Green collaboration: How environmental policies influence the relationship between R&D partners

Siri Jakobsen  
Nord University  
Business School  
siri.jakobsen@nord.no

Thomas André Lauvås  
Nord University  
Business School  
thomas.a.lauvas@nord.no

Marianne Steinmo  
Nord University  
Business School  
marianne.steinmo@nord.no

Abstract
The use of environmental policies to facilitate R&D collaborations that generate environmental innovations (EIs) is increasingly important for sustainable development. However, less is known about how different environmental policies influence the collaborative relationship between R&D partners and the EI outcomes of these collaborations. We address this gap by studying two Norwegian environmental R&D alliances and how their relative absorptive capacity and power and dependence relations develop over time. We find that command-and-control policies motivate collaboration between R&D partners with high relative absorptive capacity, whereas technology-push policies motivate collaboration between R&D partners with lower relative absorptive capacity. We also focus on the debate regarding the intended effect of policies, with the added insight that power and dependence relations might affect the relative absorptive capacity between R&D partners, which may, in turn, result in less radical EI outcomes than intended by these policies. Implications of these findings are discussed.

Jelcodes:032,038
Green collaboration: How environmental policies influence the relationship between R&D partners

ABSTRACT
The use of environmental policies to facilitate R&D collaborations that generate environmental innovations (EIs) is increasingly important for sustainable development. However, less is known about how different environmental policies influence the collaborative relationship between R&D partners and the EI outcomes of these collaborations. We address this gap by studying two Norwegian environmental R&D alliances and how their relative absorptive capacity and power and dependence relations develop over time. We find that command-and-control policies motivate collaboration between R&D partners with high relative absorptive capacity, whereas technology-push policies motivate collaboration between R&D partners with lower relative absorptive capacity. We also focus on the debate regarding the intended effect of policies, with the added insight that power and dependence relations might affect the relative absorptive capacity between R&D partners, which may, in turn, result in less radical EI outcomes than intended by these policies. Implications of these findings are discussed.

INTRODUCTION
A key challenge in the quest for more sustainable societal development is the development and commercialization of environmental innovations (EIs). EI may be defined as “the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resource use (including energy use) compared to relevant alternatives” (Kemp & Pearson, 2007, p.7). Hence, EIs differ from traditional innovations in the sense that they produce both positive spillovers for the firm and positive externalities by improving the environment (Rennings, 2000). While the firm bears the costs of the innovation, society reaps the benefits of less pollution (Beise & Rennings, 2005). This “double externality problem” makes the government, as a policy maker and facilitator, an important actor in motivating firms’ environmental development (Rennings, 2000). To motivate all types of firms, regardless of industry, size, research and development (R&D) experience, environmental attitudes, etc., different designs of environmental policies exist with different intended EI outcomes. Accordingly, technology-push policies are designed to stimulate the development of radical
innovations, while command-and-control (CAC), market-based and demand-pull policies motivate more incremental innovations (Nemet, 2009). However, the innovative outcomes from policies might not match their intentions, which calls for more studies on whether policies achieve the intended level of innovation (Bergek, Berggren, & Group, 2014; Lettice, Smart, Baruch, & Johnson, 2012). Because many policies facilitate EI outcomes through R&D collaborations (Gallagher, Grübler, Kuhl, Nemet, & Wilson, 2012; Hagedoorn, 2002), it is paramount to explore and understand the complex collaborative processes that facilitate or impede these EI outcomes (Hagedoorn, 2002; Perkmann & Walsh, 2007; Smith, 2012). Hence, the aim of this paper is to build theory on how differences in environmental policies influence the collaborative relationship between environmental R&D partners.

Because the relationship between environmental regulations and EI collaboration is complex, it is challenging to obtain an in-depth understanding of how they unfold through only one theoretical lens, making multiple perspectives necessary to explain this relationship (Ford, Steen, & Verreyne, 2014). Thus, this paper draws on two perspectives novel to the EI literature to advance our understanding on these relationships by studying R&D partners’ relative absorptive capacity in combination with power and dependence, which may provide insight into how these relationships unfold and if they reach their intended EI outcomes. First, similarities between R&D partners, as well as the ability to learn from each other, are found to be important aspects of successful R&D collaborations with innovative outcomes (Lane & Lubatkin, 1998; Powell, Koput, & Smith-Doerr, 1996; Steinmo & Rasmussen, 2016). Relative absorptive capacity is a theoretical concept that focuses on the relative similarities between partners. This concept suggests that the ability to learn from an R&D partner and thereby develop innovations is determined by R&D partners’ relative similarity of the characteristics of organizational structures, knowledge bases and dominant logics, which may explain why collaboration between different partners may or may not give the intended innovative outcomes (Lane and Lubatkin, 1998). A high relative absorptive capacity can make learning between partners easier; however, the outcomes from such collaborations will often be incremental innovation (Laursen & Salter, 2006). On the other hand, to generate more radical outcomes, the relative similarity between R&D partners should be lower because radical innovations require a broader knowledge base (Laursen & Salter, 2006). Although R&D partners with low relative similarity provide the most complementary knowledge, they are also the most challenging actors with which to collaborate because of conflicting interests related to preferred actions and outcomes of the collaboration (Bjerregaard, 2010; Howells, Ramlogan, & Cheng, 2012; Perkmann & Walsh, 2007). Hence, this paper also employs the perspective of power and
dependence, which may yield important insights into how collaborative partners address conflicting interests by exploring the consequences of power imbalance and mutual dependence in collaborative relationships (Pfeffer & Salancik, 2003). Based on these two perspectives, this paper explores the following research question: “How do differences in environmental policies influence the collaborative relationship between environmental R&D partners?”

To answer this research question, we study two Norwegian environmental R&D alliances that received public support and had objectives related to creating EI through collaboration between industries, universities and private research organizations. The alliances represent two different “polar types” of policy intervention. Alliance 1 is motivated mainly by command-and-control policies related to lowering their emissions, whereas Alliance 2 is motivated by technology-push policies targeting a large research grant from the Research Council of Norway established to address a governmental resolution regarding climate and energy challenges. Due to a notable difference related to age and maturity, the alliances are treated as two embedded single-case studies whose aim is to explore how different environmental policies influence the power and dependence between R&D partners and their relative absorptive capacity in two different research alliances.

By adding to the few in-depth studies on the dynamic relationship between EI partners (De Marchi, 2012; Yarahmadi & Higgins, 2012) and the lack of case studies providing a more comprehensive and realistic picture of the effects of environmental policies on the EI process (Kemp & Pontoglio, 2011), we contribute to the literature on environmental policies, R&D collaboration and EI in several ways. First, we contribute to environmental policy by proposing a continuum displaying the intended effects of environmental policies in terms of innovation, from incremental to radical innovation. Based on this, we argue that incrementally oriented environmental policies, such as command-and-control and demand-pull policies, motivate R&D collaboration between partners with high relative absorptive capacity. Further, we propose that more radically oriented environmental policies (e.g., technology-push) motivate collaboration between partners with lower relative absorptive capacity. Further, our research keys into the debate on the intended effect of policies (Bergek et al., 2014; Lettice et al., 2012), with the added insight that power and dependence relations (Pfeffer & Salancik, 2003) might affect the relative absorptive capacity between R&D partners. By this, we answer the calls for more empirical research on power relations between university and industry partners (Miller et al., 2016), as well as the call for more research on power relations in environmental collaboration (Yarahmadi & Higgins, 2012). Finally, our case studies provide important
insights into the few studies on the absorptive capacity processes and how they change over time (Volberda, Foss, & Lyles, 2010).

