MONIT

Monitoring and Implementing Horizontal Innovation Policy

Coherence of Environmental and Innovation Policies:

A green innovation policy in Norway?

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WORKING PAPER

MONIT is a collaborative project in the context of OECD to explore national capabilities in innovation policy and governance in the innovation driven economy

For more information, see www.step.no/monit/

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THE MONIT PROJECT

The MONIT[1] project was endorsed by the TIP[2] working party of the OECD in December 2002. Building on the results of the TIP project on National Innovation Systems (NIS), its main objective is to generate knowledge on how to improve innovation policy governance and create a more coherent and comprehensive innovation policy. The focus is on how to achieve a more horizontal innovation policy through co-ordination with non-core policy areas, vertical integration and coherence, and new forms of governance and policy making processes. More specifically it studies the foundations for innovation policy governance by highlighting issues such as political leadership, building effective co-ordination mechanisms, socio-political foundations for information exchange and policy learning, cultural factors in policy systems and related sources for coherent policy making.

The MONIT network consists of 13 countries, all devoted to generate knowledge to be shared by the others. The MONIT project is organized in 3 work packages (WP):

- WP1 consists of a broad analysis and assessment of the national policy profiles and challenges, as well as of key governance issues;
- WP2 includes policy case studies in the areas of information society, sustainable development[3], transport, and regional policy;
- WP3 will synthesize the results from WP1 and WP2 and draw the policy implications.

STEP[4] is in MONIT studying the Norwegian innovation policy system through several inter-linked studies. A main focus is to better understand the underlying logic of the Norwegian system, its roots in terms of cultural traditions and the main priorities coming out of it. Both mapping studies and more detailed studies of parts of the innovation policy system are therefore covered in the project.

Norway is the lead country in this network, while Austria, Finland and Netherlands are co-leaders. The Norwegian part of the project is commissioned by the Research Council of Norway (RCN), and funded by this council and the ministries of Science and Education, Trade and Industry and Regional Affairs. The project also consists of a learning arena organized by the users through which results and perspectives generated by MONIT is disseminated and discussed.

Svend Otto Remøe
Project responsible

[1] Monitoring and Implementing Horizontal Innovation Policy
[2] Working Party on Technology and Innovation Policy
[3] The concern of ProSus' contribution
[4] Center for Innovation Research

CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS

CFC	Chlorinefluorocarbon
EEA	European Environment Agency
EIA	environmental impact assessment
EPI	environmental policy integration
ENGO	environmental non-governmental organization
ETAP	Environmental Technologies Action Plan (EU)
GHG	green house gas
GMO	genetically modified organisms
GTC	Green Tax Commission
GWP	global warming potential
HEPI	horizontal environmental policy integration
HFC	Hydrofluorocarbon
HIP	Government Plan for a Comprehensive Innovation Policy
ISC	the Industry Structure Commission
LO	the National Council of Trade Unions
MONIT	Monitoring and Implementing Horizontal Innovation Policy
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MoER	Ministry of Education and Research
MoH	Ministry of Health
MoLR	Ministry of Local Government and Regional Development
NCSD	National Committee on Sustainable Development
MoPE	Ministry of Petroleum and Energy
MoTI	Ministry of Trade and Industry
NA21	National Action Plan for Sustainable Development
NGO	non governmental organization
NHO	Confederation of Norwegian Business and Industry
NEMS	National Environmental Monitoring System[5]
NTC	the Norwegian Trade Council
RCN	Research Council of Norway
RDS	result documentation system
SDS	National Sustainable Development Strategy
SEA	strategic environmental assessment
SEAP	sectoral Environmental Action Plan
SFT	the Norwegian State Pollution Control Authority

[5] National Environmental Monitoring System (NEMS) is a term coined by the authors. It is a loose translation of the Norwegian term “resultatoppfølgingssystemet”. No official translation to English has been proposed by the authorities. In the latest White Paper 25 (2002-2003) it is only referred to as “monitoring the results of environmental policy” [in Norwegian: “resultatoppfølging av miljøvernpolitikken”].

SINTEF	the Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology
SIVA	the Industrial Development Corporation of Norway
SND	the Norwegian Industrial and Regional Development Fund
Twh	terra watt hours (1.000.000.000.000 watt hours)
UNCED	United Nations Conference on Environment and Development (1992 Rio Conference)
VEPI	vertical environmental policy integration
WCED	World Commission on Environment and Development
WSSD	World Summit on Sustainable Development (2002 Johannesburg Conference)

SUMMARY

This MONIT report describes and analyses integration of environmental and innovation policies in Norway. The notion of environmental policy integration (EPI) is taken as point of departure. EPI was one of the most important policy references to emerge from the process following the United Nations Conference on Environment and Development in 1992 – the UNCED process – on how to achieve a sustainable development. EPI implies the incorporation of environmental objectives into all stages of policy making in non-environmental policy sectors, with a specific recognition of environmental objectives as a guiding principle for the planning and execution of policy. In the current report EPI is used to clarify "policy coherence" – a central concern in the MONIT project.

In order for the reader to better comprehend the current status of public environmental governance in Norway, the first part of the report presents Norwegian environmental politics, the National Action Plan for Sustainable Development (NA21) and two efforts of environmental policy integration: the Norwegian Environmental Monitoring System (NEMS) and the Environmental Profile of the State Budget.

The second part of the report discusses to what extent *green* innovation is reflected in the formulation and implementation of Norwegian environmental and innovation policies. The issue is discussed in accordance with both the horizontal and vertical dimension of environmental policy integration. White papers, parliamentary bills and action plans from the Ministry of Environment (MoE) and Ministry of Trade and Industry (MoTI) are presented as part of the horizontal dimension. The activities and programs of directorates subject to control by MoE and MoTI are presented as part of the vertical dimension.

In the third part of the report we present additional policy efforts on green innovation and two case studies of companies promoting green innovations. The additional policy efforts mostly refer to fiscal measures and the application of environmental taxes. The case studies on Shecco Technology and ScanWafer discuss the extent to which extent these two companies were impacted by environmental and innovation policies when developing their green technologies.

In the final and concluding chapter of the report some of the findings are highlighted: The NEMS is a unique and innovative policy effort, but it is not fully implemented. The comprehensive innovation policy action plan (HIP) contains virtually *no* references to green innovation, environmental concerns or the ecological thresholds and Earth's carrying capacity. In NA21 it is stated that the HIP "is consistent with NA21", but as shown above this is not the case. Further, a check of the directorates and initiatives under the Ministry of Environment and the Ministry of Trade and Industry reveals almost no current activities related to green innovation. The conclusion is quite clear: there is at present no green innovation policy for sustainable development in Norway and no integration between environmental and innovation policies.

The report then provides, in accordance with the analytical approach, policy recommendations along the horizontal and vertical dimensions of environmental policy integration. It calls for:

1) A strengthening of horizontal governance: A green innovation action plan – with clear and consistent, goals, timetables and specific targets – coordinated by a central authority.

2) A strengthening of vertical governance: A green innovation committee – consisting of public servants from relevant ministries and directorates – to coordinate all initiatives and programs relevant for green innovation.

3) Facilitation of green innovation through existing sectoral policy instruments: Alter existing innovation-related policy instruments to increase the integration of environmental concerns into their daily activities.

1 INTRODUCTION

In the contract Program for Research and Documentation for a Sustainable Society (ProSus) at the University of Oslo signed with the Center for Innovation Research (STEP), ProSus was tasked with preparing:

"(1) A summary description of the environmental policy trajectory in Norway, its basic priorities and political rationale. This part also includes descriptions of the processes, structures and arrangements in place for formulating and coordinating policy.

(2) A description of the policy field according to its innovation policy functions: Which environmental policies and priorities build on innovation policy functions, and which have explicit or implicit innovation consequences?"

This is related to work package (WP) 2 of the MONIT project.

As to the first task above: A description of the environmental policy trajectory in Norway could easily produce a document beyond the relevance of the project, In the interest of adhering to the project's focus, we feel that this study should be limited to topics that are more directly related to the major issues of concern; namely the monitoring and implementing horizontal innovation policy – MONIT. As we see it, there is a need to present findings that enable a better understanding of how environmental policy instruments are interacting with business and industry interests through innovation policy efforts. To conduct such an evaluation we have chosen to refer to environmental policy integration (EPI) and the benchmarks developed by Lafferty and Hovden (2003).

More specifically, we would argue that this study should focus on the promotion of sustainable production and consumption. It is not possible to measure either actual outcomes or results. However, by mapping current public policy efforts, it should be possible to document the degree to which environmental and innovation policies are integrated.

From a public policy point of view both environmental and innovation policies are easily contextualized and related to other policy arenas. Environmental policies have, or should have, wide implications for energy, transport and agricultural policies, while innovation policies have implications for regional, educational and research-oriented policies. Thus, it is appropriate to focus on these two policy areas in documenting policy integration and coherence. Still, the basic rationales of environmental and innovation policies have differed: Whereas innovation policies have promoted unlimited growth to ensure economic development, environmental policies have increasingly taken into account ecological limits on human activity in order to curb economic development that may lead to irreversible changes in global ecosystems.

Increases in the range and scope of pollution problems, and higher societal preferences for environmental quality have triggered new formal and informal demands for innovation and technological development. This has been reflected in environmental regulations. Firms and innovators today make efforts to promote cleaner processes and products

through green innovations. But to what extent are *green* innovations reflected in the formulation and implementation of Norwegian politics? Firms pursue innovation and technological change both by internal motivation and competence and by external demands. This is done not only as a consequence of public policy requirements, but due to pressures from consumers and other stakeholders within and outside the value-chain of the business in question. This study, however, is about the role of public policy coordination and the interface and coherence between environmental policy and innovation policy in Norway.

Drawing from ongoing strategic research and evaluations undertaken by ProSus, this report elaborates on the concept of environmental policy integration (EPI). In particular this report refers to horizontal and vertical environmental policy integration as developed by Lafferty and Hovden (2003) to analyze the horizontal and vertical initiatives undertaken by the government to promote environmentally sound innovations in Norway.

Regarding the horizontal dimension (HEPI) this report discusses the general governmental responsibility for sustainable development and how this is coordinated with respect to innovation policy and green innovations. Regarding the vertical dimension (VEPI), this report discusses in detail efforts undertaken by the Ministry of Environment and the Ministry of Trade and Industry aimed at contributing to the integration of environmental and innovation policies. In addition, this report reviews selected efforts undertaken by other ministries and governmental agencies, and initiatives to promote green technological innovations.

Two case studies of interesting green technological innovations by Shecco Technologies and ScanWafer are presented. *Shecco Technology* promotes a heating and cooling technology that uses natural CO_2 as propellant for mobile or residential air conditioners or in tap water heat pumps. More eco-efficient than conventional technology, Shecco-technology will replace HFCs (potent green house gases (GHGs) with significant global warming potential) and hence contribute significantly to decreasing GHG emissions. *ScanWafer* is a company producing multicrystalline silicone wafers for the solar panel industry. The industry in general has seen an annual growth of about 20 % during recent years. Using proprietary knowledge, ScanWafer produces silicon solar wafers with a world-leading sunlight-to-electricity conversion efficiency exceeding 15 %. The case is interesting not only because ScanWafer has been very innovative in the optimization of production techniques, but also because ScanWafer is a fast-growing Norwegian industrial company in a domestic labor market where industrial employment is declining.

1.1 Analytical clarifications

Although environmentally sound innovative efforts may not be presented as green initiatives, significant environmental improvements may nevertheless be achieved. An example is the silica wafer for solar panels produced by ScanWafer. It is marketed as a cost-effective alternative to other energy sources. ScanWafer's marketing says little or nothing about the fact that solar panels may contribute to more eco-efficient electricity production. Consequently, it is important to focus on the effects rather than the intents of innovations. OECD emphasizes the systemic character of environmental innovations. In

the past, green technologies usually referred to end-of-pipe technologies, but all technologies can be considered green as long as they are employed to reduce environmental impacts. Green innovations can also occur in industries besides those dedicated to supplying environmentally friendly goods and services. Even structural changes – such as more efficient information and communication technologies – may generate *unintentional* environmental benefits. Consequently, green innovations are often systemic and complex because they involve many areas of knowledge and many industrial sectors.

This report deals with the relationship between environmental and innovation policies and the extent to which there is policy coherence in the promotion of green innovations in Norway. Consequently, it does not primarily deal with technical features enabling ecological improvements, or with the impacts of such technologies. Rather it focuses on public policy responses. However, in the case study illustrations, certain technical features are referred to, in accordance with the methodological approach of the CondEcol project,[6] to illustrate environmental benefits during the life cycle of specific product innovations.

During the 1990s there was increasing public recognition and acceptance of the fact that we are facing potentially irreversible environmental damage to life-support systems and Earth's carrying capacity. The implication is clear. Environmental objectives – as a general rule – must be seen as a principal concern. Norwegian environmental policy is inspired by this realisation. There are ecological limits to which economic activity must be adapted. This stands in stark contrast to the basic reasoning of prevailing innovation policy priorities. Life-support systems are dependent on further economic growth and development. Consequently economic indicators such as increased exports, employment or number of patents are per definition positive proxies of successful innovation measures as long as development is promoted. This is often acknowledged regardless of whether the social changes are achieved in an ecologically sustainable way.

This report deals with this challenge as it aims to combine studies of two policy fields that are conceived in very different terms by various stakeholders. While systemic limitations are a focal point within environmental politics for sustainable development, this is, in most cases, not so for innovation politics where unlimited growth is a target. As reflected by the general reasoning of MONIT – is it rather important to eliminate systemic limitations, and to open up systems horizontally to enable strengthened coherence.

With a focus on green innovation policy, however, the systemic integrative efforts must consider certain environmental principles. The public policy solution lies in strengthened coordination between those policies promoting environmental objectives and those promoting innovation objectives. This report will document the extent to which such coordination exists in Norway, and explore the interface and character of green innovation policy in Norway.

[6] More details on the CondEcol project can be found at the following URL: http://www.prosus.uio.no/english/business_industry/condecol/index.htm (Accessed July 1, 2004)

2 ENVIRONMENTAL POLICY INTEGRATION (EPI) – AN ANALYTICAL REFERENCE

One of the most important policy references to emerge from the process following the United Nations Conference on Environment and Development in 1992 – the UNCED process, is "environmental policy integration (EPI)". Traditionally a particular ministry or agency was assigned the role of "environmental watchdog", which involved continuous battles with powerful stakeholders, who perceived the ministry/agency as an adversary. This is also the case in Norway where the Ministry of Environment (MoE) is asked to coordinate the National Environmental Monitoring System[7] (NEMS) as proposed in White Paper 56 of 1996-97 and specified in White Paper 8 of 1998-99. Nevertheless, the respective sectoral ministries are responsible for enforcing compliance with the regulations in NEMS.

The UNCED process, however, forms the basis for an alternative, more complementary approach – called "ecological modernization" (Reitan 2001) – which argues that both environmental and developmental issues are part and parcel of sustainable development. This integration of environmental issues into the politics in general signals sustainable development's emergence as the guiding principle for societal development (Lafferty and Meadowcraft 2000). As emphasized by Hovden and Torjussen (2002:21): "With sustainable development, environmental policy has become much more than pollution control and protection of nature, it has become a process of qualitative reappraisal of prevalent development patterns".

2.1 Coherence – the ultimate goal of horizontal innovation policy?

The conceptual paper for MONIT is the source for the comments made in this section[8]. According to the conceptual paper horizontalization is not a goal in itself, but rather a characteristic of a policy system. It is defined as the degree to which innovation policy is guided by a comprehensive national strategy in which contributions from the various sectors are linked to achieve policy coherence. There is a crucial link between horizontalization and the arrangements for coordination and governance. Consequently, the capabilities of national policy systems to generate coherent innovation policy are of primary concern. Coherence is important for many reasons:[9]

[7] National Environmental Monitoring System (NEMS) is a term coined by the authors. It is a loose translation of the Norwegian term "resultatoppfølgingssystemet". No official translation to English has been proposed by the authorities. In White Paper 25 (2002-2003) it is only referred to as "monitoring the results of environmental policy" [In Norwegian: "resultatoppfølging av miljøvernpolitikken"].

[8] For further details see; http://www.step.no/monit/jointpaper.pdf (Accessed May 4, 2004)

[9] The quote below is originally from an unpublished, undated, discussion paper from the Centre of Government Network: *Government Coherence: The Role of the Centre, OECD, PUMA*, provided by Svend Otto Remøe, the MONIT project coordinator.

- *"Coherent policies are more likely to be effective and more readily applied in a consistent and equitable way;*
- *Governments are increasingly faced with complex and difficult issues, which may impact differently on different areas of society;*
- *They frequently have a range of objectives which cannot easily be reconciled and may be in conflict;*
- *Faced with greater accountability and challenge, through parliaments, civil society and the media, lack of coherence becomes readily apparent and results in uncertainty loss of confidence.*

The concept has basically basically three dimensions:

- *Horizontal coherence, ensuring that individual, or sectoral, policies, build on each other and minimise inconsistencies in the case of (seemingly) conflicting goals;*
- *Vertical coherence, ensuring that public outputs are consistent with the original intentions of policy makers;*
- *Temporal coherence, ensuring that today's policies continues to be effective in the future by limiting potential incoherence and providing guidance for change (and relate to transition management)."*

The MONIT study aims at generating lessons for national governments on how to achieve coherence in innovation policy by highlighting issues such as political leadership, building effective co-ordination mechanisms, socio-political foundations for information exchange and policy learning, cultural factors in policy systems and related sources for coherent policy making. As part of these efforts ProSus is analysing Norwegian environmental public policy and assessing to what extent it supports efforts to promote environmentally sound innovations. The specific question raised by ProSus, however, is: How can the concept "coherence" be operationalized? We refer to the concept 'environmental policy integration' (EPI) as a way of specifying the horizontal, vertical and temporal dimensions of coherence referred to in the conceptual paper.

2.2 Environmental Policy Integration – an effort to clarify policy coherence

As an input to the MONIT project we will not engage in an open-ended discussion of environmental policy integration (EPI), but rather focus on the features contributing to more effective implementation of policies promoting green innovations.

Ute Collier's work on EPI is a valuable starting point for discussing the concept. She is one of the few who define EPI in a way that distinguishes between features of its application such as strategies and indicators. She offers (Colliers 1997:36) a three-point definition of the objective of EPI. It should aim to:

- achieve sustainable development and prevent environmental damage
- remove contradictions between policies as well as within policies
- realize mutual benefits and the goal of making policies mutually supportive

While Collier's definition places the concept of EPI in the right intellectual context and provides a number of possible indications as to what it might entail, the definition is short of a precise, *applicable* definition of EPI. In other words, as Lafferty and Hovden ask (2003:8): "How will we recognize it when we see it?"

To answer this question, Lafferty and Hovden (2003) found the early work of Arild Underdal helpful. Even though Underdal deals with policy integration in general, his approach to the problem has the appealing feature of concentrating on the character of the policymaking process. For a policy to be 'integrated', three criteria need to be satisfied: comprehensiveness, aggregation and consistency. Underdal defines an integrated policy as one where: "all significant consequences of policy decisions are recognized as decision premises, where policy options are evaluated on the basis of the effects on some aggregate measures of utility, and where the different policy elements are in accordance with each other" (Underdal 1980 – cited in Lafferty and Hovden 2003:8). The definition proposed by Underdal is very well developed and precise, but it can in principle be used for any type of policy integration. It is not specifically tied to environmental policy and its relation to sustainable development. Consequently, we lack a value hierarchy to guide the actual integration in question.

In accordance with the reasoning embedded in the UNCED process, but inspired by Underdal (1980), Lafferty and Hovden (2003:9) propose the following definition of EPI:

> Environmental policy integration implies the incorporation of environmental objectives into all stages of policy making in non-environmental policy sectors, with a specific recognition of this goal as a guiding principle for the planning and execution of policy.
>
> Further it is accompanied by an attempt to aggregate presumed environmental consequences into an overall evaluation of policy, and a commitment to minimize contradictions between environmental and sectoral policies by giving principled priority to the former over the latter.

This definition of EPI specifies the integration principle in terms of policymaking and is primarily a process-oriented concept. Environmental objectives need to be part of the fundamental premises for policy-making – including innovation policies – at all stages. The second part of the definition refers to the crucial issue in defining EPI. Most discussions – including reference documents in the MONIT project, general literature on national innovation systems (NIS) and the reasoning of ecological modernization – assume that conflicting interests between policy objectives can be resolved to the satisfaction of all affected parties. *The significance of EPI, however, refers to situations where environmental objectives must be assessed as potentially dominant*. The increasing recognition and acceptance of the fact that Earth is facing potentially irreversible damage to life-support systems clearly implies that environmental objectives – in given circumstances – must be seen as principal. However, a strong presupposition in favor of environmental concerns vis-à-vis other sectoral concerns should not be converted to what Lafferty and Hovden (2003) term an 'extra-democratic' mandate. Political priorities must be agreed upon within democratic procedures. There is considerable room, however, for strengthening the mandate for sustainable development within the policy realm of existing sectoral interests. For example, the actual role, scope and significance of a national action plan for sustainable development could serve as a 'touchstone' for reconciling various sectoral interests.

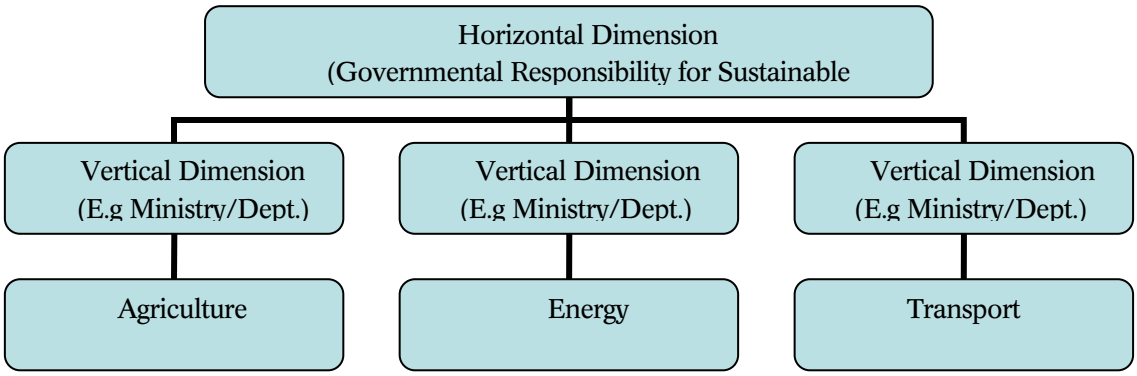

Figure 1: Environmental policy integration. Horizontal and vertical dimensions (Lafferty and Hovden 2003: 14).

As illustrated in Figure 1, EPI has horizontal and vertical dimensions. The horizontal dimension refers to the governmental responsibility for sustainable development and the overall challenge of inter-ministerial policy coordination. The vertical dimension refers to the particular sectoral responsibility of the individual ministry and its policy fields. EPI refers to the policy challenge of comprehensive coordination between the two dimensions. This challenge is the focus of the subsequent discussion. Clearly, a situation where environmental concerns have a position as central as that of financial and economic policy objectives is far away. However, the basic notion of EPI attempts to bring policy-making closer to this ideal. ProSus believes this ideal is also relevant in a MONIT context – particularly when developing green innovation policy, but also when assessing more generally the impact of innovation policy.

2.3 The horizontal dimension of EPI – HEPI

The emphasis in this report is on the integration of environmental concerns into innovation policy-making as a feature of governmental steering. The approach focuses on processes and policies promoting green innovations, and less on the technological output of the government's innovation initiatives.

The concept of HEPI refers to whether a central authority has developed a comprehensive *cross-sectoral* strategy for EPI promoting green innovations. The central authority could be the government itself, or a particular body or commission entrusted with an overarching responsibility for sustainable development. As emphasized by Lafferty and Hovden (2003:14) "If 'who gets what, where, when and how?' is the essence of a political system, the relevant understanding of HEPI is to substitute 'environmental interest' for 'who', and to insist on at least equal treatment for the environment as for other competing interests". HEPI also includes the central authority's ability to communicate to the sectors a detailed understanding of what the central authority aims to achieve by EPI; In the case of the current report the explicit implications EPI should have for the specific sectoral policies related to innovation.

