

## Project description

# Climate change Altering Nordic Energy Systems (CANES)

## 1. Introduction

National energy systems in the Nordic countries are influenced by various factors that make foresight a difficult task. The CANES project focuses on the effects of climate change, connecting this policy field to two other profound developments: The interconnection of the Nordic energy systems and the expansion of EU policies. Climate change affects national energy systems in several ways: One is actor expectations as to meteorological effects and the precautions taken on this basis. Additionally, the system's operational framework and conditions are affected by decisions on climate policy. The sum of these changes could substantially alter energy management and investment options for energy consumers, energy producers and national system operators alike.

The primary objective of the CANES project is to *improve our understanding of how investment patterns in Nordic energy systems are and will be affected by political changes aimed at mitigation of and adaptation to climate change*. Empirical focal points are how current and planned climate-induced policies at the EU and the national level affect energy demand, supply and infrastructure development in Norway and Sweden, recognising the strong interconnectedness of the national energy systems in these two countries. In order to achieve its primary objective, the project is seeking to improve our understanding of:

1. factors that promote and restrain the integration of climate concerns into EU policy areas with repercussions on investment patterns in the Nordic energy system;
2. domestic factors promoting and restraining integration of climate concerns in the Norwegian and Swedish energy systems with repercussions on national energy system investment patterns;
3. how EU policies interact with domestic factors in Norway and Sweden to strengthen/weaken investment options;
4. how domestic factors across the Nordic countries interact, through the interconnectedness of national energy systems, to affect investment patterns.

For its industrial partners, the CANES project aims to:

1. enhance their readiness to respond to political developments at national, Nordic and EU levels;
2. improve their forecasting concerning future needs for production capacity and energy infrastructure, nationally and across borders;
3. contribute to the identification of politically feasible future balancing strategies for the Nordic energy system in a carbon-constrained world.

The Fridtjof Nansen Institute (FNI) is the co-ordinator of the project. The research tasks are conducted by FNI in collaboration with the Stockholm Environment Institute (SEI) and Lund Institute of Technology. Energibedriftenes Landsforening (the Norwegian Electricity Industry Association), Norsk Industri (the Federation of Norwegian Industries), Statnett, Statkraft, Svenska Kraftnät and Vattenfall are industrial partners in the project.

## 2. Empirical status and key issues

National energy systems can be analysed as large socio-technical systems composed of interacting technical and social subsystems. The key elements of the former are energy conversion facilities, transmission and distribution systems, as well as existing energy-use technologies. The key elements of the social subsystem are actors, organisations and institutions linked together in the conversion, transmission, management and utilisation of energy – including the political actors that define the rules for maintaining and developing the technical system.

Nordic energy systems have evolved with distinct national characteristics as to their generation technologies, primary energy resources, role of electricity vs. heat and natural gas infrastructures and energy-use technologies. They are also characterised by a high degree of interconnectedness of technical systems (i.e. electricity infrastructure) and social systems (e.g. common Nordic electricity market). Additionally, they share the characteristics of technical and social interconnectedness to the larger EU system, through cross-border infrastructure and inclusion in the internal energy market with political commitments to adopt EU policies affecting the energy field. Over the past decades, the EU has increased its scope of policy competencies at the expense of the member-state level and of EEA members such as Norway. The EU has superior decision competency for policy fields under the Treaty System, notably to pursue regulations aimed at ensuring the freedom of movement of goods, services, capital and labour across national borders within the Community. The EU has gained increased competencies also in sector policies, through directives that define the sectors as part of the internal market, such as the internal energy market directives. And not least, during the 1990s the EU acquired new competencies in environmental policy fields, especially regarding climate change.

Political developments at the EU level will affect national energy systems in the Nordic countries directly, and by secondary effects caused by spill-over from EU-induced change in other Nordic countries. Decisions made in Sweden will have repercussions for developments in the Norway's energy system, and vice versa.

National energy systems in Europe contribute extensively to emissions of climate gases and have therefore over the past two decades been targeted for emission reduction policies by EU and national decision-makers. Emission reduction goals and policies have existed in parallel with other worthy political goals and instruments targeting national energy systems. EU decision-makers have sought to maximise Community welfare and growth through policies aimed at ensuring free and fair competition and trade across national energy systems, and have increasingly targeted policies aimed at containing the Community's security of supply problems. National decision-makers have on the one hand been committed by EU policies; on the other hand they have sought to achieve national-specific goals concerning climate change, other environmental aims, energy security and industrial development.

