public street, office and domestic lighting products (lamps, ballasts and luminaires) that enter onto the EU market comply with strict energy efficiency and performance criteria. The EUP Directive is a valuable tool to enable this process and it is important that the forthcoming Implementing Measures proceed quickly and effectively"* (ELC, 2007a, p. 6).
Furthermore, they introduced specific requirements in their proposal: *"For each phase, there are minimum efficiency specifications based on the existing energy efficiency label, which is itself based on luminous efficacy or lumens per watt […]. For each wattage category, manufacturers are calling for requirements to become more stringent over time. This step by step approach ensures the availability of practical energy saving alternatives in all domestic applications and is realistic,*

safeguarding the interests of consumers, employees and Europe's lighting supply chain" (ELC, 2007a, p. 8).
So the lighting industry, by means of the lighting association, directly influenced the decision-making procedure by suggesting specific measures to be introduced in the planned legislation.

Moreover, single companies of the lighting market are also trying to lobby for EU legislation, as portrayed in the following text excerpt: *"EU environmental regulation has been a fundamental driver for Philips' innovation efforts. Recent examples are the EU Eco-design requirements for energy-using products (EuP) adopted in July 2005 […]. Because the calls for increasing energy efficiency are growing internationally, and in the EU in particular, more policy intervention in this arena is expected — and welcome if, as the company argues, the policies ultimately help to dramatically expand the international market for energy-efficient lighting products. […] Philips Lighting is interested in participating, to the extent possible, in the development of regulation. When regulation is proposed, Philips Lighting, through industry associations, tries to influence it, in particular the implementation measures under EU regulation"* (OECD, 2008, p. 82-83).
This excerpt shows that industry associations are also used as a mechanism of lobbying influence on EU level of single firms-in-industries, such as Philips.

These statements found within the analysed data clearly show that the lighting industry lobbied for the introduction of legislation facilitating the switch to energy efficient lighting, while especially the implementation of minimum efficiency requirements was favoured.

Confrontational strategies are also employed by industry actors. Here, policymakers are threatened by certain consequences or occurrences resulting from taking the 'wrong' decisions and not considering industry suggestions. For instance the lighting industry tried to convince policy makers that a strong and well-working market surveillance system throughout Europe, with special efforts made by the single Member States, is an essential prerequisite as the ELC highlighted during the discussions in the context of the Consultation Forum: *"If market surveillance is not enforced rigidly in all Member States, massive shift towards imports of non-compliant products is to be expected! This would lead to closing of European manufacturing locations and loss of workplaces*" (Vito, 2009a, p. 89). Hence, there is industry concern that inadequate market surveillance measures would threaten European production plants and the related jobs which is obviously no benefit to the economy. However, it seems that through market surveillance measures the industry wants to secure their competitive position on the EU market by preventing Chinese or Indian low-quality and low-price products to enter the internal market.

Another confrontational strategy applied by the industry was to argue that plans of amending RoHS directive with aim to prohibit any amounts of mercury will introduce improved production control and testing measures and include restrictions on not yet affected substances. Using their lobbying channels, the industry tried to achieve an exemption of mercury for energy efficient technology such as CFLs, as described in the following.
The RoHS Directive regulates the use of hazardous substances in electronic and electrical devices, such as mercury. There were plans of letting the legally allowed exemptions expire which would have a huge impact on the lamp producers because it would mean that no longer exemptions for mercury contained in lamps would be made.

The industry therefore tried to convince regulators that mercury is inevitable for the case of of CFLs and a ban would threat the phase-out of ILBs due to missing alternatives; planned surveillance measures will be expensive and inconvenient.

ELC argues as follows: *"EuP Implementing Measures will force industry to phase out many mercury-free incandescent lamp types for energy efficiency reasons, to be replaced by energy efficient lamps, among which compact fluorescent lamps that contain a small amount of mercury. If a renewal of the exemptions in time fails, then within the EU lights will literally go out, and business and fair competition would be dramatically affected due to the fact that this rigid expiry date after 4 years exists. […]The few mercury free lamps available today show lower energy efficiency than comparable conventional lamps and are therefore disadvantageous from a life cycle point of view. […]Therefore ELC requests not to change the current revision process and not to introduce a general expiry date"* (ELC, 2008e, p. 2).

The amendment of RoHS Directive introduces a so-called Notified Body that should control compliance to regulations in the production phase. This is another aspect criticized by the lamp producers as they point to the fact that *"[t]he requirement on notified body is particularly troublesome since as written it implies a third party notified body needs to be involved in day to day production control or at least in a production audit mode. ELC is very concerned as it would potentially result in a very expensive and cumbersome process that adds no proportionate value or benefit. ELC members want to seek to remove all reference to Notified Bodies"* (ELC, 2009, p. 5).

As Geels (2014, p. 269) explained, especially in the context of climate change *strategic alliances* and *collective action of closed industry fronts* are another set of corporate political strategies. In the following important examples of these industry activities will be deployed.
According to ELC and CELMA, consumer education is dependent on broad alliances among different industry and societal actors: *"Work with a range of stakeholders (our value chain AIE, EUEW, PLDA, CELMA, NGOs & retailers etc) to develop and communicate user friendly information to end consumers [… aiming at the signing of an] ELC agreement with Eurelectric & Eurocommerce to raise awareness of the benefits of efficient lighting"* (ELC, 2008f, p. 4).

Moreover, the European Associations ELC, EURELECTRIC and EuroCommerce point to the benefits of a close collaboration throughout the whole retail and supply chain: *"Considering that the combined actions of the retail, wholesale and international trade sectors, the producers of CFLs and the electricity industry, with the patronage of the European Commission, could provide a strong impetus for progress towards energy-saving objectives"* (EURELECTRIC, EuroCommerce & ELC, 2008, p. 2).
The associations furthermore agreed *"to encourage their members to promote and support the distribution of CFLs in European countries, ensuring a guarantee of life duration, energy performance and lighting quality in compliance with the EcoProfile on CFLi lamps"* (EURELECTRIC, EuroCommerce & ELC, 2008, p. 3). Special focus is given to the signatory parties' *"willingness to invite other relevant parties to join this agreement under the present terms and conditions. In particular, local and regional authorities, energy agencies, NGOs, public service companies and private sponsors would be particularly welcome to participate"* (EURELECTRIC, EuroCommerce & ELC, 2008, p. 4).
There were several announcements made by governments all over the world to phase-out the least efficient technology for domestic lighting, hence collective action was visible all over the globe. *"Therefore the ELC is working closely with its international colleagues in America, China, Australia*

and Japan, to exchange best practice and learning, particularly on how to support and inform consumers" (ELC, 2008f). A global exchange of best practice objectives is therefore a good way to get consumers aware of the benefits of energy efficient lighting and educate them respectively.

Awareness raising activities also stipulates cooperation between rivalling companies as the following citation shows. *"In the Baltic countries, Philips, Osram, GE Hungary and BLV have founded the company Ekogaisma with main headquarter currently in Latvia. Currently they are executing a campaign called "Save, but don't pollute" to raise awareness that CFLi's have to be taken to the recycling points; at present it is unknown how often people follow this advice. Experts in the countries say it would be better if people could give the used CFLi back in the shops where they have bought them"* (Vito, 2009b, p. 106).

The lighting industry demanded to set up an international CFL harmonization in order to guarantee that product and quality standards are regulated in a similar way internationally. The efforts e.g. achieved the introduction of the harmonization of CFL standards in Asia as the three companies Philips, OSRAM and GE signed a memorandum of understanding, the so-called 'Manila Compact', that established particular quality standards for CFLs produced in that region (United States Agency of International Development, 2009, p. 32). The international harmonization of standards for CFLs can be seen as facilitating the production of products in Asia that comply with the European standards so that these products can be imported into the EU to satisfy the increasing demand of high-quality CFLs that will be boosted even more after the phase-out of the ILB technology.

As already indicated in the prior section, utility demand side management which has been considered in the IPCC preparations for the Kyoto Protocol are another interesting collective action of industry actors from different sectors, such as the example of RWE and Osram in India showed (Osram, 2008).

Strategies shaping cultural environment, public debate and discourses

In the following, examples of industry strategies that aim at shaping the cultural environment by influencing public discussion and discourses by e.g. imposing a specific industry frame will be stressed.

Framing the ILB as an 'energy wasting technology' is the industry's strategy to shape public opinion about this traditional technology. The following quotation from Theo van Deursen, the CEO of Philips Lighting, portrays an important frame. By presenting the incandescent light bulbs as energy wasters that can only be seen as heating devices, wasting most of its energy by giving heat to the environment, the lamp manufacturer states that this technology is therefore responsible for tremendous electricity costs and CO_2 emissions and has to be replaced by more energy efficient technology.

"The ordinary household light bulb wastes a lot of energy. These incandescent light bulbs are little more than heating devices as 95% of the energy consumed is wasted as heat. Today 80% of all light bulbs used in the home in the EU are still incandescent light bulbs. About 2 billion are currently being sold every year within the EU. The collective energy waste is very significant and equates to more than 3 billion euros in electricity costs and 20 million tons of CO_2 per year" (Philips, 2006a, So what has Philips been doing to encourage this switch?, para. 9-10).

In order to create another bad image of the traditional light bulbs, the industry presented the so-called 'mercury paradox' (ELC, 2008g, p. 11) which states that – under specific circumstances – ILBs produce more mercury emissions than CFLs. The ELC claims that "*consumers should be aware that incandescent lamps are responsible for mercury pollution as well – if the electricity used to power them is generated from coal, as those power plants emit mercury in their exhaust. In fact, in such cases, the additional electricity that must be produced to power inefficient incandescent lamps is responsible for more mercury released into the atmosphere than is contained in the CFL"* (ELC, 2008c, p. 3).

In addition, a Philips representative stated as follows: *"However, mercury is also omitted in the atmosphere from the power system, and the mercury contained in lamps need to be weighed against that emitted from power plants. Studies show that indirectly the additional energy usage of incandescent bulbs is responsible for more mercury entering the environment than that is contained in a CFL. It should also be remembered that each CFL lamp means that 6–10 incandescent bulbs don't need making, transporting and disposing off. Life cycle studies have clearly shown that about 90 % of the environmental impact of a light bulb is in its usage phase, in other words when it consumes electricity. Both these factors favour the CFL"* (Philips, 2007b, para. 8-9).
This is another *diagnostic framing strategy* due to the fact that the discussion is shaped in a way that compares household emissions with those of power plants which is not an appropriate comparison in relation to total greenhouse gas emissions. Furthermore this discursive strategy helps to frame the CFL technology as leading to less mercury emissions than ILBs even though it contains mercury while ILBs do not. So, this strategy distorts the overall picture.
Promising to improve the defective European collection and recycling system can be seen as a *prognostic frame strategy* that was intended to put an end to the doubts about an effective system by using technological promises to prevent that strict collection and recycling regulations for the industry are added to the Eco-Design Directive. ELC claimed that: *"This industry sector is proud of its environmental record and has pledged to support the environmental aims of the new Directive by minimising the environmental impact of waste electrical and electronic equipment and by responsibly promoting recycling so as to reduce the disposal of waste"* (ELC, 2005b, p. 4).

