CLIMATE AND ENERGY SYSTEMS (CES) 2007–2010
A NEW NORDIC ENERGY RESEARCH PROJECT

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ABSTRACT

A new Nordic Energy Research project, Climate and Energy Systems (CES) – Risks, Potential and Adaptation, was initiated in 2007 with a 4-year-funding from NER, the Nordic energy sector, and individual partners. The project focuses on three main renewable energy resources; hydropower, bio-fuels and wind power, and how future climate change within the next 20–30 years can impact these resources. An overview is given of the project organization, the main objectives and a working plan for the project is given.

INTRODUCTION

The project Climate and Energy Systems; Risks, Potential and Adaptation (CES) is in many ways a follow up of the Climate and Energy (CE) Nordic-Baltic research project (2003–2006), which have both been funded by Nordic Energy Research (www.nordicenergy.net) and the Nordic energy sector (Fenger, 2007). The main objective of the CE project was to make a comprehensive assessment of the impact of climate change on renewable energy resources in the Nordic area including hydropower, wind power, bio-fuels and solar energy on a longer time horizon. Scenarios for the period 2070-2100 for climate and renewable resources were developed and compared through systems simulations (Fig. 1). This comparison led to estimates of the changes in the production of the system, nevertheless, analysis of the energy systems development and of the market led to the conclusion that these changes would be overwhelming on this time scale, except for Iceland, where melting of glaciers would increase the production capacity by some 50%.

The results of the CE project serve as an important basis for an in-depth understanding of the impact of climate change on Nordic renewable energy resources, but are also important for rational decisions regarding strategies for energy policies, including strategies for the reduction of greenhouse gas emissions.

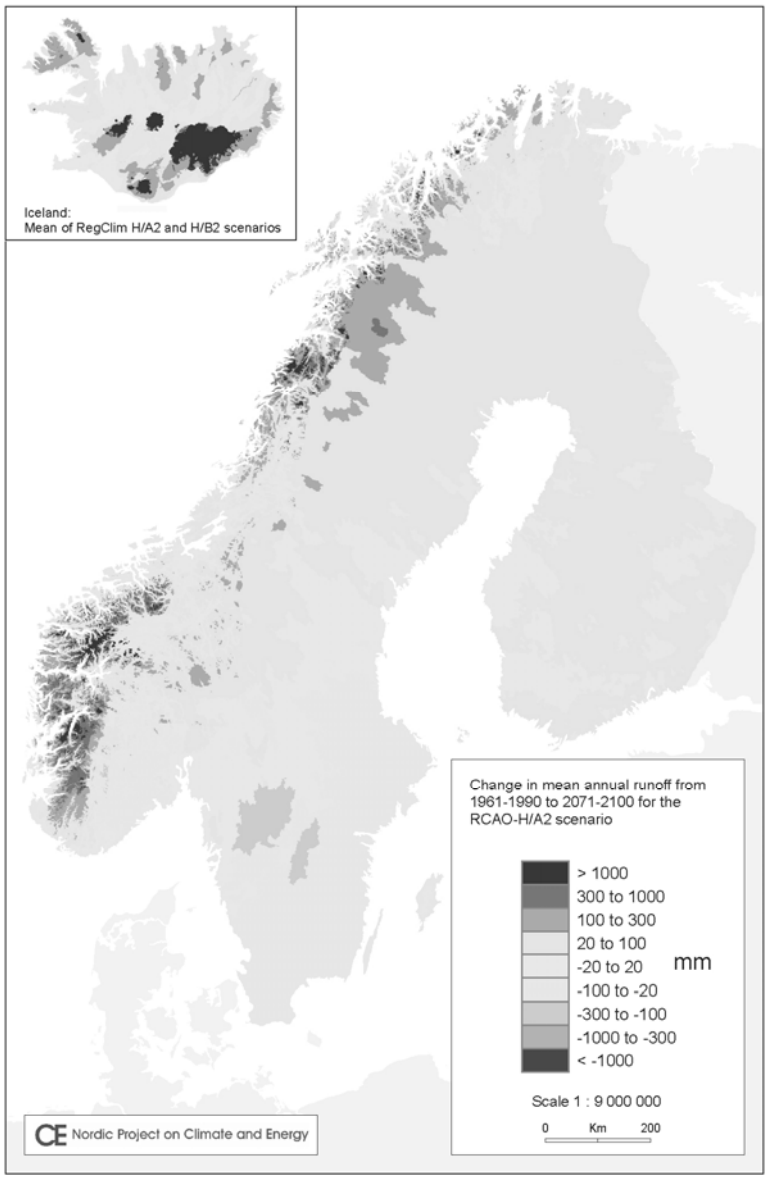

Figure 1. Change in mean annual runoff from 1961-1990 to 2070-2100 for Scandinavia and Iceland. Color version of the figure is included in the electronic version of the paper. (See Beldring et al., 2006 and Bergström et al., 2007 for further discussion).