Lafferty and Hovden (2003) propose the following benchmarks for horizontal environmental policy integration (HEPI):

- the existence of a long term sustainable development strategy (SDS)

- the existence of a central authority specifically entrusted with the supervision, coordination and implementation of the integration process
- relatively clear designations from central authority as to sectoral responsibility for overarching environmental goals
- timetables and targets for environmental policy
- periodic reporting of progress with respect to targets at both the central and sectoral levels
- an active and monitored usage of environmental impact assessments (EIA) and strategic environmental assessments (SEA) for all governmental policies

Lafferty and Hovden (2003: 15) stress the SDS as "extremely important" as "… its existence indicates a political commitment to the crucial role that the UNCED process has assigned EPI in the national policy-making context" and gives a strong indication of how a government relates to EPI in the overall decision-making process. Further an "SDS is bound to discuss matters related to economic and social development, as these are integral aspects of sustainable development." Equally important, according to Lafferty and Hovden, "is the existence of a specific central authority, an identifiable and responsible institution to oversee the process of strategic integration. This is a basic *realpolitik* aspect of the horizontal dimension, in that a separate sectoral environmental body will rarely, if ever, have the authority necessary to impose environmental objectives into the decision-making process of other sectoral authorities." We will return to whether, and to what extent, these two most important benchmarks of HEPI, and the other benchmarks mentioned in the above list, exist in Norway.

2.4 The vertical dimension of EPI – VEPI

"Vertical EPI indicates the extent to which a particular governmental sector has taken on board and implemented environmental objectives as central in the portfolio of objectives that the sector continuously pursues (Lafferty and Hovden 2003: 12)." In other words, VEPI refers to a 'greening' of sectoral policies. As underlined by Lafferty and Hovden (ibid) it is important to stress that the term "vertical" is used in a functional sense, and not in the sense of vertical constitutional division of powers. VEPI, the vertical axis of EPI as illustrated in figure 1, signifies administrative responsibility *up and down* within the arena of the specific ministerial sector.

Indicators for VEPI must refer to efforts on how a given governmental ministry aims to integrate environmental concerns into its activities. Lafferty and Hovden (2003) propose the following benchmarks:

- an initial mapping and specification of the major environmental challenges relevant to the sector
- formulation of a sectoral Environmental Action Plan
- consistent and regular employment of both environmental impact assessment (EIA) and strategic environmental assessment (SEA) for all sectoral policy decisions
- timetables and quantitative, indicator-based targets stipulated in the sectoral Environmental Action Plan – or elsewhere
- regular reporting of the state of the environmentally relevant policies within the sector

The key initiative is the existence of a strategic Environmental Action Plan. However, the plan itself will be of limited importance if it fails to properly assess and identify the key environmental challenges for the sector. Further it will be of limited value if it fails to stipulate realistic targets, benchmarks and measures for assessment of implementation results concerning sectoral environmental challenges.

2.5 Summary

To operationalize coherence – one of the key concepts in the MONIT project – we have introduced EPI and discussed its horizontal and vertical dimensions. We believe EPI is valuable and necessary for discussing the policy trajectory of environmental politics in Norway. EPI will add important perspectives to the discussion of integrating environmental and innovation policies.

The following definition of EPI, based on Lafferty and Hovden's approach, is proposed:

> *Environmental policy integration implies the incorporation of environmental objectives into all stages of policy making in non-environmental policy sectors, with a specific recognition of this goal as a guiding principle for the planning and execution of policy. Further it is accompanied by an attempt to aggregate presumed environmental consequences into an overall evaluation of policy, and a commitment to minimize contradictions between environmental and sectoral policies by giving principled priority to the former over the latter.*

This definition specifies the integration principle in terms of policy-making. The environmental objectives need to be part of the fundamental premises for policy-making at all stages – including innovation policies. This refers to both a horizontal and vertical dimension. The second part of the definition refers to the crucial issue in defining EPI. General literature on national innovation systems assumes that conflicting interests between policy objectives can be resolved to the satisfaction of all affected parties. *The significance of EPI, however, refers to situations where environmental objectives warrant principled priority*. The increasing recognition and acceptance of the fact that the world face potentially irreversible damage to life-support systems clearly implies that environmental concerns must be given preferential consideration.

Environmental policy integration has a horizontal and vertical dimension, referred to as HEPI and VEPI, respectively. With respect to *innovation policy*, HEPI refers to whether central authority has developed, and carried through, cross-sectoral strategy for promoting green innovations. VEPI indicates the extent to which a particular governmental sector has taken on board and implemented environmental concerns within the innovation objectives for the sector.

PART 1

Norwegian Environmental Policy Trajectory

3 NORWEGIAN ENVIRONMENTAL POLITICS AND THE NATIONAL ENVIRONMENTAL MONITORING SYSTEM[10]

Norwegian environmental politics is based on the principle of sector responsibility. This implies that most of the political responsibility for following up general programmes is left to the ministries and directorates of each sector. The execution of sectoral responsibility may strengthen vertical integration but still hinder horizontal policy integration. The principle of sector responsibility was first introduced in White Paper 46 (1988-89). It was further elaborated and formally acknowledged in White Paper 58 (1996-97). As a follow up, the National Environmental Monitoring System (NEMS) was proposed in White Paper 8 of 1998-99, the first 'State of the Environment Report'. This chapter describes and assesses the NEMS and the environmental profile of the State Budget. This chapter's aim is to describe Norwegian environmental politics and the environmental monitoring system in Norway in order to set the stage for analyzing green innovation policy. We begin by presenting key features of Norwegian environmental politics.

3.1 A brief introduction to Norwegian environmental politics

Norwegian environmental politics as a major policy area dates back to 1972 with the establishment of the Ministry of Environment (MoE) – the world's first ministry for environmental protection. Important subsequent developments included the establishment of the Norwegian Pollution Control Authority (SFT) on June 1, 1974, the proposing of the Pollution Control Act on March 13, 1981, and its enforcement in October 1983. The policy formation process, general choice of instruments and mode of representation for interest groups were in accordance with traditional ministerial procedures with emphasis on technical expertise and judicial instruments – what Reitan (2001) terms "administrative rationalism".

Toward the end of the 1980s, however, new signals began to appear in the area of environmental politics. The report by the World Commission on Environment and Development (WCED 1987) and the decisions made at United Nations Conference of Environment and Development (UNCED) in Rio de Janeiro in 1992, reflected a new paradigm, often referred to as "ecological modernization". Reitan (2001) describes ecological modernization as an anti-thesis to administrative rationalism. Whereas the former focuses on win-lose situations of economic growth versus environmental protection, and uses administrative/judicial instruments, the latter focuses on win-win situations and a broader range of instruments and approaches to environmental problems, in particular fiscal measures. The transition is also marked by a more active involvement of business/industry and civil society in policy formulation and implementation, with

[10] Eivind Hovden, former associate professor at ProSus, has provided substantial input to parts of this chapter.

voluntary, negotiated agreements and cooperation perceived as alternative means of achieving the new and broader ideal – sustainable development.

In White Paper 46 of 1988-89 the Norwegian Government proposed to the Norwegian Parliament efforts to follow up the requests made by the WCED. In Chapter 10 of the document, several industrial policy measures were suggested. It was stated that:

> "[Industrial] changes must be adjusted to the objectives of sustainable development. There is still time. By initiating changes now, abrupt and more costly changes can be avoided in the future." [Authors translation] (White Paper 46 (1988-89): 101)

The government identified three strategies to make industry more environmentally friendly (1) changing product technologies; (2) changing production technologies; and (3) strengthening pollution control. White Paper 46 (1988-89) refers to strengthening pollution control as the most common strategy to combat hazardous industrial discharges into the air and water, but points out that a focus on end-of-pipe solutions does not eliminate the sources of pollution. Consequently, the White Paper concludes that changes in product and production technologies which alter consumption and production structures will also be necessary if industry is to contribute to sustainable development (ibid: 102). To pursue necessary changes in industrial consumption and production, the government proposed seven policy measures: (1) Development of environmental technologies, (2) Application of environmental taxes, (3) Financial support to stimulate corporate environmental improvements, (4) Regulatory measures in accordance with the Pollution Control Act, (5) Industrial recycling and reuse, (6) A national system for hazardous waste treatment and (7) Eco-labelling and product declarations.

Eight years later, in White Paper 58 of 1996-97, the government proposed a revised "Politics for a Sustainable Development". Surprisingly, however, sustainable development was not referred to as an industrial policy concern. Rather the major industrial policy concerns were formulated in the following manner:

> "The industry is *requested* to assure that the material resource use, energy use and environmental impacts throughout the life cycle (from production, via distribution and use, to waste disposal) are significantly reduced…. Norwegian industry is *requested* to take a lead in further development of... Further industry is *requested* to use modes of transport that generate low environmental and resource loads during the transport of goods to and from the industry" [author's emphasis]. (White Paper 58 (1996-97): 103)

As illustrated by this text, Norwegian environmental politics took a new direction that may be described as "ecological modernisation" (Reitan 2001). This can be illustrated in three ways:

Firstly, Norwegian environmental politics took a new direction in terms of *policy principles*. While previous policies focused on specific environmental problems and on conservation or protection of specific natural resources, the new focus was more systemic with respect to ecosystems and broader solutions. In White Paper 58, two important principles were introduced as premises for Norwegian environmental policy making: the idea of nature's carrying capacity and the precautionary principle. The idea of *nature's carrying capacity* -- of *thresholds* or *critical levels* in relation to ecosystems – is directly related to sustainability. Given the complex and interrelated nature of ecosystems, the *precautionary principle* is introduced to address situations of scientific uncertainty in the policy-making process. The precautionary principle implies that, faced with a risk of serious or irreversible environmental damage, lack of scientific certainty neither justifies

environmental destruction nor allows postponement of policies to protect nature (Lafferty and Langhelle 1999).

Secondly, with White Paper 58 the traditional focus on nature conservation through administrative/judicial instruments was firmly expanded and *new policy instruments* were introduced, in particular economic instruments. *Cost efficiency* became a guiding principle in environmental politics. The attempt to introduce a green tax system is a key example of Norwegian experiments with economic instruments in environmental policy (Ruud 2002).

Thirdly, White Paper 58 signalled a shift to a *sector-encompassing* approach. Sustainable development issues were to be integrated in all aspects of societal planning and sectoral policy (Langhelle 2001; Hovden and Torjussen 2002). The principle of sectoral responsibility in combination with the sector-encompassing approach is still prevalent in Norwegian environmental policy, and has led to the development of the rather unique National Environmental Monitoring System (NEMS) (which will be elaborated upon in chapter 3 of this report).

3.2 The Environmental Profile of the State Budget

The "Environmental Profile of the State Budget" was the prime instrument contributing to horizontal environmental policy integration (HEPI) in the aftermath of White Paper 46 (1988-89), and as of 2004, is still standard procedure. However, it was not until 1997 that it was formalized as part of the Ministry of Environment's Parliamentary Bill 1 (the annual budget bill). The intention of the Environmental Profile was twofold. First, it was intended to give an overview of funds connected to the environmental domains within ministries. Second, ministries were to use the Environmental Profile to present the main environmental challenges, targets and initiatives planned for implementation each new fiscal year and, if possible, to describe the effects of budget allocations the previous two years (Hovden and Torjussen 2002).

The Environmental Profile has developed and improved over time. Yet, an evaluative report from the Office of the General Auditor[11] published in 1999 concluded that it suffered from a number of weaknesses. Most importantly the criteria for classifying the budgetary funds were unclear, leading to different classifications by different ministries. The report also revealed that the MoE's role as coordinator of the reporting had been vague (Riksrevisjonen 1999; Hovden and Torjussen 2002). This led to amusing results, especially in the early days when in one instance the Ministry of Defense argued that virtually *all* their spending was environmentally related, since most of their activities could be related to preventing nuclear warfare (Nøttestad 1999, cited in Hovden and Torjussen 2002).

Note that the Environmental Profile of the State Budget was established well ahead of the publication of White Paper 58 (1996-97), in which the National Environmental Monitoring System (NEMS) was introduced.

[11] The Office of the General Auditor in Norway (Riksrevisjonen) is the controlling agency of the Norwegian Parliament, the Storting. More information at: http://www.riksrevisjonen.no/Default.asp?Application=Riksrevisjonen_Engelsk (accessed March 10th 2004).

3.3 National Environmental Monitoring System - NEMS

The National Environmental Monitoring System (NEMS) is aimed at providing the government with information and updates on the state of the environment to enable an optimal environmental public policy. To our knowledge, NEMS is a promising effort trying to develop a monitoring framework for managing not only sectoral efforts, but also the overall Norwegian national environmental effort. Consequently, NEMS can be perceived as an ambitious initiative to strengthen both vertical and horizontal environmental policy integration in Norway.

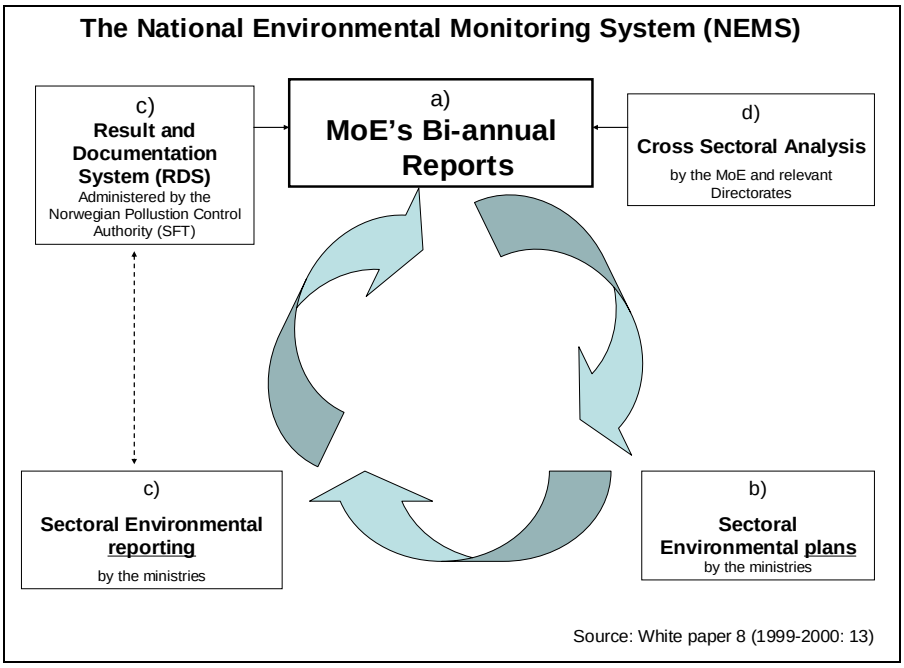

Figure 2: The main elements of the National Environmental Monitoring System (NEMS)

As illustrated in Figure 2, NEMS is based on four interrelated elements:

a) The bi-annual reports from the Ministry of the Environment: "The Government's Environmental Policy and the State of the Environment";
b) The Sectoral Environmental Action Plans (SEAP) of the ministries;
c) Sectoral environmental reporting and the "Result Documentation System" (RDS);
d) Cross Sectoral cost-benefit analysis

As indicated, the intention of NEMS is to provide continuous reporting and updates on the outcomes and impacts of public environmental policy. It can be presented as a four-stage "circular" effort:

First, the most important element of current Norwegian environmental politics in general – and NEMS in particular – is MoE's bi-annual White Paper on "The Government's Environmental Policy and the State of the Environment" (referred here to as the 'State of the Environment'). The bi-annual White Paper (***a*** in Figure 2) is a thorough publication the aim of which is to be a steering document for national public environmental policy. It also presents environmental data and results in general as well as proposed follow-ups on the public policy priorities.

Second, Sectoral Environmental Action Plans (***b*** in Figure 2) have been formulated and published by all ministries. The plans describe the environmental challenges and

instruments available to meet the challenges within the various sectoral domains and are to be updated every four years.

Third, documentation of results is needed (***c*** in Figure 2). The Result Documentation System (RDS) is a continuous monitoring and reporting system included in NEMS to provide input to the bi-annual State of the Environment reports and also to enable monitoring of the state of the environment. The RDS will be based on statistics and historical data from Statistics Norway, the Norwegian environmental authorities and sectoral reporting by the ministries.

Fourth, based on the results from the RDS and sectoral reporting, cross-sectoral cost-benefit analysis (***d*** in Figure 2) is to provide a background for the adjustment of targets or the use of policy instruments. Cross-sectoral analysis is expected to be presented in the State of the Environment report.

The MoE's bi-annual White Paper, the Sectoral Environmental Action Plans, the Result Documentation System and the cross-sectoral analysis are intended to constitute an integrated system of policy instruments, measures, and monitoring and control systems that will make it possible to manage environmental policy effectively. But, as shown below, the system is not yet fully functioning; so the potential for strengthened coherence horizontally and vertically has not yet been realized. According to the Norwegian Pollution Control Authority (SFT), NEMS is recognized worldwide as a quite innovative public environmental management and monitoring system[12].

The eight policy priority areas of NEMS[13]

Before describing the three main elements of NEMS, let us briefly present the eight priority areas constituting the organizing thematic baseline in three of the four elements in NEMS: the bi-annual White Paper, the environmental actions plans and the Result Documentation System (RDS). The eight priority areas are used as benchmarks throughout the documents included in NEMS, thus enabling easy access for the public and policy-makers to comparable data, as well as to changes in environmental policy efforts. The eight priority areas (Text Box 1) are clearly made to fit Norwegian circumstances. Some areas might seem more important (climate change) than others and the scope of each priority area varies. Outdoor recreation, for example, would in many countries probably be handled by either the ministry of sports or health. That it is given its own priority area in Norway is due to the popularity in Norway of trekking and skiing in the vast forests and mountainous areas. At the same time the

Text box 1: The eight policy priority areas of NEMS. Introduced in White Paper 58 (1996-97)

1. Conservation and sustainable use of biological diversity
2. Outdoor recreation
3. The cultural heritage
4. Eutrophication and oil pollution
5. Hazardous substances
6. Waste and recycling
7. Climate change, air pollution and noise
8. International cooperation and environmental protection in the polar areas

[12] Stated by Olle Morten Grini, scientific advisor on environmental data at SFT, during a ProSus seminar November 6th 2003. Grini is project coordinator of the RDS.
[13] A first draft of this section was written by Maria Gjølberg, ProSus

priority area is a supplement to bio-diversity and more traditional nature conservation policies. Clearly a wide variety of combinations is possible, and to discuss the basis for the definition of each priority area and the related environmental targets[14] is beyond the scope of this report. We can, however provide a very brief overview of the eight policy priority areas:

(1) Human activities are influencing and threatening *biological diversity* in many ways, and calculations show alarmingly high losses of both species and habitats (SSB 2003). Such losses may be the direct result of development or over-exploitation; or they may be caused indirectly when human activities cause pollution resulting in climate change that worsens conditions for animals and plants. One important way of responding to these challenges is to protect areas. By the end of 2001 approximately 8 per cent of Norway's land was protected (SSB 2003).

(2) Everyone should have the opportunity to take part in *outdoor recreation* as a healthy and environmentally sound leisure activity. Outdoor recreation can be sought in the inlands, valleys, mountains and coastal areas. However, there is great pressure from entrepreneurs and some politicians to develop these areas, which could result in restrictions on public access for recreation.

(3) Norway's *cultural heritage* is a basic source of knowledge about people's lives and activities throughout history and must be preserved. It can improve the understanding of the links between history and the present, with different cultures and the natural environment. Cultural monuments, sites and landscapes are, however, damaged by changes in land use.

(4) *Eutrophication* is caused by excessive discharges of nutrients into water, resulting in a deterioration of water quality. The nutrients most responsible are phosphorus and nitrogen, and the main sources are industry, agriculture, fish farming and households. Both marine areas and fresh water bodies are affected. Discharges of oil and chemicals from shipping, petroleum activities and onshore activities can damage organisms and ecosystems in the open sea, on the sea floor, in the littoral zone and on land. Pollution of coastal areas also reduces their value as recreation areas.

(5) The use of *hazardous chemicals* and emissions of these substances are responsible for one of the most serious environmental threats. A number of chemicals break down very slowly in the environment and therefore accumulate in food chains. They are a serious threat to biological diversity, food supplies, our health and the health of future generations. The most harmful chemicals, including persistent organic pollutants (POPs) such as PCBs and dioxins, can cause damage even at very low concentrations.

(6) *Waste* causes environmental problems because waste *treatment* releases pollutants. Waste dumped in land fills generates emissions of methane – a greenhouse gas. Landfills may also contain POPs and heavy metals that may pollute air and water. Waste incineration eliminates methane emissions but generates other air pollution. Hazardous waste is also generated by waste incineration. However, new technology has made it

[14] Each policy priority area has a set of strategic objectives, operational national targets and related key indicators. These are available in English at http://www.environment.no/ (accessed May 19 2004) or in the English summary of the second State of the Environment report (White Paper 24 (2000-2001)), available at http://odin.dep.no/md/engelsk/publ/stmeld/022001-040011/dok-bn.html (accessed May 19, 2004).

possible to reduce hazardous emissions. Waste contains both energy and materials that can be recovered, and the recovered materials can be used to replace primary materials.

(7) Concentrations of greenhouse gases in the atmosphere are rising as a result of human activity. The most important reason for this is emissions of CO2 from combustion of fossil fuels. As concentrations rise, the atmosphere retains more of the thermal radiation from the earth, which will cause the global mean temperature to increase – leading to *climate change*. Emission of gases containing chlorine and bromine such as CFCs and HCFCs and halons deplete the atmospheric ozone layer which protects the earth against harmful UV radiation from the sun. Excessive UV radiation may damage people, plants and animals and particularly polar marine ecosystems.

Acid rain caused by emissions of sulphur and nitrogen compounds into the air is still one of the most serious environmental problems in Norway. Emissions from other European countries account for 90 per cent of acid rain deposition in Norway (SSB 2003). Local *air pollution* may cause serious health problems in urban areas. In the largest cities, a high proportion of the population is exposed to concentrations of pollutants that increase the risk of premature death and cause health problems such as respiratory infections and lung diseases.

Noise is an environmental problem affecting a large number of people in Norway (SSB 2003). According to Statistics Norway, 5 per cent of Norwegians have sleep problems due to noise. The 'noise annoyance index' developed by Statistics Norway indicates that as much as 73 per cent of noise annoyances is caused by road traffic. Industry accounts for 14 per cent and railways for 4 per cent.

(8) *International cooperation* on environmental challenges must be strengthened in order to gain more control over international and cross-border environmental problems. Such cooperation would also help to mitigate foreign sources causing environmental damage in Norway. The *polar areas* are coming under growing pressure from human activities such as tourism, mining and pollution. For example, concentrations of environmentally hazardous PCBs in polar bears in Svalbard (Spitsbergen) have been found to be up to six times higher than concentrations of PCBs in polar bears in Canada. Norway controls areas in both the Arctic and the Antarctic. In recent years, Norwegian authorities have given higher priority to management of the natural environment in Norway's arctic territories.

3.3.1 The series of bi-annual White Papers on the State of the Environment

The series of bi-annual[15] White Papers on "The Government's Environmental policy and the State of the Environment" (referred to as ***a*** in figure 1) is the main publication and in many ways the cornerstone of NEMS. The series contains systematic reports on trends in the eight environmental priority areas referred to above and it presents the main elements in Norway's environmental policy. The ambitions are substantial. As stated in White Paper 8 (1999-2000: 9): "Just as the State Budget describes the framework for the Government's economic policy and economic trends, this White Paper is intended to describe the Government's ecological policy and environmental trends. The White Paper

[15] The original intention was to publish annual reports, but the Parliament asked the Ministry of the Environment to prepare only bi-annual reports.

will therefore be submitted at the same time as the State Budget is presented [authors' translation]".

Three bi-annual White Papers – "State of the Environment" – have so far been published. A fairly strict framework to systematize the reports has been established. The reports begin with a short introduction describing the environmental policy and its main principles, and then present the government's main priority areas and specific cross-sectoral efforts. The main body of the report, however, describes the environmental policies and the state of the environment pertaining to the eight priority areas referred to above. Each priority area is structured in the same way: it contains a presentation of the goals and targets of the specific area, the state of the environment, goals achieved, and the policy instruments and initiatives in use. The goals are divided into two levels: strategic objectives and operational national targets.

The *strategic objectives* are the government's superior goals for each of the eight policy priority areas. The strategic objectives express a political ambition on reaching or maintaining an environmental quality within a reasonable time frame. There is usually only one strategic objective for each priority area. An example is the strategic objective for depletion of the ozon layer: "All production and use of ozone-depleting substances is to be eliminated" (White Paper 8 (1999-2000)). The strategic objectives are then concretized as *operational national targets* expressing results that will be achieved within a shorter time frame. The targets are intended to reflect the main environmental problems and challenges within each result area and should, as long as there is sound scientific basis for it, be verifiable and related to specified time limits for fulfilling the targets set. Let us again illustrate with an example from the depletion of the ozon layer: "1) The consumption of halons, all types of chlorofluorocarbons (CFCs), tetrachloromethane, methyl chloroform and hydrobromofluorocarbons (HBFCs) shall be eliminated. 2) Consumption of methyl bromide shall be stabilized in 1995 and phased out by 2005. 3) Consumption of hydrochlorofluorocarbons (HCFCs) shall be stabilized in 1995 and phased out by 2015" (ibid). The operational targets are further the basis for *sectoral working targets* enabling the formulation of sectoral Environmental Action Plans from each Ministry.