The lighting industry furthermore highlighted that *"[u]nder the European Union's WEEE Directive, the European lighting industry has set up over the last few years a Europe-wide recycling infrastructure, which aims to achieve an 80% recycling rate for energy saving fluorescent lamps. These lamps are typically used for 10 years and we are confident that the recycling system will be fully operational by the time these get at the end of their life"* (ELC, 2008c, p. 3). Despite being aware of the significant problems in the waste and recycling structure, the industry claims that these problems will be solved in the future, when the first CFL lamps will reach their end of life and have to be disposed. So the industry tries to manage this essential problem by asserting that CFLs will operate for 10 years which does not seem to be a profound problem-solving.

A *discursive strategy* developed to convince consumers that energy saving lamps are safe to be used at home, is the diffusion of information on which steps to take in case of a lamp breakage. The ELC explained: *"CFLis are safe to use in your home. No mercury is released when the lamps are in use and they pose no danger to you or your family when used properly. 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. Always screw and unscrew the lamp by its base, and*

never forcefully twist the CFLi into a light socket by its tubes. Used CFLis should be disposed of properly" (ELC, 2007b).

The Lamp Manufacturer Association gives specific directions in the case of a lamp breakage which are:
"If you break a CFLi, do not panic and take the following steps:
• Ventilate the room for 20-30 minutes.
• Do not use a vacuum cleaner.
• Use gloves to remove all the bits.
• All the items used in cleaning up the spill should be treated as "universal waste" or disposed at your local lamp recycling point.
• Remove all broken lamp components from the luminaire before reusing the luminaire.
• ALWAYS switch off the mains before removing the remaining lamp components!" (ELC, 2007b).
So it was convenient for the ELC to use this 'CFLs are safe to use' frame in order to appropriately inform the consumer and give technical expertise on the steps to take in case of lamp breakage instead of confessing that there is a realistic chance that the contained mercury may have harmful consequences for consumers.

Corporate Social Responsibility strategies

To cope with normative external pressures, industry actors use corporate social responsibility strategies, e.g. to manage criticism by cooperating with environmental NGOs. An example is Philips' cooperation with Live Earth[19], as published in a press release by Philips in 2007:
"Royal Philips Electronics and Live Earth announced today Philips' global partnership with Live Earth in the campaign to combat global warming. The Live Earth partnership will enable Philips to join Live Earth on July 7, 2007 in inspiring over two billion people worldwide to take simple steps to lead a more energy efficient lifestyle. […] 'Live Earth is about engaging a global audience with solutions to the climate crisis, and we are delighted that Philips has joined us in this effort,' said Kevin Wall, Founder and Producer of Live Earth. 'Philips is a valuable partner for us in showing that some solutions that help reduce our energy consumption are easy, simple and accessible to almost every individual around the globe' " (Philips, 2007d, para. 1; 5).

Philips also cooperated with the World Wildlife Fund for Nature (WWF)[20] launching the 'Save the polar bear' campaign which is a *"pan European campaign to boost the uptake of energy efficient MASTER TL5 fluorescent lighting solutions"* (Philips, 2007e, para. 1). Philips announced to make a donation to WWF for each lamp that is sold. In more detail, the *" 'save the polar bear' campaign, which is being supported by WWF, is also intended to highlight the threat global warming poses, using the polar bear as an example - the polar bear is finding its natural habitat shrinking at an increasing rate. Philips will be targeting electrical wholesalers, installers, building owners and facility managers across Europe with direct mailings, web based information and point of sale support. The aim is to urge them 'to get the light right' by highlighting the practical benefits of MASTER TL5 fluorescent lamps and systems in terms of energy/cost/CO_2 savings and provide specific information*

[19] *"Live Earth is a monumental music event that will bring together more than 2 billion people on July 7, 2007 to combat the climate crisis. Live Earth will stage concerts in New York, London, Sydney, Tokyo, Shanghai, Rio de Janeiro, Johannesburg, Hamburg and Istanbul, and will feature a mix of both legendary music acts like The Police, Genesis, Bon Jovi and Madonna with the latest headliners like Kanye West, Kelly Clarkson, Black Eyed Peas and Jack Johnson"* (Philips, 2007d, para. 6).
[20] WWF is one of the world's largest conservation organizations working around the globe to stop the degradation of the planet's natural environment (see: http://wwf.panda.org/what_we_do/).

on climate change and the polar bear" (Philips, 2007e, para. 2). After 12 months, Philips reported, that the campaign was a great success in raising awareness among consumers that energy efficient lighting is of great importance, hence the result was a €500.000 donation to WWF (Philips, 2008). Hence, Philips creates shared value and takes an active role in combating societal problems, such as climate change, which creates an opportunity for them to anticipate or even prevent criticism.

5.3. Ambiguity in the Industry's Strategies and Argumentation

Within this sub section, particular strategies and activities of industry actors as well as the employed frames are viewed from a different angle and criticism by various actors and by the author are being discussed. Therefore, this part of the investigation is meant to detect and show the ambiguity as managed by the lighting industry and how a different problem perception ('making sense') can change the perspective on the industry strategies.

Outsourcing production and job losses in Europe

As already indicated above, European lamp manufacturers, as an economic positioning effort, outsourced their production facilities to low labour countries and closed down factories in Europe due to the light bulb ban. For instance in 2009 GE Electronics closed one factory after another in Hungary which cost the job of 2698 people directly and had also severe consequences for subcontractors so that approximately 6.000 – 7.000 jobs will be affected overall (Die Presse, 2009).
Furthermore also Osram claims that the change in the lighting industry from traditional lighting to CFLs and Stale Solid Lighting (LEDs) leads to personnel cutbacks. Until autumn of 2014 Osram will cut 8700 jobs worldwide, 1500 of these in Germany (Die Presse, 2014). But this is not enough as Osram also announced that there will be a subsequent austerity program following the current one which will cut another 7800 jobs, whereby 1700 employees will be affected in Germany (Die Presse, 2014).
Therefore it can be stated that the promised 'wins' for the European economy were exaggerated by the lamp manufacturers, as there are obviously also severe negative impacts as a result of a switch to more energy efficient lighting.

Costly market surveillance

Throughout the discussion of the Consultation Forum, ELC demanded to establish strict market surveillance measures in order to prevent that the internal market is swamped by non-compliant CFLs which might have negative side-effects on the European economy (Vito, 2009a, p. 89). However, within the Consultation Forum, Belgium was questioning whether the creation of a well-functioning system of market surveillance network between national authorities is feasible as it is almost non-existing yet and requires sufficient time to introduce national regulations, information exchange systems and respective testing facilities within member states (Federale Overheidsdienst, 2008, Potential Problems, para. 1). This aspect is especially important due to the fact that the Belgian delegates claim that the majority of CFLs are produced in China and India and show a great variety in the quality of the lamps concerning life time expectancy, low efficiency factors, poor switching cycles influencing operational times, et cetera which could then threaten the promised overall effect of a switch to CFLs (Federale Overheidsdienst, 2008, ibid.). So it seems that the industry's call for strong market surveillance is a tactic to transfer responsibilities to public authorities that then have to prevent low quality products from entering the market. However, at that point it was already obvious that European producers themselves heavily invested in new production facilities or joint ventures in Asia and belonged to the top manufacturers in especially India and China (Waide, 2006, pp. 252-253).

Thus e.g. Philips and Osram are probably those manufacturers of low quality lamps being imported to the EU to meet demand needs being boosted by the ILB ban.
A summarizing report on the findings of various projects focusing on the market surveillance experience within Eco-Design and energy label legislation is commissioned by ADEME, the French Environment and Energy Management Agency. It found that only in 5 EU member states there is significant market surveillance activity, whereas in 6 member states no activity is reported and the rest of the member countries do only take moderate to low market surveillance efforts (Krivošík and Attali, 2014, p. 11). The authorities claim that lack of human and financial resources, the low priority of eco-design on the surveillance authorities' agenda, and a lack of national testing facilities constitute the main barriers to adequate market surveillance (Krivošík and Attali, 2014, p. 13). In addition, *"one worrying fact is that […] some of the authorities have also specifically stated that they are unable to perform any ecodesign related surveillance activities and for the nearest future have no intention of doing do. Some countries plan some formal check of the technical documentation, but declared to have no plan for performing product testing"* (Krivošík and Attali, 2014, p. 13). Hence, the ADEME report perfectly shows that even years after the eco-design legislation has been implemented, market surveillance measures are still ineffective or literally non-existent in some member states.

Questionable energy saving potential of CFLs

The following paragraphs will summarize the most prominent arguments given by different actors throughout the discontinuation policy making process which constitute doubts about the framing strategy of the industry. This particular industry frame introduced the huge energy saving potential of CFLs compared to traditional lighting as portrayed by the industry players.
For instance, the Professional Lighting Designers' Association claimed throughout the review of the preparatory studies which were executed by the European Commission's professional consultants Vito that the energy saving argument is not accurate as there are interactive effects of the light source on heating and cooling needs which have to be taken into consideration. Referring to the UK Market Transformation study BNXS29, they explain that *"[…] 1.429 times the quantity of missing heat from lights will be required to heat the dwelling to the same level. […] In other words, only 17.7% of the gross delivered energy saving will be achieved in practice"* (Vito 2009a, p. 179). Hence, there is doubt about the promised energy savings from energy efficient lighting as presented by the industry due to extra heating efforts. The subsequent reaction from the Vito team on this criticism by the Professional Lighting Designers' Association explained that *"Part 1 is finalised, so this cannot be changed anymore"* (Vito 2009a, p. 179) and they also stress the fact that this issue is a horizontal one as it also concerns other domestic appliances such as TVs, PCs, etc. but was not taken into account by the respectable preparatory studies. Furthermore, the incorporation of this criticism would mean that the MEEuP parameters have to be altered which is a complicated endeavour and so the lighting designers should address the European Commission in order to put the issue forward (Vito 2009a, p. 179).

Besides, the Belgian delegates further stated that *"the efficacies for the alternative lamp technologies seem not realistic. When the power factor is taken into account, potential energy savings would be much lower. Recalculation and new figures are necessary in order to set up adequate ecodesign requirements"* (Federale Overheidsdienst, 2008, Efficacy Requirements, para. 1). In reply to this criticism, Vito declared that the *"power factor was taken into account in the overall study and that it made no significant difference to the figures"* (EC, 2009, p. 73).

The Professional Lighting Designer's Association had also some specific concers about the impact of the power factor in relation to micro generation users as they state that "*specifically for users of micro generation through combined heat and power, wind or photovoltaic systems […] with a power factor of 0.5, typical of the currently available CFL lamps, they will require approximately twice the generative capacity indicated by the lamp wattage"* (Vito, 2009a, p. 73). In the context of the impacts of a low power factor of CFLs on its energy savings, the European Council for an Energy Efficient Economy[21] (ECEEE) claimed that this is a misperception and not true. The Council *"supports the Commission's pragmatic approach of gradually tightening the power factor requirements. eceee does recommend, however, that a few large scale field tests with high CFL saturation are set up and closely measured. This would help to settle the issue and allow us all to focus the debate on more important issues"* (ECEEE, 2008, p. 2).

Even though there was proficient criticism on the promising energy saving potential of CFLs as claimed by the lighting industry, it was not followed up adequately. Instead, Vito and industry statements argued that this criticism does not hold true and therefore no recalculations within the preparatory studies are needed, but there should be some field tests in order to resolve the issue. Such field studies would not influence the preparatory studies, as their execution would lie beyond the time scope of Vito's report.