Substantial research already exists concerning overall EU and national climate change policy positions in the Nordic countries and their effect on national energy system investment needs, particularly regarding investments in new renewable electricity generation. Major research projects have analysed the interconnectedness of the Nordic energy systems and the need for the Nordic countries to co-ordinate their climate change policies in order to arrive at optimal investment solutions. However, there is a lack of studies that identify Nordic system effects and take into account the complexity of political forces at work at the EU and national levels.

Some aspects have been analysed, such as the EU Emissions Trading Directive. And some studies have focused on the impacts of climate policy on investments in new generation capacity and electricity infrastructure, based on given scenarios for growth in electricity demand. Less attention has, however, been given to near past and planned EU and national policies targeting major-energy consuming sectors and energy infrastructure development, and the potential direct and secondary effects on Nordic energy system investment needs.

And yet, such a research focus is highly topical, given the various political processes currently at work at the EU and national levels concerning major energy-demand sectors and the development of energy infrastructure in Norway and Sweden – notably the energy-intensive industries and the buildings sector, demand and supply from the Norwegian petroleum industry and the framework for construction of new energy infrastructure. Development within the two former sectors might substantially alter needs for energy production and infrastructure development in the Nordic energy system, each constituting around thirty percent of total energy demand in the two countries.

For more than a decade, national climate policies have targeted all the above-mentioned sectors in both Norway and Sweden. Differences in political priorities, natural resources, and economic and technological development give reason to believe that climate concerns are integrated in different ways and to varying degrees across sectors and countries. It must be noted that adaptation to climate change has been given scant attention in Norway and Sweden, whereas mitigation of greenhouse gas emissions has been fiercely debated.

During the past decade, the EU has increased its influence on the national sectors under study through a range of policies – some adopted, others planned. The 2003 directive establishing the emissions trading system represents a typical example, with its dramatic effect on electricity prices and electricity-intensive industries in the Nordic countries during 2005 and 2006. Revisions of the EU ETS, revision of the Environmental Guidelines for State Aid, signals provided by the high-level forum on Competitiveness, Energy and Environment, and the public consultation on the Green Paper on energy security are examples of current political processes with the potential to affect both electricity-intensive industries and the petroleum sector in the Nordic energy sectors.

Discussions about connecting offshore installations to the onshore electricity grid and plans for new generation capacity based on natural gas make the Norwegian petroleum sector important when assessing future developments within Norway's energy system. Higher levels of offshore activity as well as the development of onshore natural gas-based power capacity (with or without carbon capture and sequestration) might alter the balancing of the Nordic energy system. Offshore activities may be affected by the energy policy of the EU, and in particular the emission trading system.

When it comes to the energy-intensive industry in Norway, the EU has targeted the state aid given in the form of long-term power contracts. Within changing political framework conditions, the energy-intensive industry in Norway struggles to protect its favourable long-term contracts and electricity price privileges. Also the Swedish industry has argued in favour of price regulation, due to the steep increase in prices seen in Europe the past year, followed by similar claims from corresponding industries across Europe. Energy-intensive industry is in addition affected by the emergence of the EU-governed emissions trading system. This scheme may also affect the Norwegian policy that targets greenhouse gas emissions from petroleum activities.

Energy demand in Norwegian and Swedish buildings will be affected by the EU directive on energy performance in buildings, now being implemented in the two countries. Also relevant are the action plan for energy efficiency, the directive on energy services and the revision of the Environmental Guidelines for State Aid. Building regulations have traditionally been stricter in Sweden, but the Norwegian government is currently increasing its ambitions in this field. The introduction of energy labelling of buildings may consolidate this renewed political attention and has the potential to move the market towards energy-efficient buildings.

Finally, EU policies could also affect infrastructure development and system operator models in the Nordic energy system. A well-functioning energy infrastructure is a precondition for balancing energy supply and demand. Whereas the Nordic system is rather electricity dependent, particularly in Norway, both Norway and Sweden aim for diversity. Infrastructure development for gas and heat supply may affect electricity infrastructure needs. Energy infrastructure development is influenced both directly and indirectly by EU policies – through EU energy policy, climate policy, competition policy and policies affecting energy demand. Moreover, changes in meteorological conditions due to climate change may have profound effects on the energy infrastructure.