The paper proceeds as follows. The following section presents our theoretical framework, followed by a presentation of our methods. In the fourth section, the empirical findings are presented in conjunction with our discussion of the scholarly literature, followed by our derived propositions. Finally, we present our conclusions and the implications of our findings.

THEORETHICAL FRAMEWORK

In contrast to “normal” innovations, the market is not a strong enough determinant of environmental innovations; thus, the development of EIs cannot rely solely on market-based instruments (Demirel & Kesidou, 2011; Rennings, 2000). Hence, environmental policy and regulations are found to be very important in motivating firms to develop EIs (del Rio, Moran, & Albinana, 2011; Jaffe & Palmer, 1997; Johnstone, Haščič, & Popp, 2010). To motivate all types of firms, regardless of industry, size, R&D experience, environmental attitudes, etc., the design of environmental policies is important. However, because of the magnitude and complexity of environmental challenges, designing good policies is a multi-faceted and challenging task, and it is difficult to predict the effect of such policies on innovation (Johnstone, Haščič, Poirier, Hemar, & Michel, 2012). There is no theoretical consensus on whether different policies can be categorized or on the effects of environmental policies, which show quite mixed results as to how or whether policies achieve their intended effect (Jaffe, Newell, & Stavins, 2005; Kemp & Pontoglio, 2011). This calls for alternative perspectives to explain the relationship between policies and innovation (Ford et al., 2014). In this chapter, we first build a conceptual framework based on (1) a review of different types of policies and (2) link these policies to their intended innovative effects (see Fig. 1). The purpose of building this conceptual framework is to contribute to theory building by uniting diverse environmental policies and their intended effects on EI in one framework. Based on our empirical findings and discussion, we extend this framework by drawing on the alternative perspectives of relative absorptive capacity and resource dependency, as called for in the literature by Ford et al. (2014).

Framework of Environmental Policies and their Intended Innovative Effects

Most attempts to characterize environmental policies focus on what the policies are aimed at. These different aims can be examined related to how policies are created to influence firms’
environmental actions. In general, policy makers have two basic means at their disposal: regulations that rule out certain activities, and policies that provide incentives for private actors to engage in specific actions (Fabrizio & Hawn, 2013), often referred to as “regulatory push” and “regulatory pull” within the literature (Rennings & Rammer, 2011). Figure 1 illustrates how different types of regulations and policies can be linked to these terms. At one end of the scale, there are policies that require firms to innovate by imposing laws, acts and directives firms must obey to avoid sanctions (Rennings, 2000). These policies are often labelled command-and-control (CAC) regulations, which require firms to innovate by setting quantitative standards to emission reductions (Bergquist, Söderholm, Kinneryd, Lindmark, & Söderholm, 2013). This regulatory approach is needed, especially to stimulate innovative activities in firms with limited resources or willingness to pursue the opportunities created by a more proactive environmental policy (Zarker and Kerr, 2007). CAC regulations often target dangerous substances, noise reduction technologies and water and soil protection, with firms typically implementing “end-of-pipe technologies” (Horbach, Rammer, & Rennings, 2012). The innovative outcomes of such regulations might be limited, because when firms have reached a particular standard or objective, there is little incentive for them to innovate further (Singh, Yabar, Murakami-Suzuki, Nozaki, & Rakwal, 2016). Hence, these regulations are often related to more incremental innovations on existing technology.

Contrary to CAC regulations, the “regulatory pull” concept covers all policy approaches in which the government stimulates firms to go beyond the mere implementation of environmental regulations (Rennings & Rammer, 2011), and have a more proactive attitude towards EI. Within the “regulatory pull” concept, there are several different policy approaches. First, there is the market-based approach, such as pollutant emission taxes, subsidies or tradable emission permits (Jaffe and Stavins, 1995), which tend to perform better than CAC regulations as they motivate firms to innovate beyond pre-determined standards (Bergquist et al., 2013). Second, there are demand-pull policies that are designed to stimulate investment and subsequent improvements in environmental technologies by enlarging the possible markets for firms (Nemet, 2009). The emergence of new environmental market opportunities should motivate firms to invest in EI; however, from the traditional innovation literature, one would expect that both market-based approaches and demand-pull policies would motivate the development of more incremental innovations rather than radical innovations (Dosi, 1988). However, some environmental problems require such large technological changes to abate them that incremental changes, even over long time periods, may be insufficient (Nemet, 2009).
Thus, there is also a need for a technology-push approach to environmental policy to motivate more radical changes (as illustrated in Figure 1). This approach is typically enacted as public R&D funding and is often aimed at directly mitigating underinvestment in R&D (Peters et al., 2012), reducing the private cost of producing innovation (Nemet, 2009). An example of technology-push policies is renewable energy R&D and innovation programs aiming to mitigate climate change (Gallagher et al., 2012). A study by Johnstone et al. (2010) found that such programs had a positive and significant effect on innovation, especially on costly energy technologies, such as solar power. Because cleaner forms of energy production, such as solar, bio and wind power, cannot compete with traditional ones in terms of cost (Nesta et al., 2014), technology push-incentives appear to be required for the development and deployment of radically new technologies (Bergek et al., 2014).

The differences in the characterization of environmental policies reflect that there are many different regulatory designs, which again highlights that there is no best innovative process to address the different types of policies (Kemp & Pontoglio, 2011). Different policies may be aimed at different innovative results; hence, the policies should be designed to fit the desired outcome. Based on the discussion above, Figure 1 shows a continuum from incremental innovation at one end towards radical innovation at the other end, where the different types of policies are placed according to their innovative objectives.

**FIGURE 1**

*Conceptual Framework of Environmental Policies and their Intended Innovative Effects*

![Diagram showing the continuum from incremental to radical innovation with regulatory-push and regulatory-pull strategies.](image)

Although environmental policies are related to particular intended innovative outcomes, studies on the effects of environmental policies show quite mixed results regarding how or whether policies have their intended effect. Some studies show that market-based approaches provide the most effective incentives for innovation (Jaffe & Stavins, 1995), whereas other
studies find that market-based instruments cannot be relied upon (Kemp & Pontoglio, 2011) and should therefore be combined with other policies (Demirel & Kesidou, 2011). An example of this is Demirel and Kesidou’s (2011) study of UK firms’ environmental spending. They found that typical market-based approaches, such as environmental taxes, have no significant impact on EI. One reason why environmental policies do not reach their intended effect is proposed by a study of the funding decisions in a UK research fund. In this study, Lettice et al. (2012) found that the funding decisions in general did not match the criteria specified in the research program’s aims. Although the aim of the funding was to support more innovative projects, the funders did not favor projects that created new knowledge over those that diffused existing knowledge (Lettice et al., 2012). Taken together, there is a significant gap in our knowledge on how different policies influence innovation processes and outcomes (Bergek et al., 2014; Lettice et al., 2012). With these lacking and conflicting evidence of the relationship between regulation and innovation, there is a call for alternative perspectives that include new explanatory factors (Ford et al., 2014). Our approach to the discussion on the effects of environmental policies is to explore the alternative views of relative absorptive capacity and power and dependence, which can explain why collaboration between different partners may or may not give the intended innovative outcomes (Lane & Lubatkin, 1998; Pfeffer & Salancik, 1978; Yarahmadi & Higgins, 2012).