The industry's framing efforts that present the ILBs as 'energy wasters' being responsible for more emissions than the CFL technology is also confronted by different actors. Within the Consultation Forum, the Italian delegates also doubted the mercury paradox presented by the ELC and suggested that *"it must be carefully considered the relation between lower emission of mercury due to the use of CFL lamps and bigger quantity of the same metal used for CFL lamps"* (Consultation Forum, 2008a, 2. Italian position concerning, para. 13). Italy furthermore highlighted that a switch to CFL lamps will lead to a possible increase of mercury emissions due to the production process as well as the whole life cycle and therefore urged to implement precautionary measures for facilitating an adequate disposal (Consultation Forum, 2008a, Italian position concerning, para. 14). The consumer organisation BEUC[22] also made clear throughout the consultations that *"they do not share the Commission's views that energy savings from CFLs will outweigh the increase in mercury"* (Consultation Forum, 2008c, pp. 8-9).

The European Environmental Bureau was concerned about the dripping method which is used to fill the lamps with mercury and at which high amounts of mercury are emitted especially in production places outside the EU (EC, 2009, p. 79). The organisation therefore demands a 2mg target for the mercury content of CFLs. In response, the ELC confirmed that such a target could operate as a solution for this problem, but at that point such a limit would only be realized through manufacturing within the European Union (EC, 2009, p. 79).
In the light of the fact, that general assumptions state that 80% of the CFLs consumed in EU-27 comes from Asia and acknowledging that this amount is very likely to increase (EC, 2009, p. 72), the

[21] The ECEEE (European Council for an Energy Efficient Economy) is a membership-based Non-Governmental Organisation that provides analysis of policies and evidence-based knowledge while promoting energy efficiency by facilitating networking and cooperation. Among its members – ranging from National Energy Agencies, Research facilities, and energy consulting companies to environmental NGOs and umbrella organisations (see: http://www.eceee.org/members/MembersForum). One of these umbrella organisations is EuroACE European Alliance of Companies for Energy Efficiency in Buildings which embraces companies such as Philips and GE Lighting as their members (see: http://www.euroace.org/EuroACEMembersList.aspx).
[22] BEUC is the European Consumer Organisation including 40 independent national consumer groups from various European countries (see: http://www.beuc.org/about-beuc/who-we-are).

concerns about the dripping method and the consequential mercury emissions becomes especially substantial and are not dealt with adequately.

Concerns about collection and recycling system

As already indicated, under some conditions which reflect mainly every-day-life conditions and not laboratory ones as introduced by the lamp industry, CFLs will not last as promised. Moreover, a set-up time frame of ten years for an adequately functioning recycling system is inappropriate and will lead to exceeding mercury emissions to the environment.

ELC has set up disposal guidelines for CFLs and recognized them as special waste which should not end in the in the household waste – if better options exist (ELC, 2007b). But the federation recommends further that *"[i]f your local waste management agency offers no other disposal options except your household garbage, place the CFLi in a plastic bag and seal it before putting it in the trash. If your waste agency incinerates its garbage, you should search a wider geographic area for proper disposal options such as your local tip. Never send a CFL or other mercury containing product to an incinerator"* (ELC, 2007b). These guidelines point out that first, proper disposal options were not yet working well and at some places even non-existent, and second it also indicates that consumers have to go wider distances, assumingly by car which produces CO_2 emissions that are not acknowledged within the preparatory studies of Vito later on. Hence, the collection and recycling scheme of CFLs is not only producing huge Hg but also CO_2 emissions, which should actually be cut by the switch to CFLs.

In relation to an inadequate collection and recycling of CFLs, Sweden commented within the Consultation Forum that *"[m]etallic mercury doesn't easily become part of the food chain. However, when a CFL bulb breaks in a landfill, there is much less dissipation and bacteria convert metallic mercury into methyl-mercury which is 100 times more soluble in fat"* (Consultation Forum, 2008c, p. 8). Hence, in this case mercury can easily become part of the food chain.

Exposition to mercury

Another opposing line of reasoning is the fact that under certain circumstances workers and consumers might be exposed to mercury which may have severe consequences. The first thing which has to be highlighted was presented by the Italian delegates within the Consultation Forum. They pointed to the instructions the US Environmental Protection Agency recommends as clean-up measures in case of lamp breakage: *"immediately place all cleanup materials outside the building in [… an] outdoor protected area. […] For at least the next few times you vacuum, shut off the central forced-air heating/air conditioning system and open a window prior to vacuuming. Keep the central heating/air conditioning system shut off and the window open for at least 15 minutes after vacuuming is completed"* (Consultation Forum, 2008a, Appendix A1, para. 6). The presented procedures are even more extensive than the ones given by the ELC which have already been discussed above.

If these mercury-containing lamps are safe and the amount of mercury is seen to be negligible the question arises why such comprehensive cleaning measures have to be taken in order to protect consumers and if the energy efficient lamps that contain mercury are really a win for the society.

Moreover, according to a newspaper article from the Sunday Times published in May 2009, *"[l]arge numbers of Chinese workers have been poisoned by mercury, which forms part of the compact fluorescent lightbulbs"* (Sheridan, 2009a, para. 2). Moreover, the Australian news brand 'The Australian' (Sheridan, 2009b) as well as the Austrian news magazine 'Profil' published articles

discussing this topic, too[23], so it is reported that medical tests have analysed the blood and urine of hundreds of Chinese employees working in lamp factories. The results showed high levels of mercury and in several cases levels were also exceeding legal norms by far. Furthermore, doctors of local health facilities have declared that they also treated workers being employed with a plant that is an Osram operation and who showed symptoms of mercury poisoning. However, an Osram spokesman denied these accusations referring to Osram's high standards being in accordance with German regulations even on a global level (Profil, 2009, n.p.).

But the problem of poisonous mercury could also constitute a problem within European borders as the following press release by the British public body Health and Safety Executive reported: *"A recycling company and its director have been fined a total of £145,000 for exposing workers to toxic mercury fumes at a site in Huddersfield. Twenty employees had levels of mercury in their system above UK guidance levels, and five of them showed extremely high levels following the exposure between October 2007 and August 2008"* (Health and Safety Executive, 2010, para. 1-2).
Considering the danger of poisoning that workers handling mercury containing lamps, inside and outside the Europe, are exposed to, the argumentation of the industry that switching to CFLs is beneficial for society is not appropriate.

Concerns about MEEuP[24]

Within the MEEuP methodology the parameters which were used for measuring the environmental effects of the transportation of the Energy using Products (EuPs) did not specify the types of transport and the distances between the production facilities of the lamps and the retailer's central warehouse as only volumes of the product were considered. A mixture of different kind of transport, namely by trucks, sea and air freight and rail, and assumed distances were incorporated. The European Commission's consultants, Vito, stated in their report that "*[t]his assumption could be considered as disadvantageous for lamps mainly produced in Europe (e.g. GLS-F and GLS-C) and advantageous for lamps produced in Asia (e.g. CFLi)*" (VITO, 2009b, p. 146). However, they directly relativize their statement by pointing to the fact that "[…] *the contribution of the distribution phase to the environmental impacts is either low in relative terms compared to other life cycle phases […]*" (VITO, 2009b, p. 146).
As already indicated above in terms of the dripping method used outside EU borders, another aspect is confronting the industry's claim that a switch to energy efficient lighting will be a 'win' for the environment. It is the fact, that CFLs produce great amounts of hazardous waste as well as emissions of heavy metals to water and furthermore cause eutrophication within the phase of production. This is also acknowledged within the Vito Report but again relativized according to the claim that the production plays a negligible role within the life cycle assessment as the use phase is the most important cycle as determined in the MEEuP.

Furthermore Vito presented another problem-solving option within the preparatory study which *"[…] is to improve the production process itself, in order to reduce the quantity of hazardous waste created in production of electronic components. Such real-life changes in production are, however, out of the scope of eco-design of lamps and cannot be taken into account in the context of the MEEuP"* (Vito, 2009b, p. 158).

[23] The full newspaper article by the Sunday Times could not be accessed online free of charge, therefore a second article by Profil was reviewed which dealt with the very same topic.
[24] For an in-depth analysis of the concerns about the MEEuP please have a look at the Appendix of this study. To focus on purely technical matters of the MEEuP at this point, will go beyond the scope of the study.

Thus, the case of hazardous waste within the production phase is dealt with by only referring to the point that it could not be handled by means of the MEEuP which is inadequate as hazardous waste should be treated with more importance. Therefore, a more competent reply to this profound criticism would have been appreciated.

Another concern which is also related to measurements taken within MEEuP is the accused uncertainty about the parameters of (eco-)toxicity, as VHK[25] stated that *"[t]he way we handled the weighting of Heavy Metals has been the most debated issue by the reviewers and we would like to direct the reader to the MEEUP Project Report with the complete reviewer's comments and our answers"* (EC, 2005a, p. 61). Some experts were concerned that the adopted mechanisms of the MEEuP do not incorporate the possibility of substances ending up in ground water, the oceans or going up the food chain and hence being toxic (EC, 2005b, p. 150). Throughout the discussion (EC, 2005b, Appendix IV, p. 5) it was also clarified that the experts are in a position to offer scientific recommendations and advice to policy makers, but the precarious decision in how far to weigh across the different environmental impacts – especially those referring to toxic and hazardous substances possibly threatening the well-being of humans and wildlife – will be completely left to political decision making.
Despite the criticism of some experts referring to too unspecific measurements of toxicity, especially concerning heavy metals emissions, there was also criticism that the VHK methods were too strict and should be simplified (EC, 2005b, p. 163), as demanded by experts from the industry (Siemens[26], IBM and PE-Europe).

This is an apparent example of the industry trying to influence the methodology for energy using products legislation in order to circumvent that some products may perform bad on their environmental impacts especially concerning heavy metals in this specific case.
As the Acting Director General of DG Enterprise and Industry, Mr. Zourek, puts it tellingly within his opening speech at the Commission MEEuP workshop: *"[The EuP Directive…] introduces an integrated and holistic way to address the product's environmental performance, thus avoiding risk of focusing in a fragmented way on particular environmental aspects or phases of the product's life cycle. […] today is one of several opportunities for industry and other stakeholders to discuss the methodology. More detailed studies will pave the way for deciding whether and which kind of implementing measures are justified or necessary"* (EC, 2005b, Appendix V, pp. 1-2).

Concerns about SCENIHR report

In respect of the SCENIHR report, it has to be stressed that Dr Magda Havas who is associate professor of Environmental and Resource Studies at Trent University in Canada has been requested by the Committee to give information about the effects of CFLs on light sensitivity. She is an expert in the research field of electromagnetic pollution focusing on CFL radio wave frequencies that cause 'dirty electricity' and poor power quality. In her report submitted to the SCENIHR Committee prior to its' final report, she concluded as follows: *"The energy efficient compact fluorescent lights that are commercial available generate radio frequency radiation and ultraviolet radiation, they contain mercury-a known neurotoxin, and they are making some people ill. Instead of promoting these light bulbs governments around the world should be insisting that manufactures produces light bulbs that are electromagnetically clean and contain no toxic chemicals. Some of these are already available*

[25] VHK is Van Holsteijn en Kemna BV, the external consultancy company that established the MEEuP on behalf of the European Commission.
[26] In these times, Osram still belonged to the Siemens AG.

