Transformation to a low Carbon Economy

(Main supervisor: Karl W. Steininger)

To limit global warming below 2 degrees requires significant GHG emissions reductions by mid-century, involving substantial innovation both regarding the implementation of technologies and societal processes. This PhD project can focus on either specific technological transitions (particularly solar electricity) or the innovation environment more generally.

The recent strong cost decline in photovoltaics module production costs, together with a shift in energy carrier demand towards electricity in many sectors (e.g. mobility, space heating in zero-emissions housing, appliances and production processes), indicate the high potential of photovoltaics in GHG mitigation. Insights are sought on (a) the economic factors determining the implementation of PV (both local and large-scale distributed generation across time zones and hemispheres), (b) the economic implications for both the national economy and that of trading partners.

The more general issue in informing society on low carbon transformations is the interaction of climate policy with the endogenous dynamics of innovation. Insights sought at this level include (a) the economic factors determining the establishment of new technologies and practices serving a low-carbon economy, (b) the framework conditions, enhancing and blocking mechanisms of the innovation environment in technological and societal terms, and (c) the implications for the time path and thresholds of innovations to become “game changers”.

Methodologically the project can – inter alia – build upon and refine Wegener Centers (i) set of macroeconomic-oriented environmental models in the CGE tradition developed to analyse climate policy at various levels, from sectoral at the national level (e.g. Steininger and Bachner 2014) to multisectoral at the global level (Bednar-Friedl et al., 2012; Schinko et al., 2014), (ii) dynamic technology cost analyses based on learning curves, e.g. for photovoltaics (Grossmann et al. 2012) and vehicle propulsion technologies (Kulmer 2013). Developing the mutual linkage and enriching of these modelling strands promises to grant new core insights for low-carbon transitions.

The project contributes to answering the DK research question 3

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Thresholds and fat tail risks in public decision making about climate change

(Main supervisor: Birgit Bednar-Friedl or Karl Steininger)

In economics, discounting of distant future damages has been regarded as one key obstacle in addressing climate change. Yet, in the more recent literature an additional problem has been identified: fat tails in probability distributions of future climate change impacts. Fat tails means that high damages due to e.g. temperature increases by +10°C or more compared to pre-industrial levels may emerge at small, but non-negligible probability. As shown by Weitzman (2009) in his dismal theorem, ignoring this characteristic of climate change damages may lead to inappropriate decisions at the very least.

Managing or reducing such climate risks necessitates better knowledge of the "true" probability distributions of climate damages. Moreover, coping with such risks requires approaches beyond the conventional approach of expected utility maximization such as a precautionary approach which focuses on insuring against such risks (Ackerman et al. 2009). In this PhD project, questions like the following will be addressed: What are relevant damage thresholds and risks in climatic, technological, economic and social systems and what do we know about their probability distributions? How can the societal decision framework be revised to better deal with these challenges? What are the advantages and disadvantages of different approaches? What can be learned from other problems, e.g. at smaller scales?

Depending on the expertise and the interest of the successful applicant, this project allows for different methodological approaches and disciplinary backgrounds. Starting from decision theory, different methodological options can be explored to improve upon the standard expected utility framework, but also related fields like real options analysis may be appropriate points of departure. In the ecology and environmental economics literature, existing work on dealing with thresholds and bifurcations may provide useful starting points.

The project contributes to answering the DK research question 1

References:

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