

Resilience of Energy Systems: Energy Crises, Trends and Climate Change

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The current energy system is a major driver of climate change. At the same time, the energy system itself is affected by climate change. Some elements of energy supply will change the characteristics of its availability (e.g. hydro power) and a modification in energy demand will occur (e.g. heating and cooling). Therefore, simultaneous mitigation and adaptation has to take place.

The energy system in the next decades will face fundamental restructuring. Climate mitigation scenarios show the requirements of shifting towards zero- and low-carbon energy solutions. The availability of fossil resources (first of all oil) as well as global conflicts might cause energy shortages leading to energy crises. Demographic and social changes as well as technology developments could lead to additional challenges and opportunities. These trends, possibly occurring energy crises and climate change partly are potential sources of heavy vulnerability of the energy system. The question arises how mitigation efforts, adaptation measures and responses to changing side conditions might be integrated. This question is investigated in the ACRP-project PRESENCE (Power through Resilience of Energy Systems: Energy Crises, Trends and Climate Change, www.eeg.tuwien.ac.at/presence) which will be completed in September 2013.

The **core objective of this project** is to provide measures and pathways how to increase the resilience of energy systems in the view of climate change, possible trends and energy crises as well as the transformation of our energy system into a low- and zero carbon future for the Austrian case.

Based on this overall objective we analyse the following detailed **research questions**:

- What could be the impact of climate change on energy systems?
- What are possible developments of the energy system given ambitious mitigation targets, possible energy crises, energy price shocks and other trends?
- What are specific challenges of a low/zero carbon energy system in a changing climate?
- How can we assess the possible impacts of extreme events on the energy system? What is the probability for the energy system to be affected by different type of extreme events?
- How can the concept of resilience be further elaborated and applied to energy systems in terms of our project? What are further possible indicators for resilience?

- What are steps and concepts to increase the resilience of energy systems in the light of climate change, possible energy crises and trends?
- Which adaptation measures to climate change simultaneously lead to a low/zero carbon energy system and increase the resilience of energy systems?

General methodology

The methodological approach in the project PRESENCE is based on the following steps:

- Extend and elaborate the methodological framework for the term “resilience” and put it in the context of energy systems. This will be done in the light of climate change, social and technological change, possible energy crises.
- Develop a methodological framework for assessing the impact of extreme events.
- Derive key meteorological data from climate scenario ensembles
- Derive the impact of climate change and related extreme events on hydro power, heating and cooling energy demand of buildings and on a low/zero carbon electricity system.
- Derive adaptation measures for an increased resilience of energy systems
- Derive conclusions and recommendations how to increase the resilience of energy systems

Our **system boundary** of the term “energy system” includes the following sectors: (1) hydro power, (2) selected aspects of cooling water availability for thermal power plants and industrial energy related processes, (3) heating and cooling of buildings and (4) electricity generation, storage and transmission.

Results

The core and final result of this project will be recommendations on pathways how to increase the resilience of the Austrian energy system in the light of climate change, technological change and eventual energy crises and shocks. These pathways will include adaptation measures for adapting to climate change while simultaneously contributing to climate change mitigation and taking account essential exogenous trends and developments.

In this presentation, we will present the preliminary and intermediate results regarding:

- Climate scenarios based on 3 RCMs from the ENSEMBLE project with A1B emission scenario, bias corrected and localized using the E-OBS dataset on European scale (25x25 km) and INCA dataset (1x1 km) for Austria
- Methodological approach for assessing the impact of extreme events on the energy system
- Definition of resilience concepts of the energy system
- Hydro power generation in all the major river basins of Austria under three different climate scenarios
- Heating and cooling energy demand in Austria under various climate change scenarios and other exogenous parameters; impact of adaptation measures
- Scenarios of the electricity system up to 2080

Based on these preliminary results the presentation will include a discussion of policy recommendations for the development of a resilient Austrian energy system.