(CLED) but are too expensive for regular use. With a growing number of people developing electrohypersensitivity we have a serious emerging and newly identified health risk that is likely to get worse until regulations restricting our exposure to electromagnetic pollutants are enforced. Since everyone uses light bulbs and since the incandescent light bulbs are being phased out this is an area that requires immediate attention" (Havas, 2008, p. 8).

Even though the SCENIHR Committee requested her expertise, it seems that her results were completely ignored, as there can be found no references in the final report pointing to her research findings. According to Visser (2012), the SCENIHR was a policy initiative putting an end to the discussion about health issues due to the fact that despite this report there have been sustained concerns about the effects on health related to the use of energy efficient lighting and the ban on ILBs (Visser, 2012, p. 47). Thus, it can be claimed that the benefits to society as promised by ELC and CELMA are conflicting with the fact that certain people within the EU experience aggravated health impacts from the use of CFLs and do utterly suffer from the discontinuation if the ILB technology.

5.4. Industry's Strategies of Addressing Discontinuation Problems

The sub-parts of the analysis of the discontinuation of the ILBs from the industry perspective so far re-constructed the general Eco-Design decision-making process and its' context in general. And in addition, the different discontinuation barrier types and their related specific issues on the one hand and a detailed overview of the strategies of action applied by the industry on the other hand are deployed. This part of the analysis is now giving an overview on which sets of strategies, derived from Geels (2014) TEF approach, were used by the lighting industry in order to address the different kinds of discontinuation issues that have been experienced. Again, it has to be stated that the barriers mentioned are specifically seen from the industry perspective and cannot be transferred to the view of other actors involved in the discontinuation process.

Within the final section of this sub-chapter, the analysed and conceptualized types of discontinuation barriers and the related industry strategies of action to address those barriers are summarized and discussed in general, so without the ILB case context. This general discussion contributes to an improved understanding of the discontinuation of a technology with a special focus on the industry's impact from a general perspective.

The lighting industry's strategies of governing barriers to discontinuation

Table three portrays an integrated evaluation on which strategies of action were determined to address the specific issues of the different discontinuation barriers which have been identified in the first part of the analysis. It has to be mentioned that at some points various strategic efforts from different set of strategy types have been applied to solve the same specific issue which is clearly depicted in the table.

Strategy of Action	Discontinuation Barrier-Types	Issue for Discontinuation
Economic Positioning	Financial	Initial Costs EEL
	Market (Organization)	Limited availability of high-quality, low cost EEL replacements
		Production capacity of EEL
	Information & Awareness	Lack of awareness of disadvantages of ILBs & benefits of EEL
		Lack of knowledge & skills: public, commercial, residential, industrial
		Poor understanding of Eco-labelling
	Regulatory institutional	Lack of guidelines ensuring international CFL quality standards
	Technical	Low quality & low suitability of EEL
	Environmental & Health Risk Perception	Misperception of Hg amount in CFLs compared to emissions using inefficient lighting
		Concerns over mercury and other heavy metals content in CFLs in relation to health and the environment
Corporate Political Strategies	Financial	Initial costs EEL
	Market (Organization)	Inefficient technology still prevalent
	Information & awareness	Lack of awareness of disadvantages of ILBs & benefits of EEL
		Lack of knowledge & skills: public, commercial, residential, industrial
	Regulatory institutional	Lack of policies & laws encouraging EEL
		Lack of policy restricting supply of inefficient lamps
		Lack of guidelines ensuring international CFL quality standards
	Technical	Low quality & low suitability of EEL
		Lack of testing facilities to monitor, verify compliance with standards
Shaping cultural environment/public debates	Information & awareness	Lack of awareness of disadvantages of ILBs & benefits of EEL
	Regulatory institutional	Lack of policies & laws encouraging EEL
		Lack of policy restricting supply of inefficient lamps
	Environmental & Health Risk Perception	Misperception of Hg amount in CFLs compared to emissions using inefficient lighting
		Concerns over mercury and other heavy metals content in CFLs in relation to health and the environment
Corporate Social Responsibility	Information & awareness	Lack of awareness of disadvantages of ILBs & benefits of EEL
	Environmental & Health Risk Perception	Concerns over mercury and other heavy metals content in CFLs in relation to health and the environment

Table 3 Lighting Industry's Strategies of Action and related Discontinuation Issues

Financial barriers

According to the public industry discourse, the financial barrier of consumers being deterred to switch to more energy efficient lighting because of the high initial price of the products is a dominant issue. However, this problem could be tackled by first shifting the consumer focus from the initial costs of energy savers to the cost-over-life, hence making them aware of the financial as well as environmental benefits of the replacement technology by employing *marketing* strategies. Obviously, decreasing the price of the energy efficient solution should help overcome the initial purchase price issue, as high prices deter costumers from buying CFLs. Here, the lighting industry highlighted actions like the outsourcing of the production to low cost countries which can be seen as *economic positioning* efforts. *Lobbying* for introducing fiscal instruments such as a lowered VAT on the most efficient products or subsidizing the new technologies was also preferred. The different strategies that should address the problem of high initial costs of energy efficient lighting for the consumer adequately portray that technology cannot be seen as only an artefact but that it is embedded in social structures with human agency involved (Pinch & Bijker, 1987; Rip & Kemp, 1998; Geels, 2004a; Borrás & Edler, 2014). Hence, consumers need to be 'nudged' in the direction of changing their former preferences to buy the cheaper light bulbs to now buying energy efficient lighting by means of technical expertise that was translated into everyday expertise. Moreover, the problem solution approaches by the industry reflects nicely on Geels' (2014) TEF approach, as it shows that the industry is interacting with costumers through marketing, and with the supply chain in order to manage the outsourcing of production lines. Obviously, lobbying efforts show the industry's embedding into the socio-political environment, in this case with policymakers, and further stress the lobbying channels available for industry lobbyists, as stressed by Coen (2009, p. 147).

Market (organization) barriers

The problem type being related to the lighting market and its organization was addressed by various industry action strategies. First of all, domestic lighting needed to be recognized as a product group in the Eco Design Framework. This was achieved by *corporate political strategies* such as feeding the policy process with industry-specific information and expert knowledge on CFL saving potential in combination with direct lobbying efforts. As van Schendelen (2010, p. 206) claims, feeding the EU officials with technical expertise is inevitable as they have plenty of political expertise but lack technical knowledge, thus, this situation offers great opportunities for industry experts to set through their specific goals. In this context, the economic policy culture (Jasanoff & Wynne, 1998) seems to be the most influential one in transferring its knowledge into the policy cycle. Another prominent strategy was to offer an improved high-quality generation of energy efficient lighting products and significantly seizing the range of products as to offer different sizes and shapes of lamps as well as variations of the light spectrum of lamps which has been done by *economic positioning* efforts. Seizing the range of products is also reflecting the trajectory on which the CFL moved from the 'niche' level to the 'technological regime' meso-level (Kemp et al. 1994; Berkhout, Smith & Stirling, 2003, p. 7) by means of a learning process containing significant enhancements and further developments focusing on the applicability of the CFL technology (Kemp et al. 1998, p. 186). Another very strong action tool of the lighting manufacturers was to employ *direct lobbying* to convince policy-makers to introduce minimum efficiency requirements on lighting in the context of the Eco-Design Directive which would therefore lead to a phase-out of inefficient lamps, as the availability of this traditional technology is seen as another market barrier; hence it needed to be phased-out by legislation. Again, the institutional set-up of the European Union offers promising opportunity

structures for industry lobbyists ('capable agents') and enables governance of change from the classic light bulb to energy efficient lighting (Borrás & Edler, 2014). Making use of certain technology transfer mechanisms such as using the promising Chinese production volume of CFLs as well as cooperating with partners around the world – from developed as well as developing countries – in order to address production capacity issues and further developing the future technology of LEDs to make them marketable in the long run, are clearly *economic positioning* activities. In the context of collaborating with the Chinese or Indian lighting market actors and exploiting their production volume, European lighting manufacturers aimed at a global harmonization of quality standards in order to sell high-quality products imported from these countries in the EU. This can be classified as collective action and thus *corporate political strategy*. The international harmonization of CFL standards can also be seen as an opportunity structure, facilitating change in the socio-technical system, as presented by Borrás and Edler (2014).

Information and awareness barriers

Shaping the cultural environment and public debate strategies as well as *economic positioning* were the premier tools to overcome the information and awareness barriers as conceived by the industry actors. The traditional technology of ILBs has been given an 'energy wasting' frame to claim its' inefficiency and disadvantages to the end-user and policy-maker. Besides, information about the advantages and saving potential of the more energy efficient solutions have been broadly diffused through marketing strategies such as information campaigns and education programmes to reach end-users and policy-makers. In addition, also retailers and other relevant lighting industry actors were involved in information and education campaigns. They should be trained to provide accurate information to the whole supply chain and to the end-user so that consumers get convincing information about energy efficient lighting at the point-of-sales and sales numbers increase. Framing the ILB as 'energy waster' and the CFL as 'energy saver' is a powerful discursive strategy in the negotiation towards change between state and non-state actors (Borrás & Edler, 2013, p. 6). It has to be highlighted that this discursive strategy was used within the whole range of the socio-political as well as the economic environment in which the lighting industry is embedded (Geels, 2014). Policy makers, the whole supply chain, civil society and costumers were approached in order to raise awareness, change behaviours and influence public debate. Marketing strategies aiming at a correct consumer understanding of the Eco-label were also important to the industry as the costumer should take an informed choice and favour energy efficient lighting. Building advocacy coalitions among industry players to create a closed industry front is another *corporate political strategy* to better inform consumers about the switch to more efficient technologies. The collective action is also reflected in the embedding of firm-in-industries into the wider industry regime which means that there exists a collective mindset and belief system. The same mission is shared among different industry actors, namely the international diffusion of energy efficient lighting while phasing-out the ILB (cf. Geels, 2014).

Trustworthiness of industry actors in the light of the consumer is enhanced as well as criticism prevented by working together with environmental NGOs and showing *corporate social responsibility*. The lack of feeling responsible for switching to energy efficient lighting, due to the fact that a lot of users do not directly pay the accommodations' energy bill or do not know which part of the energy bill is made of electricity, was an issue that had to be overcome by means of marketing measures which should 'educate' the end-user and offer accurate information on these matters.

Regulatory institutional barriers

In this respect, the most prominent set of strategies was the *corporate political* one. The industry used their various lobbying channels in order to 'push' policy makers to opt for minimum efficiency requirements which would lead to a phase-out. The latter was preferred to be gradual in order to make industry capable of adequately addressing the other barriers and minimise consequences. The efforts of industry actors to achieve that mercury content of CFLs will be exempted from the general ban on mercury regulated under the RoHS Directive is another lobbying strategy to overcome regulatory institutional barriers. The lobbying efforts were also used to introduce legislation on EU and also national level in order to promote the uptake of energy efficient lighting products. For instance 'green' public procurement measures involving the installation of energy efficient lighting in the buildings of the European institutions have been often discussed by industry actors as an end to the experienced issues.