3.3.2 Sectoral Environmental Action Plans (SEAP)

The sectoral Environmental Action Plans (***b*** in Figure 1) are an important part of the government's environmental politics to ensure coherence and to promote environmental policy integration. Each ministry is responsible for presenting a sectoral plan that covers the administrative domain of the ministry and sectoral areas of responsibility. Plans must present the environmental impact of the sector, the driving forces behind the impact, the sectoral environmental goals, and instruments and efforts to be used to deal with the identified challenges. The design and reasoning of the Pressure-State-Response (PSR) is very much influenced by the Drivers Pressures, State, Impact, and Response – DPSIR framework – developed by the European Environment Agency (EEA).[16]

Multiple sectors often contribute to the same environmental problems. Thus the idea behind the Sectoral Environmental Action Plan is to illuminate the sectoral

[16] The PSR model was developed by the OECD and is a simplified version of the DPSIR model proposed by the European Environment Agency (EEA). For further details see: http://glossary.eea.eu.int/EEAGlossary/D/DPSIR

responsibilities related to the eight priority areas and how each sector will contribute to solve environmental challenges. Further, as stated in White Paper 58 of 1996-97, the action plans may show how each ministry can contribute to fulfilling the government's overall environmental policy towards sustainable development. It is decided by the Norwegian Parliament – in accordance with White Paper 8 of 1998-99 – that the sectoral action plans must be updated every four years. Each ministry has, however, only published one SEAP. Statskonsult[17] (2003) has evaluated the plans, and a decision on how to proceed with the SEAPs is pending in the MoE.

In general the Environmental Action Plans are divided into three sections: An introductory section presents a summary of the ministry's main environmental challenges, responsibilities and responses, and an overview of the government's environmental policy. The second section is a status report presenting the environmental issues especially relevant for the particular ministry/sector. The third section contains a presentation of the eight policy priority areas. In this section, strategic objectives and operational national targets are referred to and the ministries are asked to specify the particular sectoral challenges and responses in each priority area. The Environmental Action Plans published by all Ministries must follow the framework and references included in MoE's bi-annual White Paper 'State of the environment'.

3.3.3 Reporting and documentation of environmental results

NEMS is dependent on a well-functioning system for reporting and documenting results of environmental policy implementation in each sector. White Paper 58 (1996-97:15) states that:

> The Government will further develop a national result monitoring system [RDS] for implemented environmental measures, environmental impacts, and the state of the environment. This will provide the necessary basis for being able to control development in a sustainable direction, for instance by making it possible to see the aggregate environmental impact of the activity within various sectors in an overall context. (author's translation)

This was further specified in White Paper 8 of 1998-99, the first 'State of the Environment Report', and the State Pollution Control Board (SFT) was asked by the MoE to develop a system with key indicators. This system became the Result and Documentation System (RDS). However, for NEMS to function efficiently, the various sectors and particular ministries must submit actual results of the implementation of sectoral Environmental Action Plans in accordance with the eight policy priority areas (see Text Box 1 above). This remains a challenge.

3.3.3.1 The Result and Documentation System (RDS)

The goal of the *RDS* (***c*** in Figure 1) is to assemble environmental data which can be measured, calculated and registered in order to follow up the government's environmental policy. The *RDS* is a web-based documentation system developed and administered by the Norwegian Pollution Control Authorities (SFT)[18], and is primarily based on statistics and

[17] Statskonsult is a state-owned limited company that deals with public management development. For more information visit: www.statskonsult.no (Accessed Sept 15, 2004)
[18] http://www.sft.no/english/ (Accessed Sept 8, 2004)

information from SFT, the Statistics Norway (SSB)[19] and other environmental public policy agencies in Norway[20]. Most data is updated annually, but some of it will be updated continuously. Reports will be delivered to the MoE annually. It is, however, possible for the environmental agencies and the MoE to assemble a wide variety of data for specific purposes whenever needed.

As of April 2004[21] SFT was developing a prototype including data from the main environmental public policy agencies. Based on a Pressure-State-Response-model,[22] the RDS will consist of descriptions of:

- the state of the environment relative to given environmental goals and key figures;
- the government's use of policy instruments to meet environmental goals
- response of the environment and change of conduct in the sectors as a response to the use of policy instruments

According to the plan and design, the RDS will contribute to strengthening environmental public policy making by the government and in the sectors. Consequently, a well-functioning RDS may facilitate both VEPI and HEPI as data assembled in RDS will provide new possibilities for documentation and evaluation of environmental policy. Data from the RDS will be provided to the bi-annual State of the Environment report, the environmental and sectoral authorities and to the web site www.environment.no (a simplified and popularized version of the RDS). The web site is an information source on the state of the environment and the government's environmental policy – systematized around the eight priority areas of NEMS.

3.3.3.2 Sectoral Reporting – still a missing link

A crucial element of NEMS is *sectoral reporting* (***c*** in Figure 1 above) of results from the ministries' implementation of their sectoral action plans. Sectoral reporting, a responsibility of individual ministries, *was* supposed to be done annually, not only to facilitate internal follow up of the ministries' policy implementation, but also to enable the functioning of the RDS in accordance with established routines, formats and standards. However, as of September 2004 no ministry had yet initiated this task. A clarification from the MoE on the RDS, and on the NEMS in particular, will be needed to fulfill the objectives stated in Whitepaper 58 (1996-97) and specified in the first State of the Environment Report. But this clarification is still pending in the MoE. The fourth State of the Environment Report to be published in 2005 might give the governments position on how to proceed on sectoral reporting.

3.3.4 Cross sectoral analysis

Partly based on the information from RDS, cross sectoral analyses are expected to give important feedback to NEMS. Such analyses are intended to form the basis for cross-sectoral applications of policy instruments. ProSus is, however, only aware of one cross

[19] http://www.ssb.no/english/ (Accessed Sept 8, 2004)
[20] For the full list of contributors to the RDS please consult: http://www.environment.no/templates/TopPage.aspx?id=3142#B . (Accessed Sept 10, 2003)
[21] The project started in 1998 after the proposal in White Paper 58 (1996-97).
[22] For further details see footnote 16.

sectoral analysis completed so far. The Norwegian Pollution Control Authority completed in 2000 a cross sectoral cost analysis of Norwegian measures to abate climate change. The 2000 analysis was revised in 2002. Norwegian policy is currently based on the calculation that the cost of fulfilling Norway's Kyoto obligations is NOK350 per tonne CO2 equivalents. With a quota price lower than NOK350, it would be more cost effective to make use of the Kyoto mechanisms. The extent to which this will be cost effective will depend on the international quota price. For example, at a quota price of NOK150, Norway can fulfil 60 per cent of its Kyoto obligation cost effectively through national action.

3.4 The current status of public environmental governance in Norway

A full assessment of NEMS has not been conducted, primarily because parts of the system – particularly the sectoral reporting by each ministry – have not yet been implemented. The Sectoral Environmental Action Plans, however, have been evaluated by Statskonsult.[23] Statskonsult states that all ministries have issued a first generation Environmental Action Plan,[24] and a summary of each plan has been presented in the State of the Environment reports. Nevertheless, Statskonsult (2003) concludes as follows:

- The Sectoral Environmental Action Plans vary significantly in scope and content.
- The plans are not very concrete or demanding
- The plans have only to a limited degree functioned as steering documents in the ministries
- The composition of the plans has varied regarding the degree of political involvement and priority in each ministry
- Work based on the plans has to date had little effect on the environment

Twelve of the fifteen action plans are written in accordance with the NEMS structure and with explicit reference to the eight priority areas. However, only two ministries have developed sector-specific objectives in accordance with the eight priority areas. And only in one case did a ministry actually present a total overview of policy instruments related to the priority areas. Most interesting is Statskonsult's conclusion that none of the ministries explicitly present inter-ministerial collaborative environmental initiatives. The evaluation confirms that several of the sectoral ministries do collaborate with the Ministry of Environment. However, no collaboration with *other* ministries on environmentally related challenges is documented. Finally, in none of the sectoral Environmental Action Plans are cost estimates specified for particular environmental initiatives or projects.

Apparently there are a lot of challenges to be resolved with respect to the sectoral Environmental Action Plans and with respect to NEMS in general. According to representatives from MoE, however, one additional effort is referred to as a valid indication of proper environmental governance: Environmental Assessments.

[23] Statskonult (The Directorate for Communication and Public Management): http://www.statskonsult.no/info/english.htm (Accessed Sept. 18, 2003)
[24] The Ministry of Health and the Ministry of Social Affairs have together submitted a plan,The Ministry of Foreign Affairs has not made their plan public, but a copy can be obtained by contacting the Ministry.

Environmental Assessments

Agenda 21, particularly chapter 8, recommends the use of two types of environmental assessment in national policy: Environmental Impact Assessment (EIA) concerns the environmental impact of specific projects while Strategic Environmental Assessment (SEA) concerns environmental consequences of policies, plans and programme initiatives. EIA and SEA could easily have been incorporated in NEMS, but they were not. However, EIA was at least incorporated in the Planning and Building Act in 1990 and regulations regarding EIA were strengthened in 1996 as a result of an EU directive on EIA (Hovden and Torjussen 2002).

Despite the fact that an expansion of traditional EIA principles to policy related issues may be somewhat problematic, Norway has also taken steps towards implementing SEA. SEA is perceived worldwide as an important tool for achieving sustainable development (Husby 1997). However, SEA requires that significant effects of all proposals submitted to the cabinet and the parliament must be assessed by the ministry responsible for the proposal and the MoE must be consulted in the process (Husby 1997:17-19). In 2000 the Administrative Order of 1994 was replaced by a new order, but significant room was left for interpretation regarding which policies and projects should be subject to assessment (Torjussen 2002).

3.5 Summary of the Norwegian environmental policy trajectory

The environmental policy trajectory presented above has provided a brief understanding of changes in Norwegian environmental policy governance. The principle of sector responsibility was institutionalized in 1997 as part of NEMS. This is a unique and innovative policy effort to enable policy coordination and integration across different sectoral interests and responsibilities. The NEMS cannot however be characterized as fully operational. Three bi-annual State of the Environment reports have been produced and presented to the Parliament, all ministries have published their Environmental Action Plans (SEAP), and the Pollution Control Board has developed a prototype for a Result and Documentation System. Nevertheless, sectoral reporting on the status of efforts implemented in accordance with the eight policy priority areas has not been completed. Further, the first generation SEAPs – supposed to be updated every four years – were as of September 2004 not commenced. The SEAPs have been evaluated by Statskonsult, but while MoE is considering how to proceed, few actions have been taken. There are also challenges related to the cross sectoral analysis. To our knowledge only one such analysis has been completed (on climate change), perhaps because the task is more complicated than expected.

Besides the challenges associated with policy efforts promoting a NEMS, there are other policy challenges. Concerning the proposed benchmarks on HEPI and VEPI, it is questionable whether current public procedures of environmental assessment are strategic in nature. We question whether SEAs include explicit alternatives to proposed projects or policies. Rather, the assessments seem to be limited to a technical screening of already chosen alternatives. If this is the case concerning environmental politics alone, SEAs relevance for Norwegian sustainable development policy may be questioned. Does the National Action Plan for Sustainable Development – NA21 – makes a difference?

4 THE NATIONAL ACTION PLAN FOR SUSTAINABLE DEVELOPMENT – NA21[25]

As part of the State Budget for 2004 (White Paper 1 (2003-2004) chapter 6), the government proposed a national *Action Plan* for sustainable development – NA21. The Ministry of Finance is given the responsibility for NA21. NA21 is following up on the Rio Summit on Sustainable Development in 1992, the Johannesburg Summit on Sustainable Development in 2002, the Nordic Strategy for Sustainable Development from 2001 and other international obligations. Agenda 21 from the Rio Summit encourages all nations to develop strategies and action plans for sustainable development (UN 1993: Ch 8.7). The Norwegian Government states that work on NA21 draws from the experience of other countries where such plans have already been produced (White Paper 1 2003-2004: Ch 6.1). Further it states that it:

> …is important that the initiatives on Sustainable Development are closely connected to the main political and economical documents… and;
>
> …to avoid that the work on Sustainable Development and environmental policies leads their own lives side by side these [budget etc] political processes. (Author's translation)

As part of mapping the environmental policy trajectory of Norway, we want to determine if statement is valid. One would expect NA21 to draw on and be in accordance with NEMS. So, to what extent are the efforts formulated in NA21 connected to ongoing political processes of public environmental governance?

4.1 The content of NA21

NA21 briefly discusses the concept "sustainable development", draws up the lines from the Brundtland Commission via the Rio and Johannesburg summits and recalls important documents such as the Rio Declaration, the Climate Convention, the Convention on Bio-diversity, the UN Millennium Development Goals[26] and the Plan of Implementation from Johannesburg. NA21 recalls that the discussion on sustainable development is based on the three pillars of economic, social and environmental issues.

NA21 emphasizes the need to keep the carrying capacity of the earth in mind, and the need for de-coupling economic growth from environmental protection. Global trends and challenges are presented for a variety of issues such as global trade barriers and reindeer farming in Norway. The action plan also presents several principles that are intended to influence political actions. Explicit references are made to the precautionary principle and "polluter pays" principles and to eco-system thinking and the carrying capacity of Earth.

Inspired by ongoing work in OECD, EU and the Nordic Council of Ministers, indicators are proposed in selected issue areas (developmental aid; GHG emissions and trans-boundary pollutants; biological diversity and sustainable economic development). It

[25] As of April 2004, an English version of the complete action plan is available on the following url: http://odin.dep.no/archive/finvedlegg/01/39/nat_a060.pdf

[26] For further information please consult http://www.un.org/millenniumgoals/ (accessed Nov 12, 2003)

is emphasized, however, that these are preliminary and that an indicator committee or expert group should be established during the fall of 2003. An annual indicator report is proposed, and it will be a central part of a proposed information strategy for NA21 (White Paper 1 2003-2004: Ch 6.6.5). The five-member-strong expert committee was appointed by the Ministry of Finance in December 2004 with the mandate of proposing indicators to strengthen sustainable development. This work is scheduled to be finished when a White Paper is published (scheduled for the end of 2004).

4.1.1 The national policy for sustainable development

Section 6.5 of the action plan deals more explicitly with the policy for sustainable development. The Government has chosen to focus on seven main policy areas. Actions within each area are being proposed. Examples of initiatives in each main policy area, with emphasis on environmental policy priorities, are presented below.

Text box 2: Main policy areas presented in NA21

1. International cooperation for sustainable development and reduction of poverty
2. Climate, Ozone and Long-range Transboundary Air Pollution
3. Biological Diversity and Cultural Heritage
4. Natural resources
5. Health and Hazardous Chemicals
6. Sustainable Economic Development
7. Sami (Nordic indigenous people) perspectives on environmental and resource allocation

Area 1, *International cooperation for sustainable development and reduction of poverty,* is mainly concerned with issues related to poverty reduction and developmental aid. But it is also concerned with international and regional cooperation on environmental and sustainable development issues. The government assures that it will promote and strengthen environmental aspects in international trade regulations, and promote equality between the WTO free trade agreements and multilateral environmental agreements. The government has tasked the Minister of Environment, Børge Brende, who will serve as chairman of the Commission on Sustainable Development (CSD) during 2003 and 2004, with promoting the environmental pillar of sustainable development.

The government's main goal concerning climate under Area 2, *Climate, Ozone and Long-range Transboundary Air Pollution,* is to take national and international responsibility for working on global climate issues. Concerning ozone, the government's main goal is to stop all emissions of ozone-depleting substances (ODS) in Norway. The government guarantees that it will meet its obligations under the Montreal Protocol[27] and EU regulations of 2002[28], and to continuing its work to assure that the phasing out of ODS does not result in increased use of potent GHGs like hydrofluorocarbons (HFCs). Later in section three of this report we will discuss the case of Shecco Technology. It is an example of Norwegian efforts to promote environmentally sound innovation reducing use of HFCs.

[27] "The Montreal Protocol on Substances that Deplete the Ozone Layer", agreed on September 16, 1987 at the Headquarters of the International Civil Aviation Organization in Montreal. Available at: http://www.unep.org/ozone/montreal.shtml (Accessed Nov 14th 2003).
[28] Regulation (EC) No 2037/2000 of the European Parliament and of the Council on Substances that Deplete the Ozone Layer, June 29, 2000. Available at: http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/l_244/l_24420000929en00010024.pdf (Accessed Nov 14th 2003).

Biological Diversity and Cultural Heritage are heavily emphasized. The government aims to eliminate the loss of biological diversity in Norway by 2010. An extensive White Paper entitled "Biological Diversity – Sector Responsibility and Coordination" (White Paper 42 2000-2001) has been published, and biological diversity and forest protection have been high on the political agenda. Area 4, *Natural Resources,* is central in the Norwegian context, due to the natural resources and especially the large petroleum reserves on the Norwegian continental shelf. The government's main goal in policy Area 5 of NA21 is to assure that emissions and the use of *hazardous chemicals* do not lead to damage to either human health or nature's reproductive capacity.

Area 6, sustainable economic development, is concerned with issues such as social welfare initiatives, education and R&D. Interestingly however, in a MONIT context, are the proposals on research for sustainable development through the Research Council of Norway and the reference to the Government Plan for a Comprehensive Innovation Policy[29] (HIP), which was presented a few weeks after NA21. The government claims that HIP is consistent with NA21 and that innovations' significance for the environment, health and development is one of many causes for developing a more a coherent innovation policy. We will return to this in Part 2. Next we will focus on environmental policy and whether NA21 contributes to strengthening the management of Norwegian environmental policy.

4.2 Does NA21 contribute to a strengthened management of Norwegian environmental policy

The proposed policy for sustainable development touches upon many challenges, but does it promote coherence in Norwegian environmental policy? From a MONIT perspective, the following passage on page 22 in NA21 is of interest: "the work on sustainable development requires that economic, social and environmental considerations related to each other. This requires an integration of decision-making at several political levels". The government emphasizes that NA21 will be followed-up in various ministry White Papers. For the environmental aspect of sustainable development we assume that this at least is related to the bi-annual State of the Environment reports. However, only indicators on climate change/transboundary air pollution and biological diversity are included in NA21. Therefore, what is the relationship of NA21 to NEMS?

It is interesting to note that the seven main policy areas in NA21 do not fully correspond to the eight environmental priority areas in the NEMS documents. One reason for this is that sustainable development encompasses not only environmental issues but also social and economic issues. However, it is interesting to note that there are no references to the relationship between the benchmarks included in NA21 (Box 2) and benchmarks in NEMS (Box 1) which were presented in the previous chapter.

Apparently, there are difficulties in coordinating efforts by the MoE under NEMS, with efforts by the Ministry of Finance under NA21. Throughout the 1990s Norwegian authorities established a number of inter-ministerial committees and groups to address sustainable development issues. Some of these groups have been ad hoc, reporting on

[29] In Norwegian termed "Fra idè til verdi. Regjeringens plan for en helhetlig innovasjonspolitikk" (HIP) (MoTI 2003)

single issues such as environmental taxes, climate policy, environmental instruments, biodiversity and sustainable consumption (Hovden and Torjussen 2002). An official Norwegian Report (NOU 4 1995) from 1995 showed that the inter-ministerial committees and groups had been successful in reducing conflicts and laying a foundation for inter-ministerial cooperation. However, Hovden and Torjussen (2002:25) point out that cooperation depends in part on the ministries' willingness to prioritize environmental interests over sectoral interests, and that this is due to the fact that the Ministry of Environment does not exercise ultimate power on environmental issues and is therefore forced to negotiate objectives and strategies with other ministries.

The National Action Plan for Sustainable Development proposes that the Ad Hoc Inter-ministerial Steering Committee, consisting of deputy ministers, be converted into a permanent committee. This would be a welcome development, but it remains to be seen how (if formed) a permanent committee would affect institutionalized practices concerning governing of NEMS.

In accordance with the proposals made in White Paper 58 (1996-97) and specified in the first 'State of the Environment' report in 1999-2000, a list of major environmental challenges was formulated in accordance with the eight environmental priority areas. The evaluation conducted by Statskonsult (2003) confirms that all ministries have formulated a sectoral Environmental Action Plan. However, regarding consistent and regular implementation of both EIA and SEA, the picture is less promising. This is confirmed regarding timetables and quantitative indicator-based targets stipulated in the sectoral Environmental Action Plans. The question is: Does this also influence coherence with public innovation policies? This has relevance for the integration of environmental concerns into innovation policy – the subject of the next chapter.

PART 2

Coherence of environmental and innovation policies in Norway – a presentation of current efforts promoted by the Ministry of the Environment and the Ministry of Trade and Industry

5 THE DEGREE OF ENVIRONMENTAL POLICY INTEGRATION IN PROMOTING GREEN INNOVATIONS

The environmental policy system has been presented with reference to the National Environmental Monitoring System (NEMS). This has been complemented with a presentation of the National Action Plan for Sustainable Development (NA21). We have documented that efforts promoted by each ministry are in accordance with the principles of sectoral responsibility. However, the national environmental governance that could be strengthened by NEMS still has significant potential for improvement.

In NA21 references are made to the government's plan for a comprehensive innovation policy (HIP). The government claims that HIP will be consistent with NA21. Further, it is stated in NA21 that innovation's significance for the environment is one reason for developing a more coherent innovation policy. We take this at face value and proceed below with a presentation of the actual coordinated efforts between environmental and innovation policy with reference to environmental policy integration and the benchmarks related to horizontal integration (HEPI) and vertical integration (VEPI) presented in chapter 2. As illustrated in Figure 2 below, chapter 6 on the horizontal dimension will elaborate further on relevant White Papers in which references to governance for green innovation could be found. We start by reviewing documents on environmental policy, then review the latest efforts on sustainable development, and finally review the comprehensive innovation policy plan (HIP). In particular we elaborate on documents referred to in the previous environmental policy section in this report, by analyzing the content of White Paper 48 of 1988-89, White Paper 58 of 1996-97 and the three bi-annual 'State of the Environment Reports'. Do the environmental policy documents have references to green innovation? We will also analyze the content of NA21, and will conclude by discussing the status of green innovation efforts within Norwegian sustainable development politics.

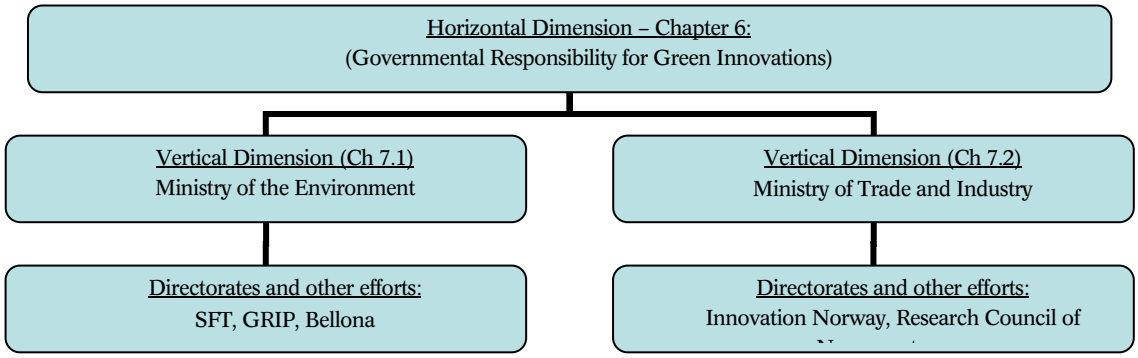

Figure 3: The vertical dimensions of MoE and MoTI.

A study of the horizontal dimension, however, would be incomplete without a detailed description of innovation policy efforts. Consequently, we describe the government's plan for a comprehensive innovation policy (HIP). Our aim is to identify policy efforts to promote green innovations. Finally, we discuss to what extent a environmental and innovation policies are integrated horizontally to promote green innovation.

Then in chapter 7 we will, in accordance with the project description, study the efforts of the Ministry of Environment and the Ministry of Trade and Industry to promote green innovation within their sectors. Explicit references are made to their Environmental Action Plans, the environmental profile of the State Budget and MoE's and MoTI's directorates and other subsector activities.