Relative Absorptive Capacity

Absorptive capacity is defined as a firm’s “ability to recognize the value of new, external information, assimilate it, and apply it for commercial ends” (Cohen & Levinthal, 1990, p.128). This concept focuses on how firms can best absorb external knowledge from collaboration partners (Fosfuri & Tribó, 2008; Zahra & George, 2002). Lane and Lubatkin (1998) extend the absorptive capacity concept by focusing on with whom an alliance should be formed and propose the notion of relative absorptive capacity. This construct suggests that the ability of a firm to learn from another partner and thereby develop innovations is determined by the relative characteristics of both firms in the collaboration. This means that the ability of one firm to learn from another partner is dependent on the similarity of both firms’ organizational structures, knowledge bases and dominant logics. The first determinant of relative absorptive capacity brought up by Lane and Lubatkin (1998) is the organizational structure, which is defined as “the formal allocation of work roles and the administrative mechanisms to control and integrate work activities including those which cross formal organizational boundaries” (Child, 1972, p.2). More precisely, the organizational structure will decide who has the decision rights within
an organization. The overall decision right will often lie with a board of directors or CEO, who distribute rights among decision agents within the organization (Jensen & Meckling, 1992). In relation to decisions on environmental issues, Martin et al. (2012) studied UK manufacturing plants and found that firms are more likely to adopt climate-friendly management practices if this decision lies with an environmental or energy manager rather than with the CEO.

Second, learning in alliances is easiest when the partners have similar basic knowledge but different specialized knowledge (De Clercq & Sapienza, 2001; Lane & Lubatkin, 1998). Having similar basic knowledge refers to a general understanding of the traditions and techniques within a discipline/industry, whereas specialized knowledge is related to knowledge of a specific technical domain. Understanding basic knowledge enables firms to understand other actors’ assumptions, which makes the firm more capable of evaluating the importance of new knowledge for its own ventures (Lane & Lubatkin, 1998). A challenge within EI processes is that they are rather complex and require information and skills distant from the traditional knowledge base of the firm (De Marchi & Grandinetti, 2013). This constraint makes collaboration key to gaining access to new environmental knowledge (De Marchi, 2012; Foxon & Andersen, 2009). Hence, from the perspective of relative absorptive capacity, the ideal partner in EI might be one with similar basic knowledge but specialized environmental knowledge. Further, as the firm collaborates with more types of collaboration partners, the more likely it is to develop an EI (Cainelli, De Marchi, & Grandinetti, 2015). Ghisetti, Marzucchi, and Montresor (2015) support that some knowledge variety is required to engage in EI, but a knowledge search that is too broad can expose a firm to redundant or inconsistent information that might even discourage firms from adopting an EI.

Third, Lane and Lubatkin argue that similarities in firms’ dominant logics can affect interorganizational learning. A dominant logic is defined as “a mind set, world view or conceptualization of the business and the administrative tools to accomplish goals and make decisions in that business” (Prahalad & Bettis, 2002, p.81). Lane and Lubatkin use the concept in relation to the similarities between partner firms’ commercial objectives. As the dominant logics are more similar, the easier it will be to commercially apply new knowledge from the partner (Lane & Lubatkin, 1998). In R&D collaboration, different partners will often have different dominant logics because no firms have identical dominant logics. This dominant logic will decide which “data” the organization will pay attention to and act as a “filter” through which these data are selected (Bettis & Prahalad, 1995). Changing a dominant logic is extremely difficult but necessary to seize new opportunities (Prahalad, 2004).
When partners have high similarity in these characteristics, they have a high relative absorptive capacity. With increasing relative absorptive capacity between partners in R&D collaboration, innovation is easier. However, the innovations derived from this collaboration will be significantly based on imitation and, hence, incremental in nature (Lane & Lubatkin, 1998). Gluch et al. (2009) studied EI in the Swedish construction industry and found that firms within this industry shared information mainly with their closest parties. This led to group thinking, reducing the innovative capacity into a mimetic rut in which firms did the same things. This links back to our discussion on environmental policy and how different policies are aimed at different innovation outcomes but will not necessarily reach these objectives. As the discussion on policies shows, there are various reasons why environmental policies do not reach their intended objectives. One reason that policies might not reach their intentions may be unbalances in the relationship between R&D partners, which is further explored through the theoretical perspective of resource dependence theory.

Resource Dependence Theory

Resource dependence theory focuses on the balance between partners through the combination of power imbalance and mutual dependence in relationships (Pfeffer & Salancik, 2003). Mutual dependence helps us understand why firms seek long-term relationships, whereas power imbalance can explain why firms resist certain interorganizational actions (Casciaro & Piskorski, 2005). Within resource dependence theory, the distribution of power and dependence is often discussed because interdependencies are not necessarily symmetric or balanced (Pfeffer & Salancik, 2003). When one actor controls the use of a resource, this can be a major source of power (Pfeffer & Salancik, 2003). However, an unbalanced relationship is unstable because it may encourage the use of power (Emerson, 1962), which can be damaging for the relationship (Gulati & Sytch, 2007). In this situation, it is important to build and sustain mutual commitment, which enables the collaborating partners to engage in the value-creating coordination of interdependent activities (Holm, Eriksson, & Johanson, 1999). This is a time-consuming process that requires commitment from all parties to form a balanced dependence relationship (Holm et al., 1999). Partners in dependent relationships tend to develop mutual empathy and a focus on joint success, which is important for a long-term horizon for the relationship (Gulati & Sytch, 2007). In this process, flexibility, seen as the will and capability to respond to changing circumstances, is found to be an important determinant (Czakon, 2009). With this flexibility and mutuality within the alliance, trust and understanding among partners evolve and can lead to a convergence of organizational structures (Biermann, 2008), which means that the partners
can become more similar. This might then influence the relative absorptive capacity between R&D partners (Lane & Lubatkin, 1998).

**Theoretical Framework**

In summary, the theoretical discussion in this chapter that will be explored further in the empirical part of the paper can be presented in the following model:

**FIGURE 2**  
**Theoretical Framework**

![Theoretical Framework Diagram]

Figure 2 shows the proposed relationships between the main theoretical concepts discussed. First, we will explore how environmental policies motivate R&D collaboration and further how these policies might influence the relative absorptive capacity of R&D partners. Second, we will explore if and under what circumstances power and dependence relations between R&D partners can influence the relative absorptive capacity between partners.