Employing the 'win-win frame' of energy efficient lighting for policy makers highlighting the promising potential of energy efficient lighting, such as making the European economy more competitive, supporting to achieve Kyoto targets, etc. was also a strategic tool used by the industry to *shape discourses and public debate*. The utilization of market analyses e.g. from the International Energy Agency or the OECD can be seen as specific information tactic in order to convince the European 'technocrats' taking the 'right' decisions about new legislation in favour of energy efficient lighting products and is thus classified as *corporate political strategy*. In addition, the industry's call for a global harmonization of quality standards which can be seen as organized pressure for regulators, as well as *economic positioning* efforts as exchanging the know-how between developed and developing countries are strategic instruments to overcome the issue of missing legislative guidelines ensuring CFL quality standards. The various efforts undertaken by industry actors to address the regulatory institutional barriers also portray the three different contexts in which the firm-in-industry is embedded (Geels, 2014). The direct lobbying obviously shows relations with policy makers, and framing and discourse tools have been used to shape the public debate. The utilization of the market analyses from OECD and IEA can be seen as interaction with 'knowledge suppliers', and global harmonization efforts show the ties within the industry regime, agreeing on common regulations and standards. Hence, in the ILB case the three environments the lighting industry is embedded in, are perfectly reflected when it comes to addressing regulatory barriers. Also the conceptualisation of Borrás and Edler (2014) of 'capable agents' making use of 'opportunity structures' is reflected within this set of strategies as the industry actors strategically and intentionally made use of the various strategies in order to aim at change, which in this specific case is the discontinuation of ILBs and the promotion of energy efficient lighting. Especially in the light of grand societal challenges, as in this case climate change (Borrás & Edler, 2014) and sustainability, and the challenge of increasing international competition, the lighting industry used the discursive strategy of framing the phase-out of ILBs and simultaneous promotion of energy efficient lighting as a 'win-win' for industry, costumers and governments. By doing so, they wanted to convince policy makers of the need of minimum energy efficiency requirements on lighting. Hence, an environment that facilitates companies' innovative capabilities within the lighting market is created while firms-in-industries are taking a lead position in facing societal problems (Shapira, Smits & Kuhlmann, 2010, pp. 455-456).

Technical barriers

In order to settle technical problems with the energy efficient lighting technology, the industry actors focused on *economic positioning* activities by improving the quality of the products and increasing the range of products that can be offered to the consumer. For instance, dimmable CFLs had to be developed further in order to be ready for the market and lamps had to be designed that fit in existing luminaires so that retrofitting is possible. According to Borrás and Edler (2014, p. 33), this is the social agent instrument of technology assessment, it could also be seen as the specific constructive assessment as presented by (Schot & Rip, 1997). Here, feedback and input from end-use costumers and technical experts are used for the re-design of the technology, as it was the case with the CFLs. Market analyses observing and surveying what keeps people from purchasing CFLs were undergone in the European Union (Lefèvre et al., 2006). Addressing the issue related to the lack of facilities capable of strict market surveillance facilities, trying to detect non-compliance products on the market, the industry factors pointed to the necessity of implementing strong market surveillance measures which should primarily be realized by Member States of the European Union. Hence, they transferred responsibilities of high-quality products on to public institutions by means of pursuing lobbying efforts using *corporate political strategy*. In the light of Borrás' and Edlers's (2014, p. 8-9) work, this situation shows that social agents (here the lighting industry) is promoting the implementation of the governance instrument of market surveillance in order to address technical barriers which hinder change. Putting forward voluntary compliance schemes to certain quality standards as well as labelling programmes was also seen to be an effective collective action of addressing the quality issue of CFLs. Building upon the work of Borrás and Edler (2014, p. 33) this is another social (industry) agent instrument of non-binding voluntary self-commitment agreements, establishing a *"soft form of accountability"* (Borrás & Edler, ibid) creating another argument for change towards energy efficient lighting, as CFL quality issues were claimed to be addressed by these voluntary arrangements.

Environmental and health risk perception barriers

Offering the frame of the 'mercury paradox' of ILBs was a strategic action to overcome the issue of consumers' concerns about the mercury content of CFLs and *shaping public debate* on this topic. Industry referred to the minimum of hazardous substances allowed in lighting appliances, such as 5mg of mercury allowed in CFLs, by means of the EU RoHS Directive. Due to the fact that CFLs complied with EU regulation, consumers should not be worried about the mercury content which can be seen as a discursive tactic to downplay the mercury problem. Besides that, the industry actors' promised the creation of a better functioning of the recycling system achieving a recycling rate of 80% within the following ten years which is another discursive effort. So the concerns about consequences of a bad recycling which leads to potential health and environmental threats should be diminished. As this system is regulated under the WEEE Directive, the industry used this piece of legislation to calm opposing actors by explaining that the collection and recycling infrastructure is adequately taken care of by environmentally sound management. Referring to the jurisdiction of the RoHS and WEEE Directive can be considered as legitimizing tools for the phase-out of ILBs as these directives also stress that the main substituting technology, the CFL, is 'safe to use' and mercury does not pose a problem to health or environment.

Additional marketing tools have been applied to convince the consumer that CFLs are safe, e.g. by distributing information on which steps to take in case of a lamp breakage. Hence, the industry

believes end-users are satisfactorily informed about the correct handling of the mercury containing technology. *Corporate social responsibility* efforts in terms of working together with environmental NGOs which also promote the diffusion of energy saving lamps will also achieve greater trustworthiness among consumers and helps to overcome environmental and health risk perception barriers. The cooperation with NGOs shows the interaction and ties connecting the firm-in-industries, here Philips, with activists and social movements, thus embedding it in the wider socio-political context (cf. Geels, 2014). Moreover, 'ambiguity' as addressed by Borrás and Edler (2014, p. 29) plays a significant role in the way the lighting industry deals with environmental and health risk barriers and the subsequent issues. The industry agents have decided on making sense of their 'mercury' experience and interpreting it accordingly. Hence, they introduced the 'mercury paradox' and the 'CFLs are safe to use' interpretative frameworks while interacting with the social reality and hence preventing criticism about environmental and health risks of CFLs.

The industry's way of governing discontinuation issues

Throughout the analysis of this study, various issues of discontinuation are reconstructed that were experienced as problematic situations by industry actors in the context of the discontinuation of the ILB technology. In a next step these identified issues were integrated into different types of barriers towards discontinuation seen from a general perspective, while again considered as barriers from the angle of an industry which is focusing on a market perspective. Within a next step, the industry's different types of barriers are summarized and associated with discontinuation of technology in general in this section of the study.

- *Financial barriers:*
  The experienced financial barrier of discontinuing an incumbent technology and replacing it with an alternative one are the mostly higher initial purchase price of the alternative product, deterring consumers to buy it.

- *Market (organization) barriers:*
  Another barrier concerns the market and its organization. In case an old technology should be replaced by a new one, the relevant actors of that particular technology market have to re-organize and restructure the market infrastructures of the socio-technical system in order to execute the switch of technologies.

- *Information and awareness barriers:*
  This type of barriers consists of the consumers' unawareness about the existence, technological enhancements, as well as other benefits of the replacement technology or about the disadvantages that can be related to the incumbent technology. Moreover inaccurate or lacking information about the new technology itself and its EU Eco-label characteristic, as well as poor skills handling the innovative technology constitute more issues for this specific type of barriers. These information and awareness barriers can affect different levels of the socio-technical system.

- *Regulatory institutional barriers:*
  If an industry seeks to discontinue an incumbent technology unfavourable regulations or legislations might be in force that either do not fully allow for an adequate promotion of the

emerging technology or still allows the incumbent technology on the market, and hence are considered as problems. In addition, missing international guidelines on quality standards for the innovative technology might hinder its entering of the internal EU market as product standards are considered to be high in Europe.

- *Technical barriers:*
  As emerging technologies are prone to technical 'teething problems' these have to be ruled out as an adequate replacement of the old technology is favoured. In case discontinuation is done by setting minimum requirements for a particular technology, the missing testing facilities monitoring and verifying that the replacing technology meets those standards might constitute another general issue of the technical barriers to discontinuation.

- *Environmental and health risk perception barriers:*
  The innovative technology replacing the old one might be exposed to perceptions that associate it with environmental and health risks, such as the content of heavy metals as mercury and other hazardous substances.

Within this study, the various discontinuation issues were assigned to different sets of strategies employed by the lighting industry in order to overcome the identified barriers. In the following these industry strategies of actions will be reviewed from a general perspective on purposeful technology discontinuation governance.

- *Economic positioning strategies:*
  Marketing and sales measures, supply chain and operations management, as well as innovation strategies can be classified in this set of strategies and may address – as a single strategy or in combination – a variety of problems. For instance economic positioning may antagonise consumers' resistance to replace old technology with an innovative one by continuously improving and seizing the range of available, innovative technology that is aimed at replacing the old technology so that a larger amount of consumer needs and expectations of that replacement technology will be met. Economic positioning can furthermore promote change throughout the different levels of the socio-technical system and diminish costs of the innovation process itself. Market transfer mechanism which can be seen as innovation strategy is a further aspect governing discontinuation in a way that the probably insufficient new technology is enhanced and made marketable as well as creating an international environment which is prone to cooperate in terms of the production and exchange of relevant technological knowledge and properties to facilitate innovative market transformations.

- *Corporate political strategies:*
  Lobbying is a powerful tool that enables industry actors to govern a range of discontinuation barriers. Most prominently a ban on old technology, e.g. by introducing certain standards and requirements on a product group, is very effective to stimulate innovation and industry can try to influence the pace of the phase-out in a way that suits market re-organization efforts. Moreover, new legislation or regulations is able to rule out deficiencies of discontinuation in terms of promoting technical enhancements, offering a legislative framework of innovation through discontinuation as well as settling health and

environmental perceived threats associated with the new technology e.g. by introducing legal limits on hazardous substances.
Another corporate political strategy which supports industry actors in their efforts towards innovation through discontinuation is the collective action of the voluntary acknowledgment of a certification or labelling scheme, preferably at an international level. It facilitates market organization efforts, for instance if the production capacity of the replacement technology is scarce within Europe, imports from outside the EU borders can be used to overcome this barrier. Moreover, also quality issues of the new technological innovation will be ruled out by introducing international certification schemes. By feeding their expert knowledge and information into the policy making process and at various levels, industry actors arrange for setting and keeping the push for innovation on the political agenda.

- *Shaping cultural environment, broad ideologies and public debates*
  Employing framing strategies as well as discursive strategies is a powerful tool in order to introduce a negative picture of the 'inefficient' technology that needs to be discontinued as well as framing the replacement technology in a way that policy makers are willing to decide on the ban in order to push the diffusion of the energy efficient alternative. Furthermore, denying or downplaying problems related to the environmental or health impact helps to create or enhance consumer confidence in the product.

- *Corporate social responsibility:*
  The collaboration with environmental NGOs can also act as window of opportunity to set through innovation policies as policy makers and consumers are less concerned about environmental or health impacts of the innovation product and hence less criticism can be expected or a greater audience can be reached as it was the case when Philips collaborated with Live Earth.