ORGANIZATION OF THE CLIMATE AND ENERGY SYSTEMS (CES) PROJECT

Funding for the CES project comes from the Nordic Energy Research (53%), the Nordic Energy Sector (33%) and the internal funding of the individual participants (14%). The project management is located at NEA, Iceland, under which the project is organized as a matrix structure with four working groups (WG) on renewable energy resources, i.e. Hydropower–hydrological models, Hydropower–glaciers/snow/ice, Biofuels and Wind power groups (Fig. 1). Another five WG have been created to work on the

interdisciplinary level and cross-cut the renewable energy resource groups; Statistical Analysis, Risk Assessment, Climate Scenarios, Energy System Analysis and Information Management. These WG are served and supported by a Steering Group, consisting of a representative from each of the WG and a spokesman from each of the five partners from the Nordic energy sector (Fig. 2). Bi-annual meetings of the Steering group will be held and the individual WG will have their workshops in conjunction with the annual meetings. To secure collaboration on the national level between the different activities, individual partners will establish national groups. The Information Management group will then be responsible for information dissemination, active stakeholder involvement and the public outreach throughout the project.

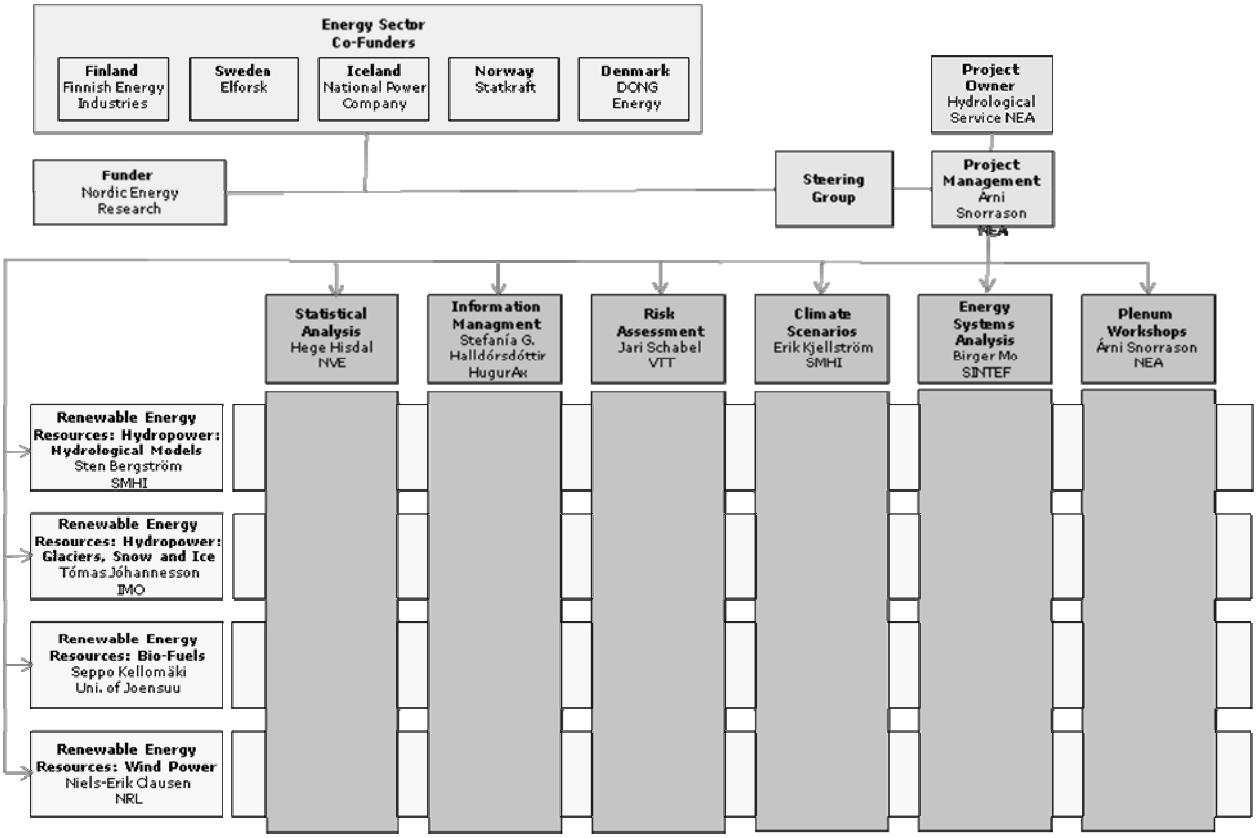

Figure 2. Organization of the Climate and Energy Systems (CES) project 2007–2010.