**METHODS**

Case studies provide a comprehensive and realistic picture of the effects of environmental regulations on the environmental innovation process (Kemp & Pontoglio, 2011). This paper employs a case study approach to enhance the existing framework and to build the relevant theory (Yin, 2013). Theory-building case studies are well suited for studying new areas of research (Eisenhardt, 1989), and although R&D collaboration has received increased attention, there are still gaps related to the nature of collaborative relationships (Perkmann & Walsh, 2007), especially in relation to EI (De Marchi, 2012).

**Case Selection**
This study used a longitudinal case study design of two environmental research alliances to explore how different environmental policies can influence the nature of collaborative relationships through their relative absorptive capacity. Both alliances include firm and research partners, the latter include universities and private research organizations (organizations that conduct contract R&D for the private and public sectors) (see Table 1). Both cases are chosen on the basis of theoretical sampling, where the purpose is to choose cases that are likely to either replicate or extend the emergent theory (Eisenhardt, 1989). To build theory on the effects of environmental policy, we chose the two alliances as cases to more easily observe contrasting patterns in the data because they represented two different “polar types” of policy intervention (Eisenhardt & Graebner, 2007).

First, Alliance 1 is motivated mainly by command-and-control policies related to lowering their emissions, whereas Alliance 2 is motivated by technology-push policies targeting a large research grant from the Research Council of Norway established to address a governmental resolution regarding climate and energy challenges. The main objective of Alliance 2 is to establish research centers that operate for eight years and conduct concentrated, focused and long-term research of high international caliber and to promote innovation to address these environmental challenges.

Despite their similarities, the alliances have notable differences in terms of age and maturity. Alliance 1 is mature, established in 1989, whereas Alliance 2 is rather new, established in 2009. It would be problematic to draw conclusions based on a cross-case comparison because the differences between the alliances could be due to age, not to differences in policy. To address this challenge, we treat the alliances as two embedded single-case studies rather than one multiple-case study. Using single-case studies is appropriate in this study because our cases are both critical and longitudinal. They are critical because they have a strategic importance in relation to the general problem under study (Flyvbjerg, 2006), and their longitudinal nature enables us to specify how certain conditions presented in the theoretical framework can change over time (Yin, 2013).

Further, the embeddedness of the case studies will also strengthen the conclusions drawn from the single cases, as using embedded case studies provides the ability to look at sub-units that are situated within a larger case and to analyze these subunits both separately and as a cross-case analysis between the subunits (Baxter & Jack, 2008). In our case, we have two sub-units; one sub-unit consisting of a group of organizations representing the firms and one sub-unit consisting of a group of organizations representing two universities and private research organizations. To explore how different environmental policies influence the relative absorptive
capacity between R&D partners, we first analyze firm partners and research partners separately. Then, we analyze the alliances as a whole based on a cross-case comparison of the group of firm partners and group of research partners.

**TABLE 1**

Characteristics of the Research Alliances

<table>
<thead>
<tr>
<th>Alliance 1. Established by the industry in 1989.</th>
<th>Environmental policy</th>
<th>Objective</th>
<th>Participants</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainly command-and-control. Aims to pursue EIs that are needed to address present and future regulations.</td>
<td>To pursue environmental improvements and to increase the technological qualifications of firm employees.</td>
<td>All firm partners in the business sector in Norway (6) and a university, and a research organization as participants and hosts for each project.</td>
<td>Research grants from the Research Council of Norway (30%-50%) and participation fees from firm partners (50%-70%).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alliance 2. Established by universities and research organizations in 2009.</th>
<th>Environmental policy</th>
<th>Objective</th>
<th>Participants</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology-push. Established to address a governmental resolution regarding climate and energy challenges.</td>
<td>To conduct high-level, long-term international research to solve specific challenges in the energy industry and identify new, innovative solutions.</td>
<td>A university hosts the alliance. Each project includes universities (2), research organizations (5-8) and firm partners (10-15) that cover large parts of the industry’s value chain.</td>
<td>Research grants from the Research Council of Norway (50%) and financing from the firm partners (25%) and research partners (25%).</td>
<td></td>
</tr>
</tbody>
</table>

**3.2 Data Collection**

We began the data collection inductively (Golden-Biddle & Locke, 2007; Stake, 1995) before turning back to the relevant literature and secondary data between the interviews. In both

---

3 An approximate number is given to preserve anonymity.
alliances, we developed interview questions based on a preliminary literature review and secondary data, such as annual and evaluation reports, before commencing the interviews (Yin, 2013). In Alliance 1, we supplemented our study by observing the participants at a seminar arranged by the alliance, where research projects were presented and discussed before conducting the interviews. The informants from the industry were selected from the involved firms’ employees. In Alliance 1, these represented CEOs, researchers, an engineer and a policy manager, whereas in Alliance 2, a CEO, two technology managers and two project managers were interviewed. From the universities and research organizations, the informants were researchers involved in the alliances. To obtain an in-depth understanding of how the collaboration process unfolded over time, 55 in-depth interviews were collected, where 28 represented Alliance 1 and 27 represented Alliance 2 (see Table 2). The interviews were conducted longitudinally; the first round in 2011 and the following round from September 2013 to February 2014. The follow-up interviews aimed to uncover any changes in relative absorptive capacity and to give additional information about topics that were found in the first round to be of interest in the analysis of the interviews.

**TABLE 2**

**Informants Interviewed (number of individuals in parentheses)**

<table>
<thead>
<tr>
<th>Informants (2011)</th>
<th>Alliance 1</th>
<th>Alliance 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm</td>
<td>Universities and private research organizations</td>
<td>Firm</td>
</tr>
<tr>
<td>CEOs (5)</td>
<td>Research partners (4)</td>
<td>CEO (1)</td>
</tr>
<tr>
<td>Researchers (4)</td>
<td>Engineer (1)</td>
<td>Technology managers (2)</td>
</tr>
<tr>
<td>Engineer (1)</td>
<td>Policy manager (1)</td>
<td>Project managers (2)</td>
</tr>
<tr>
<td>Informants (September 2013 - February 2014)</td>
<td>CEOs (4)</td>
<td>Research partners (2)</td>
</tr>
<tr>
<td>Researchers (4)</td>
<td>Project managers (2)</td>
<td>Technology managers (2)</td>
</tr>
<tr>
<td>Engineer (1)</td>
<td>Policy manager (1)</td>
<td></td>
</tr>
<tr>
<td>Total interviews</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>Secondary sources</td>
<td>Firm presentations</td>
<td>Project presentations</td>
</tr>
<tr>
<td></td>
<td>Press articles</td>
<td>Press articles</td>
</tr>
<tr>
<td></td>
<td>Web sites</td>
<td>Web sites</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


The data collection in both alliances used a similar semi-structured interview guide with certain individual modifications. The questions were divided into themes related to, i.e., the partners’ motivation, expectations and involvement in the alliances, the interaction between the alliance partners and the research and innovation activities. By taking into account the different perspectives of our informants and to limit bias (Eisenhardt & Graebner, 2007), we designed and relied upon two separate interview protocols, one for firm partners and one for research partners. The questions were designed to provide insights regarding the R&D collaboration processes from the point of view of firm and research partners. The interview guide was meant to serve as a checklist to ensure that all relevant topics are covered, but the aim of the interviews was to establish a conversational style in which the interviewees talked about the topics as freely as possible (Patton, 2015). The interviews were always conducted with two or more researchers from the research team to minimize interviewer bias. During the interviews, the interview questions were more “fine-tuned” and additional questions were added to the interview protocol (Eisenhardt, 1989). We used a retrospective interviewing approach to gain deeper insight into the evolution of the relationships between the R&D partners and to obtain accurate information on the factors that might have influenced these relationships (Miller, Cardinal, & Glick, 1997). With this approach, we tried to encourage the informant to reconstruct past experiences (Fraenkel, Wallen, & Hyun, 1993) and to reflect on present situations. Using a retrospective approach has its pitfalls: namely, the informants will view the past through the lens of the present (Silverman, 2013). However, people seldom forget about significant events (Denzin & Lincoln, 2011). There were also situations in which we wanted the informants to give more details on key events or unclear statements. In such situations, we asked follow-up questions such as “Why did you do that?”, “Who was involved in that event?”, and “When did this happen?”. To avoid bias, we avoided the use of theoretical concepts in the interview setting.