6. Conclusion and Discussion

The final chapter of this thesis presents the concluding results of the conducted analysis of the industry's role within the ILB discontinuation governance process and its ways of coping with the identified barriers. The first section elaborates on the insights of the conducted study and the ways these add to the comprehension of the way technology discontinuation is integral part of the phenomenon of the governance of socio-technical transitions. In the context of dedicated discontinuation governance, the second part of this chapter offers a bigger picture on how the empirical findings of this investigation can be incorporated into the conceptual background already presented in chapter two. The final section of this chapter will give an outlook on further research that on the one hand should focus on in-depth research methods enhancing the understanding of discontinuation of a technology on the industry micro level, for instance by interviewing managers of firm-in-industries that were involved in the Eco Design process. On the other hand it will stress the importance to further examine the industry's role within the global diffusion of energy efficient lighting.

6.1. Discontinuation - Integral Part of Innovation and Industry Influence on its Governance

A crucial notion of this study that has already been stressed several times within this thesis, is considering the discontinuation of a socio-technical system as an integral part of the technological innovation process. However, the prevailing conception among socio-technical transition scholars approaches innovation in the light of emerging technologies as driving change towards replacing the incumbent technology due to technological advancements.

The example of the ILB case demonstrated that the availability of an advanced and more efficient lighting technology does not subsequently result in the replacement of the old and inefficient lamp technology by the emerging one, as for instance CFLs have already been on the market since the 1970s for domestic lighting purposes.

Major pressures to speed up the switch to energy efficient lighting alternatives and to put it on the EU political agenda came from industry actors who were aware of the possibility of phasing-out the least efficient products by setting minimum efficiency requirements that were feasible to implement in the context of the Eco-Design Framework. As the reports from IPCC (1995) and IEA (1998a; 1998b) show, early work for providing the basis for introducing minimum efficiency requirements as public policy tool to transform the market towards energy efficiency products had already started before the Kyoto Protocol was signed. Industry actors thus called for various policy initiations, while minimum efficiency requirements was one of the most prominent ones, but also introduced their own initiatives, some of them in cooperation with e.g. EU institutions, governments, environmental organisations and energy utilities. Therefore it can be stated that the technological transitions in residential lighting cannot be analysed separately from especially industry endeavours towards the discontinuation of ILBs. Besides that, the industry pressures and efforts towards the phase-out of inefficient lighting exemplify also the purposeful governance of discontinuation.

Due to the fact that the market transformation of domestic lighting was developing too slowly, industry actors purposefully and strategically took action by pushing for the implementation of minimum efficiency requirements for lamps which would result in the phasing-out of the least efficient products. In order to overcome certain barriers to discontinuation also international efforts were made, such as the harmonization of CFL quality standards and the execution of particular pilot studies in order to use the evaluated insights to incorporate them into the endeavours promoting an international diffusion of CFLs even in developing countries. From those pilot projects, learning experiences have been derived which further shaped industry efforts to transform the market towards energy efficient lighting. This process is also reflected by Geels (2014, p. 272). Especially the consumer perception and purchasing behaviour played an integral part in the learning process, as most of the barriers to discontinuation can be traced back to consumer wants and needs and strategies to overcome these barriers have been established respectively. The subsequent part will introduce the ‘big picture’ of the industry endeavours by means of connecting the empirical findings of this investigation to the concepts that have been introduced within chapter two of this study.

6.2. What the Industry Perspective on Discontinuation Governance Adds to Relevant Literature

Within this section the overall governance aspects that are presented by the empirical findings of the investigation are introduced and contribute to drawing a bigger picture about the ILB discontinuation process from the 'lighting industry-as-governance-maker' perspective. As Stegmaier, Kuhlmann and Visser (2014, p. 115) put it, *"the governance efforts that are necessary to end the governance structures and processes underpinning the old system are of equal importance in order to see the full picture of system's discontinuation".*

The industry established a 'governance dispositif' (Stegmaier, Kuhlmann & Vissers, 2014, p. 117), which portrayed the ILB as 'energy waster', the CFL as 'energy saver' and the switch to energy efficient lighting as a 'triple win' for the environment, consumers, and the European economy. This discourse significantly facilitated the creation of collective action (Coen, 2009, p. 156) and broad advocacy coalition, between the lighting companies and their associations, the wholesale and retailers and also environmental NGOs, as the various actors had a shared consensus on the problem perception. Thus, turning towards more energy efficient lighting was seen as favourable policy option by the various actors.
The maintenance of the presented 'governance dispositif' moreover involved to manage ambiguity (Borrás & Edler, 2014; Choo, 2006) over health and environmental concerns related to the mercury contained in CFLs. Here, additional policy instruments were used by the industry in order to transfer responsibilities in terms of hazardous substances as well as waste and recycling by pointing to the jurisdiction of 'supplementing' legislation (RoHs and WEEE Directive) and thus successfully preventing additional requirements for industry actors from being ruled under the eco-design directive. Furthermore, ambiguity about the (eco)toxicity of products was managed by means of the MEEUP as it relied on the expertise of industry actors that were also directly involved in setting up this methodology study.

The finding that 'everyday users' were significantly less involved into the eco-design procedure compared to 'elite visionary agents' (Smith & Stirling, 2010) has to be highlighted, so out of the 30 stakeholders selected to participate within the Consultation Forum, 21 organisations can be categorized as industry actors, while only three groups represented consumers and two organisations had an environmental background (Consultation Forum, 2014). This fact can also be interpreted in a way that the technical rationality was the dominant one among the competing stakeholder rationalities (cf. Lin, 2003) while simultaneously the economic 'policy culture' (cf. Jasanoff & Wynne, 1998) was prevailing and significantly influencing the policy making process.

Another remark that refers to Geels' (2014) TEF and adds to this approach is the governance trajectory of the ILB discontinuation. It has to be stated that within this part, the specific industry perspective, that has been adopted throughout the analysis, is been discarded in order to aim at a broader picture of the ILB discontinuation. The empirical findings of this investigation suggest that firm-in-industries, in this specific case predominantly represented by Philips, faced pressures from various environments in which it is being embedded. A major pressure can be related to the economic (task) environment and seen as a 'missed economic potential'. Profit margins from ILB sales were considered to be low while more profitable technologies, especially CFLs, were already in the pipeline, ready to take over the socio-technical system from the 'niche level'. However, the diffusion of the new lamp could not reach the reported (Waide, 2006; 2010), promising market potential as governance mechanisms aiming at promoting the 'novelty' (Kemp et al. 1998) did not

work adequately and consumers refused to take the switch to energy efficient lighting solutions. Thus, ILBs were still dominating the domestic lighting market.

The societal grand challenge of climate change and the targets set by the Kyoto Protocol to address this problem is often viewed as an external pressure, associated with the socio-political environment, affecting industry actors which have to react and reorient accordingly (Geels, 2014, pp. 272-273). However, the empirical insights gathered in this investigation suggest that the climate change debate and the policy reactions with the aim of significantly reducing CO_2 emissions, by e.g. decreasing energy consumption, predominantly facilitated the industry efforts to a market transformation towards EEL. That means that Geels' (2014, ibid) presented spill-over effect from the socio-political to the economic task environment rather forcing a firm-in-industries to change, is in the ILB case also found to facilitate change that is already favoured by industry actors. This suggestion is also confirmed by the findings that showed profound strategic, and intentional (Stegmaier et al., 2014) corporate political strategies of single firms-in-industries and their respective federations trying to convince policy-makers of implementing legislation that finally leads to the discontinuation of the ILB technology.

The empirical insights of the ILB case furthermore point to a global policy trajectory which can be detected in its early stages in the 1990s even before the Kyoto protocol was signed as e.g. stated in the IPCC report in 1995 (p. 142) where minimum efficiency requirements are already presented as policy option. Hence, the industry is not only embedded within the socio-political environment in terms of 'traditional' policy makers such as member of parliaments, or in the EU case the European Commission, but also within the intergovernmental organization environment, in the ILB case e.g. the United Nations Environmental Programme (UNEP) which set up the IPCC. However, the agenda setting, starting 'ante Kyoto', evolved throughout the years, evaluating policy options and making them more specific, focusing on certain product groups while involving a broad range of actors, as already stated by Stegmaier, Kuhlmann and Vissers (2014, p. 117). However, on a European level, the lighting actors played a significant role as governance maker within this process, as they managed that domestic lighting was considered as a suitable product group being addressed by the specifications of the eco-design directive.

Bearing in mind the global policy trajectory which was translated into the European Eco-Design legislation that regulated the discontinuation of the ILB and acknowledging the facilitating advantages of the climate change debate for industry actors, the Eco-Design Directive can be considered as an 'opportunity structure' (Borrás & Edler, 2014). It also gives reason to interpret industry behaviour as exploiting the institutional/regulatory EU channel. The question of who instrumentalizes whom in the ILB case, was already put forward by Stegmaier, Kuhlmann and Vissers (2014, p. 125). The EU eco-design directive significantly facilitated the transition of the innovative CFL technology from the niche level to the landscape level while simultaneously discontinuing the until then dominant socio-technical system of ILBs (cf. Berkhout, Smith & Stirling, 2003; Kemp et al., 1998; Kuhlmann et al., 2010). To put it differently, the window of opportunity (Geels, 2004b) offered by the state was purposefully (Stegmaier, Kuhlmann & Vissers, p. 125) exploited by industry actors in order to drive change in the socio-technical system of the ILB by means of 'strategic endeavour' (Kuhlmann, Shapira & Smits, 2010, p. 2). There is a statement in the IEA's report from 2006 which nicely underlines this interpretation as it states: *"More generally, however, the difficulty in "policing" the use of lighting in the home suggests that minimum energy performance requirements for the lamps themselves may be a better policy choice, especially if complemented by market-*

transformation initiatives to stimulate the uptake of fluorescent lighting in place of incandescent lamps" (Waide, 2006, p. 185).

Nevertheless, the 'greening' of the economy related to the climate change debate also put pressure on the industry. The internal industry regime (Geels, 2014) needed adjustment and incumbents governed change within the socio-technical system in order to meet the demand-boost of EEL as a consequence of the ILB discontinuation. Technical knowledge and capabilities were reoriented towards efficient lighting by means of e.g. technology transfer mechanisms, strategic intelligence was gathered to initiate a learning process to address market barriers (especially consumer perception), and the sustainability thought was being adopted as integral part of the incumbents' mindset and beliefs. Furthermore, newly introduced self-regulation measures (e.g. global harmonization of CFL standards) constituted another internal measure of governance within the lighting industry regime. Of course, also the economic task environment of the lighting industry, such as the supply chain and retailers were governed by means of agreements on the promotion of EEL and education and training of retail personnel.

All in all, this case study illustrated that industry actors strategically governed change towards discontinuation of a socio-technical system by employing different set of strategies adjusted to the respective environment. The phenomenon can be described as *"tentative industrial – embedded in economic environments and socio-political environments – trying to derive advantages from 'discontinuation' efforts"* (Kuhlmann, personal communication, May 5, 2015). Besides, incumbent firms failed to govern change in the socio-technical system to its full potential by means of their role as an 'innovation entrepreneur' that employs discursive and market instruments. Therefore, the results of this case study suggest that the lighting industry intentionally opted for entering the policy-making sphere as 'institutional policy entrepreneur'. In this way industry was steering change by utilizing the regulatory power of the European Commission.

6.3. Further Research

Within this part of the study, the analyst reflects on recommendations for further research which is considered to be suitable for further broadening and deepening the understanding of the analysed phenomenon.