On this background, the research tasks of the project, defined by the objectives set out in section 1, are organised as four separate work packages.

### **3. Work packages**

#### **Work package I: Integration of climate concerns in EU policy**

This work discusses integration of climate change mitigation and adaptation in EU policies, with a main focus on policy areas of particular relevance for the actors in the energy system. Some policies are important for many actors within the system (such as state aid rules and the emission trading system), while others are specific to a few system actors (such as policies for energy use in buildings). Emission reduction is but one goal in these policies, while free and fair competition, increased security of supply and industrial development are others. Climate integration is thus very much a matter of how emission reduction is given priority and made coherent with these other concerns.

Applying a broad definition of policy, we investigate various kinds of political documents (Action Plans, Green/White Papers, Directives, Programmes, Communications, etc.). Policy include regulatory measures, spreading of norms and standards as well as follow-up sanctioning mechanisms adopted to ensure policy implementation in member states. To capture evolution over time, we compare climate integration in selected policy areas at different points in time

Two research questions are being explored, dealing with the dependent variable and explanatory factors, respectively;

- 1a) How and to what degree are climate concerns integrated in EU policies targeting:
  - the demand side of the energy system (the buildings sector and energy-intensive industries, including the petroleum industry)

- the supply side of the energy system (energy infrastructure and production systems)

1b) Which factors have promoted and restrained integration of climate concerns in these EU policies? Our examination include the role of:

- the European Commission
- the interests and power of member states
- organisational fields evolving at the EU level
- the global climate regime

At a general level, some explanatory studies of EU policy output tend to highlight the role of the Commission while others regard the power play between member states as the main explanatory approach. Both are being explored and contrasted with approaches that take into account also ‘field-level factors’ at the EU level and the effect of the global climate regime.

Concerning the *Commission*, we examine to what extent actions reflect the positions, capacity and access to decision processes of the various Directorates General. We also examine the Commission’s formal capacities and negotiating skills, in order to discuss its role as an actor in its own right with abilities to affect the final policy outcome. Degree of contact with relevant committees in the European Parliament is one obvious strategy for the Commission to strengthen its powers.

This approach is contrasted with a perspective that sees the Council’s decisions as reflecting *the power balance between the EU member states*. Climate integration policy will here be promoted by the Council if this is in line with the positions of the most powerful member states.

Whether and how *organisational fields at EU level* affect the integration of climate concerns depends on the prevalent social rules and level of institutionalisation of energy system actors in focus, industry, petroleum, buildings and energy. We explore the existence of such rules and their coherence with climate concerns. An organisational field will most likely affect EU policy development if it is strongly institutionalised, with actors connected across national boundaries and following similar societal rules all over Europe.

Concerning *the global climate regime*, we explore its strength (policy rules and follow-up mechanisms) in affecting climate integration in EU policies.

## **Work package II: Integration of climate concerns in various domestic fields**

This work aims to explain the integration of climate change mitigation and adaptation in the national energy systems of Norway and Sweden, with a specific focus on the system actors selected for this study.

The research questions that are being explored are:

2a) How and to what degree are climate concerns integrated in:

- the energy-intensive industry in Norway
- the energy-intensive industry in Sweden
- buildings in Norway
- buildings in Sweden

- power production in Norway
- power production in Sweden
- the petroleum sector in Norway
- energy infrastructure development (electricity, heat, natural gas) in Norway
- energy infrastructure development (electricity, heat, natural gas) in Sweden

2b) Which factors promote and restrain integration of climate concerns within these parts of the system? Among other factors, we examine:

- the strength of EU policy
- domestic organisational fields
- the aims of domestic political executives (national policy)

A stepwise exploratory process is needed for answering question 2a. First, we examine the relation between social rules within the field and climate concerns. Next, we explore how these rules guide behaviour (mitigation and adaptation behaviour). Adaptation to climate change includes actions taken to avert negative impacts and accommodate positive impacts of climate change. This is particularly relevant for system-actors in the buildings sector, power producers and energy infrastructure agents.