3.3 Data Analysis
The interviews were recorded and transcribed verbatim as a part of the data analysis process (Yin, 2013). We used qualitative analysis software (NVivo 10) as a tool to assist with the coding and categorization process of the interview data. The coding began from a careful reading of the interviews, line by line, and paragraph by paragraph, naming and coding the empirical material. In the coding of the data, we integrated theory-driven deductive codes (e.g., dominant logics) with data-driven inductive (sub)codes (e.g., time horizon) (Langley, 1999).
Accordingly, the theory-driven deductive codes were coded with theoretical dimensions (Eisenhardt, 1989), including critical characteristics and events on how different policies affected the relative absorptive capacity between R&D partners. Here, our conceptual framework on relative absorptive capacity and resource dependency was mapped as the main theoretical perspectives for this study. Following Lane and Lubatkin (1998), the relative absorptive capacity between the firm group and the group of researchers was measured with the following categories: organizational structures, knowledge bases and dominant logics. The resource dependency was measured by the power balance and mutual dependence between the firm group and the group of researchers (Pfeffer & Salancik, 2003). The coding procedure was discussed by the authors to increase the rigor of the analytical generalization of the empirical data. Triangulation of the data sources was applied by comparing interview data with secondary data, such as reports, newsletters, press releases and websites.

It is problematic to make general conclusions based on two single-case studies, but the longitudinal and embedded nature of the cases means they are likely to provide clues about the causal mechanisms that explain how environmental policies influence the relative absorptive capacity between firms (Gerring, 2006). Contrary to measuring causal effects, the identification of causal mechanisms occurs when we combine theoretical knowledge and empirical knowledge of how variables interrelate (Gerring, 2006). As stated in the paragraph above, we did this by comparing our empirical data with the theoretical framework proposed in the literature review. The causal mechanisms uncovered in this pattern-matching activity are presented through the development of propositions. To build reliable propositions, we went back and forth between the theory and empirical data to create theoretical propositions that have a close fit with the data (Eisenhardt, 1989). Proposition 1 is related to Alliance 1, whereas Propositions 2 and 3 are related to Alliance 2. These propositions are meant as first steps in theory building and as a guide for future research.

**FINDINGS AND DISCUSSION**

Our analysis aims to explore how different environmental policies influence the relative absorptive capacity between R&D partners. Because our data are both retrospective and longitudinal, they provide the opportunity to look both backwards and forwards on how the relationships between environmental R&D partners develop over time. We will first analyze how policies influence the relative absorptive capacity in Alliance 1, followed by a bit more extensive analysis of Alliance 2 because this alliance experienced more changes in relative absorptive capacity during our data collection. In the discussion below, we integrate the case
findings with the scholarly literature and develop propositions to clarify our theoretical arguments.

The collaboration in Alliance 1 is stimulated by command-and-control regulations to reduce the emission of dangerous substances (Horbach et al., 2012), as illustrated by the quote from one of the research partners: “The government has been a driving force. There are a lot of demands related to emissions”. In this industry, they choose to address these regulations together, rather than each firm facing them alone. As a firm partner states, “We do not have to invent the wheel separately”. To analyze how this policy approach might influence the relative absorptive capacity, Table 3 maps the relative absorptive capacity based on Lane and Lubatkin’s (1998) classification of similarities in organizational structures, knowledge bases and dominant logics. Regarding the analysis of relative absorptive capacity, an important aspect is that what constitutes relevant prior knowledge, organizational structures, and similar dominant logics will vary with the types of organizations studied, and these differences must be taken into account when analyzing empirical examples of relative absorptive capacity (Lane, Salk, & Lyles, 2001). Hence, our analysis of R&D partners takes into account that both alliances consists of two groups – firm and research partners – and that there are different organizational structures (meaning decision rights), knowledge bases and dominant logics, both within and between these groups.

**TABLE 3**

The Relative Absorptive Capacity within Alliance 1

<table>
<thead>
<tr>
<th>Organizational structures</th>
<th>Knowledge base</th>
<th>Dominant logics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larger international corporations own four of the five firms, and the decision to participate in the alliance lies with the owner.</td>
<td>Because they operated in the same industry over several years, the firms and the research partners possess similar basic knowledge.</td>
<td>Alliance 1 mainly follows the dominant logics of the firms, and the research partners are very aware of the firms’ interests in the alliance.</td>
</tr>
<tr>
<td>“It was a challenge to convince our owners [to join the alliance]” (Firm partner).</td>
<td>“They [the research partners] have experience from the industry and understand how to start a dialogue” (Firm partner).</td>
<td>“We have great influence on the projects and the premises of the collaboration” (Firm partner).</td>
</tr>
<tr>
<td>“They [the foreign owners] are determined to have R&amp;D activities in Norway as well... to make us able to solve</td>
<td>“They [the research partners] need to have a foundation in the industry to do a good job” (Firm partner).</td>
<td>“We influence the topics of the doctoral thesis” (Firm partner).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“We are very attentive to the industry” (Research partner).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Because of long-standing close collaboration between the firms and the</td>
</tr>
</tbody>
</table>
problems in the future” (Firm partner).

The research partners add specialized knowledge to the alliance:

“When we need specialized knowledge, we have researchers [in the alliance] that know about our industry and research questions that are relevant for us” (Firm partner).

“They [the research partners] add knowledge, and it is very important for us to have such competent research partners” (Firm partner).

research partners, the research partners have learned the firms’ logics:

“When we have such a close collaboration with the industry, it is easier for us to understand what’s relevant and useful for the industry” (Research partner).

“When we are working with and talk about the industry, we are talking about the same thing” (Research partner).

“Some of us [researchers] have worked for a long time in the industry. We are therefore ‘raised’ in accordance with the objectives of the industry” (Research partner).