Making use of process tracing methods which means magnifying the very micro-level of the ILB discontinuation process would be promising due to the fact that at a more in-depth explanation will be reached and the researcher will be enabled to reconstruct the process more specifically. As Checkel (2005) claims, in-depth interview focusing on only a few actors being involved in the process is a prominent way of getting a deeper understanding of how specific mechanisms, such as persuasion, occurred and were applied by particular actors. The data sampling method for process tracing is discussed as a very promising supporting tool as it helps reconstructing an event or also a set of events. Tansey (2007, p. 766-767) explains as follows: *"the usage that is arguably most relevant to process tracing entails conducting elite interviews to establish the decisions and actions that lay behind an event or series of event. Through direct and focused questioning, researchers can reconstruct political episodes on the basis of the respondents' testimonies, stitching together various accounts to form a broader picture of a complex phenomenon."* In this respect, interviewing top managers of single lighting companies such as Philips, GE and Osram, or from the representation of the companies on EU level, namely the ELC, as well as EU policy-makers, research consultants and representatives of consumer or environmental organizations that have been involved within the ILB

discontinuation process, would clearly allow for getting an even deeper understanding and make the picture more complex. Using the process tracing analysis approach furthermore means that the discontinuation can be addressed by acknowledging the different perspectives or 'realities' of the various actors and how they experienced the process. In addition, it might be possible to detect causal mechanisms, as the process tracing method is aiming for. It may also be possible to get access to confidential documents being of high importance within the decision-making process, such as internal industry memos, as the interviewed persons will possibly develop trust in the researcher and therefore allow him access.

Another recommendation is to further stress the global perspective and analyse the general pattern related to the goals of the UNPCC report, the UN demand side management strategies and focus on the structuration of exchange of knowledge about discontinuation of ILB in a global context. For example the pilot projects referred to by the IEA (IEA, 1998b, p. 39) can be interpreted as practical study for the industry to get to know how to overcome barriers, especially consumer barriers, and to learn from these pilot studies and put the knowledge into the global diffusion mechanisms. However more detailed investigation of this topic is needed. The research focus in the global scale of ILB discontinuation can be aimed at by a similar research project that seeks to reconstruct the discontinuation process on a global scale, where the European discontinuation was only a single example. That means gather data in form of policy documents and other relevant documents from the UN and the other organisations being involved such as the world bank, the single development banks, the GEF, IEA, OECD, etc. If one thinks about companies like OSRAM, GE and Philips that are so-called global players, operating their businesses across the borders of nation states and even across continents, it becomes obvious that also the structuration and governance of ILB discontinuation in the context of switching to more energy efficient lighting solutions is done on a global scale. Hence, further research should preferably address the global industry governance of discontinuation.

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Appendix A

In-depth analysis of the concerns about MEEUP measures

For the interested reader, this part of the appendix offers a more detailed view on the concerns the author detected throughout the analysis in the context of the MEEUP.

CO_2 Emissions by Transportation

Within the MEEuP methodology the parameters which were used for measuring the environmental effects of the transportation of the Energy using Products (EuPs) did not specify the types of transport and the distances between the production facilities of the lamps and the retailer's central warehouse as only volumes of the product were considered. A mixture of different kind of transport, namely by trucks, sea and air freight and rail, and assumed distances were incorporated. The European Commission's consultants, Vito, stated in their report that "*[t]his assumption could be considered as disadvantageous for lamps mainly produced in Europe (e.g. GLS-F and GLS-C) and advantageous for lamps produced in Asia (e.g. CFLi)*" (VITO, 2009b, p. 146). However, they directly relativize their statement by pointing to the fact that "[…] *the contribution of the distribution phase to the environmental impacts is either low in relative terms compared to other life cycle phases […]*" (VITO, 2009b, p. 146).

Concerns about collection and recycling system

As already indicated, under some conditions (which are more daily-life conditions and not the laboratory ones introduced by the lamp industry) CFLs will not last as promised. Moreover, a set-up time frame of ten years for an adequately functioning recycling system is inappropriate and will lead to exceeding mercury emissions to the environment.

ELC has set up disposal guidelines for CFLs and recognized them as special waste which should not end in the in the household waste – if better options exist (ELC, 2007b, n.p.). But the federation recommends further that *"[i]f your local waste management agency offers no other disposal options except your household garbage, place the CFLi in a plastic bag and seal it before putting it in the trash. If your waste agency incinerates its garbage, you should search a wider geographic area for proper disposal options such as your local tip. Never send a CFL or other mercury containing product to an incinerator"* (ELC, 2007b, ibid.). These guidelines point out that first, proper disposal options were not yet working well and at some places even non-existent, and second it also indicates that consumers have to go wider distances, assumingly by car which produces CO_2 emissions that are not acknowledged within the preparatory studies of Vito later on. Hence, the collection and recycling scheme of CFLs is not only producing huge Hg but also CO_2 emissions, which should actually be cut by the switch to CFLs.

In relation to an inadequate collection and recycling of CFLs, Sweden commented within the *Consultation Forum that "[m]etallic mercury doesn't easily become part of the food chain. However, when a CFL bulb breaks in a landfill, there is much less dissipation and bacteria convert metallic mercury into methyl-mercury which is 100 times more soluble in fat"* (Consultation Forum, 2008c, p. 8).

Exposition to mercury

Another opposing line of reasoning is the fact that under certain circumstances workers and consumers might be exposed to mercury which may have severe consequences. The first thing which has to be highlighted was presented by the Italian delegates within the Consultation Forum. They pointed to the instructions the US Environmental Protection Agency recommends as clean-up measures in case of lamp breakage: *"immediately place all cleanup materials outside the building in [… an] outdoor protected area. […] For at least the next few times you vacuum, shut off the central forced-air heating/air conditioning system and open a window prior to vacuuming. Keep the central heating/air conditioning system shut off and the window open for at least 15 minutes after vacuuming is completed"* (Consultation Forum, 2008a, Appendix A1, para. 6). The presented procedures are even more extensive than the ones given by the ELC which have already been discussed above.

If these mercury-containing lamps are safe and the amount of mercury is seen to be negligible the question arises why such comprehensive cleaning measures have to be taken in order to protect consumers and if the energy efficient lamps that contain mercury are really a win for the society.

Moreover, according to a newspaper article from the Sunday Times published in May 2009, *"[l]arge numbers of Chinese workers have been poisoned by mercury, which forms part of the compact fluorescent lightbulbs"* (Sheridan, 2009a, para. 2). The Austrian news magazine 'Profil' also discussed this topic and reported that medical tests have analysed the blood and urine of hundreds of Chinese employees working in lamp factories. The results showed high levels of mercury and in several cases levels were also exceeding legal norms by far. Furthermore, doctors of local health facilities have declared that they also treated workers being employed with a plant that is an Osram operation and who showed symptoms of mercury poisoning. However, an Osram spokesman denied these accusations referring to Osram's high standards being in accordance with German regulations even on a global level (Profil, 2009, n.p.).

But the problem of poisonous mercury could also constitute a problem within European borders as the following press release by the British public body Health and Safety Executive reported: *"A recycling company and its director have been fined a total of £145,000 for exposing workers to toxic mercury fumes at a site in Huddersfield. Twenty employees had levels of mercury in their system above UK guidance levels, and five of them showed extremely high levels following the exposure between October 2007 and August 2008"* (Health and Safety Executive, 2010, para. 1-2).

Considering the danger of poisoning that workers handling mercury containing lamps, inside and outside the Europe, are exposed to, the argumentation of the industry that switching to CFLs is beneficial for society is not appropriate.

In production phase the impacts on hazardous waste, eutrophication and emissions of heavy metals to water are relativized

As already indicated above in terms of the dripping method used outside EU borders, another aspect is confronting the industry's claim that a switch to energy efficient lighting will be a 'win' for the environment. It is the fact, that CFLs produce great amounts of hazardous waste as well as emissions of heavy metals to water and furthermore cause eutrophication within the phase of production. This is also acknowledged within the Vito Report but again relativized according to the claim that the

production plays a negligible role within the life cycle assessment as the use phase is the most important cycle.

"The relatively high impacts of CFLi in the production phase for the three indicators "hazardous waste", "eutrophication" and "emissions of heavy metals to water" are due to the integrated electronic ballast (modelled with a PWB in the EcoReport). The inventories for the electronic components are characterised by relatively high environmental impacts compared to "basic" materials such as glass and metal. This is a typical example of a case where adding electronics can improve efficiency, but this may create more impacts in the production phase. But thanks to the life cycle approach, using a common functional unit (lumen per hour), it can be concluded that despite this trade-off in production, the CFLi has the best performance over the life cycle (see section 5.6 for the comparison of the base-cases)" (Vito, 2009b, p. 158).

The tables below, calculated by Vito relying on the EcoReport established in the MEEuP, are presenting the results of the impact assessment for the base-case of ILBs and CFLs.

Table 5-6: Environmental assessment results from EcoReport (base-case GLS)

Base-Case GLS										0 BIO
Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL
Resources Use and Emissions		Material	Manuf.	Total	BUTION		Disposal	Recycl.	Total	
Materials	unit									
Bulk Plastics	g			0			0	0	0	0
TecPlastics	g			0			0	0	0	0
Ferro	g			0			0	0	0	0
Non-ferro	g			1			1	0	1	0
Coating	g			0			0	0	0	0
Electronics	g			0			0	0	0	0
Misc.	g			20			20	0	20	0
Total weight	g			21			21	0	21	0
Other Resources & Waste							debet	see note! credit		
Total Energy (GER)	MJ	1	0	1	52	567	1	0	1	621
of which, electricity (in primary MJ)	MJ	0	0	0	0	567	0	0	0	567
Water (process)	ltr	0	0	0	0	38	0	0	0	38
Water (cooling)	ltr	0	0	0	0	1512	0	0	0	1512
Waste, non-haz./ landfill	g	5	0	5	52	657	26	0	26	740
Waste, hazardous/ incinerated	g	0	0	0	1	13	0	0	0	14
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	0	0	0	5	25	0	0	0	29
Ozone Depletion, emissions	mg R-11 eq	negligible								
Acidification, emissions	g SO2 eq.	0	0	0	12	146	0	0	0	158
Volatile Organic Compounds (VOC)	g	0	0	0	0	0	0	0	0	0
Persistent Organic Pollutants (POP)	ng i-Teq	0	0	0	0	4	0	0	0	4
Heavy Metals	mg Ni eq.	0	0	0	3	10	0	0	0	13
PAHs	mg Ni eq.	0	0	0	3	1	0	0	0	4
Particulate Matter (PM, dust)	g	0	0	0	1	3	2	0	2	6
Emissions (Water)										
Heavy Metals	mg Hg/20	0	0	0	0	4	0	0	0	4
Eutrophication	g PO4	0	0	0	0	0	0	0	0	0
Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

Figure 4 Environmental Impact Assessment Results from EcoReport (Base-case GLS)
(See: Vito, 2009b, p. 144)

Table 5-10: Environmental assessment results from EcoReport (base-case CFLi)

