Environmental Economics Working Group

Oldenburg Center for Sustainability Economics and Management

# Chameleon – Adaptation to climate change in the utility sector

**Climate change alters and endangers our social and technical infrastructure. The Chameleon project investigates the ways in which the energy and transport sector can adapt to climate change. One study focuses on the impact of heat waves on electricity generation and market prices. For the analysis, an economic merit order model of the German Power system was developed and applied.**

## Motivation

Increasing mean temperature and frequency of heat waves due to climate change may impede electricity generation in several ways. For thermoelectric power plants, water shortages are one of the central challenges that might tighten in the future. During the heat waves in 2003 and 2006 in Europe, already many power plants have been curtailed. Yet the effect of the capacity reductions experienced in the past, and additional heat wave impacts from climate change have hardly been investigated.

## Method

- Economic merit order model of the German power generation system, covering all current non-renewable power plants (above 20MW), to simulate the power prices at the European Electricity Exchange (EEX).
- Two scenarios are compared: (1) heat wave scenario with real reductions of thermal power plant capacities in July 2006, and (2) counterfactual scenario with normal plant availabilities (no heat wave).
- Comparison of costs, rents and prices. Sensitivity analysis with respect to climate change.

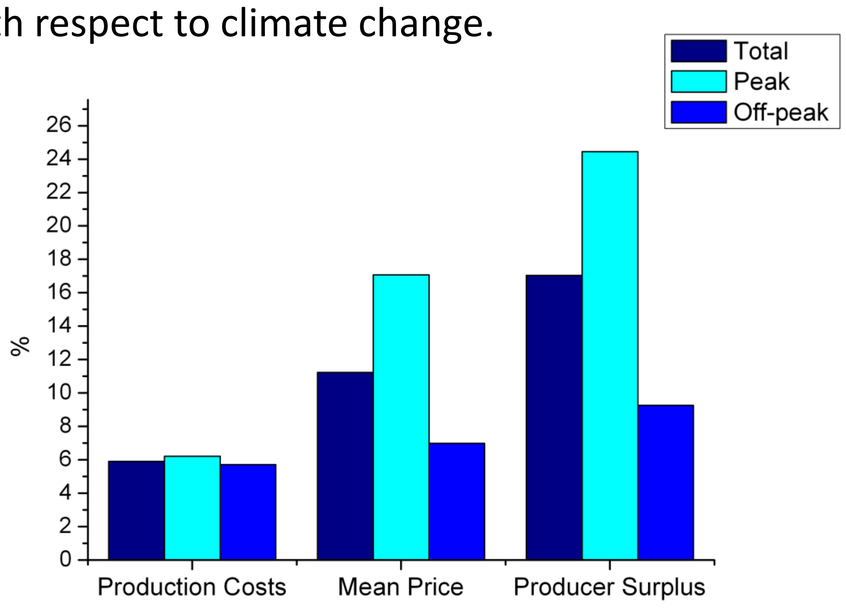


**Figure 1:** Effect of capacity reductions on production costs, price and producer surplus (mean values per MWh)

## Results

Capacity reductions due to the 2006 heat wave show the following main pattern: electricity spot market prices increase on average by 11% (see Figure 1) and more than generation costs (Ø 6 % or € 16 m in total). This leads to an additional producer surplus of € 55 m. Consumers bear a disproportionate burden of heat wave costs.

The main pattern remains mostly unaltered for additional heat wave impacts (e.g., increased electricity demand, reduced hydropower capacity) and also for more strict capacity reductions that are likely under climate change. The cost effects, however, become considerably more pronounced with increasing heat wave stress. This picture changes if demand-side management or an increasing RES-E share of domestic production are introduced.

## Conclusions

If mitigation fails or is postponed globally, the impacts of climate change on the current energy system are very likely to rise. Increases in feed-in from renewable resources and demand-side management can counter the effects to a considerable degree.

Countries with a shift toward a renewable energy supply can be expected to be much less susceptible to cooling water scarcity than those with a high share of nuclear and coal-fired power plants.


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## Further Research Topics

- Adaptation to Climate Change
- International Environmental Agreements
- Transformation of the Energy System

## Regular Courses

Environmental Economics, Resource Economics, Institutional Economics, Advanced Topics in Sustainability Economics & Management, Practical Projects (e.g. Simulation & Gaming)


**Literature**

Pechan A. & Eisenack K. (2014): The impact of heat waves on electricity spot markets, in: *Energy Economics*. Vol.43, pp. 63-71.

Eisenack K. & Stecker R. (2012): A framework for analyzing climate change adaptations as actions, in: *Mitigation and Adaptation Strategies for Global Change.* Vol. 17 (3), pp. 243-260.