MAIN OBJECTIVES OF THE CES PROJECT

An increase of uncertainty about the future of renewable resources under climate change is a key issue for the energy sector. Some renewable energy resources are likely to increase their productivity, on the other hand, changes in the seasonal and geographical patterns of production and demand need to be managed. Disturbances and costs due to possible changes in extremes as

floods, droughts or storms need to be dealt with. Uncertainty translates into riskier decisions within the sector including operational and market issues, short term responses or investments. It also calls for adaptation measures including e.g., ensuring dam safety.

The goal of the new Climate and Energy Systems project is to look at climate impacts closer in time and assess the development of the Nordic electricity system for the next 20–30 years. It will address how the conditions for production of renewable energy in the Nordic area might change due to global warming. It will focus on the potential production and the future safety of the production systems as well as uncertainties.

The key objectives are summarized as:

- Understanding of the natural variability and predictability of climate and renewable energy systems at different scales in space and time.
- Assessment of the risks due to changes in probabilities and nature of extreme events.
- Assessment of the risks and opportunities due to changes in production of renewable energy.
- Development of guiding principles for decisions under climate variability and change.
- Development of adaptation strategies.
- A structured dialog with stakeholders.

WORKING PLAN FOR THE PROJECT

Each of the partners within individual working groups has laid out detailed working plan for the years 2008–2010 and has started their work accordingly.

Renewable Energy Resources

Identical questions await the four renewable energy resource groups, i.e. how will future climate change affect the different resources. The analyses of the impacts on renewable energy sources will be based on climate scenarios, and depending on the energy source, different types of models will be used for both production and safety analyses.

Climate Scenarios

New regional climate scenario simulations will be conducted using the advanced regional climate models RCA and HIRHAM. The scenarios will cover the period until 2050. Probabilistic analysis will provide both decadal ranges and probabilities of climate variability and change in the Nordic region until 2050. The link between regional climate scenarios and the

recent/ongoing climate behaviour will be analyzed. Customized regional climate scenarios for risk analyses will be developed.

Statistical Analysis

Historical time series and scenarios for the Nordic area will be analysed on all time scales with a focus on extremes. It will include statistical methods to quantify uncertainties in extreme estimates caused by climate variability and change, and to improve the understanding of links between large scale circulation patterns, climate, hydrology and renewable energy.

Energy System Analysis

Future development of the electricity system will be outlined with focus on possible developments of the Nord Pool electricity system up to 2050. System analysis for the near future will be based on detailed simulations for the Nordic electricity system with the EMPS model for a few specific scenarios for given future years, e.g. 2010 and 2015, with the 'correct' climate.

Risk Assessment

An evaluation of risk under increased uncertainty in order to improve decision making in a changing climate will be carried out through the following steps: 1) Review of risk and uncertainty management approaches used in the energy sector; and 2) Integration of risk and uncertainty in decision support tools. A risk management framework will be adopted according to the emphasis of the industrial partners and will be developed during the early phases of the project.

Relevance to stakeholders in the energy sector

One of the primary goals is though to involve stakeholders in the energy sector as a change in hydro-climatological variability may lead to changes in the operation of reservoirs and wind turbines and the energy production potential itself. In particular the variability in hydropower is a great concern in the light of some very wet years and some sudden dry years, which have resulted in highly variable prices on electricity. To do so stakeholder meetings will be held, focusing on information needs of stakeholders, and the quality, context of use, accessibility, and overall benefit (or cost) of incorporating climate data into the decision-making framework. Mechanisms for evaluation and feedback will be incorporated into stakeholder meetings. Emphasis on two-way communication between groups that develop products and tools and those who use them implies an evolving relationship; therefore, an iterative approach involving testing of products and services over time may be useful.

Information Management

It is the responsibility of the information management group to disseminate information both within the project and to the public using a public outreach program based on modern web-based, multi media information technologies and methodologies (www.os.is/ces). The program will make important information on the impact of climate change on the Nordic energy environment accessible and understandable to the energy sector, public, policy makers and the educational and scientific community. Extensive use of modern geographical tools on the web will provide means to disseminate map-based results on climate, climate scenarios, scenarios on the renewable energy resources, demands, risks, etc.

During the timeframe of the former CE project (2003–2006) over 300 abstracts, reports and papers were published (www.os.is/ce). Similar activity is planned within the CES project where reports on studies within each working group will be published in the scientific literature, at conferences and through the news media. A final report will summarize the main results from the project and highlight measures of success in collaboration. In addition to bi-annual meetings and workshops planned throughout the whole timeframe of the project, a concluding international science meeting is planned in 2010.

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