6 ENVIRONMENTAL AND INNOVATION POLICY: THE HORIZONTAL DIMENSION

White Papers 46 (1988-89) and 58 (1996-97) are, along with recent bi annual "State of the Environment" reports, the most important and influential environmental policy documents. They are the cornerstones of Norwegian environmental policy. Prime Minister Gro Harlem Brundtland,[30] former head of the World Commission for Sustainable Development (WCED), had significant influence in the drafting of the two White Papers. In general, White Paper 46 is more pro-active than White Paper 58 regarding how public actors should be involved in promoting trade, industry and environmental responsibility (Ruud 2002). In this report, however, we will study how the two White Papers can be related to green innovations. This chapter will focus on current innovation policy documents and particularly on the government's plan for comprehensive innovation policy – HIP. We search environmental, sustainable development and innovation policy documents, for references to the actual interface of environmental and innovation policy. This is done to answer the following question: To what extent is it possible to document public policy efforts to promote green innovations?

6.1 White Paper 46 (1988-89) "Environment and Development. Norway's follow up of the World Commission's Report"

In the first section of the White Paper reference is made to "…a national goal for environmental technology…":

> "The Government is committed to an initiative for the development of environmental technology. By this initiative it is possible to combine the need to solve our own environmental problems and the possibilities of developing new products and markets for Norwegian business and industry."[31] (White Paper 46 (1988-89): Ch 5.6.1 "National Goals and Actions to solve the main challenges")

This message is further emphasized in the second section of the White Paper (Ch 10.4 and 10.5), which refers to policy instruments promoting 1) changes in product 2) changes in processing technologies 3) end-of-pipe-oriented pollution control. The main policy instrument for these three strategies is the development of environmental technology. Research and cooperation between industry and the authorities must be improved. The government explicitly stated that the transition from research and development to diffusion and the *widely adopted use of environmental technology has proved to be difficult and that this problem will be addressed* (White Paper 46 (1988-89): Ch 10.5).

According to the White Paper, the development of environmental technology will be stimulated by state development contracts. It is further emphasized that to monitor the

[30] Gro Harlem Brundtland headed three Norwegian governments: from Feb 4th 1981 – Oct 14th 1981, from May 9th 1986 – Oct 16th 1989 and from Nov 3rd 1990 – Oct 25th 1996.

[31] Authors' translation. Original text: "Regjeringen går inn for en større satsing på utvikling av miljøteknologi. Gjennom en slik satsing kan en kombinere behovene for løsninger på våre egne miljøproblemer med muligheten til å omsette nye produkter og vinne nye markeder for norsk næringsliv"

development of environmental technology it is necessary to coordinate instruments being utilized *and* to develop new policy instruments for that purpose. Chapter 10.5.1 emphasizes that *strengthening of policy coordination in this field will be considered* to monitor research on environmental technology and coordinate use of existing and new policy instruments for industrializing and utilizing new technologies. Finally, the White Paper states that government procurement policies should favor environmentally sound products. As proposed in Whiter Paper 46 (1988-89), the government launched a national campaign promoting cleaner production. The development of environmental technology was given high priority and special programmes were supported by the Ministry of Environment and Ministry of Industry and Energy. At the same time two comprehensive R&D programmes were organized and funded by the Research Council of Norway. The objective of the programmes was to strengthen the competitiveness of Norwegian companies by increasing productivity, reducing environmental impacts, developing environmental technology and improving management

The national campaign for cleaner production technologies was funded by 50 million NOK annually between 1991 and 1995. Demonstration projects were launched in several companies, with the goal of implementing cleaner production strategies at plant level.[32] The environmental improvements which resulted from these projects were disseminated to other companies. Finally, strengthened efforts were made to promote technical environmental assessments of pollution-intensive industries – with the aim of both documenting existing emissions, and, more importantly, pursuing cleaner production. Assessments of about 300 companies were conducted.[33]

In 1995 a survey of 224 firms which had been offered technical environmental assessment schemes, was undertaken to identify the results and lessons learned from the cleaner production campaign (Aasen and Onsager 1995). Respondents generally said that[34] the assessments benefited them economically through lower expenditure due to reduced and/or more efficient use of production input and that emissions were lowered because wastes were reduced. About 39 percent of the firms which had been offered technical environmental assessment schemes reduced their discharges of pollutants into water by more than 20 percent. These firms reduced both waste from production and hazardous waste. Ten per cent of the surveyed firms reduced waste and discharges by more than 50 percent. Only 9 per cent stated that the assessments had not led to improvement of the environment. Despite the promising results the assessment schemes promoting industrial environmental improvements (that also could trigger green innovations) were discontinued.

The focus on environmental technology and greening of industry in White Paper 46 (1988-89) was significant. It was therefore expected that White Paper 58 (1996-97), aimed at establishing a sustainable development policy in Norway, would include policy initiatives on green innovations.

[32] According to Uno Abrahamsen, at the State Pollution Control Board, such demonstration projects included recovery of sulphur at Statoil's Slagentangen oil refinery and strengthened control of nitrogen emissions at Norsk Hydro's Glomfjord fertilizer plant.
[33] ibid
[34] The response rate was remarkably high as 216 out of 224 firms returned the questionnaire.

6.2 White Paper 58 (1996-97): "Environmental Policy for Sustainable Development"

The promised White Paper on Sustainable Development (SD) policy – announced in the cleaner production campaign – did not become the policy document on SD that many expected. It turned out to be limited to an environmental policy for SD. Once again the Norwegian Government postponed the commitments it had made in accordance with chapter 8 of Agenda 21. While the focus on environmental technologies and the promotion of green innovations was quite explicit in White Paper 46, these issues were hardly mentioned in White Paper 58. Instead, White Paper 46 focused on such policy instruments as fiscal measures and voluntary agreements. Industry was *asked* to be more pro-active, and *encouraged* to extend the life time of their products and focus on the products lifecycle. However, no concrete measures were proposed by the government.

In Chapter 7.3, which deals with national climate policy, development of environmental technology is briefly mentioned. Special reference is made to a five-year research programme KLIMATEK initiated in 1997 by the Research Council of Norway. KLIMATEK was co-financed by the MoE, MoPE, and MoTI. Its objective was to test technologies which could reduce emissions of CO_2 and other GHGs. Further, in White Paper 58, development of environmental technologies is mentioned in relation to policy instruments for renewable energy production (Ch 7.3.2.3). The most concrete step is a 50 million NOK grant from the state budget of 1997 to develop bio-energy technology. Solar energy, heat pumps and wind energy are also briefly mentioned but not with reference to green innovative efforts. Emphasis was placed on facilitating use of renewable energy but very few concrete efforts were presented. The most concrete efforts concerned energy-saving schemes.

Despite promising results, in 1995 the government decided to discontinue the cleaner production campaign which it had launched with White Paper 46 (1988-89). White Paper 58 (1996-97) announced the establishment of an environmental fund ("Statens Miljøfond") to stimulate development of environmental technologies, but after the initial funding of NOK 250 million was spent, it also was discontinued. This was also the fate of targeted technology funds under the FUNN programme of the Research Council. SkatteFUNN later replaced FUNN, but SkatteFUNN is reflecting the objective of promoting fiscal neutrality in public policy implementation and does not have any targeted technology or environmental objectives.

In contrast to White Paper 46 (1988-89) no specific green innovation efforts are called for in White Paper 58 (1996-97). Consequently, except for prospects for tax deductions, the Government assumes that green innovations and cleaner production are to be promoted by industries themselves. Rather than motivating industry through special policy schemes to promote cleaner production, vague requests are chosen as the public policy option. Under policies recommended in White Paper 58, the greening of industry is to a large extent left to market forces; the associated risks are to be borne by the firms themselves.

6.3 The bi-annual 'State of the Environment' reports

Green innovations are hardly mentioned in the bi-annual White Papers on "The Governments Environmental Policy and the State of the Environment". The White Paper on "the State of the Environment", as mentioned above, is the main publication and in many ways the cornerstone of NEMS. As stated in White Paper 8 (1999-2000: 9): "Just as the State Budget describes the Government's economic policy and economic trends; this White Paper is intended to describe the Government's ecological policy and environmental trends. The White Paper will therefore be submitted at around the same time as the State budget is presented"[35]. Therefore, to some degree it overlaps and complements the Environmental Profile of the State Budget. However, while the Environmental Profile gives an overview of the financial resources allocated by each ministry to environmental purposes, the "State of the Environment report" systematically reports on actual emissions and their impact on the environment. In addition, it provides an overview of existing policies, describes central targets in the environmental policy, and gives valuable historical insight into the main priorities of the Ministry of Environment and the government's environmental policies at the time of the report's release.

In a MONIT perspective it is therefore interesting to note that none of the three "State of the Environment reports" produced so far mentions innovation or related topics in a systematic manner. Further, none of them lists innovation or technology development in the overviews of main priorities.

In the first two "State of the Environment" reports – White Paper 8 (1999-2000) and White Paper 24 (2000-2001) – innovation and technology development are only mentioned in relation to the KLIMATEK research program and the "Environmental fund" to reduce GHG emissions. Both initiatives are presented in detail below.

When MoE published the most recent "State of the Environment" report (White Paper 25 (2002-2003)) – in April 2003 – both the KLIMATEK program and the "Climate fund" had been terminated. The only references made to development of environmental technology are vague and related to increasing spending on research and development on "technology that reduces GHG emissions" and "environmentally friendly energy technology" (White Paper 25 (2002-2003): 101-103). Although not specifically mentioned in the document, the above probably concerns the "Renergi"[36] research programme at the Research Council of Norway. The Renergi programme has a budget of NOK 150 million[37] for 2004 and NOK 175 million[38] for 2005. Its main goal is "to develop knowledge and solutions as the basis for environment-friendly, efficient and effective management of the country's energy resources, security of supply and internationally competitive economic development related to the energy sector"[39]. The Renergi programme is indeed a major research program by Norwegian standards, and it might lead to innovation of green technologies. A number of ministries are contributing financially, including the MoE and

[35] Authors' translation. Original Norwegian text: "På lik linje med Nasjonalbudsjettet som viser Regjeringens opplegg for den økonomiske politikken og den økonomiske utviklingen, vil denne meldingen vise Regjeringens opplegg for den økologiske politikken og utviklingen i miljøet. Meldingen blir derfor lagt fram i nær tilknytning til framleggelsen av statsbudsjettet."
[36] Renergi is a short for 'ren energi'. The English equivalent is 'Cleanergy', a short for clean energy.
[37] Approximately EUR 17,65 million (exchange rate 8,5)
[38] Approximately EUR 20,6 million (exchange rate 8,5)
[39] More information at www.renergi.com (accessed May 24, 2004).

MoTI. The main contribution[40], however, comes from the Ministry of Petroleum and Energy.

6.4 The National Action Plan for Sustainable Development – NA21

The existence of a long term national strategy for sustainable development is the first benchmark on the proposed checklist for a horizontal environmental policy integration (HEPI) introduced by Lafferty and Hovden (2003). NA21 is a long term strategy, but it remains to be seen to what degree it will have influence on green innovations. It has been criticized for being even less concrete than already published policy documents like those referred to in the NEMS (ProSus 2003).

Development of environmental technologies is mentioned several times in NA21. Therefore, NA21, written by the Ministry of Finance, seems to place more emphasis on the issue than the State of the Environment reports and other administrative documents from the Ministry of Environment. However, it makes mention of only one specific instrument: "The government will (…) strengthen the basic research through the fund for research and innovation" (White Paper 1 (2003-2004): 195)[41]. This fund, established in 1999 to fulfill the four politically defined fields for research (marine research, information and communication technology, medicine and health and research on the intersection between energy and the environment) is managed by the Department of Research and Education and has capital of NOK 31,8 billion. (MoER, St.prp. nr. 1 2002-2003)[42]. One-third of the fund is channeled to the universities, and two-thirds of the fund is channeled through the Research Council of Norway. The fund has contributed to research on environmental issues. To be eligible for grants, research projects do not *necessarily* have to deal with either the environment or innovation. *Quality* is the main criterion for funding. The universities and the Research Council of Norway are free to manage the funding according to their own priorities. Thus, a goal of the fund is to strengthen long term basic research in general, particularly in the four politically prioritized research areas. It cannot be perceived as an instrument for achieving innovation or environmental policy goals per se.

Two more references to innovation are made in NA21. One is related to policy instruments for sustainable development (White Paper 1 (2003-2004): Ch 6.4.2). Under the section concerning Research and Development, increased use of "environmentally sound technology"[43] is mentioned as decisive to reducing the negative environmental impact(s) of economic development[44]. It is stated that Norway can be an important contributor to the development of environmentally sound technology and that a long-term policy and policy instruments are crucial to making business and industry invest in such technology. Economic instruments (unspecified) are highlighted as having the potential to give strong incentives to the development and commercialization of green technology.

[40] To the author's knowledge at least 80 %
[41] Information on the "Fund for Research and Innovation" is collected by Maria Gjølberg at ProSus.
[42] http://odin.dep.no/repub/03-04/pdf/ufd.pdf (Accessed March 18, 2004).
[43] In Norwegian: "Miljøvennlig teknologi".
[44] In Norwegian: "…Økt bruk av miljøvennlig teknologi (…) er avgjørende for å oppnå at sammenhengen mellom økonomisk utvikling og miljøbelastning reduseres." (White Paper 1 (2003-2004): 185)

The other reference to innovation in NA21 is in section 6.6.1 and regards the role of business and industry in sustainable production. Like White Paper 58, NA21 envisions the role of government as a passive one. NA21 states that the capacity of business and industry to innovate towards more sustainable production processes, and their willingness to assume social responsibility are decisive for achieving political goals. NA21 mentions that cooperation between business and industry and international organizations like World Business Council for Sustainable Development (WBCSD)[45], UN Global Compact[46] and ILO[47] is important. Business and industry is urged to increase the use of environmental management systems and to strengthen the focus on developing environmentally sound technology, eco-design, environmentally friendly products and industrial ecology, which – according to NA21 – will increase the possibilities for exporting green technologies and environmentally sound solutions. Thus the somewhat reactive and passive position that the government has taken towards business and industry since the release of White Paper 58 in 1996, has not been challenged with the release of NA21.

6.4.1 The status of green innovation efforts in Norwegian environmental politics for sustainable development

After studying the most relevant *environmental* policy documents and initiatives it is possible to conclude that there is a lack of focus on green innovations. The environmental fund and the KLIMATEK programmes is mentioned in White Papers 58 (1996-97) and in the first two "State of the Environment" reports – White Paper 8 (1999-2000) and White Paper 24 (2000-2001). However – as previously stated – both of these were discontinued in January 2004. Still, the National Action Plan for Sustainable Development (NA21) mentions innovation more often, and seems to be more concerned about the need for environmentally sound innovations and technologies than White Paper 58 (1996-97). NA21 does not, however, mention any concrete measures to promote such green innovations. Furthermore, the only policy instrument mentioned in the latest "State of the Environment Report" published in the spring of 2003 – the Renergi programme – is not referred to in NA21. But NA21 refers to the Plan for a Comprehensive Innovation Policy presented by Ministry of Trade and Industry a few weeks after NA21 was presented as part of the State Budget. It is stated that the comprehensive innovation policy plan will be consistent with the NA21 (White Paper 1 (2003-2004): Ch 6.5.6). Will this actually be followed up? In order to answer this question, we now turn to documents related to innovation policy which have been published by the Ministry of Trade and Industry (MoTI), "the Ministry of Innovation".

6.5 Recent governmental efforts to strengthen innovation policy in Norway

In the introduction to a recent parliamentary bill presented by the Ministry of Trade and Industry on "Policy instruments for an innovative and creative business and industry"

[45] http://www.wbcsd.ch (Accessed March 15, 2004)
[46] http://www.unglobalcompact.org (Accessed March 15, 2004)
[47] http://www.ilo.org/ (Accessed March 15, 2004)

(Parliamentary Bill 51 (2002-2003), sustainable development is referred to as one of four main goals in the government's economic policy. The other three goals are full employment, development of the welfare state and fair income distribution (Parliamentary Bill 51 (2002-2003): 5). The principal proposal in the bill is the establishment of "Innovation Norway"[48], a new public entity aimed at promoting increased innovation in firms all over the country. We will make a detailed presentation of Innovation Norway in chapter 7. In this section we will describe references to green innovation in the latest two general innovation policy documents published by the Ministry of Trade and Industry: Parliamentary Bill 51 (2002-2003) and the Government's Plan for a Comprehensive Innovation Policy, published in 2003.

6.5.1 Parliamentary Bill 51 (2002-2003) "Policy instruments for an innovative and creative business and industry"

According to Parliamentary Bill 51 (2002-2003) on "a creative and innovative business", the main goal of the innovation policy is *to contribute to increased innovation in business and industry in all parts of the country*. This implies that regional policy also will focus on innovation. With the exception of the introduction – as mentioned above – sustainable development is not mentioned in the parliamentary bill and there are few references to environmental matters, except for brief case studies of companies.

The cases of five "success" companies are thoroughly presented in text boxes in the bill. These companies were, according to the bill, launched with support from governmental institutions. Three of the five companies, Repant[49], ScanWafer ASA[50] and Energos ASA[51], have an environmental component in their business activities. Such a component was not, however, highlighted by or called for by MoTI in the parliamentary bill. Is this an indication that environmental issues are not considered important in innovation policies?

When the parliamentary bill was debated in the Standing Committee on Trade and Industry, development of environmental technologies was discussed (Innst St nr 283 (2002-2003): Ch 2.17). The Socialist Party (SV) proposed the establishment of a center to promote environmental technology (Dok nr 8: 93 (2002-2003)), but this was not supported by others, nor were alternatives proposed. Hence, it may appear that the Norwegian Parliament does not support, in its innovation policy, measures to promote green innovations. To get a more comprehensive picture of the situation, we thoroughly studied the latest innovation policy efforts presented by the government and the Government's Plan for a Comprehensive Innovation Policy. Our findings are presented in 6.5.2.

[48] Innovation Norway is a merger of four previously independent public entities: The Norwegian Tourist Board, The Norwegian Trade Council, The Norwegian Industrial and Development Fund (SND) and the Government Consultative Office for Inventors (SVO).
[49] Repant AS delivers Reverse Vending Machines (RVM) for beverage containers. The company is especially focusing on the emerging German market. More info at: http://www.repant.com/ (accessed March 16th 2004).
[50] ScanWafer ASA is a world-leading producer of multicrystalline silica wafers for the solar cell industry. More info at: http://www.scanwafer.com/index.php/4740 (Accessed march 16, 2004).
[51] Energos ASA has developed and is producing advanced small scale waste-to-energy plants. More info at http://www.energos.com/ (Accessed March 16, 2004).

6.5.2 From Idea to Value – the Government's Plan for a Comprehensive Innovation Policy[52]

The plan was launched in October 2003. In January 2004 an impressive innovation conference with 700 participants was held with great festivity. In preparatory work during the summer of 2002, the plan was discussed in the government's Research Committee[53], where amongst others the Ministry of the Environment was represented. Some 13-14 inter-ministerial groups were established and consulted. The official status of the document is "plan", a type of document without administrative status. It will therefore not be given further political democratic treatment, nor will it necessarily be followed up or assessed.

The government's ambitious vision for its Innovation Policy is that "Norway is to be one of the most innovative countries in the world". The Government has with the plan "embarked on the development of a comprehensive innovation policy", a "long term and wide-ranging task" and "the first steps of a long journey" (MoTI 2003: 5). The plan "will contribute to a more coordinated and targeted effort, across various policy and administrative areas" (ibid: 5). The plan is signed by the Ministers of Local Government and Regional Development, Education and Research, Agriculture, Petroleum and Energy and Trade and Industry.

The Minister of Environment, however, has not signed the plan. According to a MoTI representative[54], the Ministry of Environment (MoE) has been aware of the process from its start when it was discussed in the government and the government's Research Committee. However, it was not "considered necessary" that MoE participated. Further, it has not been a goal in itself to highlight certain issues or sectors in the plan. MoE has, however, had representatives on some of the interdepartmental committees working on the plan and has therefore had an opportunity to influence the process and the document.

It is evident that environmental matters have not been important in the plan. Environment is mentioned in only a few places in the plan. The following is one example: "there are numerous examples of stricter international environmental requirements promoting innovation within businesses that have to adapt to a changed regulatory framework" (MoTI 2003: 10). Besides this rather reactive reference, environment is mentioned briefly in relation to the EU Lisbon Strategy and the development of an "efficient, safe and environmentally friendly transport system" in Norway.

In conclusion, it would not be an exaggeration to state that the Plan for a Comprehensive Innovation Policy developed by the Ministry of Trade and Industry does not address environmental matters at all. Green innovations are not discussed and sustainable development is merely a rhetorical initial statement without further substantive follow-ups in terms of policy initiatives.

[52] The full English text of the plan is available at: http://www.odin.dep.no/archive/nhdvedlegg/01/10/fromi033.pdf (accessed March 15, 2004).
[53] Norwegian term: Regjeringens Forskningsutvalg (RFU)
[54] Telephone interview March 16, 2004.

6.6 Concluding remarks on horizontal policy integration for green innovations

Innovation is hardly mentioned in the most important *environmental* since White Paper 46 of 1988-89. The only policy instrument that is left is the Renergi research programme. But, environmental issues are hardly mentioned in the most important and recent *innovation* policy documents either. The Plan for a Comprehensive Innovation Policy (HIP) does not consider environmental issues at all. This is interesting, especially when recalling that the NA21 stated that the HIP will be consistent with the NA21. The two documents were written and published at the same time and by the same government. Despite this, they have nothing in common at the policy level. We interpret this as an evidence of only minor horizontal integration between environmental and innovation policies. It is reasonable to conclude after studying these documents that innovation, environmental technologies and goals related to these issues are not priorities of the government.

Using Lafferty's and Hovden's (2003) benchmarks, presented in section 2.3 as a reference, but modified to focus on green innovation, it is possible to summarize the horizontal dimension of environmental and innovation policies as follows:

1. The existence of a long term national development strategy on green innovations

A national action plan on sustainable development and a comprehensive plan on innovation are presented, but the plans are not related to each other. Consequently, there is no national development strategy for green innovations policy. However, inspired by the environmental technology action plan (ETAP) proposed by the EU Commission, MoE has asked the Pollution Control Board (SFT) to elaborate on the opportunities for developing an environmental innovation plan for Norway. For further details see the next chapter.

2. The existence of a central authority specifically entrusted with the supervision, coordination and implementation of green innovation policy

An expert group has been asked to develop national indicators to facilitate the realization of the objectives stated in NA21. Further, a committee with deputy ministers[55] follows up the innovation policy plan, but MoE is not represented on this committee. In general no efforts are being made to supervise, coordinate or implement a green innovation policy in Norway.

3. Central authority has clearly designated sectoral responsibility for achieving overarching goals on green innovations

Sectoral responsibility is designated in only a few cases. We will review specific studies of relevant ministries and directorates in the next chapter.

4. Timetables and targets for green innovation policy

Within the field of environmental policy, the NEMS has specified eight policy priority areas with strategic objectives and operational national targets. The objectives and targets are not, however, related to innovation policy. Without supervision, coordination and

[55] Norwegian term: "Regjeringens innovasjonsutvalg"

implementation, and without clearly designated sectoral responsibility from central authority, it is not surprising that there are neither timetables nor targets for the realization of a green innovation policy in Norway.

5. Periodic reporting of progress on goals at both the central and sectoral levels
Periodic progress reports were supposed to be part of the NEMS, but within the field of innovation no such reports are being made. Ministries – including the Ministry of Trade and Industry – have not reported on progress in the eight policy areas included in NEMS. Progress reports on innovation policy are also lacking. In short, periodic reporting does not exist.

6. Active and monitored use of assessments of all governmental policies
Regular environmental assessments are not used as a strategic tool in environmental politics. Alternative policy options are not considered. Rather the consequences of chosen policies are specified. Assessments remain technical, but even this is not considered with respect to green innovation policies.

In conclusion, horizontal coordination of environmental and innovation policies is virtually nonexistent. Consequently there is significant room for improvement. We will elaborate further on the horizontal coordination in the final section of this report. Next we will document if there are policy instruments in use within the MoE and MoTI aiming at promoting green innovations.

7 ENVIRONMENTAL AND INNOVATION POLICY: THE VERTICAL DIMENSION

While the previous chapter presented the horizontal dimension illustrated in figure 3, this chapter presents the vertically oriented initiatives and instruments of the Ministries of Environment and Trade and Industry. Taking each ministry's Environmental Action Plan and their respective Environmental Profiles in the State Budget as points of departure, the instruments and institutions of each sector which are most relevant to initiatives for green innovations are presented below.

The ministries' Environmental Action Plans are an important part of the National Environmental Monitoring System (NEMS). The environmental profile of the State Budget is an account of each sector's financial efforts on environmental issues. The efforts presented in this chapter are selected from each ministry's presentation of relevant institutions in the above-mentioned documents. Assuming that the ministries would not downplay their initiatives on environmental issues, this selection is considered to be fully representative. Still we remain focused on the interface between environment and innovation – the sector-specific efforts of promoting green innovation.