Life cycle Impact per product:								Date	Author		
Base-Case CFLi									0 BIO		
Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL
Resources Use and Emissions		Material	Manuf.	Total	BUTION		Disposal	Recycl.	Total	
Materials	**unit**									
Bulk Plastics	g			0			0	0	0	0
TecPlastics	g			0			0	0	0	0
Ferro	g			0			0	0	0	0
Non-ferro	g			1			0	1	1	0
Coating	g			0			0	0	0	0
Electronics	g			18			14	5	18	0
Misc.	g			31			2	30	31	0
Total weight	g			51			15	35	51	0
Other Resources & Waste							debet	see note! credit		
Total Energy (GER)	MJ	10	2	12	53	860	1	1	0	925
of which, electricity (in primary MJ)	MJ	6	0	7	0	860	0	1	-1	866
Water (process)	ltr	8	0	8	0	57	0	0	0	65
Water (cooling)	ltr	2	1	3	0	2293	0	0	0	2296
Waste, non-haz./ landfill	g	48	2	50	52	998	4	2	3	1103
Waste, hazardous/ incinerated	g	78	0	78	1	21	5	1	4	103
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	0	0	1	5	38	0	0	0	43
Ozone Depletion, emissions	mg R-11 eq	negligible								
Acidification, emissions	g SO2 eq.	4	1	5	12	221	0	0	0	239
Volatile Organic Compounds (VOC)	g	0	0	0	0	0	0	0	0	0
Persistent Organic Pollutants (POP)	ng i-Teq	0	0	0	0	6	0	0	0	6
Heavy Metals	mg Ni eq.	1	0	1	3	15	0	0	0	18
PAHs	mg Ni eq.	0	0	0	3	2	0	0	0	5
Particulate Matter (PM, dust)	g	0	0	0	1	5	1	0	1	7
Emissions (Water)										
Heavy Metals	mg Hg/20	6	0	6	0	6	0	0	0	11
Eutrophication	g PO4	0	0	0	0	0	0	0	0	0
Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

Figure 5 Environmental Impact Assessment Results from EcoReport (base-case CFLi)
(See: Vito, 2009b, p. 156)

As it can be seen, the levels of non-hazardous waste in the production phase of CFLs are ten times higher than compared to GLS and the hazardous waste for GLS is 0g whereas the production of CFLs results in the creation of 71g of hazardous waste. Hence, levels of both types of waste are significantly higher in case of CFLs.

Vito came up with several possible solutions for this specific problem with the ballasts of CFLs, such as reducing the weight of the ballasts which would cause further problems related to retrofitting existing luminaires. This problem solving approach targeting design options seems to be in line with the general solution offered by VHK within the MEEuP Final Report, namely that *"[…] the environmental impact of raw material production and the manufacture of half-products or even some components is only the responsibility of the EuP-industry in as much as it can be influenced by design decisions. […] Naturally the EuP-designer can influence the environmental impact by lowering certain material requirements regarding corrosion resistance (influences the exact alloy) or the surface quality (e.g. influences the percentage of recycled material that can be used), but basically he or she is just a critical consumer in a huge materials shop with fixed prices (for the environment)"* (EC, 2005a, p. 25). Or, to put it bluntly, like VHK did within the European Commission Workshop on 3rd of October 2005 in Brussels: "*Lightweight is Beautiful - in the trade off between less mass and perhaps a higher impact per kg, the overall outcome is that lightweight usually wins*" (EC, 2005b, Appendix V). Thus, the consultancy establishing the Methodology for Energy using Products recommends to the

EuP producers to lower the weight of products in order to circumvent high environmental impacts while being aware that this may have consequences on the quality of the products.

Furthermore Vito presented another option within the preparatory study which *"[…] is to improve the production process itself, in order to reduce the quantity of hazardous waste created in production of electronic components. Such real-life changes in production are, however, out of the scope of eco-design of lamps and cannot be taken into account in the context of the MEEuP"* (Vito, 2009b, p. 158).
Thus, the case of hazardous waste within the production phase is dealt with by only referring to the point that it could not be handled by means of the MEEuP which is inadequate as hazardous waste should be treated with more importance. Therefore, a more competent reply to this profound criticism would have been appreciated.

In addition, Vito stated as follows:

"As mentioned, we consider that the eutrophication impact is negligible compared to other products such as a 32'' LCD TV (cf. EuP Lot 5). Furthermore, when comparing per lumen and per hour, a CFLi is 'better' than an incandescent lamp and even better than a halogen lamp (except for eutrophication)" (Vito, 2009b, p. 158).

This line of reasoning can be criticized because it is not adequate to compare the eutrophication level to a very different kind of product group such as a LCD TV which has obviously a heavier weight than a CFL instead of comparing it to the respectable base-cases such as ILBs or Halogen lamps.
Another simple assumption which would conflict this point of view, is the amount of CFLs used in a household compared to LCD TVs, as the EU-27 average for lighting points installed in an household in 2007 was 24,3. 54% of these lights are GLS, 23% are energy saving lamps and 23% are halogen bulbs (Vito, 2009b, p. 69). If we now execute a simple thought experiment, namely that in case all types of GLS are banned, the equal share of former GLS lighting points will be split and divided to energy savers and halogens, both technologies then make up 50% of installed lamps, in counts 12,15. Compared to an assumed limited number of LCD TVs in an average household, the eutrophication impact of CFLs will possibly no longer be negligible.
Besides, the eutrophication aspect is once again relativized in terms of putting more emphasis on the saved energy within the use phase which is compared per lumen and hour.

Uncertainty about (eco-) toxicity measurements in MEEUP

Another concern which is also related to measurements taken within MEEuP is the accused uncertainty about the parameters of (eco-)toxicity, as VHK[27] stated that *"[t]he way we handled the weighting of Heavy Metals has been the most debated issue by the reviewers and we would like to direct the reader to the MEEUP Project Report with the complete reviewer's comments and our answers"* (EC, 2005a, p. 61).

[27] VHK is Van Holsteijn en Kemna BV, the external consultancy company that established the MEEuP on behalf of the European Commission

When analysing the mentioned part where experts reviewed and criticized VHK's work on Heavy Metals, there is one passage which is of importance as researchers from the Institute of Environmental Sciences (CML) of the University of Leiden stated:
"All methods considered in the text have as a problem that emissions cannot be related to concentrations, as the contribution to concentration depends on time the substance remains in the environment. This time depends on breakdown and immobilisation processes. Substances also migrate through, medial like water air and soil and persistent pollutants may go into the oceans. Some substances show biomagnification, as when they are taken up in fat and go up the food chain. Though surely not final, reckoning with such mechanisms makes the comparison between substances, and adding them up according to their potential toxicity totally superior to methods based on allowable concentrations. This is a clear advice" (EC, 2005b, p. 150).

The direct answer of VHK reads as follows: *"[…] without addressing every single issue, the comments by Gjalt Huppes were largely taken into account in the underlying draft in as much as the boundary conditions of this assignment allowed"* (EC, 2005b, p. 153). This means that for an ordinary person it is nearly impossible to retrace if these critical comments concerning the weighting of e.g. heavy metals have been incorporated into the methodology or not, as the statement given by the Commission's consultants is utterly vague. The only way to see if the methodology was changed is to check whether there are differences in methods within the draft and the final version of the MEEuP. However, as the weighting mechanisms are controversial, even among professionals, a layperson will most likely not grasp alterations made within applied formula.

Another passage reveals more details on VHK's reasoning concerning the applied weighting process and reads as follows:

"As you probably can imagine, to use the header "toxic substances" implies much more than we are willing and able to imply. It would imply e.g. that substances that are not included would not be toxic: We have no way of knowing that. The only thing we know is that they are not part of EU legislation, nor even of draft legislation. […]Furthermore, to use the header "toxic substances" would imply that the weighting factors are a measure of the toxicity of these substances. Again, we have no way of knowing that. We have studied of course whether there is a scientific consensus, some un-controversial (eco-)toxicity index that would appeal to all. But, as you probably know, there isn't (e.g. see Declaration of Apeldoorn, see latest call for tender from ICCM). We are no toxicologists, we don't make fate analyses or studies of these substances in nature in various persistent or non-persistent forms. The only thing that we give here are weighting factors based on legally imposed threshold values. And the only thing that this tells our main audience, the policy makers: If an energy-using product has a high score on this indicator that there is a relatively high risk that certain items/actors in the product life cycle will surpass the legally imposed thresholds of the Air Quality directives. No more, no less" (EC, 2005b, pp. 159-160).

Even though the explanation given seems reasonable as the correct measuring and weighting of toxic substances is a highly disputed and complex topic, it would have been advisable to ask experts like toxicologists for additional advise on these matters, as toxic substances in energy using products is a very significant issue that should not be underestimated. The most adequate way of measuring and weighing these substances is especially desirable when the opinion of the critical experts is taken into consideration referring to the fact that toxic material can end up in the ground water, the

oceans and also the food chain. It is obvious that these consequences have to be avoided without any doubt, however, due to the measures taken in the MEEuP, these concerns cannot be completely ruled out. Another matter which is worth mentioning is that it is questionable why some of the toxic substances that, according to the LCA experts are seen to be toxic, are not categorized as such by EU legislation such as the RoHS and WEEE directives as referred to in VHK's answer (EC, 2005b, p. 159).

Throughout the discussions about weighing factors, various stakeholders agreed on the fact that *"weighing across categories is a political decision in the first place [… and…] that it is not the VHK assignment to weigh between categories like Global Warming and Acidification. 'The question if it is better e.g. to have sick people than dead birds has been debated for decades and we are not going to give that answer'"* (EC, 2005b, Appendix IV, p. 5). This statement clarifies that the experts are in a position to offer scientific recommendations and advice to policy makers, but the precarious decision in how far to weigh across the different environmental impacts – especially those referring to toxic and hazardous substances possibly threatening the well-being of humans and wildlife – will be completely left to political decision making.

Despite the criticism of some experts referring to too unspecific measurements of toxicity, especially concerning heavy metals emissions, there was also criticism that the VHK methods were too strict and should be simplified, as demanded by experts from the industry (Siemens[28], IBM and PE-Europe) in the following:

"Our suggestion to VHK to simplify the method for heavy metals is to mention only the kind of heavy metal which has either the highest value or if possible the three of the heavy metals which appear with the highest values. The reader must be informed that further information is available in the detailed LCA-studies or wherever. During a trace back other values can be discussed if necessary" (EC, 2005b, p. 163).

The answer from VHK made clear that the selection of substances was made on the basis of EU legislation and that *"[t]here is no legal ground to exclude a priori certain substances that the legislator has deemed important enough to include in a directive"* (EC, 2005b, p. 163).

This is an apparent example of the industry trying to influence the methodology for energy using products legislation in order to circumvent that some products may perform bad on their environmental impacts especially concerning heavy metals in this specific case.
As the Acting Director General of DG Enterprise and Industry, Mr. Zourek, puts it tellingly within his opening speech at the Commission MEEuP workshop: *"[The EuP Directive…] introduces an integrated and holistic way to address the product's environmental performance, thus avoiding risk of focusing in a fragmented way on particular environmental aspects or phases of the product's life cycle. […] today is one of several opportunities for industry and other stakeholders to discuss the methodology. More detailed studies will pave the way for deciding whether and which kind of implementing measures are justified or necessary"* (EC, 2005b, Appendix V, pp. 1-2).

[28] In these times, Osram still belonged to the Siemens AG.