When addressing question 2b, the *strength of EU policies* is made operational in line with the criteria set out in WP 1. We expect *organisational field logic-impacts* on the integration of climate concerns to reflect prevalent societal rules and the level of institutionalisation among the actors affected: industry, petroleum, buildings and energy respectively. Field-level factors will be expected to affect how climate concerns are coped with if actors are strongly connected and follow similar normative and cognitive rules. The role of domestic policy-makers is expected to be conditioned on specific national political objectives and the room for manoeuvre that EU policy allows for domestic policy. Whether there is room for the domestic politicians to freely form the level and kind of integration will result from the discrepancy between the pressure from the EU and the level of institutionalisation within the organisational fields in focus. Whether and how the room for manoeuvre is exploited or not is, however, an empirical question.

Ultimately, the evolution of the organisational fields and their interactions will affect how actors make choices, including investments. The work package examines these ‘material changes’ empirically and chart out the trends in EU and domestic policies as well as field developments, in order to gain some predictive capacity regarding how actual energy investments, systems and operations might develop into the future (see work package IV).

### **Work package III: Carbon-constrained energy infrastructure development**

This work package addresses the mutual dependency existing between the Norwegian and Swedish energy systems and how climate change-induced policies adopted in one country could affect energy demand and supply, the development of various energy infrastructures (electricity, heat, natural gas) and system operator roles in the other country. As infrastructure development will rely heavily on the development of supply and demand, this examination relates to the other work packages. Main research question:

3a) To what extent and in which ways do developments in energy-related sectors in Sweden affect developments in energy-related sectors in Norway, and vice versa?

The work package collects data and analyse patterns on how the two energy systems are connected physically and socially, in close contact with the industrial partners of the project. We next analyse how different climate mitigation and adaptation behaviour might have repercussions across the system – how the behaviour of an actor in one part of the system will affect actors in other parts of the system.

#### **Work package IV: Deriving theory conclusions and improving partner capacity for forecasting**

This work package synthesises the results from the other work packages, aiming to discuss and propose theory development and strengthen the forecasting capacity of the partners involved and other energy system agents. Conclusions are drawn concerning the relative importance of EU policies, domestic factors and spill-over from neighbouring countries when discussing how climate change may affect investment patterns within the national energy systems of Norway and Sweden. The importance of policies aimed at climate change mitigation and adaptation are being discussed in relation to other forces of change.

The synthesis provides the basis for assessing issues of particular importance to the partners. Our aim is to equip project-collaborators with a deeper understanding of the current processes of change within the energy system, and to help to identify the politically most likely and feasible future developments. The long-term patterns of energy demand, supply as well as infrastructure needs, within the Norwegian and Swedish energy systems and the forecasting need of national system agents and system operators will be analysed. The insights provided through the systematic investigation of fundamental drivers for the Nordic energy system is being checked against the assumptions included in existing scenario analyses of future patterns of demand, supply and infrastructure development. Existing forecasts will provide templates for discussing insights from the project. Earlier assumptions made about total demand and demand patterns as well as supply and infrastructure needs will be critically examined and discussed. Finally, the work package rounds off the project with a more normative discussion of current Nordic models of system-operator responsibilities under climate change constraints.

Main research questions:

- 4a) How do domestic factors, EU policies and developments within neighbouring countries interact and affect energy demand, supply and investment needs within the energy systems in Norway and Sweden?
- 4b) How may the former be taken into account when developing forecasting models?
- 4c) Are Nordic system operators equipped with sufficient decision-leverage to respond to proactive climate policies while also ensuring long-term balancing of the system?

#### **The PhD project**

The PhD project included in the project will be conducted by FNI Research Fellow Elin Lerum Boasson and will be linked especially to work packages 1, 2 and 3. The focus is on the domestic sectors affected by climate policies and EU policies. It encompasses studies of the buildings sector at EU level and domestic level in both Norway and Sweden, EU policy targeting energy-intensive industry and petroleum, and developments within these sectors in Norway. The PhD project will provide both empirical and theoretical bases pivotal to fulfilling the overarching aims of CANES. Investment needs within the Nordic energy system are not directly in focus in the PhD project, rather this work provides a foundation for such elaborations.