7.1 Ministry of Environment (MoE)

7.1.1 The Environmental Action Plan presented by MoE

The Ministry of Environment (MoE) is the coordinating body for environmental policy vis à vis the sectors and is responsible for the National Environmental Monitoring System (NEMS). The ministry's own Environmental Action Plan was issued in 2003, after the plans of all the other ministries had been issued. Because it is relatively new we consider it to give an accurate impression of current Environmental Action Plans and political environmental priorities.

The first section of the action plan gives a brief introduction to NEMS and defines the role of MoE. The second section gives a short introduction to MoE's reporting and information initiatives, e.g. the Result Documentation System (RDS). The third section gives a thorough presentation of the eight Policy Priority Areas and MoE's responsibility and policy instruments for all of them. This section is quite extensive because the Ministry is responsible for following up all the areas.

Innovation or development of environmental technology are, however, not mentioned in relation to the national targets, prioritized policy instruments or responsibilities of the MoE. In the section on climate change it is stated that the most important policy instrument of the MoE is the CO2-tax, which covers about 65 per cent of all CO2-emissions. A reference is also made to innovation and technical change. It is, however, clearly stated that the Ministry of Petroleum and Energy (MoPE) has the overall responsibility for budget allocations and development of energy technologies, including new renewable energies and natural gas power plants with CO_2 handling (MoE 2003: 23).

Most of the policy instruments mentioned in MoE's Environmental Action Plan are related to financial instruments, prohibitions and regulations. It is of course possible that taxes and emission control stimulates the development of more sound environmental technologies, but the Action Plan does not seem to anticipate such consequences. In short innovation is not mentioned. It is also worth noticing that the State Pollution Control Board and the Norwegian Foundation for Sustainable Production and Consumption (GRIP) is just briefly mentioned.

7.1.2 The Environmental Profile of the State Budget 2004

As referred to previously, all Ministries have to specify their budget allocations related to environmental matters. Not surprisingly, MoE's Parliamentary Bill on the State Budget mostly concerns environmental issues. The 174-page document extensively covers all financial allocations of the Ministry, their purpose and to some degree their expected outcome. It gives a good, up-to-date account of the amounts allocated and their destination. This said, the quantified measure "financial allocations" will never be sufficient to assess the actual effect of the allocations, but the Environmental Profile can be read as a correction and "verification" to policy statements made.

The impression of a lack of commitment to green innovation in the Environmental Action Plan of the Ministry of Environment is not altered when reading the Environmental Profile. Nevertheless, there are a few references to green innovation in the document. One of them is especially interesting: Bellona[56], one of Norway's most visible Environmental Non-Governmental Organizations (ENGO) has been granted resources to report on energy technology projects. Bellona does not, in contrast to other ENGOs, receive government funding due to government regulations prohibiting funding of organizations without dues-paying members[57]. But Bellona has previously received some funding from the Ministry of Foreign Affairs, Ministry of Petroleum and Energy and Ministry of Transport and Communication to specific projects, but never from the MoE. It is therefore interesting to note that MoE has allocated 900,000 NOK[58] to Bellona to "…contribute to increased knowledge about more environmentally friendly energy technology and environmental technology" for fiscal year 2004 (MoE Parliamentary Bill 1 (2003-2004): 113). The only prerequisite are that Bellona must apply the money to specific projects and that the organization must cooperate with relevant research units and industrial entities. The money is provided as a one time grant from an item for information on sustainable production and consumption. Bellona has applied several times for funding[59] and hope to receive similar funding in the future. As of mid-March 2004 Bellona had not decided how to use the funds.[60]

Apart from some funding for the development of water cleansing technology, the Bellona-grant is the most specific allocation related to green innovations in MoE's Environmental Profile. We will now consider two other actors that could be seen to have

[56] http://www.bellona.no/en/index.html (Accessed March 19, 2004)
[57] Bellona does not keep membership lists. It funds its activities from donations and partnerships with business and industry.
[58] Approximately 110,000 EUR (Exchange rate: 8,20).
[59] Telephone interview with Dag Hotvedt at Bellona on March 23, 2004.
[60] Telephone interview with Camilla Haugsten at Bellona on March 23, 2004.

innovation policy functions – GRIP and SFT. Both receive most of their funding from the MoE.

7.1.3 GRIP

GRIP – the Norwegian Foundation for Sustainable Production and Consumption[61] – was founded as an independent foundation in 1995 by Torbjørn Berntsen, Minister of the Environment in the Brundtland Government[62]. GRIP is only briefly mentioned in MoE's Environmental Action Plan and the Environmental Profile, but with 20 employees and an annual budget of NOK 33 million in 2002, it is an important initiative promoting a greening of trade and industry in Norway. GRIP works primarily with companies that do not pollute in a legal sense, but still have an impact on the environment through their means of transport, energy use, waste disposal and so forth. MoE is GRIP's main financial contributor, e.g. GRIP received approximately half of its income from MoE in 2002. Other big sources of funding are the Ministry of Local Government and Regional Development, which contributed NOK 6 million and Ministry of Petroleum and Energy,[63] which contributed almost NOK 3 million[64]. GRIP's own income, from seminars, courses etc totaled NOK 7 million in 2002. MoTI has *not* contributed funds to GRIP and GRIP is not part of MoTI's portfolio, but when sustainable or environmental production and consumption are discussed, MoTI frequently mentions GRIP as an example.

According to Sigve Aasebø of GRIP,[65] innovation is an underlying theme of GRIP's activities given the references to innovation in Agenda 21 Chapter 4, but GRIP does not currently have many specific activities directly aimed at innovation and the environment. Mr Aasebø stresses, however, that in their view all the businesses they are working with, are involved in product development and therefore, depending on how one defines innovation, are also indirectly involved in green innovation.

Noteworthy efforts by GRIP are its Glassbjørnen (Glass Bear) Award, and its (now terminated) EcoDesign and EcoBuild programmes. GRIP gives its Glassbjørnen Award annually. The award itself does probably not directly contribute to more green innovation, but the ceremony is a high-profile event in which the Minister of Environment and other prominent persons usually participate, and thereby gives much needed attention to green innovation. The Glassbjørnen award is given in five subcategories: innovation, eco-design, recycling, company of the year and price of honor. According to GRIP's web site, the innovation award is given for work which stimulates innovation of environmental technology and which contributes to disseminating information about the significance and possibilities related to development and implementation of new environmentally friendly solutions.

The EcoBuild programme, initiated by the building sector in 1998 and terminated in 2002, was a heavyweight initiative with a NOK 170 million budget administered by GRIP. The programme's goal was to increase eco-efficiency in the building and real estate

[61] For further details see: http://www.grip.no/ (Accessed May 28, 2004)
[62] According to GRIP's Annual Report of 2001.
[63] Provided through the Norwegian Water Resources and Energy Directorate (NVE) and Enova SF.
[64] According to Sigve Aasebø in a Telephone interview May 28, 2004, the financial support from Ministry of Local Government and Regional Development and Ministry of Petroleum and Energy in 2002, was mainly related to the EcoBuild programme.
[65] Telephone interview March 9, 2004.

industry. It was one of the first mainly environmentally oriented projects initiated by the building sector in Norway and was funded equally by the authorities and the building industry. The project was fairly highly profiled and members of its board of directors were key building industry executives.

The EcoDesign programme encouraged product developers and industrial designers to take environmental concerns into account during the design process. The programme arranged conferences and courses, stimulated debates and published eco-design guidelines and manuals. The programme's most significant contribution to innovation was to increase general awareness about eco-design, e.g. in the design schools. Although the EcoDesign programme was terminated in 2003[66], information it produced is still disseminated through courses arranged by GRIP and contact with design schools.

7.1.4 Norwegian Pollution Control Authority (SFT)

The Pollution Control Authority (SFT) is a directorate with a staff of 270 under the Ministry of Environment. According to Per Døvle[67] SFT is currently involved in only two efforts directly related to innovation: a database presenting best practices and lessons learned, and some preparatory work concerning a plan on environmental (technological) innovations commissioned by the MoE. It can of course be argued that SFT's current work, such as issuing emission permits and drafting environmental regulations, indirectly contributes to the development of green innovations and particularly environmental technologies and important end-of-pipe solutions. We will, however, highlight examples of previous SFT work related to green innovations.

According to Per Døvle of SFT[68], SFT's most important effort was its Program for Environmental Technology. During its existence (1990-1998) the program allocated approximately NOK 310 million[69] to business and industry. The program's aims were threefold: 1) to solve Norwegian environmental problems, 2) to achieve national environmental targets and 3) to stimulate Norwegian business and industry to develop environmental technology. About 60 per cent of the funds were used in a project the goal of which was to develop cleaner technology in Norwegian industry. The balance was offered as grants for the development of environmental technology in particularly pollution-intensive sectors and businesses. A special focus was placed on demonstration and pilot projects promoting radical technical and managerial innovations towards a greening of industry. Several processing industries such as pulp and paper benefited from this programme.

Currently SFT's engagement in green innovation is limited. The database on best practices and lessons learned[70] is small and based on voluntary reporting. It is not particularly utilized by either SFT or external stakeholders. Still, the database consists of

[66] The final report from the programme is available at: http://www.grip.no/okodesign/dokumenter/2004-02-06_okodesignsluttrapp.pdf (Accessed May 28, 2004)
[67] Telephone interview April 27, 2004.
[68] Telephone interview April 27, 2004.
[69] Equivalent to EUR 36,5 million (exchange rate: 8,5)
[70] http://www.sft.no/om_oss/godeeksempler/ Available in Norwegian only (Accessed April 28, 2004)

about 40 initiatives ranging from recycling of waste in a kindergarten to CO2 injection at the Utsira geological formation in the North Sea.

In January 2004 the EU Commission presented its Environmental Technologies Action Plan (ETAP), characterizing it as an effort to stimulate technologies for sustainable development.[71] SFT have during spring 2004 done preparatory work for MoE on a report on environmental technology. In a horizontal policy integration perspective it is interesting that this happened less than two months after the presentation of the HIP. In fact, the ongoing work on green technology and response and follow up of the EU ETAP was initialized in February 2004 at the same time as the HIP was launched in a big public event – an event where the Minister of Environment did not even participate. This shows an evident lack of coherence and integration of innovation and environmental policies. At the same time the preparatory work on environmental technology confirms that MoE sees green technology as part of its sectoral responsibility.

While the comprehensive innovation plan published by the MoTI leaves out environmental issues, and the MoE is not currently involved in efforts promoting innovations, it is promising that MoE is considering to publish an environmental technology action plan. According to ProSus' sources, however, MoE's efforts are a response to the EU ETAP rather than the Norwegian HIP and will therefore not necessarily be coordinated with the Ministry in charge of innovation policy, MoTI. But maybe the MoTI has its own vertical initiatives on green innovation?

7.2 Ministry of Trade and Industry (MoTI)

7.2.1 The Environmental Action Plan presented by MoTI[72]

To strengthen environmental policy integration within MoTI, the ministry, in response to a proposal included in White Paper 58 (1996-97), formulated an Environmental Action Plan for 2001-2005. It was introduced by the former minister of MoTI, Grete Knudsen, of the Labour Party. Her successor, Ansgar Gabrielsen of the Conservative Party has not made any efforts to revise this Environmental Action Plan. Consequently, we assume that it still reflects the political priorities of MoTI.

In its Environmental Action Plan for 2001-2005 MoTI presents its perception of the major features of Norwegian environmental policy priorities. It seems like MoTI's environmental focus has shifted from end-of-pipe solutions and clean-ups to prevention and changes in product and processing technologies. The plan presents changes in the regulatory framework. MoTI emphasizes that promising opportunities are created by voluntary agreements and self-regulatory efforts by individual firms and/or branch organizations.

The action plan emphasizes the need to develop regulatory measures that are both governing and cost-effective. Governing-efficiency means that actual achievements of environmental policy objectives are made with a high degree of certainty while cost-efficiency means that the expenses must be directed to areas with the highest degree of environmental gains. Also policy instruments outside the sectoral responsibility of MoTI

[71] More information at http://europa.eu.int/comm/environment/etap/ (Accessed May 4, 2004)
[72] This section is written with input from Maria Gjølberg at ProSus.

such as GRIP, the Eco-Lighthouse Program, Environmental Labeling ISO and EMAS. Despite the fact that this is an Environmental Action Plan from the "ministry of innovation", no efforts on green innovations are proposed or referred to.

7.2.2 The Environmental Profile of the State Budget 2004

In the chapter on the Environmental Profile in MoTI's Parliamentary Bill on the 2004 State Budget (MoTI Parliamentary Bill nr 1 (2003-2004)) it is stated that the government will:

> "… *motivate* business and industry to be one step ahead in the implementation of environmental efforts. This will contribute to a better environment, lay the groundwork for Norwegian industry to develop advantages in environmental technologies and strengthen the long term competitiveness in business and industry".

It is further stated that

> "products and services that contribute to solve environmental challenges can be an important part of business opportunities and open new markets (environmental technology and -services)". [Authors translation] (MoTI Parliamentary Bill nr 1 (2003-2004))

Three central aims of the Ministry's environmental policy are identified in this chapter:

- Contribute to a policy and resource use nationally and internationally that unite environmental considerations, trade policy and business considerations
- To contribute to the development and use of environmentally friendly technology, products and services
- To work actively in international organizations to reduce and prevent negative environmental impacts from shipping [Authors' translation]

However, very few specific initiatives for realizing these aims are presented in the chapter. Furthermore, it states that an important task for the Ministry is to contribute to the development of well-functioning markets for environmental products, processes and services, but it does not specify how this will be achieved. It further states that research and development on these issues is a high priority of the Research Council of Norway (RCN). RCN's research program EMBa[73] (Energy, Environment and Construction) is highlighted as an example of such R and D. According to the Environmental Profile, MoTI has allocated NOK 113,7 million[74] to RCN for environmental research in 2004, of which NOK 27 million[75] has been earmarked for the EMBa programme.

Part of the environmental profile is to explain results from previous allocations of resources. According to the Ministry, all projects financed by SND/Innovation Norway have been assessed with regard to environmental issues. It is further stated that in 2002, 312 million NOK[76] was allocated to projects that contribute to increased eco-efficiency. This relatively high amount of money stems from the fact that when evaluating the projects financed by the SND, the SND executive officers tick a number of boxes that characterize the projects. If the environment box for some reason is ticked, it "counts" as an environmental project and is filed in the list projects subject to reporting in the

[73] "Energi, miljø, bygg og anlegg", http://www.program.forskningsradet.no/emba/ (Accessed March 23rd 2004). EMBa is being merged into the Renergi programme. Visit www.renergi.com for more information. (Accessed May 25, 2004)
[74] Approximately 13,4 million EUR (Exchange rate: 8,50)
[75] Approximately 3,2 million EUR (Exchange rate: 8,50)
[76] Approximately 36,7 million EUR (Exchange rate: 8,50)

Environmental Profile, even though environmental issues were not really a central concern of the project.

Our interpretation of the contents of the Environmental Profile suggests that the development of environmental technologies seems to be a central priority of MoTI. Nevertheless, we note that very few specific measures on green innovations are described in the Environmental Profile. In summary, the Environmental Profile of the State Budget 2004 goes no further than White Paper 58 (1996-97): *urging* business and industry to innovate in an environmentally sounder way.

We will next describe how specific initiatives by directorates under MoTI actually contribute to green innovations.

7.2.3 Innovation Norway (including former SND)

Innovation Norway was established January 1, 2004, as a direct consequence of Parliamentary Bill 51 (2002-2003). Innovation Norway spearheads the government's innovation strategy. With 700 employees, and offices in all Norwegian counties and more than 30 foreign countries, it is a big organization by Norwegian standards. Innovation Norway was formed by merging into one organization The Norwegian Tourist Board, The Norwegian Trade Council, The Norwegian Industrial and Development Fund (SND) and the Government Consultative Office for Inventors (SVO). The merger seeks to achieve synergy and coordination of the innovation policy instruments of the former organizations. The inclusion of the Norwegian Trade Council will probably add value towards achieving Innovation Norway's vision statement: "giving local ideas global opportunities".

SND was before the merger the MoTI agency mainly responsible for promoting business development and innovation. It is therefore especially relevant in a MONIT context and deserves a more thorough presentation. At the time it was merged into Innovation Norway, SND had significant influence on business development and innovation in Norway, especially in the regions. Except for an Environmental Fund, described below, there were only a few projects related to environmental issues in SND, and therefore it is not easy to assess the extent to which these projects influenced green innovations in Norway. According to Bjørn Nordby in Innovation Norway,[77] SND "environment projects" in the 1990s were related to environmental warranties and bio-energy in the agricultural sector. He also noted a rather vague request in SND's "Executives Manual" to encourage environmental certification and that expenses related to environmental certification could be included in project applications[78]. As there a few current activities on green innovation by Innovation Norway let us now turn to a brief presentation of four green innovation efforts by former SND.

First there was the *project on environmental warranties*[79], initiated and financed by MoE but administered by SND. It ran from 1990 to 1996. It had an annual budget of NOK 75 million the first two years and NOK 100 million annually the remaining four

[77] Telephone Interview April 28, 2004.

[78] The request is made in the introduction of SND's "Executives Manual" and references EMAS, ISO 14000 and the "Eco-Light house program".

[79] All information regarding the project on environmental warranties and the executive officers committee was provided by Mr. Emil Jessen of Innovation Norway in a telephone interview May 25, 2004.

years. The project was organized as a warranty provider to the banks whereby SND gave to the banks, on behalf of MoE, a so-called "simple guarantee"[80] to cover the uninsured portions of loans. The applications were processed by SND, but formally approved by MoE. About 20 guarantees were issued annually. Included amongst the approved applications were prototype projects regarding waste recovery plants, bio-fuel plants, and one waste combustion plant. The *commercial* success of the warranty project, however, was limited, due mainly to over capacity in the waste recycling market and a government-proposed domestic market (which never materialized) for water treatment.

Second, a very interesting feature of the Norwegian initiatives from 1988 to 1998 to develop environmental technologies was an *inter-institutional committee* consisting of executive officers from SND, SFT, RCN, NTC and some ministries. It was headed by Tor Petter Johnsen from RCN and met on a quarterly basis. According to SND's Emil Jessen, the committee managed and coordinated the applications for funding for environmental technology projects, both related to SFT's program for environmental technologies, the research programs managed by the RCN and the initiatives managed by SND. Although the committee was evaluated as very successful (Hagen et al 1996) it ceased to exist once funding for environmental technology programs dried up.

Third, a project on bio-energy in the agricultural sector started in 2003 and will continue for the foreseeable future. It subsidizes 25 per cent of the cost of machinery to make chips for bio-combustion plants. It also subsidizes small combustion plants producing heat for various recipients. For 2004 the budget for bio-energy in the agricultural sector is NOK 18 million[81] and the project aims at involving farmers in a wider segment of the agricultural value chain by adding forestry products. This expansion is in accordance with MoA's vision of stimulating the agricultural sector to engage in additional activities to ensure new (and steadier) sources of income.

Fourth, a very important and interesting initiative is *"The Environmental Fund"*, the most recent action of significance undertaken in Norway to promote green innovations. It is the biggest effort ever undertaken to promote green technology in Norway and deserves a somewhat thorough presentation: The fun was proposed by the Jagland Government in 1997 as part of a bigger package[82] when the government announced, to a great deal of controversy, that it would propose construction of two natural gas energy plants in Norway. Although the fund was coordinated by SND, it was fully financed by MoE, and SFT acted as advisor and gave assessments of specific project proposals. The original proposal in the State Budget of 1997-98 was to allocate NOK 500 million[83] for low-cost loans to industry, including 100 million NOK to cover financial losses. The Jagland Government resigned before the fund was approved by the Parliament. Eventually, the revised State Budget proposed half that amount (NOK 250 million). This amount was distributed to 64 companies with a total investment frame of NOK 855 million[84], thereby contributing with NOK 208 million, or 24 per cent, of the total investments.

The fund's purpose was to "… ensure financing of projects contributing to reductions in green house gas emissions and other polluting discharges that would otherwise not be

[80] Norwegian term: "simpel kausjon"
[81] EUR 2,1 million (exchange rate 8,5)
[82] The KLIMATEK programme at the Research Council of Norway was also part of the package.
[83] 250 million NOK in 1998 (Approximately EUR 59 million, exchange rate 8,5)
[84] Approximately EUR 104 million (Exchange rate 8,20)

financed in the capital market". The first of three main conclusions in an evaluation of the fund by Hartmark Consulting (2003), however, was that it to a lesser degree than expected been triggering for the projects. According to Bjørn Nordby[85] this conclusion was puzzling to Innovation Norway because most programs are evaluated to have a positive effect.

The main goal of the fund was "to stimulate business and industry to adopt and develop new environmental technology". However, only 7 of the 64 projects, accounting for 6 per cent of the funds allocated, were actually concerned with development of new environmental technology. Therefore, the second main conclusion of the Hartmark evaluation was that the fund had not reached its goal of supporting projects contributing to innovation and/or development of environmental technology. The evaluation did, however, state that such projects probably were the riskiest. Mr. Nordby explained that SND actually received very few applications from projects concerned with development of new environmental technology, and that he was not aware of any "good" projects being rejected.

The third main conclusion of the Hartmark evaluation is positive: the targets for reducing greenhouse gas (GHG) emissions were fulfilled, and the national deposit systems and incentives to reduce waste accumulation in all sectors have contributed to establishment of new businesses and systems. Most financed projects had to do with reducing emissions of GHGs, which was in accordance with the fund's guidelines.

The overall conclusion of the Hartmark Consulting evaluation was that the funded projects had positive environmental effects, but that they contributed little to the development of new technology. Mr. Nordby states[86] that these effects were not surprising as improved environment more than business development was the goal of the Environmental Fund. In a Norwegian context the establishment of the Environmental Fund by the Jagland Government was considered quite offensive, all the more so when plans were announced to expand it. In the first Bondevik Government, however, the fund was disbanded.

Leaving the Environmental Fund let us now turn to MoTI's Environmental Profile in the State Budget (MoTI Parliamentary Bill 1 (2003-2004): 43): In the Environmental Profile it is stated that 8 per cent of SND's financial allocations in 2002 went to projects "improving eco-efficiency through improvement of existing products, production processes and/or system solutions"[87] and that "all projects financed by SND are assessed in relation to environmental issues". This seems quite impressive and according to Mr. Nordby, the number had risen to 10 per cent in 2003. It is, however, difficult to assess both the quality of improvements resulting from such projects, and whether 10 per cent of the projects actually were related to innovation. The impressive numbers referred to are unfortunately misleading. The numbers are produced when SND's executive officers tick boxes on a form categorizing the projects and do as such not give any indication on for example how much and to what extent a product is improved. In SND's executives manual it is stated that the "environment box" should be ticked when:

> "The project leads to higher eco-efficiency through improvement of products, production processes and/or system solutions.

[85] Telephone interview April 28, 2004.
[86] ibid
[87] Authors translation.

The box should be ticked for projects that are more or less environmentally grounded, for instance:

- Projects that have as a primary concern to develop/commercialize business ideas related to environmental technology
- Investment/development projects that have as one of their goals to improve the environmental quality of a company's products, production processes or other related aspects"[88]

There is no specific requirement that Innovation Norway give priority to "environmental projects" when it decides on funding applications, but according to SND's "Executives Manual" (which is still in use in Innovation Norway) Innovation Norway is obliged to address environmental issues in relation to external risks and possibilities[89] as well as in a final section on environmental concerns[90].

Innovation Norway is in many ways still in its infancy. The publishing of an action plan – maybe also including environmental matters – is expected during fall 2004. The bio-energy program has been extended. In addition, renewable energy projects are being planned as a result of the internationalization of one of Norway's most important sectors – the energy sector. As of April 2004 the project group has arranged seminars and workshops with stakeholders and possible projects are being assessed. According to Bjørn Nordby, the renewable energy project lacks funding but *will* be carried forward, although it is not yet clear how.

7.2.4 Other initiatives by MoTI

Argentum Fondsinvesteringer AS

Argentum Fondsinvesteringer AS is a government-owned investment company, and "the only pure fund-of-fund investor in the private equity sector in Norway"[91]. After the Norwegian Parliament passed White Paper 38 (2000-2001) on "Organizing of Investment Companies", Argentum was established in 2001 with total assets of NOK 2,45 billion[92]. Seven investment areas were chosen[93], amongst them the environment.