From Table 3, we observe that the relative absorptive capacity within Alliance 1 is relatively high because there are many similarities for all three determinants, organizational structures, knowledge bases and dominant logics. First, four of five firms have similar organizational structures, with larger international corporations owning them. Hence, the decision to participate in the alliance lies with the foreign owners. As the quotes in Table 3 show, this decision is easier for some firms than for others. However, once involved, the foreign owners were satisfied with the results of the alliance. Because Scandinavian (and German) firms face stricter environmental policies (Horbach, Oltra, & Belin, 2013; Porter & van der Linde, 1995), the organizational structures of the firms in Alliance 1 contribute to the distribution of environmental knowledge to other firms within the corporation, which makes the investments in the alliance valuable beyond the Norwegian context. This is illustrated by the quote from a firm partner: “I show our [foreign owner] the results from the alliance, and this knowledge is very much appreciated”.

The second category of relative absorptive capacity is knowledge bases. In Alliance 1, many of the persons working in the university or research organization had worked in the industry at some point in time and therefore share a common basic knowledge with the firm partners. The following quote from a research partner shows this: “We who work at [the University and the research organization] have worked in the industry. So, at some point in time, we have been colleagues or classmates”. This indicates that research partners share with the firms basic knowledge that is found to be important for learning in alliances (De Clercq & Sapienza, 2001; Lane & Lubatkin, 1998). However, having a broader range of specialized
knowledge is important for innovativeness (Laursen & Salter, 2006). Because the industry faces stricter demands, it is important for them to have research partners with similar basic knowledge that understand their problems and have specialized knowledge to come up with solutions. Hence, the firm partners state that they contribute by building specialized knowledge within the research organization and university, as illustrated by the quote: “[the alliance] contributes to building and sustaining relevant knowledge within [the research partners]. Without the alliance, they would not have so many research projects”.

Further, Table 3 shows that Alliance 1 follows the dominant logic of the firms and addresses the challenges the firms feel are important for their environmental development. This is illustrated by the following quote from a firm partner: “We have focused a lot on general problems such as environmental emissions... All firms struggle with much diffuse emissions such as smoke and dust”. According to Bettis and Prahalad (1995), following a common dominant logic allows the firms to anticipate their environments, which we observe in Alliance 1. With long-standing collaboration between partners with similar knowledge bases and dominant logics, firms are able to anticipate future regulations and develop knowledge ahead of the regulations. This keys into the debate on future regulations as an incentive for environmental innovation (Carrión-Flores & Innes, 2010; Horbach et al., 2012; Mickwitz, Hyvättinen, & Kivimaa, 2008). A firm partner summarizes this as follows: “The whole industry has been proactive in environmental questions, and we are therefore a bit ahead of the Norwegian and European legislation. We have enough knowledge to anticipate what [regulations] are coming. In that way, we can position ourselves in relation to environmental issues”.

Summarizing the analysis of Alliance 1, we observe that firms that face the same command-and-control policies related to industry emissions choose to collaborate with partners with relatively similar organizational structures, knowledge bases and dominant logics to face these policies. The consequences of high levels of relative absorptive capacity between R&D partners will likely be that this alliance will achieve mostly incremental innovations (Lane & Lubatkin, 1998). Based on this, we propose the following:

Proposition 1: More incremental environmental policies (e.g., command-and-control) motivate collaboration between R&D partners with higher relative absorptive capacity.

The collaboration in Alliance 2 is stimulated by a technology-push initiative through research grants, where universities and research organizations are lead partners. The objective of the
alliance is to “establish time-limited research centres which conduct concentrated, focused and long-term research of high international calibre in order to solve specific challenges in the field” (Research Council of Norway, 2015). From Table 4, we observe that the relative absorptive capacity within Alliance 2 is relatively low because there is some distance in all three dimensions, organizational structures, knowledge bases and (especially) dominant logics.

### TABLE 4

The Relative Absorptive Capacity within Alliance 2, Years 1-4

<table>
<thead>
<tr>
<th>Years 1-4</th>
<th>Organizational structures</th>
<th>Knowledge bases</th>
<th>Dominant logics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Generally, there are differences in organizational structures between the firms and research partners. Moreover, the organizational structures vary among the firms, with a combination of interest organizations and firms, as well as differences in ownership (private/public).</td>
<td>The firms and the research partners possess similar basic knowledge, but there are differences in specialized knowledge.</td>
<td>The alliance is led by the research partners and follows their research objectives and dominant logic, whereas the industry wants more applied research.</td>
</tr>
<tr>
<td></td>
<td>“It’s hard to take into account the interests from 10-15 firms, and it’s even harder when an interest organization represents 10-15 additional firms” (Research partner).</td>
<td>“There is a difference between the firms (...) firm X knows a lot about these processes. However, they complement their own knowledge with the research conducted in the alliance to create even more knowledge” (Research partner).</td>
<td>“I think there is very little focus on product development in [the research alliance]. They focus on research for the sake of research. The focus should have been much more commercially oriented and rooted in the industry” (Firm partner).</td>
</tr>
<tr>
<td></td>
<td>In addition, a couple of firms and interest organizations dropped out from the alliance for strategic or financial reasons.</td>
<td>“I have worked there [in the research organization] for approximately 15 years” (Firm partner).</td>
<td>“We felt that we, and the industry we represent, could not influence the relevancy of the research activities. Only one of the 15 research projects that goes on in the alliance is relevant for us” (Firm partner).</td>
</tr>
<tr>
<td></td>
<td>“We knew firm X through a former EU project, and a couple of them [their employees] wanted to join the alliance and signed up on behalf of the firm. They stayed in the alliance for one year before they dropped out: The management thought the research focus [in the alliance] did not fit as well as they first thought” (Research partner).</td>
<td>A part of the reason [for joining the alliance] was the wish to preserve and build the sphere of competence because we could say that the research community [in Norway] is relatively small (Firm partner).</td>
<td>“The alliance has not achieved any great inventions” (Firm partner).</td>
</tr>
<tr>
<td></td>
<td>One of the involved firms has an R&amp;D department and consequently has some structures similar to the research partners.</td>
<td>“We want to have a solid research community in our field, and that contributes to strengthen us commercially as a company. In certain cases, we need to approach a research community. That</td>
<td>“The main innovative activity is the production of [academic] papers” (Research partner).</td>
</tr>
</tbody>
</table>
There are many small actors in this industry. Many of the firm partners do not have their own R&D department or R&D personnel (...) We need them to dedicate more time for the research activities. The firms respond that they cannot allow employees to spend their time on R&D activities” (Research partner).

was a considerable driver for joining the alliance” (Firm partner).

“An important factor is the time horizon. They [the firm partners] want to squeeze out some ‘tricks’ from us to save their financial position next year. That approach does not bring about much research” (Research partner).

