

# Dealing with Uncertainties in the Transition to a Sustainable Energy Infrastructure: An integrative Approach

## Coordinator:

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## Involved organisations:

Technische Universiteit Delft  
Universiteit Utrecht

## Program term:

2003-2009

## Summary of problem definition:

The total energy system undergoes continuous change. The energy infrastructure is typically a 'slow and inert' component of the energy system. Modifications require very high investments and once choices are made, energy infrastructure is in place for decades, possibly resulting in lock-in situations for the longer term. Due to the large number of factors that influence the choice and preference for a certain set-up of the energy infrastructure, the planning and development strategy over longer time is a very complex matter. Different uncertainties affect planning and development of energy infrastructure over time; contextual (e.g. development of energy prices and energy demand patterns), the very different systems that could be envisaged on longer term (e.g. gas dominated, electricity dominated, distributed vs. centralized generation concepts), the very different trajectories towards developing a new or revised infrastructure and the decisions underway that can affect the flexibility for change over time, as well as technological development as such. In addition, the sector has been undergoing rapid institutional change (privatisation, liberalisation, upscaling, internationalisation), introducing new and uncertain future contexts for stakeholders. In present practice, many of these uncertainties are often ignored, or at best, accepted but not dealt with in a conscious and systematic manner. As a result, the infrastructure development may very well inhibit rather than facilitate long-term transitions to more sustainable energy systems. In this programme a systematic and integrative methodology is developed and tested that, first, identifies different uncertainties (technical, economic, institutional and behavioural), relating to knowledge about developments in the infrastructure system itself, in its surroundings, and in the values and perceptions guiding decision making processes and stakeholder behaviour. Second, the methodology is used to analyse and assesses the relative importance of the various uncertainties. Third, strategies are developed and tested to deal with the uncertainties, acknowledging that a significant part of the uncertainties cannot easily be eliminated and that policy and management strategies need to be developed to explicitly take this into account. The strategy design will include both substantive and process and institutional elements. Key products include (a) the methodology for analysis and strategy design in light of uncertainty, (b) its application in the context of developing sustainable energy infrastructure, from the perspective of the government as well as from the perspective of individual actors; and (c) specific policy recommendations for the energy infrastructure.

## Subprojects:

- Dealing with uncertainties in sustainability-led energy infrastructure transitions: Integrated Analysis and Design, E. Pruyt.
- System studies of energy infrastructure options and development trajectories over time; methodology development and strategy design with inclusion of uncertainty analyses from techno-economic perspective. L. Dittmar.
- Managing uncertainties in energy innovations and transition processes, I.S.M. Meijer.

## Results:

- Meijer, I.S.M. (2008), Uncertainty and entrepreneurial action. The role of uncertainty in the development of emerging technologies. PhD thesis. Universiteit Utrecht
- See the NWO-website for a full list of publications, [www.nwo.nl/energieonderzoek](http://www.nwo.nl/energieonderzoek)