Due to its mandate as a fund-of-fund investor, however, Argentum is dependent on the portfolios of other Norwegian funds to make their investments and according to Argentum's CTO Nils Vogt[94] there are no funds in Norway having a purely environmental profile, but of the 25 funds registered at The Norwegian Venture Capital Association[95] there are 7 which have environment-related investments. As of January 2004, Argentum was involved in five funds investing in energy, ICT and life sciences. In Argentum's own case, it has no investments related to green innovations, except for investments in the company Pure Process Solutions (part of the EnergiVekst Fund[96]), a company involved in

[88] Authors translation
[89] From "krav til innstilling", requirement 4, "eksterne forhold", in SND's Executives Manual."
[90] From "krav til innstilling", requirement 10.3 "Miljøvurderinger", in SND's Executives Manual."
[91] Citation from Argentum's web pages (http://www.argentum.no/index.php?lang=eng . Accessed Sept 15, 2004)
[92] EUR 299 million (Exchange rate 8,20).
[93] Technology/ICT, Marine, Bio technology, Energy, Environment, Maritime and Health/medicine (Parliamentary Bill 51 (2002-2003): Ch 6.8).
[94] Telephone interview Jan 23, 2004 and E-mail to the authors May 28, 2004.
[95] Norwegian term: "Norsk Venture Kapital Forening". For more information visit: http://www.nvca.no/ (Accessed June 1, 2004)
[96] For more info visit http://www.energivekst.no/ (Accessed June 1, 2004)

cleansing technology for water and oil within the petroleum sector. Vogt emphasizes[97] that Argentum is a purely commercial actor, which does not have a mandate favoring certain sectors or technologies.

SIVA SF

SIVA (The Industrial Development Corporation of Norway) was founded in 1968 as a national actor to develop innovation networks throughout the country and has the role of catalyst and investor to foster innovation and business development. In 2003 it was transferred from the Ministry of Local Government and Regional Development to be fully owned by the Ministry of Trade and Industry (MoTI) in 2003. "Since 1994, SIVA has been gradually changing from being a state-owned company managing industrial property to being a modern innovation and investment company"[98]. SIVA's basic strategy is to develop strong local and regional business and industry clusters in Norway. It has 40 employees, total assets of EUR 440 million and invested EUR 33 million in 2002[99].

According to SIVA's Terje Sæterli[100] the main innovation activities of SIVA involve programmes for business gardens and incubators. SIVA has, however, no specific environmental requirements for providing funding and support. SIVA's decisions on funding are based mainly on the economic merits of each project. Some regional political considerations are taken into account, too.

7.3 Concluding remarks on vertical policy integration for green innovations

Although there have been some interesting environmental technology projects and initiatives the last 15 years, there are few current projects, either ongoing or in the pipeline. SFT's program for environmental technology, and SND's program on environmental warranties and its Environmental Fund were interesting and fairly big projects, but are now terminated and there are no evidence that they will be taken up again. It is, however, interesting to note that all the initiatives related to environmental issues, managed by former SND were financed by the Ministry of Environment, not the Ministy of Trade and Industry because SND (and now Innovation Norway) always has been in MoTI portfolio.

As we did with HEPI in Chapter 6, we will now apply Lafferty's and Hovden's (2003) benchmarks presented in chapter 2.4 to the vertical dimension – VEPI – again modifying them to focus explicitly on green innovation. Lafferty and Hovden (2003) state that the key factor is whether or not a strategic Environmental Action Plan exist. However, the plan itself will be of limited importance unless it properly identifies and then assesses the key environmental challenges for the relevant sector or if it fails to stipulate realistic targets, benchmarks and measures for objective assessment of implementation results

[97] Telephone interview Jan 23, 2004.
[98] Authors translation. Original text: "Det siste 10-året er SIVA forandret fra å være en statlig forvaltningsetat for industrieiendom til dagens moderne innovasjons- og investeringsselskap". Source: http://www.nhnett.net/C125654E0043B247/8486CEFD06DD6D7041256802004F331F/D9E6B2C0FDD72883412568B4005E62C8?OpenDocument (Accessed Sept 15, 2004)
[99] Information collected from SIVA's web-page: http://www.siva.no/ (Accessed March 8, 2004).
[100] Telephone interview March 9, 2004.

concerning prevailing environmental challenges related to the sector or Ministry in question.

Recalling that there is little emphasis on innovation and development of environmental technology in the horizontal steering documents referred to in chapter 6 and that there are not yet any sectoral action plans for green innovation in place, it is not surprising that the findings on the vertical dimension (as proposed by Lafferty and Hovden (2003)) are limited:

1. **An initial mapping and specification of the major challenges and opportunities related to green innovation relevant to the sector**
   We are not aware of any such mappings or specifications.

2. **Formulation of a sectoral green innovation action plan**
   A sectoral green innovation plan is not in place. SFT has done some preparatory work for the MoE on environmental technologies. This process has just started and it is not sure what the outcome will be. It is, however, highly unlikely that a sectoral green innovation action plan will be produced.

3. **Consistent and regular employment of both environmental impact assessment (EIA) and strategic environmental assessment (SEA) for all sectoral policy decisions related to innovation**
   We are not aware that any such assessments have been conducted.

4. **Timetables and quantitative, indicator-based targets stipulated in the sectoral green innovation action plan – or elsewhere**
   There is currently no sectoral green innovation action plan or other strategies related to green innovation in Norway and hence no timetables or indicator based targets stipulated.

5. **Regular reporting of the state of the green innovation relevant policies within the sector**
   As there seems to be no relevant policies promoting green innovation, there is no reporting and nothing to report on.

One would have to conclude from the above that the degree of policy integration of environmental and innovation policies in Norway is low. There are a few initiatives in place, but they are insignificant and not related either to each other or to any strategy. There are no strategic actions or plans for green innovation. It further seems that during the last decade the focus on green innovation and environmental technologies has been reduced. However, Innovation Norway is still in its infancy. As of spring 2004, it is working on strategy papers that *might* place greater emphasis on green innovation.

It is clear from the material presented in the previous two chapters that in MoE and MoTI there is plenty of room for improvement regarding green innovation. There are, however, initiatives from other ministries that slightly moderate this picture. The following section will present some of these initiatives and two case studies of green technologies. Then we will in chapter 10 conclude by reviewing policy recommendations.

PART 3

Additional Policy Efforts, Case studies, Conclusions and Policy Recommendations

8 ADDTIONAL POLICY EFFORTS ON GREEN INNOVATIONS: MOSTLY FISCAL MEASURES

There are a number of regulatory approaches to promote green innovation. The concern of this report is to identify the existence and dynamics of the interface between environmental and innovation policy efforts. Is there a green innovation policy in Norway? Based on studies of the efforts promoted by MoE and MoTI the answer is, "No". Few efforts are currently ongoing, and those efforts that could have made a difference – such as the Environmental Fund (Statens Miljøfond) – have not received additional funding. However, the recent efforts of RCN's Renergi, including KLIMATEK, may represent a new window of opportunity.

Does the lack of a green innovation policy imply that Norway has not implemented any green innovation policy efforts at all? As referred to in chapter 3, there has been a clear shift in environmental political priorities from administrative rationalism towards ecological modernisation. Firms are *requested* to improve their performances and the use of economic instruments has been strengthened. In our search for green innovation policy efforts, we will therefore briefly present both existing *environmental taxes* and the fiscal incentives for R&D proposed by *SkatteFUNN*.

The focus so far in this report has been on the ministries in charge of environmental and innovation policies, MoE and MoTI. We now expand this focus to include the fiscal measures of the Ministry of Finance (MoF). However, there are other ministries and directorates that may play an influential role in promoting green innovation. We therefore also briefly present *Enova*, a state enterprise under the Ministry of Petroleum and Energy (MoPE). Enova has financial resources available to promote green innovation and an explicit aim to promote new renewable energy sources – a crucial reference with respect to green innovations. Finally, we will present *Green National Government in Norway* – Green Government[101] – and the potential for the state to be a green supplier and consumer, creating new domestic markets and triggering green innovation in industry and business.

8.1 Application of environmental taxes

According to White Paper 58 (1996-97), the government wanted to change the tax system in such a way that it would become more profitable for firms to be environmentally conscious. As stated on page 30 of the White Paper, "industrial policies will be developed within the context of sustainable development". This stands in contrast to the more theoretical reasoning of the Green Tax Commission (GTC), appointed by the government in December 1994 at the request of the Norwegian Parliament during budget debates. A major objective of GTC was to discuss the long term role of fiscal measures in promoting increased employment and an improved environment (NOU: 9 1996). The GTC argued quite convincingly that Norway could increase both economic growth and

[101] In Norwegian termed "Grønn Stat".

environmental protection through extended CO_2 taxation of all polluters. However, such a fiscal approach would be financially detrimental for those industries not having short-term economic or technical opportunities to replace the processing technologies causing CO_2 emissions. One example is the primary aluminum industry (Ruud 2002).

When the GTC arguments became more manifest through a proposed extension of fiscal taxation, the Brundtland Government appointed another commission to propose a strategy to make industries green without either reducing their competitiveness or changing the then existing tax system. This commission, the Industry Structure Commission (ISC), had 12 members, all of whom came from industry and business. There were no representatives on the commission from MoE, the research community, or environmental NGOs. In contrast, of the 16 members of the Green Tax Commission only 2 came directly from industry and business. This commission's work was presented in a government report in 1996 entitled "Competition, Knowledge and Environment" (NOU 23 1996). The ISC proposed a number of measures that stood in striking contrast to the macro-based approach of the Green Tax Commission. The ISC argued, in line with the reasoning of ecological modernization, that in the long run there are no serious conflicts between a reasonable industrial policy and good environmental policy. Consequently, to promote sustainable development, the ISC did not perceive any need for forced structural changes through fiscal measures – like CO2 taxation – to alter the composition and performance of Norwegian industry. In principle the ISC supports fiscal environmental measures because they could create incentives to develop and use product and process technologies that are more environmentally sound and cost efficient. However, the GTC proposal for an extension in the fiscal tax base to include processing industries like aluminium producers was strongly rejected. As of April 2004 there is a tax on 64 per cent of all CO2 emissions in Norway[102].

8.2 SkatteFUNN[103]

SkatteFUNN is currently one of the most important instruments in Norwegian innovation policy. Its main goal is to increase and improve R&D activities in business and industry through more systematic and integrated commercial efforts. The program was established in 2001and implemented in 2002 as a follow up to the FUNN-program. It is administered by the RCN and Innovation Norway. Big enterprises can have up to 18 per cent and small and medium sized enterprises (SMB)[104] can have up to 20 per cent of their R&D expenditures reimbursed through tax-reductions. If a company acts alone, the maximum size of the R&D project eligible for support is NOK 4 million. If a company cooperates with an approved research institution the maximum is NOK 8 million.

SkatteFUNN is one of the government's means for reaching by 2005 the OECD-mandated level of R&D. This would mean an increase from today's level of 1,62 per cent

[102] For more information on this, please visit http://www.environment.no/templates/PageWithRightListing 2328.aspx (Accessed May 4, 2004)

[103] Information in this section on SkatteFUNN is gathered from http://www.skattefunn.no (Accessed March 31, 2004). Information in English is available here: http://jaguar.intrapoint.no/skattefunn_v2/index.php?kat=English (Accessed Sept 24, 2004)

[104] Less than 250 employees, less than EUR 40 million in annual turnover, and less than 25-percent-owned by a big enterprise.

of GDP to 2,3 per cent of GDP. In 2002 more than 3100 applications for reimbursement of R&D expenditures were submitted, and 2670 were approved. The approved projects had R&D expenditures totaling NOK 4,5 billion, which as a result of the programme resulted in approximately NOK 760 million in tax reductions (MoTI Parliamentary Bill 1 2003-2004: 119). In contrast to the FUNN programme (SkatteFunn's predecessor) that had limits on its total allocations, SkatteFUNN allows any business to be eligible for tax reductions as long as its projects are approved by RCN or Innovation Norway. In a MONIT-context, however, one must note that there are no specific criteria related to environmental issues in the SkatteFUNN program. The program does therefore *not* contribute to an integration of environmental and innovation policies.

8.3 ENOVA

ENOVA SF, established in 2001, is a state enterprise fully owned by the Ministry of Petroleum and Energy (Ot Prp 35 (2000-2001). According to ENOVA's web site[105] its "main mission is to contribute to environmentally sound and rational use and production of energy, relying on financial instruments and incentives to stimulate market actors and mechanisms to achieve national energy policy goals". ENOVA's major goal is to save 10 Twh by 2010 through stimulating cost-effective and environmentally sound investments in households and business and industry. According to statements on their web site, the establishment of Enova SF signals "a shift in Norway's organization and implementation of its energy efficiency and renewable energy policy. By gathering strategic policy responsibilities in a small, flexible and market-oriented organization, Norway has wanted to create a pro-active agency that has the capacity to stimulate energy efficiency by motivating cost-effective and environmentally sound investment decisions. Enova SF enjoys considerable freedom with regard to the choice and composition of its strategic foci and policy measures".

To achieve ENOVA's objectives, "the Norwegian Parliament has set up an Energy Fund and indicated grants within a framework of up to NOK 5 billion[106] over a ten-year period". The funding will come from a levy on electricity distribution tariffs and from ordinary grants in the State Budget. ENOVA is one of the government's most important instruments in the areas of energy conservation and utilization of more environmentally friendly energy sources.

Currently, organizations are invited to apply for funding from programmes in the following areas:

1. **Heat distribution** (infrastructure) and heat generation based on renewable energy sources, such as bio energy and waste: Enova SF can contribute up to 15% of the total project cost.
2. **Energy End Use**:
    a. Industry: Energy savings and efficiency improvements in industry
    b. Energy management in large commercial buildings
    c. Energy management in small commercial buildings

[105] Most information in this section is collected from ENOVA's website http://www.enova.no/?itemid=425 (Accessed Sept 24, 2004)

[106] Approximately EUR 560 million (Exchange Rate 8,50)

d. Retrofitting of more efficient street lighting
e. Energy management in residential buildings

3. **Wind energy**: The maximum subsidy level is 10% of the total investment, but the programme also aims to demonstrate the viability and aid *commercialization* of wind technology, which is particularly suitable for Norwegian climate conditions, by providing a maximum of 60% of approved project costs.
4. **Renewable energy (other than wind)**: The aim is to improve deployment of renewable energy technologies. Initially priority has been placed on solar space and solar water heating and projects that combine solar heating with energy sources other than electricity.

Enova has also been given the task of commercializing **natural gas**, but with White Paper 47 (2003-2004) the Ministry of Petroleum and Energy has taken a separate initiative to set up an innovation body in the Grenland District in Telemark County to promote an environmentally sound natural-gas generating plant with CO_2 handling. Enova will apparently not be involved in the technological development that facilitates a more environmentally sound consumption and utilization of the same natural gas. This reflects lack of vertical policy integration.

In a MONIT context it is interesting to note that ENOVA SF is focusing on *commercialization* of new renewable energy technologies. Consequently ENOVA has not been involved in inventions and technology development as the efforts promoted by ScanWafer and Shecco Technology, presented in section 9 below.

A remaining challenge is how to stimulate demand for green innovations. Can the public authorities play a role by creating a market for green innovations through a greening of governmental purchasing activities?

8.4 Green Government

"Green Government" is a state environmental management scheme based on the principles formulated in ISO-14000 and EMAS[107]. Its goal is to implement environment into the government management systems. Green Government started out as a pilot project in 1998-2001 covering 10 institutions. The project was considered successful and showed that the potential for realizing environmental gains in governmental institutions was significant. Four focus areas were selected: procurement, waste management, energy and transport. Initially the ministries lead the way, starting implementation in 2002. By the end of 2005, however, all national government institutions are to implement Green Government. The national authorities are also, through § 6 in the Law on public procurement[108], instructed to take environmental considerations in their purchases.

The Environmental Action Plans formulated by both MoTI and MoE refer to the Green Government project. Green Government has a particular focus on public procurement policy and on the extent to which environmental considerations can be

[107] More information on Green Government at www.gronnstat.no. An English pamphlet presenting the scheme is available at http://www.odin.dep.no/filarkiv/179934/Info-brosjyre-engelsk.pdf (Both accessed May 27, 2004.)
[108] Available online (in Norwegian only) at: http://www.lovdata.no/all/nl-19990716-069.html (Accessed May 27, 2004).

included in the decision-making process. The Environmental Action Plan of MoTI refers to a purchasing manual that the ministry has been responsible for developing[109]. The manual will help public servants to formulate strategic and specific environmental prerequisites to suppliers. MoTI refers to the Green Government project, but underlines that this must be followed up with a general strengthening in the market demand for innovative solutions creating positive environmental benefits. As formulated: "When the government is increasing its demand for 'green solutions', it is probable that business also must increase its activity and particular suppliers of such solutions" (MoTI 2001: 28).

In contrast to the efforts formulated specifically with respect to the eight priority areas, the efforts promoting Green government are not connected to the NEMS framework. Green Government, however, is mentioned in most of the sectoral Environmental Action Plans, but it is never related to green innovation policy.

[109] The manual is now published and available (unfortunately in Norwegian only) at http://odin.dep.no/archive/nhdvedlegg/01/10/ferdi044.pdf (Accessed May 27, 2004)

9 TWO RELEVANT BUSINESS CASES

This section is based on ongoing research at ProSus related to the CondEcol project[110]. We will present two Norwegian environmental innovations promoted by Shecco Technologies[111] and ScanWafer[112].

Shecco™ Technology is a part of Hydro Pronova AS, which is the venture company of Norsk Hydro ASA. Shecco promotes a heating and cooling technology based on natural CO_2. The technology will in this report be referred to as "Shecco Technology" or "CO_2-technology . It offers energy-efficient and environmentally friendly solutions for stationary and mobile heating and cooling devices. It represents a potential significant contribution to reduced greenhouse-emission from mobile and stationary air-conditioners and tap water heaters due to its energy efficiency and the replacement of HFC's, a potent greenhouse gas (GHG), with CO_2.

Renewable Energy Corporation (REC) is the only company in the world that covers the whole value chain of solar energy – from the manufacturing of solar grade polysilicon feedstock to the marketing of photovoltaic (PV) systems to the consumer. By technological innovation, economics of scale and synergies along the whole value chain, REC offers high-performing PV components and systems at prices which continue to go down. In this report we have chosen to focus on the production of multicrystalline silica wafers, manufactured by ScanWafer, a company fully controlled by REC. The silica wafers constitute about 30 per cent of the total cost of a solar panel. They are the parts that determine the panel's energy output. Hence, the wafers are crucial to making solar energy a competitive technology.

We will present the most important technological features of the innovations by Shecco Technology and ScanWafer and will briefly describe when and how the environmental benefits of these innovations become evident. We will trace the history of both companies from their respective R&D phases to the marketing of their inventions.

9.1 Shecco heating and cooling technology

Shecco Technology was founded in 1987, at a time when HFCs were seen as a possible solution to a major environmental problem – the hole in Earth's ozone layer. The Montreal Protocol, signed that same year, was a tremendous breakthrough of international environmental agreements because it curbed emissions of ozone-depleting substances.[113] Today the ozone layer is still being depleted, but measurements suggest that atmospheric concentrations of ozone-depleting substances have peaked and begun to

[110] More information at: http://www.prosus.uio.no/industri/condecol/index.htm (Accessed April 30, 2004)
[111] http://www.shecco.com (Accessed April 30, 2004)
[112] http://www.scanwafer.com/ (Accessed April 30, 2004)
[113] Chlorinefloridecarbons (CFC's) etc.

decline. Consumption of ozone-depleting substances is dropping rapidly and the ozone layer is expected to recover by 2050[114].

The hole in the ozone layer was regarded as one of the major environmental disasters of our time and urgent measures against ozone-depleting substances were taken. Alternatives (HCFCs and HFCs) to ozone-depleting substances had, however, detrimental side effects that were *undercommunicated* during negotiations of the Montreal Protocol. These alternatives are greenhouse gases (GHGs), which contribute significantly to global warming. Hence, the Montreal protocol represented a major ecological challenge. One environmental problem (emission of ozone-depleting substances) was solved while a new was created (green house gas emissions)[115].

The late Professor Gustav Lorentzen and his team at The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology (SINTEF) were aware of the adverse environmental consequences caused by the switch to HFCs so they studied alternative refrigerants: natural fluids like ammonia, hydrocarbons (HC)[116], water and carbon dioxide (CO_2). They found that CO_2 had clear advantages over the other working fluids due to its heating and cooling performances, but also because it was non-flammable and non-toxic. Knowledge about CO_2's cooling performance, however, was not new. They were discovered in the 1850s.

The first cooling system based on CO_2 was built in 1869 and the use of CO_2 in cooling systems later came into widespread use. In the 1940s, however, CO_2 cooling systems disappeared from the market, mainly due to technical problems and the invention of new fluids like chlorinefloridecarbons (CFCs). Due to the high pressure required in CO_2 cooling systems, leakages were a serious problem. In secrecy Lorentzen and his team started to develop a prototype cooling system based on CO_2 under the name "R2000". They solved the leakage problem using a "method for operating a vapour compression cycle under trans- or supercritical conditions". This basically involved closing the CO_2 circuit with an expansion valve. In 1989 they filed a patent application[117] and a new era for CO_2 as refrigerant began.

9.1.1 Eco-efficient technological features

Shecco Technology[118] is an energy-efficient and environmentally friendly heating and cooling technology based on natural CO_2. The technology can be used in mobile air conditioners (MACs) for passenger cars, or in both mobile and stationary refrigeration units, e.g. for food storage. Because the technology allows for a mobile air-conditioner to be "reversed", the unit can be used for heating, e.g. in cars or to heat water. The use of CO_2 as a refrigerant significantly reduces global warming because it replaces the potent

[114] Source: State of the Environment Norway (http://www.environment.no/) Accessed April 30, 2004. Another valuable source of information on the ozone layer is http://www.unep.org/ozone/Public_Information/index.asp (Accessed April 30, 2004)
[115] Note that CFC's were, in addition to depleting the ozone layer, also GHGs.
[116] i.e. propane
[117] The patent documents are available at http://www.shecco.com/patents/EP424474_B2.pdf (Accessed April 30th 2004)
[118] Visit Shecco Technology's website http://www.shecco.com for more information (accessed March 26th 2004)

GHG, HFC 134a[119], a refrigerant with a global warming potential (GWP) of 1300[120]. By comparison CO_2 has a GWP of 1.

Shecco Technology is suitable for a variety of heating and cooling applications. Currently Shecco Technology is used in residential tap water heating in Japan, in commercial refrigeration in supermarkets, soft drink vending machines, and mobile air-conditioning (MACs). The main ecological advantages of Shecco Technology compared to competing technologies are its greater energy efficiency and lower direct GHG emissions during use and at end-of-life disposal. We have chosen, in this report, to focus on the tap water heating and MAC applications. All applications, however, have common features because they are based on the same patents and CO_2 as refrigerant.

We now turn to a detailed description of the main eco-efficient advantages of the Shecco Technology[121]. First, Shecco Technology reuses CO_2, e.g. from ammonia and petrochemical plants, that would otherwise probably be emitted. Shecco Technology therefore only delays emissions that would otherwise have taken place, but no primary production of CO_2 is required. Compared to conventional MAC technology based on HFC the reuse of CO_2 represents an environmental gain because production of HFC 134a also implies GHG emissions. According to a representative for DuPont[122], one of the world's major producers of HFC, "total production" of one kilogram HFC-134a is estimated to emit 8-10 kilograms of CO_2-equivalents. Others claim that emissions are as high as 77 kg (Campbell and McCulloch 1998). In a MAC suitable for a mid size sedan about half a kilogram of HFC is needed.

Second, another ecological advantage of Shecco Technology is found when comparing CO_2 MACs to conventional HFC-134a technologies regarding impact during use: leakages of CO_2 will not pose any additional global warming as the CO_2 would have been vented anyway. For conventional MACs based on HFC this should not be a problem if they had been tight and did not need refill of coolant and if they had an end of lifetime regime. This is not the case, however: several tests reveal that there are major leakages of HFC from conventional air-conditioning systems in cars. A European Commission (2003) optimistic estimate is that direct lifetime emissions from one HFC-driven MAC unit equal 1531 kilos of CO_2 equivalents. A pessimistic estimate[123] is 3108 kilos of CO_2 equivalents during the lifetime of a conventional (HFC-134a propellant) mobile air-conditioning unit.

If HFCs are vented at end of life disposal they cause global warming. In accordance with the reasoning above, this is not the case with the CO_2 technology. In some countries there are regimes and procedures in place for recovery and disposal of HFC at final disposal, but most countries do not have such procedures in place at all. Air-conditioning

[119] The most widely used coolant in mobile air-conditioners is R-134a/HFC-134a. In stationary equipment a wide variety of coolants are used. For simplicity's sake we will only refer to HFC 134a in this report.

[120] In this report GWP is measured in accordance with IPCC standards (IPCC 2001) whereby the GWP is measured over a 100-year period. This is the same methodology used in the Kyoto Agreements. If one measures GWP over 20 years, the GWP of HFC-134a is 3400 times the GWP of CO2 (Godal and Fuglestvedt 2002).