First, the organizational structures are complex because the alliance consists of several research and firm partners. A firm partner describes the establishment of the alliance as a “midwifery, where public R&D funding worked as a trigger for building a national team on environmental energy”, which is a typical technology-push incentive targeting cleaner forms of energy production that cannot compete with traditional ones in terms of cost (Nesta, Vona, & Nicolli, 2014). A leading research partner describes the formation of the alliance as completely new for them, where researchers across institutions and departments jointly build a larger research team: “we pick the best people for the job, regardless of where they come from”. In addition to a broad research team, the alliance also included diverse firms and interest organizations. A work-package leader within the alliance highlights the advantage of having a variety of partners: “when we are several [partners], we are able to look at the environmental influence across the industry [the whole value chain]”. However, this positive aspect has its downside because having several actors with different organizational structures makes it difficult to manage all the different interests and relations. This is illustrated by a quote from a research partner: “A challenge with this alliance is that it covers everything, and has a long-time horizon (...) The firm partners are interested in their part, and they have to work through a lot of ‘noise’ to get their little piece of the puzzle”. Among the firm partners, the organizational structure differs and may be confusing for the research partners. A quote from a research partner who witnessed a firm partner leave the alliance exemplifies this: “I talked with the wrong person (...) the one that has participated was not the decision maker. A subgroup took the decision to leave the alliance. That sort of firm structure is a challenge for us. I should have approached that subgroup directly, not indirectly”. Hence, the numerous organizational structures decrease the relative absorptive capacity in Alliance 2.

Second, the knowledge bases in Alliance 2 are similar with regard to basic knowledge, as many of the firm partners hold a Ph.D. or a Master of Science degree from a university. Because the alliance is supposed to cover the whole value chain, the specialized knowledge is
high between specific firms and specific research partners. However, the specialized knowledge within the group of firm partners and within the group of research partners is rather low, as exemplified by the following quote from a research partner: “they [another research partner] have limited knowledge on our type of technology”. Further, as in Alliance 1, it is important for the firms to collaborate with research partners that understand their challenges and are capable of providing specific solutions, due to harsh competition from other industries. Hence, by participating in the alliance, the firms wanted to develop the research partners’ specialized knowledge, as illustrated by the following quote: “We joined the alliance partly because we wanted to preserve and develop the research partner’s knowledge”.

Third, Table 4 shows that Alliance 2 follows the dominant logic of the research partners and addresses the challenges they judge as important for the development of new environmental knowledge. This is illustrated by a quote from a firm partner: “The results from the alliance were pretty far from what we perceived as useful. There were little and quite narrow results”. As Bettis and Prahalad (1995) state, different partners will often have different dominant logics and pay attention to different “data”. This seems to be the case in Alliance 2. Because the commercial objectives appear to be very different, aligning the dominant logics of the research and firm partners seems to be a challenge in Alliance 2. This relates to previous research, in which scientists claimed to be oriented toward the publication system, whereas firm partners face the commercial imperative to apply exploitable results through short-term applied research (Becker & Trowler, 1989; Perkmann & Walsh, 2007). A quote from a research partner exemplifies this: “I think the clue is different expectations. The firms in general, or many of them, have an expectation to turn research into commercialized products in a short time-horizon”. This supports the findings of Bjerregaard (2010) in which firm partners and universities had different interests, goals and time horizons for conducting R&D. Hence, the conflicting dominant logics lower the relative absorptive capacity in Alliance 2.

Summarizing the analysis of Alliance 2, years 1-4, we observe that technology-push incentives motivate collaboration between R&D partners with less similar organizational structures, knowledge bases and dominant logics. The consequences of lower relative absorptive capacity between R&D partners will most likely lead to a broader knowledge base that have higher propensity for radical innovations (Laursen & Salter, 2006). We propose the following:

Proposition 2: More radical environmental policies (e.g., technology-push) motivate collaboration between R&D partners with lower relative absorptive capacity.
In Alliance 2, we observe changes in the relative absorptive capacity, which are further explored through the balance of power and dependence between the R&D partners. The power to decide the direction of the research process was placed with the research partners based on the direction of the research grant (technology-push).

In the period from years 1 to 4 (see Table 5 and Figure 3), there was an unbalanced power and dependence relationship in Alliance 2. The quotes in Table 5 shows that the collaboration between R&D partners with low relative absorptive capacity is challenging, in line with Howells et al. (2012), who show that partners likely to provide the most complementary knowledge are also the most challenging actors with which to collaborate. In Alliance 2, the firms experienced that the research partners decided the direction of the research projects and that these projects were not relevant for the firms. Eventually, this led to a situation in which some firm partners withdrew from the alliance, which created trouble for the research partners because they were dependent on the financial contributions of their firm partners to perform the research they set out to do. This narrative is in line with Pfeffer and Salancik’s (2003) claim that, if a partner exerts power, it might end up destroying value rather than creating value. As a reaction to this situation, the research partners had to give up some power and instead “please” the firms by making the projects more relevant for the firm partners. By giving away power and making the research more relevant for the firms, the relationship between power and dependence shifted, as illustrated in Figure 3.

**TABLE 5**

**Balance of Power and Dependence in Alliance 2**

<table>
<thead>
<tr>
<th>Years 1-4</th>
<th>Power</th>
<th>Dependence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From the beginning of the collaboration, the power to decide the direction of the research resided with the research partners.</td>
<td>In the beginning of the collaboration, the research partners not only had large amounts of power but also experienced high dependency on the firms.</td>
</tr>
<tr>
<td></td>
<td>“The initiative mostly comes from the [research partners], and we do not receive much benefit from the output” (Firm partner).</td>
<td>“Many of the firm partners are rather passive [in the collaboration]” (Research partner).</td>
</tr>
<tr>
<td></td>
<td>“Actually, we should have been positioned to have influence... I remember I asked the [research partners] to work on a special task relevant to us. They answered that it was interesting, but that it had to be considered the</td>
<td>“They [the firm partners] don’t show up; they don’t prioritize coming and discussing things with us and the other partners” (Research partner).</td>
</tr>
</tbody>
</table>

Years 4-7 Over time, the firms attained more power to influence the alliance objectives. This change came about after an external mid-term evaluation of the alliance.

“The alliance was not designed for our [the firm] needs. I think that experience came unexpected [on the research partners] in the mid-term evaluation” (Firm partner).

“We have not committed ourselves [the firm] for the last three-year period. For that, we must see a change [in the research activities]” (Firm partner).

“We [the firm] have pushed them hard, which they have taken into account...They have become better and more to the point” (Firm partner).

“How much power should the firm partners have in the alliance? It is not stated anywhere. What is clear is that the firm partners need to be satisfied. However, how much time should I employ to satisfy a firm partner that contributes to only 2 percent of the budget? Then again, the 2 percent generates four to five times the amount [from governmental and research partner funding]. That balance is difficult” (Research partner).

“We barely have contact. However, I will not blame just the research partners for that; we could have been more proactive” (Firm partner).

Over time, the firm partners (that did not drop out) became more involved in the alliance. With increasing influence, the alliance became more relevant for the firm partners, which again made them more dependent on the research partners.

“Now the research partners have much more dialogue with the firms, and they may have had to do that if they wanted to continue with the alliance after the mid-term evaluation” (Firm partner).

“The research partners have become much more proactive” (Firm partner).

“In principle, the alliance is a competence-building project. However, we do some development activities for the firm partners that actually should not have been done within the alliance. It is to satisfy the firm partners” (Research partner).

“We are dependent on them; it is hard for us to criticize [the firm partners] in return” (Research partner).
In the period from years 1 to 4, the research partners not only had large amounts of power but also experienced a high level of dependence on the firm partners in the sense that they needed their financial contributions. At the same time, the firm partners were in a situation in which they experienced little power over the direction of the innovation process and consequently felt that they did not depend on the results from the research to develop EIs in their own firms. In this situation, some partners used the power they had, which was to exit or threaten to exit the alliance. This finding is supported by other studies that find that power imbalances can explain why firms resist certain interorganizational actions (Casciaro & Piskorski, 2005).