## **4. Project organisation and management**

The three-year CANES project (2007-2009, with a further year devoted to finalisation of the PhD project in 2010) is being co-ordinated by the Fridtjof Nansen Institute (FNI) in collaboration with the Stockholm Environment Institute. Industrial partners are the Norwegian Electricity Industry Association (Energibedriftenes Landsforening), the Federation of Norwegian Industries (Norsk Industri), Statnett, Statkraft, Svenska Statnät and Vattenfall. Lund Institute of Technology is an associated research partner to the project. FNI strives to establish viable discussions that can provide mutual learning for all the participating actors. Regular reference group meetings serve as forums for exchange of ideas and discussions of work in progress.

### **Fridtjof Nansen Institute (FNI)**

Fridtjof Nansen Institute (FNI) is an independent foundation engaged in research on international environmental, energy and resource management politics. The main academic discipline represented is political science, but FNI researchers also hold degrees in law, economics, history, social anthropology and biology. The institute has long experience in studying international climate policy, energy policy in the Nordic countries as well as EU policy. FNI has studied EU policy impacts on the Norwegian energy system in various projects and is currently engaged in a joint project with the Institute for Energy Technology (IFE) financed by the Norwegian Research Council's RENERGI programme: 'Norwegian energy technology innovation and diffusion in a global technology market with international commitments'. The role of FNI in this project is to assess how EU policies affect Norway's choice of specific energy-conversion technologies (windpower, bioenergy, biofuels, hydrogen, natural gas) and end-use technologies (buildings technology). The results from this project and the theory framework developed for assessing EU impact on domestic policy is providing important inputs into CANES.

### **Stockholm Environment Institute (SEI)**

The Stockholm Environment Institute (SEI) is a policy research institute specialising in sustainable development and environment issues. Its research programme aims to clarify the requirements, strategies and policies for a transition to sustainability. The project is undertaken by researchers in the Policy & Institutions (P&I) Programme. P&I analyses policies and decisions as well as the processes and institutions in place for making them, contributing to more sustainable decisions and more effective and efficient policy and planning processes and improved governance. Work is based on theory from the social, planning, and political sciences. Current relevant P&I activities focus on understanding how environment-related policy and planning decisions are made and analysing how they may constrain or contribute to sustainability. Among the assessment methods applied are scenario methodology, material flows and resource analysis, participatory methods and strategic assessments. Further, SEI focuses on institutional arrangements, analysing and strengthening institutional capacities, mechanisms, and processes, including management systems and arrangements for knowledge use and co-ordination in decision-making structures such as inter-governmental organisations, national sector agencies, regional and municipal planning, firms, and development co-operation agencies.

### **Active Industry Partners**

The project's industry partners have been chosen on the basis of their paramount importance within the energy systems of Norway and Sweden. Their participation ensures a valuable knowledge base for the work of the project. *Svenska Kraftnät* is the Swedish state utility

responsible for operating, planning and investing in Sweden's main electricity grid and gas pipelines and it has duties as Swedish electricity system operator. *Statnett* is a public enterprise, owned by the Norwegian state, responsible for operating, planning and investing in Norway's main electricity grid and sub-sea cables to other countries, and for co-ordinating supply and demand in the Norwegian power system. *Statnett* has responsibility for ensuring short-term balancing of demand and supply. *Vattenfall* ranks as the fourth largest electricity producer and the largest producer of heat in Europe. Beyond Sweden, where the company accounts for around half of total electricity production, the company also has activities in Denmark, Finland, Poland, and Germany. The company is involved along the whole electricity supply chain: in production, transmission, distribution, sales and trade as well in production, distribution of sales of district heat. *Vattenfall* is a subsidiary of *Vattenfall AB*, owned by the Swedish state. *Statkraft*, a state-owned company, is Norway's leading producer of electricity and number three in the Nordic energy system. *Statkraft* is also involved in Sweden, Germany, the Netherlands and Bulgaria. The company has its main activities in production, wholesale and trade of electricity. Through subsidiaries and shareholdings in Norwegian regional companies, the company is involved in distribution, end-user sales, district heating and broadband activities. The *Norwegian Electricity Industry Association (EBL)* is the trade organisation for around 260 energy companies. The main purpose of the *EBL* is to deal with industry-related economic and political issues on behalf of its members, and to provide good framework conditions for the industry with respect to financial, legal and technical issues. The *Federation of Norwegian Industries (Norsk Industri)* is the trade organisation for around 2,000 manufacturing and process industry companies, including the energy-intensive industries of Norway.