[121] In the CondEcol project the technological data are organized in accordance with the eco-design wheel. More on this and a more thorough technological presentation of Shecco Technology can be found in Ruud and Larsen (2003) and Brekke and Larsen (forthcoming).

[122] E-mail form DuPont representative to the authors dated June 3, 2003.

[123] Implies that the mechanics are not skilled, that there is no recovering and recycling equipment in the garages, that the HFC is not recovered at final disposal and so on (EU Commission, 2003).

propellant can be recycled, but the available technology is not yet in wide use. Another important aspect is that destruction of HFCs requires extremely high temperatures. In Norway, decomposing the HFC molecules during the production of cement solves this problem[124]. In other countries, such as Japan, energy-intensive plants are used for the decomposing of HFC and CFC. To summarize: to avoid GHG emissions at end-of-life disposal conventional heat pump technology requires a regime for recovery of HFC. Even if the HFCs are recovered, the destruction process is very energy intensive, and thus contributing to global warming. On the contrary, no special infrastructure is necessary to avoid GHG emissions when dealing with CO_2, either during the service life of units using it, or end-of-life disposal.

By introducing CO_2 MACs GHG emissions from production and end-of-life disposal of HFC would be eliminated. The numbers might not seem very high at first glance, but considering that about 187 million passenger cars were in use in 2002 in the EU alone,[125] and that MAC units are standard equipment in most of the 55 million cars produced worldwide annually the total number is significant. Another benefit of CO_2 technology is that besides reducing direct emissions of GHGs, it also increases energy efficiency. The use of air-conditioning in cars causes increased fuel consumption. For example, indirect CO_2 emissions related to energy use of MACs during a vehicle's lifetime are a lot higher than direct emissions. Tests show that Shecco Technology is more energy efficient than conventional MAC systems under normal (outside air) temperature conditions[126] and equally energy efficient under hot conditions[127]. The energy consumption referred to above is related to the technology's cooling abilities. But the technology is, due to high operating pressures in the systems, also capable of delivering energy-efficient heating. This feature is important in modern diesel-powered vehicles because modern energy-efficient diesel engines do not produce enough residual heat to warm the passenger compartment. Therefore, such vehicles need passenger compartment heating units which, if they use Shecco Technology, will be more environmentally friendly. The same would apply to future hybrid and fuel cell cars. Therefore, applying Shecco Technology in combined heating and cooling units in cars is very environmentally friendly.

Denso Corporation[128] has realized the technology's heating advantages. In May 2001 Denso introduced Shecco Technology in tap water heaters in Japan. Japanese use very hot water in their homes. Energy to heat water accounts for 35 percent of energy consumption in Japan. Prior to Denso Corporation's breakthrough, no energy-saving solutions had been applied to water heating equipment in Japan. Compared to gas-fired[129] water heating systems, the systems using Shecco Technology reduce CO_2 emissions by 50%. Furthermore the Shecco Technology has low operating costs: up to 80% lower according to Denso's claims.

[124] HFCs are burned together with CFCs at 2000 degrees Celsius. The cement industry needs chlorine in the production process; hence their interest in CFCs. HFCs do not contain chlorine. However, the cement industry is burning them as a courtesy to environmental interests at the present time.
[125] Source: The European Automobile Manufacturers Association (ACEA) http://www.acea.be/ACEA/Car_Parc_1995-2002.pdf (Accessed May 2, 2004)
[126] Defined as typical US, Japanese or European climate.
[127] A typical example would be Phoenix, Arizona or Dubai…
[128] http://www.globaldenso.com/en/ (Accessed May 2, 2004)
[129] Methane and LPG.

9.1.2 The innovation journey – the short version

In 1989 Gustav Lorentzen approached Norsk Hydro with what he claimed was a solution to environmental problems related to the use of HFCs in heating and cooling technology. Norsk Hydro studied his documentation carefully and listened to him. Prof. Lorentzen was widely regarded as a guru in his field and Norsk Hydro wisely took him seriously. As the presentation of the technology in 9.1.1 above shows, the technology has a significant beneficial ecological potential. Norsk Hydro saw this potential.[130] They also realized that mutual benefits could be exploited between the Shecco Technology and Norsk Hydro's world leading aluminum tube technology, which is used in heat exchangers. Hydro also saw the financial potential from the patenting and licensing of Lorentzen's technology.

Despite all the above, Norsk Hydro had difficulty finding a "home" for Lorentzen's technology in the conglomerate. The gas division could not combine it with their other activities due to volume issues, but the aluminium division saw its environmental benefits. Moreover, they were already manufacturing aluminium tubes for the MAC industry and had the competence to patent Lorentzen's technology and bring it to market. It was decided to pursue a strategy targeting the MAC industry, called MAC2000, aimed at having the first MAC units on the road by the turn of the century. The car industry itself was searching for solutions to the environmental problems caused by the use of CFC and HFC in automobile air-conditioning units. In 1991, collaboration between European car manufacturers was launched (RACE) to develop and test CO_2 systems for automobile air-conditioning. The companies participating were BMW, DaimlerBenz, Rover, Volvo, VW, Behr, Danfoss, and Valco, and the project received financial support from the EU. By 1997 the RACE test results were known, and the message was clear: the technology worked. Norsk Hydro soon learned, however, that the automobile industry was not willing to change rapidly. The costs related to the transition from CFCs to HFCs were one stumbling block. Furthermore, the powerful chemical industry had its objections to change.

The first commercial breakthrough came in 2000, but not in the mobile air-conditioning industry. In 1990, the Denso Corporation, a leading Japanese manufacturer of air-conditioning systems for cars, began work on developing new, more energy-efficient heat pumps for heating tap water in Tokyo. The company's attention was drawn to SINTEF's successful experiments on the use of CO_2 heat pumps. The result was the Eco Cute, a small, neat and efficient water heater. The work was done for TEPCO (Tokyo Electric Power Company[131]). A license agreement between Hydro and Denso on heat pumps for heating tap water in Japanese homes was signed in 2001.

9.1.3 Main actors and influences, barriers and drivers

Norsk Hydro's involvement in the Shecco technology is founded on worldwide patents of the process. As soon as the patent rights were secured, it became evident to the Shecco entrepreneurs that the industrial and scientific networks in the heating and cooling

[130] At the same time Norsk Hydro showed a growing concern for the environment and actually published their first "environmental report" in 1989.
[131] More info at URL: http://www.tepco.co.jp/en/index-e.html ((Accessed July 30, 2004)

industry were extremely important for the development of the technology, both scientifically and financially. A strategy was developed to activate technical and commercial alliances. In the early 1990's Norsk Hydro financed research at SINTEF and at The Air Conditioning and Refrigeration Center (ACRC) at the University of Illinois in Urbana[132]. The project in Urbana was very successful, especially because the technology through this project "went public" for the first time and was introduced to the worldwide research community. Several automobile manufacturers (Ford, Toyota and Daimler Chrysler) showed interest in the technology. These automobile manufacturers participated in developing the technology by financing both external and in-house research. All these efforts snowballed, and it was possible to develop the technology by spreading development costs among several actors. This represented a significant driving force in the development of the Shecco technology. Furthermore, a commercial network was also established to ensure that Hydro could guarantee access to the CO_2 technology without compromising its relationships with customers in the air-conditioning industry that Hydro's Aluminium Division[133] was supplying. SINTEF played a central roll, communicating technological details and application ideas to both existing and potential customers.

Norsk Hydro spent about NOK 60 million over a ten-year period to finance the development of the patents. This was allocated from the company's research budgets. Norsk Hydro did not apply for additional funding from banks, financial institutions or venture funds. It is difficult to estimate the value of the networks and alliances that were activated by Hydro. Perhaps thousands of people have been working on projects related to the CO_2 technology since 1989.

The main barrier to the introduction and diffusion of Shecco technology to the mobile air-conditioning market has been the existing infrastructure which favors the conventional technology. When CFCs were regulated through the Montreal Protocol in 1987, the chemical industry had already developed HFC 134a as an alternative to CFCs. The switch involved costs and therefore the automobile industry has been slow to initiate a voluntary change. This could change soon. The EU has proposed legislation that will phase out HFC 134a by either 2009 or 2011 and totally ban the use of HFC 134a from 2014. In any case, the automobile industry will have to adapt to new, more energy-efficient diesel engines, hybrids and fuel cell cars requiring more eco-efficient units for heating the passenger compartment. Therefore, there is a very large future market for heating applications using Shecco Technology. Simultaneously there are significant environmental benefits in terms of reduced CO_2 emissions from the European car fleet.

As mentioned above, the water heating applications of the technology were developed by Denso Corporation based on license agreements with Shecco. Prior to those license agreements, Denso was solely focused on producing automobile auxiliary systems, such as MAC units, for the Japanese automobile industry, and had never developed technology for other applications such as tap water heating. We do not know much about how Denso developed the technology, but it is clear that they somehow applied a MAC heat exchanger technology to tap water heating units. Their application of technology from one industry to another has created significant opportunities for Denso in the Japanese tap water heating market. Denso applied the technology to water heating without any

[132] http://acrc.me.uiuc.edu/ (Accessed July 17 2003.)
[133] http://www.hydro.com/en/our_business/aluminium/index.html (Accessed July 30, 2004)

involvement by Norsk Hydro, but with some assistance from SINTEF. Perhaps this case holds significant lessons about how a single technology can be applied to very different industries worldwide.

9.2 ScanWafer

ScanWafer's story is very different from Shecco's. ScanWafer produces silica wafers, essential parts in the production of solar energy panels. In response to the question "What is the innovation", Erik Sauar, research director at ScanWafer, responds[134] "We make a product that is marginally better, but physically identical. It has slightly better crystals, but is clearly the same product as those existing before. We have, however, introduced important innovations to optimize the production techniques".

ScanWafer was established in 1994, but is since 2000 controlled by Renewable Energy Corporation (REC), the only company in the world that covers the whole value chain of solar energy – from the manufacturing of solar-grade polysilicon feedstock to the marketing of photovoltaic (PV) systems to the consumer. By creating technological innovations, economies of scale and synergies along the whole value chain, REC offers high-performance PV components and systems at market prices which are continuing to decline. Their goal is to make solar energy increasingly more competitive, because REC believes that competitively priced solar energy is the only long-term answer to the world's need for clean, affordable energy. ScanWafer – the focus of this section – is crucial in reaching this goal.

While scientists may disagree on what is causing *current* climate change and extreme weather, nobody is denying that Earth is suffering from the negative impacts of environmentally unfriendly energy technology and excessive consumption of energy based on fossil fuels. Although technologies for utilizing traditional energy sources are continuously being improved, supplies of those sources are strictly limited. Fossil fuels – oil, gas and coal – are likely to be depleted in the next few generations. Among the renewable energy sources – sun, wind and water – the sun is in some ways the newest to be exploited by mankind. While mankind harnessed water and wind power long ago, it was only 50 years ago that mankind first succeeded in generating electrical power directly from sunlight.

9.2.1 Eco-efficient technological features

While Shecco's main innovation and ecological advantages are related to impact during use, ScanWafer's innovations are related to optimization of production techniques and the obvious ecological advantages related to impact during use. According to ScanWafer[135] the efficiency of multicrystalline wafers has increased by about 25 % from 1997 to 2003. In the same period the price of wafers has declined about 20% while the price of silica raw material has risen *250%*, from about 10 USD to 25 USD. This reflects a general trend in the industry: fierce competition and a need to innovate along the whole value chain in order to survive.

[134] Telephone interview March 3, 2004.
[135] http://www.scanwafer.com/index.php/4740 (Accessed Feb 23, 2004).

Regarding raw materials for the wafers, silica is the main component of a solar cell. Solar cells can be made of different materials using different technologies. The technologies based on multicrystalline and monocrystalline silica wafers are currently the most common, and of all solar cells produced annually, 50% have wafers made of multicrystalline silica. ScanWafer only produces multicrystalline silica wafers and the company believes that multicrystalline silica is and will continue to be the most cost-effective material because it is reasonably priced, and allows for the use of a cost-efficient production process. The company also believes that this material makes possible further, *significant* cost reductions in the manufacturing process. Furthermore, it believes that the energy-producing efficiency of the cells can be increased beyond the current 15.5%.

Because the cost of wafers constitutes a substantial part of the solar cell's total cost, ScanWafer and its competitors strive to reduce the amount of material used to produce each wafer. One of ScanWafer competitive advantages is a specially developed wire saw to cut the silica blocks into very thin wafers, about one-third of a millimetre thick, i.e. 330 microns. REC's goal is to cut wafers at a thickness of 200 microns by 2010. ScanWafer has also introduced recycling of production consumables, which is significant both for its environmental impact and its impact on production costs.

For the solar cell industry, optimization of production techniques poses the main challenge to advances in the efficiency of the panels. Improvements are possible across the whole production process: purification of solar grade feedstock, melting and crystallization of pure silica doped with boron, the cutting of wafers from the multicrystalline silica, the surface treatment of the solar cell, and the imprinting of electrical contacts on the wafer. It is probably possible to increase the efficiency of the solar cells by up to 15%. ScanWafer's main advantages are a high degree of automation in the production process and an efficient furnace for producing ingots, which is the most critical part of the process. Regarding the furnace, its main advantage is related to the fact that the size of the oven is four times the size of those used by competitors within the PV industry. Consequently higher volumes can be produced. This makes the melting of silica into ingots very cost efficient. The modular design of solar energy systems makes solar energy suitable for producing energy at the site of its consumption, e.g. roof-top solar panels can power a household. Typical installations produce 3-5 kW, which meets the energy needs[136] of a household. For private homes, the energy could be produced during daytime, when the household's demand for energy is low, but the need for energy is high in offices and shops, especially where drifting of AC-units in offices and shops requires considerable amounts of energy. This opens up possibilities for systems and infrastructure which distribute to the grid surplus energy from rooftop solar panels on private homes. With traditional stand-alone solar systems, energy storage would be required, making the total system expensive and not very flexible. An integrated system where the excess capacity could be supplied to the grid, avoids the need for storage, but requires that the local energy system be adapted to such decentralized production. For example, Germany has introduced policy instruments to facilitate distribution of solar energy from roof top panels to the grid. The program was initiated at a political level[137] and guarantees

[136] This does not apply where electricity is used for heating.
[137] When the Red-Green coalition won the elections in 1999, the Green party demanded subsidies for renewable energies to join the government. The coming policies were announced, which lead to

households a high fixed price for the energy they supply. The fixed price is as of 2004 0.51 per kWh, about four times the current electricity price the household pays for "conventional" electricity. In addition, generous loans and subsidies were given to households that wanted to install their own roof-top energy plants.[138]

In areas where electricity infrastructure is not well developed, stand-alone solar energy systems are a viable and cost-effective solution for electricity production. This solution is especially interesting in less developed parts of the world where infrastructure for electricity supply through a grid is not established. In fact is also the case in the Norwegian market segment for supplying electricity to holiday cottages without access to the grid. During the 1980s this was the biggest single market for solar panels in the world. At that time BP Solar had 25% of its annual sales in Norway, and the sales were important for the development of the PV technology. It is further interesting to note that solar power was commercialized at this level in Norway long before global warming and CO_2 emissions became major issues in national and global environmental politics, which could be interpreted to illustrate the commercial potential of solar cell technology.

The main ecological advantages of solar energy are related to the absence of negative environmental impacts during the use solar power systems. The eco-effective advantages of the PV technology are obvious compared to electricity generation based on fossil fuels: Solar panels do not cause any negative environmental impact during use. When solar rays hit the panel they are simply converted to electricity by the wafers. A crucial aspect, from a life cycle perspective, is the amount of energy used in the manufacturing of solar panels in general and wafers in particular. According to the PV industry, pay back time (PBT) to recover the cost of the energy used in *manufacturing* a solar panel is currently estimated to be 2-4 years, depending on the amount of sun to which the panel is exposed. Due to technological improvements, the PBT has been radically reduced during recent years. Considering also that the cost per watt generated by solar energy has been radically reduced the last 10 years, the cost of electricity generated by solar energy has become increasingly competitive. According to the "Handbook of Photovoltaic Science and Engineering" (Hegedus and Luque 2003), the cost per Wp (peak watt) has been reduced by about 5 % per year since 1998. According to Erik Sauar, in some parts of the world, like Southern Japan, prices of photo voltaic electricity can be as cheap as about 0.22 per kWh.[139] This price is similar to the price Japanese households pay for electricity delivered from conventional, non-renewable sources.

9.2.2 The innovation journey – the short version

In the late 1980's Elkem ASA[140], one of the world's leading suppliers of metals and materials[141], including silica, developed a strategy for selling silica downstream. Alf

a total stand still in the PV energy market for about 10 months. Nobody wanted to invest in panels when they knew that a subsidy arrangement was coming up.

[138] For more information on this please consult the official "100.000 roofs program" http://www.100000daecher.de/ (accessed Feb 23, 2004) and related internet sites. They give an overview of much solar energy that can be produced from a rooftop installation and gives a calculation of costs related to it.

[139] Prices presuppose 1700 hours of sun annually, an estimated life time of the panel of 50 years and 5% interest rate on the loan

[140] Consult http://www.elkem.com/ for more information (Accessed May 2, 2004).

Bjørseth former R&D director of Elkem, and now chairman of the board of ScanWafer, was responsible for the project. Elkem bought Crystallox, a company spun off from research projects at Oxford University, and the world-leading producer of furnaces for silica smelting. Elkem had considered establishing a multicrystalline silica factory in Norway, but with the fall of the wall between East and West Europe in 1989 the market was flooded with cheap raw material from the East, and Elkem got into serious financial problems. Elkem was forced to cease investments in the segment and Mr Bjørseth left his position.

In 1994 ScanWafer was established by Mr Bjørseth and Reidar Langmo, CEO of Meløy Næringsutvikling AS[142]. Bjørseth had technological competence in the field and a vision of Norway as a perfect location for silica wafer production. Glomfjord in Nordland County in northern Norway was chosen as the site for a production facility. It offered an existing industrial infrastructure, an abundance of inexpensive hydroelectric power, large quantities of free cooling water for the production process and an available experienced, stable and skilled labour force familiar with shift work on a 24 hour basis.

ScanWafer later increased its production capacity from 10 MW to more than 70 MW by opening a second production line in Glomfjord, and commenced construction of a third plant at a new site, Herøya (200km south-south-east of Oslo) in August 2003. ScanWafer is now one of the world's biggest suppliers of multicrystalline silicon wafers with production totaling around 110 MW at an efficiency rate of 14%. Its expansion is going against the trend in manufacturing in Norway, which has experienced a decline in industrial employment in recent years.

9.2.3 Main actors and influences, barriers and drivers

The similarities with the Shecco case are evident regarding the driving forces behind technology development at REC. Champions seemed to be important in both cases. Had Mr. Bjørseth not forged ahead despite the difficulties at Elkem, multicrystalline silica wafer production would probably never have been started in Norway. While Shecco's innovations resulted from ideas developed by an academic scholar who came to Norsk Hydro, ScanWafer's innovations were driven by champions from within industry.

However, as in the case of Shecco, success at ScanWafer would not have been realized without significant industrial networking involving dedicated personnel in other companies. For example: In cooperation with the German company ALD, ScanWafer has developed a very effective furnace for the smelting of multicrystalline silicon into blocks. In cooperation with Vesuvius[143] ScanWafer have developed high-tech ceramic pots for the smelting of silicon into ingots. Experts from Mitsubishi, ScanWafer's biggest customer have been working part time at the Glomfjord plants to cut costs in wafer production. (The cost of wafers constitutes 50% of the cost of a Mitsubishi solar cell.) In cooperation with HCT[144], a Swiss company specializing in wire saws which slice the ingots into wafers, more efficient saws are being developed. Exclusive deals on the purchase of equipment

[141] Elkem's main products are ferroalloys, silicon metal, aluminium, carbon and microsilica.
[142] Some more information about Meløy Næringsutvikling is available at http://www.meloynett.com/download/www-MNU2003.pdf (Accessed May 3, 2004)
[143] http://www.vesuvius.com (Accessed July 30, 2004)
[144] http://www.hct.ch (Accessed July 30, 2004)

from ALD, Vesuvius, and HCT are critical to ScanWafer's ability to achieve low costs and a relatively big share of the market for wafers and emphasize the importance of industrial networks for succeeding in the PV-industry. According to Erik Sauar[145], R&D manager at ScanWafer, these supplier relationships make market penetration by new actors – lacking access to exclusive technology – very difficult.

At start up in 1994, ScanWafer found it difficult to raise funds to build the first production line in Glomfjord. Financial support was eventually secured from Meløy Næringsutvikling AS, an investment company owned by the Meløy municipality (50 %), Norsk Hydro (25 %) and two local banks. Some funding and resources were also allocated from SND and SIVA, referred to in chapter 7.2 above. Financing seems to have been more difficult for ScanWafer than for Shecco, because ScanWafer had to obtain funding from the open market whereas Shecco, to a large degree, could rely on funding from Norsk Hydro. ScanWafer has received R&D support from the RCN and some EU funding. Erik Sauar states that on many occasions ScanWafer has been offered better investment conditions by countries other than Norway – including EU countries such as Germany. An example is when ScanWafer decided to set up a new plant at Herøya (ScanWafers third plant). Local authorities of the county of Bayern in Southern Germany offered ScanWafer investment grants and tax credits. Representatives of SND – now part of Innovation Norway – charged that this was in violation of the European Economic Treaty (EET). According to Alf Bjørseth,[146] German authorities dismissed theses charges. ScanWafer eventually decided to locate the factory at Herøya, but this was done without the Norwegian government's support. Norsk Hydro and the major bank in Norway, DnB, supported the new production facilities.

There do not seem to be major hurdles to overcome in developing and market introduction of ScanWafer's technology, unlike the case of Shecco Technology. Nevertheless, it has been difficult to raise funds for investments in its three Norwegian factories. Despite these difficulties, ScanWafer has become a success story. The company has grown into one of the biggest suppliers of multicrystalline wafers in the world. ScanWafer has top-of-the-line production equipment, an experienced workforce and enjoys a solid market position.

9.3 To what extent are the two cases impacted by environmental and innovation policy integration in Norway?

It is clear that both Shecco and ScanWafer developed without major financial or other support from the Norwegian Government, although SIVA contributed to ScanWafer's first production line in Glomfjord.

The Shecco case is an example of what is probably a typical innovation processes within big Norwegian companies: SINTEF and Norsk Hydro kept the development of Shecco Technology secret until the patent application was filed. Then the Shecco team did *not* turn to Norwegian authorities for assistance from SFT's Program for Environmental Technology (see section 7.1.4 above) or SND's environmental warranties program (see section 7.2.3 above), but rather created worldwide research networks on its

[145] Interview June 26, 2003.
[146] Stated on November 14, 2003 during an innovation conference organized by NHO at Telenor EXPO.

own. According to Per Døvle at SFT[147], they were aware of Shecco's project, but an application for funding was never received. The case illustrates that commercial firms do not necessarily seek government assistance as a first recourse when developing new technologies.

In the Shecco case it is definitely a complicating element that the strategy of the Shecco team was to try to enter the Mobile Air Conditioning (MAC) market. In retrospect this could probably never have been facilitated by the Norwegian authorities anyway, as the need for extensive changes in a global industry required efforts on a high and concerted political level. There was, however, a meeting in the mid 1990s between the team and the Minister of the Environment at the time, Thorbjørn Berntsen. According to Mr. Rolf Marstrander[148], former research director at Norsk Hydro ASA, the Minister was very interested in the project and promised to confer with the German Minister of the Environment on the issue, but the Shecco team never received any feedback or follow ups from the MoE.

It is also important to remember that technology development is only the first stage in a long innovation journey. Although there was a system in place to finance demonstration projects, it was not a recourse sought by the Shecco team. Nevertheless, policy instruments for creating a market or finding a niche where the technology can be tested in real life (and where production can be cut), is of great importance. This is especially the case when the innovation in question is directed at mass production in a market that already has accepted alternatives in widespread use, like in the Shecco case: Given the prevailing preferences and the complexity of the MAC segment, it could therefore be easier to design policy instruments for the commercialization of the CO_2 technology in other applications such as tap water heating or cooling counters for supermarkets etc. Any national authorities should have expertise to evaluate such cases.

The ScanWafer case is somewhat different. The company has managed to set up three production lines providing work places in areas where industrial activity is reduced or disbanded. (This reminds us of the importance of including social references beyond ecological concerns. Sustainable development is based on three pillars and innovation and commercial development is not only related to financial and economic affairs. Employment and social change in general is crucial. Our concern, however, is that this social change must remain environmentally sound.) The SND and SIVA did contribute to the ScanWafer success story, but their contributions were not necessary to that success. The Herøya plant was set up *despite* rather than because of SND. ScanWafer's success is not a result of Norwegian environmental or innovation policies, an certainly not a result of integration of the two policy fields.