Over time, we observe a shift in power and dependence in Alliance 2. From years 4 to 7, the research partners accepted the demands of the dissatisfied firm partners and made the research more relevant for the firms. This resulted in a redistribution of power and dependence, balancing the former power imbalance (see Figure 3, years 4-7). Here, the research partners took into account that they are dependent on industry funding to maintain the alliance and “gave” more power to the firms. This approach, in turn, made the alliance more relevant for the firms and made the firms more dependent on the alliance. Previous studies have found that research partners’ flexibility and willingness to respond to the firms are crucial for maintaining the long-term horizon of the collaboration (Czakon, 2009). Our findings show that balance in power and dependence develops over time and that this makes the collaboration less challenging. In the process of balancing the relationship between power and dependence, the
relative absorptive capacity also increased, especially in the dimension of dominant logics, with
the alliance following the dominant logic of the firms to a larger extent (see Table 6).

TABLE 6
The Relative Absorptive Capacity within Alliance 2, Years 4–7

<table>
<thead>
<tr>
<th>Years 4-7</th>
<th>Organizational structures</th>
<th>Knowledge base</th>
<th>Dominant logics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“We have addressed the need for more communication with the firm partners regarding the yearly work plan and the mid-term evaluation. Therefore, we arranged a visit to all of the firm partners. The research partners met with the [firm] contact person, that is normally higher up on the organizational ladder, in addition to other relevant employees who took the time to meet us when we visited them” (Research partner). “We have now dedicated more internal capacity to follow up on the research activities in the alliance” (Firm partner).</td>
<td>There have been some adjustments to fit the diverse knowledge bases. “We received presentations that were too technical or too general. Lately, we have had presentations that have been a really god fit” (Firm partner). “I always get new ideas when I participate in the meetings [with the research partners]” (Firm partner). “We are now collecting data from all firm partners, which should result in a ‘picture’ of the whole value chain today and how it may look in the future. After that, we are going to propose a suggestion for every single firm partner” (Research partner).</td>
<td>Over time, the alliance increasingly followed the dominant logic of the firm partners. “There have been some discussions doing measurements [in some of the firm partner’s locations] (...) these measurement campaigns are to some extent advanced consulting” (Research partner). “The firms have asked for more specific results (...) then the research becomes more short term” (Research partner). “I think the alliance has improved firm partner involvement. I guess they [the research partners] have taken the feedback from the firms into consideration” (Firm partner). In addition, the firm partners took the dominant logics of the research partners into consideration. “We may have had wrong expectations when we entered [the alliance]. We expected commercial results, but we will not have that. We get a direction and some interesting findings that we can use” (Firm partner).</td>
</tr>
</tbody>
</table>

Over time, with the convergence of power and dependence between the firm and the research partners, the two sides improved their understanding of each other’s problems and challenges. Thus, we observe that the relative similarities in the dimensions of organizational structures, knowledge bases, and (especially) dominant logics have increased. However, the consequences of a more balanced relationship with higher levels of relative absorptive capacity can be more incremental innovations (Lane & Lubatkin, 1998), which are the opposite of the policy’s intention. Based on this, we propose the following:
Proposition 3: With converging power and dependence between environmental R&D partners, the relative absorptive capacity between partners increases.

5. CONCLUSION AND IMPLICATIONS

This paper builds theory on how differences in environmental policies influence the collaborative relationship between environmental R&D partners. By studying two Norwegian R&D alliances over time, we contribute to the debate on the intended effect of policies (Bergek et al., 2014; Lettice et al., 2012), with the added insight that power and dependence relations (Pfeffer & Salancik, 2003) might affect the relative absorptive capacity between R&D partners, which may result in other outcomes than the intention of the policies. Based on our propositions, Figure 4 offers a revised version of the conceptual framework of environmental policies and their intended effects (Figure 1).

Figure 4
Revised version of Figure 1: The Proposed Relationship between Environmental Policies, their Intended Effects and the Level of Relative Absorptive Capacity.

First, from Alliance 1, we found that command-and-control policies motivate collaboration between R&D partners with high relative absorptive capacity, which will likely result in mostly incremental innovative results from this alliance (Lane & Lubatkin, 1998). Second, from Alliance 2, we found that technology-push policies motivate collaboration between R&D partners with lower relative absorptive capacity, which will likely lead to a broader knowledge base that have a higher propensity for radical innovations (Laursen & Salter, 2006). Third, we analyzed the development of power and dependence relations in Alliance 2 and propose that,
with converging power and dependence, the relative absorptive capacity between partners increases. The consequences of a more balanced relationship with higher level of relative absorptive capacity can be that the innovative results from the alliance will be more incremental (Lane & Lubatkin, 1998), which is the opposite of the policy intention. Thus, some policies may not reach their intended objectives (Lettice et al., 2012).

5.1 Implications and Limitations
Our results have important implications for policy makers and for organizations engaging in environmental R&D collaboration. First, policy makers should be aware of the effect different policies have on the relationship between potential collaboration partners. When policies are designed to motivate R&D collaboration between partners with different levels of similarities, they have implications for the collaborative relationship because too diverse partners may face problems when collaborating, whereas too similar partners may face problems when developing radical knowledge. Hence, different policies for increased R&D collaboration may be adopted depending on whether the aim is to develop incremental or radical environmental innovations. As collaboration between less-similar partners may be more difficult to develop than collaboration between similar partners, we advise policy makers to adapt long-period R&D collaboration programs when targeting collaboration between diverse partners.

Further, our results have important implications for firms engaging in environmental R&D collaboration. Our findings show that different environmental policies motivate the formation of different R&D partnerships. On one hand, when facing command-and-control policies, firms might benefit from collaboration with quite similar R&D partners, with whom they share a high relative absorptive capacity. On the other hand, when targeting more radical policies, such as technology-push policies, firms might engage in R&D collaboration with more diverse partners. However, if the alliance consists of diverse partners, it is of the utmost importance to make sure that all partners have clarified their expectations to the collaboration and that the power and dependence within the relationship have been mapped. As our findings show, an imbalance in power and dependence can give rise to collaborative tensions. Firms and R&D partners might both benefit from alliances by giving away more power and making the research more relevant for both partners.

Our study has several limitations. First, the paper is based on two cases influenced by two different policy approaches, which limits the transferability of the results. Future research could include more cases with different policy approaches to explore whether our conceptual
model is transferable to other contexts. Our results indicate that different policies offer different innovative outcomes; however, more data are needed to clearly show the relationship between environmental policies and different innovation outcomes, which is left for future research. Another limitation is related to the qualitative nature of our research. Future research could statistically test our propositions to explore whether our results are transferable to other environmental R&D alliances. However, more case studies are needed to explore the underlying processes between R&D partners and how they affect the innovation processes.

6. REFERENCES


Yin, R. K. 2013. *Case study research: design and methods*. Los Angeles, Calif.: SAGE.