[147] Stated at meeting in MoE, May 5, 2004.
[148] Interview Nov 11, 2002.

10 CONCLUSIONS AND POLICY RECOMMENDATIONS

By 1997, 159 countries had established national commissions, or other national coordinating bodies, on sustainable development. These were initiated in order to develop an integrated approach to sustainable development and to include civil society in the process of developing strategies and agendas. This was also the case in Norway. In 1990 the National Committee on Sustainable Development (NCSD) was established. According to its mandate, the NCSD was to promote sustainable development by integrating environmental concerns into public and private activities. Two of NCSD's other tasks were to build national and international consensus, and to build alliances between government, the business sector, trade unions, the research sector, voluntary organizations and youth. The mandate was quite vague, and NCSD had considerable freedom to decide its own agenda and work (Hovden and Torjussen 2002).

In the period 1990 – 1993 NCSD held a number of meetings, but there are no records of meetings after 1993. Hovden and Torjussen (2002) argue that the poor relationship between the government and the environmental movement may have been one of the reasons for disbanding NCSD. The former Minister of the Environment, Thorbjørn Berntsen has claimed that it was disbanded mainly because business and labour became "tired of listening to the doomsday prophecies of the environmental movement" (Hovden and Torjussen 2002: 27). Regardless of the reason, it is clear that the visions of integrating environmental concerns into public and private activities were not realized. This was also the case for integration of environmental and innovation policies. When the resources for environmental technology dried up in the late 1990s, the executive officers' committee was dissolved[149]. The only politically initiated effort that remained was the Environmental Fund, under the sole direction of the SND.

When the government prepared its National *Strategy* for Sustainable Development prior to the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, it was again criticized for not involving non-state actors. Those involved in preparatory work for the National *Action Plan* (NA21) tried to address such criticisms by involving various stakeholders in a number of planning meetings, and the resulting action plan is quite explicit in calling for a communication platform characterized by transparency and public involvement. But it is still unclear as to whether the plan promotes policy integration in general and a green innovation policy in particular. The findings documented in this report are not very promising in that regard.

10.1 Findings

The National Environmental Monitoring System (NEMS) is an innovative exercise in policy integration. The system could, if fully operational, be a valuable tool for integrating environmental concerns into other policy areas. The bi-annual "State of the Environment"

[149] According to Emil Jessen, telephone interview May 25, 2004.

reports constitute a good basis for following up on environmental policy issues, and significant efforts have been made to formulate and publish sectoral Environmental Action Plans. As documented, however, the NEMS is not fully operational in accordance with the intentions of its founders. The major deficiencies are: a lack of reporting from the ministries on their efforts and incomplete work on the Result Documentation System (RDS). Further, the sectoral Environmental Action Plans need improvement, especially in meeting operational targets in accordance with the eight priority areas.

The comprehensive innovation policy action plan (HIP) is not really very innovative, and in terms of being an action plan, not very comprehensive. This is the case, at least, regarding environmental concerns and green innovation. This report documents that the HIP contains virtually no references to environmental concerns and does not take the ecological thresholds and Earth's carrying capacity into account. This stands in striking contrast to the basic the National Action Plan on Sustainable Development, NA21, in which the need for de-coupling is presupposed: Current economic growth trajectories cannot be sustained unless environmental concerns are taken into account. Indirectly the NA21 emphasizes that sustainable economic development must include a green innovation policy. In NA21 it is stated that the HIP "is consistent with NA21" (White Paper 1 (2003-2004): Ch 6.5.6), but as shown above: the HIP does not have references to environmental issues.

Further, a check of the directorates and initiatives under the Ministry of Environment and the Ministry of Trade and Industry reveals almost no current activities related to green innovation. On the contrary, the number of policy instruments related to green innovation and environmental technologies have declined significantly since the late 1980s, a finding that is supported by the evaluation of the most important policy documents published by the two ministries over the last 15 years. It is also worth noting that the funds for these few initiatives have mainly been provided by the MoE whereas MoTI is responsible for the innovation policy. The conclusion is quite clear: there is at present no green innovation policy for sustainable development in Norway and no integration between environmental and innovation policies.

Initiatives by other ministries, such as CO_2 taxation, SkatteFUNN and the schemes proposed by Enova, may all represent potentially important policy efforts in a green innovation context. However, we have very few findings that indicate that this actually is the case. Enova has no mandate to get involved in technology development. Its mandate is limited to the commercialization of newly innovated energy technologies. SkatteFUNN does not involve measures to specifically promote green innovation, and the logic behind CO_2 taxation assumes that, tax penalties related to specific emissions, will motivate firms to change technologies. However, it is beyond the scope of this report to evaluate the degree to which financial measures, like the CO_2 tax, have actually contributed to the development of green innovations. But given that most of the major polluting industries have been granted CO_2 tax exemptions[150], it is clear that there are few effective incentives for reducing such emissions.

[150] This is not the case for the petroleum industry.

10.2 Policy recommendations

The extensive documentation provided here clearly indicates that there is no integration between environmental and innovation policies. Consequently, there is currently no such thing as a green innovation policy in Norway. How could this situation be changed?

In accordance with our analytical approach, our first recommendation calls for improvement along two dimensions:

1) Strengthening of horizontal governance
2) Strengthening of vertical governance.

In the short term, however, it might be more feasible and realistic to reconsider the initiatives documented throughout this report. We will therefore propose a third set of policy recommendations related to vertical governance, namely simple alterations of some of the existing innovation initiatives:

3) Facilitating green innovation through existing sectoral policy instruments.

10.2.1 A strengthening of horizontal governance

Achieving greater cohesion through horizontal governance means that policy efforts must be coordinated and funding allocated. Recalling that there is currently no green innovation policy in Norway, a first and very important measure would be to **develop a Green Innovation Action Plan** (GIAP) for Norway that is compatible with other national policy efforts such as the National Action Plan for Sustainable Development (NA21) and the Plan for a Comprehensive Innovation Policy (HIP). If this is not feasible and alternative would be to develop an equivalent to current efforts undertaken in the EU with regards to the Environmental Technology Action Plan (ETAP). This would further support national efforts to strengthen sustainable development.

Preparatory work on a plan similar to the EU ETAP has recently been initiated by the MoE. We will not propose specific content for such a green innovation action plan. It is important, however, that it includes aspects of governance and that it addresses how actual activities of, for instance, a greening of industry, could be managed by various ministries and directorates. It is further important that an eventual plan be integrated and coordinated with other efforts undertaken by the Government to strengthen the national innovation policy.

A central authority specifically entrusted with the supervision, coordination and implementation of green innovation policy should be established. The authority should primarily be located at a high political level – the Prime Minister's Office, for example – to ensure policy integration, allocation of resources and a stable and long-term commitment to the task of promoting green innovation in Norway. Taking into account the political realities in Norway, however, an alternative solution would be to strengthen the position of the committee coordinating the National Action Plan for Sustainable Development (NA21). A strengthening of green innovation should be a crucial and necessary concern of a body entrusted with the task of strengthening sustainable development. Consequently, the NA21 committee of deputy ministers, which currently has limited its efforts to the development of national sustainable development indicators, should be more concerned with green innovation governance. (The NA21 committee of deputy ministers includes representatives from both MoE and the MoTI, in contrast to a committee of deputy

ministers established to promote the HIP, where the MoE is not represented). By strengthening governance for green innovation, the NA21 committee could make a significant contribution to the strengthening of sustainable development in Norway – integrating economic, social and ecological improvements.

As part of these efforts a clear initiative as to sectoral responsibility for **overarching goals** on green innovations should be initiated by the central authorities. Further, **timetables and targets** for green innovation policy should be developed and periodic **reporting** of progress with respect to targets at both the central and sectoral levels should be done, preferably in accordance with the NEMS. Finally, it is important to promote an active and monitored usage of **assessments** for all governmental policies related to green innovation. This should be a crucial task for the high-level committee entrusted with the challenge of horizontal governance.

10.2.2 A strengthening of vertical governance

As already indicated, this report has clearly documented that plans are not carried out in practice, especially in relation to the NEMS. Furthermore, implementation of several plans has not yet even begun. We are, therefore, not convinced that sectoral plans for green innovation will show significant improvement in terms of actual practice(s). However, as mentioned in the above discussion of horizontal governance, we strongly believe that Norway should develop a Green Innovation Action Plan, and that the plan should be supervised and enforced at a high political level. Such a central body would, however, only be capable of making broad strategic decisions on policy priorities and assuming overall responsibility for the efforts. Fulfillment of the actual objectives of a green innovation plan also requires vertical, and more "hands on", governance initiatives.

This "hands on" coordination could be achieved by establishing a **green innovation committee** consisting of public servants from relevant ministries and directorates, but with wider participation than the former executive officers committee referred to in chapter 7.2.3 above. Acting as a clearing house and coordinating body for the policy instruments in use, it should be capable of covering the whole innovation chain from invention to diffusion, and it could build up valuable expertise and experience on green innovations. It is important that the group operate with transparency and predictability, and – most crucially – with long-term financial and other resources at its disposal. The committee should also involve some sort of stakeholder management, and act as a secretariat, forum and meeting place for discussing, presenting and getting feed-back on actual green innovative efforts taking place in society. Acknowledging that innovation is not a linear process, there must be guidelines and goals, but also considerable room for creativity and unorthodox ideas and solutions.

A green innovation policy plan with central government responsibility for coordination and control could more effectively make use of financial, organizational, technological and human resources in the search for both development and diffusion of green innovation towards sustainable development. This could enable a strengthening of vertical governance, not only through new policy efforts but also with reference to already existing policy instruments.

10.2.3 Facilitating green innovation through existing policy instruments

If one is willing to accept that there are major global and local environmental challenges that need to be solved, and that innovation may be a part of the solution, it is, in our view, possible to alter some of the innovation-related policy instruments already in use. Given current policy instruments, a general recommendation would be that all directorates and initiatives described in the current report aim to increase the integration of environmental concerns in their daily activities related to innovation.

It should further be expected that **Innovation Norway** treat environmental concerns seriously and publish a strategy that promotes green innovation. In a European context it would be strange indeed if a state initiative like Innovation Norway did not take into account environmental concerns in their strategic plans and actual practices. Nevertheless at the moment they do not seem to take them into account. **Argentum and SIVA** should also be expected, to a greater extent, to take environmental concerns into account in their activities.

ENOVA is set up by the Ministry of Petroleum and Energy to contribute to environmentally sound and rational use and production of energy. ENOVA is currently focusing on the commercialization of new renewable energy technologies, but could, with its extensive financial resources, also be a significant actor promoting green innovation and green technology development.

A more specific example would be **SkatteFUNN.** Here between 18 and 20 per cent of costs related to company R&D activities is reimbursed as tax deductions. It would be possible to increase the rate of deductions by, for example, 5 or 10 per cent if environmental improvements could be documented. This would be a relatively cheap alteration of an existing instrument and it would show that there is political will to reward those who want to improve existing products, or develop new products that are more environmentally sound. Such an increase in tax deductions would encourage companies to promote environmentally sound solutions, and to focus their research and development in a more sustainable direction. The Pollution Control Authority should be able to verify actual improvements in these areas. If companies choose not to seek extra tax deductions by developing environmentally friendly solutions, the scheme will not imply extra costs for the government.

Finally, we note that the **Green Government** arrangements are to be integrated in all government operations in Norway, so that by the end of 2005 all national government institutions will have environmental management as an integral part of their management systems. A special focus on state procurement is to be used to facilitate a domestic market for environmentally friendly products and innovations. A challenging step on most innovation journeys is to take the crucial leap from “prototype” to “mass production”. If the state acted in a more environmentally responsible way, it could also insist that environmentally friendly solutions be sought more frequently. This would be instrumental in creating markets for green innovations – a very important step related to diffusion – and would also reduce commercial risk. With reference to the Shecco case presented above, for example, it would be of great importance if all state institutions stipulated stronger standards for eco-friendly cooling devises in public tenders.

The above mentioned examples can be easily extended. Efforts must, however, be supported, coordinated and enforced by the proposed committee of deputy ministers, and

should be directly embedded in the national efforts for strengthening sustainable development – NA21. We recognize, however, that achieving policy coherence is complicated and requires time, dedication and will. The ultimate question is whether and to what extent political will exists in the specific ministries and the Prime Minister's Office to integrate environmental and innovation policies in Norway. As long as political will is lacking, national efforts for promoting green innovations will remain insufficient, and national policies for achieving sustainable development will lack a highly relevant and broadly applicable instrument for change.

REFERENCES

Brekke, Kjell Arne and Olav Mosvold Larsen (forthcoming): *Market based Lock-in in the CondEcol cases. How useful is the Eco-Design Wheel?* ProSus Working paper. Oslo: University of Oslo - ProSus

Campbell N.J. and A. McCulloch (1998). The Climate Change Implications of Manufacturing Refrigerants. A Calculation of Production Energy Contents of Some Common Refrigerants, *Transactions of the Institution of Chemical Engineers*, Vol. 76, Part B, August 1998.

Collier, Ute (1997): *Energy and Environment in the European Union*. Aldershot: Asgate

Dokument nr 8: 93 (2002-2003): Forslag fra stortingsrepresentantene Inge Ryan, Øystein Djupedal, Ingvild Vaggen Malvik og Heidi Sørensen om opprettelse av et fond for nyetableringer og innovasjon basert på miljøteknologi

EU Commission (2003): *Consultation Paper. How to considerably reduce greenhouse gas emissions due to mobile air conditioners*. European Commission, DG Environment. Brussels, Feb 4 2003 (Available at: http://europa.eu.int/comm/environment/air/mac2003/pdf/consultation_paper.pdf Accessed June 1, 2004)

Godal, Odd and Jan Fuglestvedt (2002): ”Hvilke klimagasser er viktigst å redusere?” in *Cicerone* 1/2002. Oslo: Cicero – Centre for Climate Research

Hagen, Inger, Lasse Bræin og Tom E Christensen (1996): *”Hele virkemiddelapparatet i arbeid”: Evaluering av norsk miljøteknologisatsing 1989-94.* Oslo: Norsk institutt for studier av forskning og utdanning (NIFU)

Hartmark Consulting (2003): *Evaluering av Statens miljøfond for Miljøverndepartementet*. Utført av Hartmark Consutlig AS Desember 2003. [Evaluation of the Government’s Environmental Fund for the Ministry of the Environment. Conducted by Hartmark Consulting AS December 2003.] Available in Norwegian only. Limited circulation. (Copies should be available from the Ministry of the Environment.)

Hovden, Eivind and Gard Lindseth (2002): ”Norwegian Climate Policy 1989-2002” in Lafferty et al *Realizing Rio in Norway. Evaluative Studies of Sustainable Development.* Oslo: ProSus

Hovden and Torjussen (2002): “Environmental Policy Integration in Norway” in Lafferty et al *Realizing Rio in Norway. Evaluative Studies of Sustainable Development.* Oslo: ProSus

Husby, S. R. (1997): *Miljøvurderinger. Hvor ofte og hvordan omtales mijløhensyn i offentlige utredninge, meldinger og proposisjoner?*, Oslo: NIBR, prosjektrapport 1997: 31

Innst St nr 283 (2002-2003): *Innstilling fra næringskomiteen om virkemidler for et innovativt og nyskapende næringsliv og om forslag fra stortingsrepresentantene Inge Ryan, Øystein Djupedal, Ingvild Vaggen Malvik og Heidi Sørensen om opprettelse av et fond for nyetableringer og innovasjon basert på miljøteknologi*. Oslo: The standing committee on trade on industry in the Storting (Available at http://www.stortinget.no/inns/inns-200203-283.html Accessed June 1, 2004)

International Panel on Climate Change – IPPC (2001): Summary for Policy makers – a report of working group 1 of the IPPC, Geneva; United Nations

Lafferty, William M. and E. Hovden (2003): "Environmental Policy Integration: Towards an Analytical Framework" in *Environmental Politics*, Vol. 12, No.3, Autumn 2003, pp. 1-22. London: Frank Cass

Lafferty, William M. and Oluf Langhelle (1999): *Towards Sustainable Development: The Goals of Development and the Conditions of Sustainability*. London: Macmillan

Lafferty, William M. and James Meadowcraft (eds) (2000): *Implementing Sustainable Development: Strategies and Initiatives in high Consumption Societies,* Oxford: Oxford University Press

Langhelle, Oluf (2000): "Norway: Reluctantly carrying the torch", in Lafferty and Meadowcraft (eds.) *Implementing Sustainable Development. Strategies and Initiatives in High Consumption Societies*, Oxford: Oxford University Press

MoE (2003): *Miljøhandlingsplan for Miljøverndepartementet 2003-2006 [Environmental Action Plan for Ministry of Environment 2003-2006]*. Ministry of Environment. Available at: http://odin.dep.no/filarkiv/162248/T-1420.pdf (Accessed June 1, 2004)

MoE (2000-2001): Ministry of Environment White Paper 42 (2000-2001): *Biologisk mangfold Sektoransvar og samordning.* English summary of the report: "Norwegian biodiversity policy and action plan - cross-sectoral responsibilities and coordination" is available at http://www.odin.dep.no/md/engelsk/publ/stmeld/022001-040019/index-dok000-b-n-a.html (Accessed June 1, 2004).

MoE Parliamentary Bill 1 (2003-2004): *St.prp. nr. 1 (2002-2003). FOR BUDSJETTERMINEN 2003. Utgiftskapittel: 1400-1471, 2422 og 2465. Inntektskapittel: 4400-4471, 5322 og 5621. [Ministry of the Environment's Parliamentary Bill nr 1 2003-2004 on the State Budget]* Oslo: MoE (Available, in Norwegian only, at http://odin.dep.no/md/norsk/publ/stprp/022001-030008/dok-bn.html Accessed June 1, 2004)

MoER, St.prp. 1 (2002-2003): *St.prp. nr. 1 (2003-2004). FOR BUDSJETTERMINEN 2004. Utgiftskapitler: 1800-1830, 2440-2442 og 2490. Inntektskapitler: 4810-4860, 5440, 5490, 5608, 5680 og 5685. [Ministry of Education and Research's Parliamentary Bill nr 1 2003-2004 on the State Budget]* Oslo: MoER (Available, in Norwegian only, at http://odin.dep.no/oed/norsk/publ/stprp/026001-030024/dok-bn.html Accessed June 1, 2004)

MoH (2002): *Sektorvis miljøhandlingsplan for Helsedepartementet og Sosialdepartementet [Environemtnal Action Plan for the Ministry of Health and the Ministry of Social Affairs]*. Oslo: Ministry of Health

MONIT (2003): "Joint Conceptual Paper". Unpublished paper. Available from the authors.

MoTI (2001): *Nærings- og handelsdepartementets Miljøhandlingsplan 2001-2005 [Environmental Action Plan for Ministry of Trade and Industry 2003-2006]*. Ministry of Trade and Industry. Available at: http://odin.dep.no/nhd/norsk/publ/handlingsplaner/024001-990116/dok-bn.html (Accessed June 1, 2004)

MoTI (2003): *From idea to value. The Governments Plan for a Comprehensive Innovation Policy*. Oslo: Ministry of Trade and Industry. (Also available online at: http://www.odin.dep.no/nhd/engelsk/publ/handlingsplaner/024071-220006/index-dok000-b-n-a.html Accessed June 1, 2004)

MoTI Parliamentary Bill. Nr 1 (2003-2004): *St.prp. nr. 1 (2003-2004). FOR BUDSJETTERMINEN 2004. Utgiftskapitler: 900-953, 2421, 2426 og 2460. Inntektskapitler: 3900-3961, 5320, 5325, 5343, 5460, 5609, 5625 og 5656. [Ministry of Trade and Industry's Parliamentary Bill nr 1 2003-2004 on the State Budget]* Oslo: MoTI (Available, in Norwegian only, at http://odin.dep.no/filarkiv/189201/budsjett2004nhd.pdf Accessed June 1, 2004)

NOU 4 (1995): *Virkemidler i miljøpolitikken* Oslo: Ministry of Environment (Available in Norwegian only at http://www.odin.dep.no/md/norsk/publ/utredninger/nou/022005-020001/dok-bn.html Accessed June 1, 2004)

NOU 9 (1996): *Grønne skatter - en politikk for bedre miljø og høy sysselsetting [Green taxes – a Policy for sound environment and high employment]* Oslo: Ministry of Finance and Customs. (Available, in Norwegian only, at http://odin.dep.no/fin/norsk/publ/utredninger/NOU/006005-020013/dok-bn.html Accessed June 1, 2004)

NOU 23 (1996): *Konkurranse, kompetanse og miljø. Næringspolitiske hovedstrategier [Competition, competence and the environment].* Oslo: Minstry of Trade, Industry

and Energy. (Available, in Norwegian only, at http://odin.dep.no/odinarkiv/norsk/norges_off_utredn/1996/038005-020005/dok-bn.html Accessed June 1, 2004)

Ot Prp 35 (2000-2001): *Om lov om endringar i lov 29. juni 1990 nr. 50 om produksjon, omforming, overføring, omsetning og fordeling av energi m.m. (energilova)*. Oslo: Ministry of Petroleum and Energy

Porter and van der Linde (1995): "Green and Competitive" in *Harvard Business Review* September- October 1995

ProSus (2003): *Skisse til Nasjonal Agenda 21. Kommentarer og anbefalinger fra Program for forskning og utredning for et bærekraftig samfunn (ProSus).* Arbeidsnotat nr 1/03. Oslo: ProSus. (Available in Norwegian only at http://www.prosus.uio.no/publikasjoner/Arb_not/2003/Notat1.pdf Accessed June 1, 2004)

RCN (2003): *Research Council of Norway Annual Report 2002.*Oslo: Research Council of Norway

Reitan, M. (2001): "Ecological Modernization and 'Realpolitik': Ideas, Interests and Institutions", *Environmental Politics*, Vol 17, no. 2: 1-16.

Riksrevisjonen (1999): "Riksrevisjonens undersøkelse vedrørende regjeringens miljørapportering til Stortinget." *Riskrevisjonens Administrative rapporter* nr 1 1999. Oslo: Riksrevisjonen

Ruud (2002): "Industry and Environmental Responibility. From Proactive to Reactive Public Policies", in Lafferty et al *Realizing Rio in Norway. Evaluative Studies of Sustainable Development.* Oslo: ProSus

Statskonsult (2003): "Evaluering av sektorvise miljøhandlingsplaner" *Statskonsult Rapport* 2003:6. Oslo: Statskonsult

Parliamentary Bill 51 (2002-2003): *Virkemidler for et innovativt og nyskapende næringsliv. [Parliamentary Bill 51 (2002-2003) Policy instruments for an innovative and creative business and industry]* Oslo: Minstry of Trade and Industry (Available, in Norwegian only, at http://odin.dep.no/nhd/norsk/publ/stprp/024001-030016/dok-bn.html Accessed June 1, 2004)

SSB (2003): *Naturressurser og miljø 2003*. Oslo/Kongsvinger: Statistisk Sentralbyrå

Torjussen, Solveig (2002): *Styring for en bærekraftig utvikling – En evaluering av offentlige tiltak for sektorintegrasjon i Norge1987-2001.* Oslo; ProSus, University of Oslo, Report 3/02

UN (1993): *Earth Summit Agenda 21. The United Nations Programme of Action from Rio.* Geneve: United Nations Department for Public Information.

WCED (1987): *Our Common Future.* World Commission on Environment and Development. Oxford: Oxford University Press.

White Paper 46 (1988-89): *Miljø og utvikling. Norges oppfølging av Verdenskommisjonens rapport.* Oslo: Ministry of the Environment

White Paper 58 (1996-97): *Miljøvernpolitikk for en bærekraftig utvikling. Dugnad for framtida*. Oslo: Ministry of the Environment

White Paper 8 (1999-2000): *Regjeringens miljøvernpolitikk og rikets miljøtilstand [The Government's Environmental Policy and the State of the Environment]* Oslo: Ministry of the Environment

White Paper 24 (2000-2001): *Regjeringens miljøvernpolitikk og rikets miljøtilstand [The Government's Environmental Policy and the State of the Environment]* Oslo: Ministry of the Environment

White Paper 38 (2000-2001) *Om organisering av investeringsselskap [On the organizing of investment companies].* Oslo: Ministry of Trade and Industry

White Paper 25 (2002-2003): *Regjeringens miljøvernpolitikk og rikets miljøtilstand [The Governmen'ts Environmental Policy and the State of the Environment]* Oslo: Ministry of the Environment

White Paper 1 (2003-2004): *Nasjonalbudsjettet 2004. [The State Budget 2004]*. Oslo: Minstry of Finance