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The production of future knowledge

An empirical analysis of energy scenario construction processes in the border zone of science and politics

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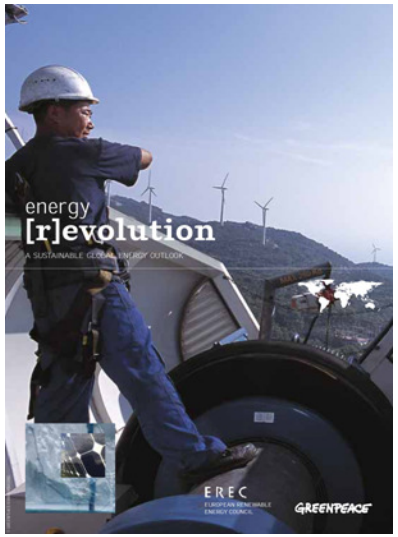
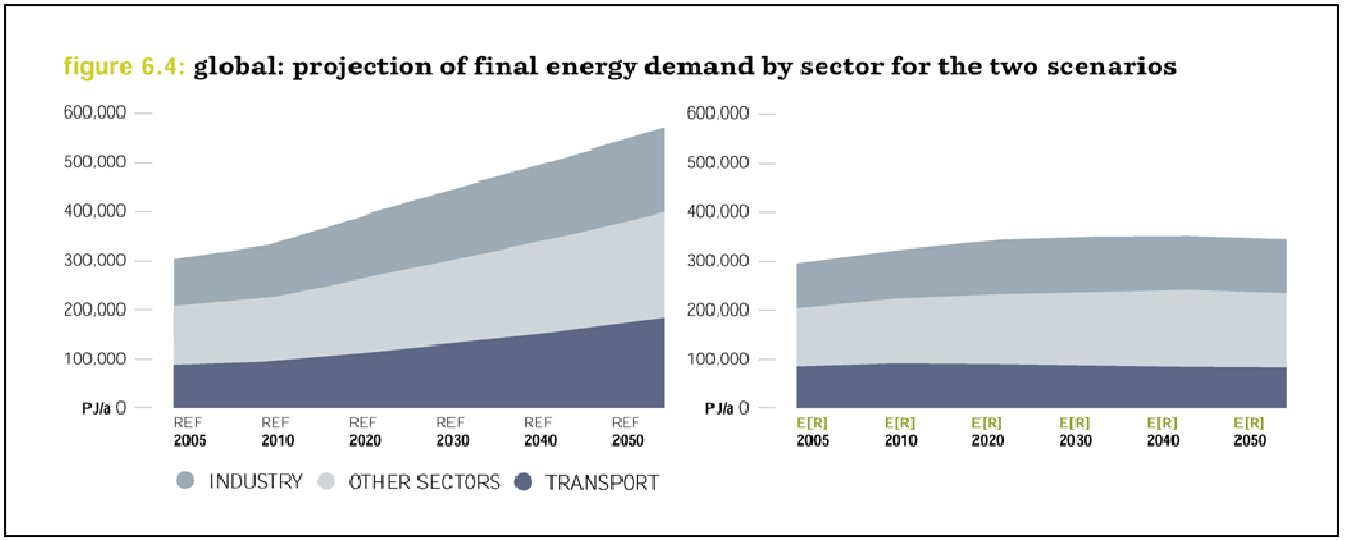
Introduction
A first glance on energy scenarios

Energy scenarios play an important role in the discussion about the future of energy supply. They are published as **experts' reports** by **specialised scientific institutes** on **behalf of political institutions** and generated using **computer models.**

Typically one report contains **one to four single scenarios**.





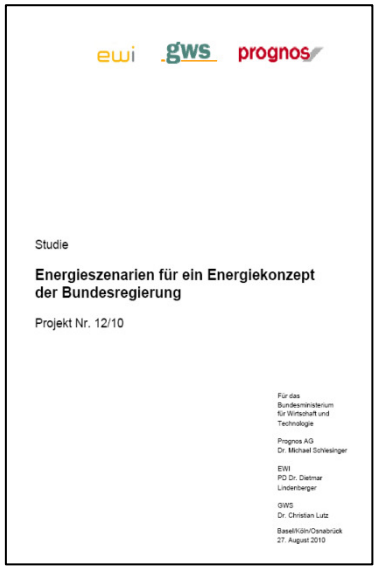
Teske, Sven et al., 2008: Energy (R)evolution - A Sustainable Global Energy Outlook.

A first glance on energy scenarios

In Germany the experts' reports are produced by approx. 15 institutes **in great quantity.** Their **foci vary** from broader descriptions of "what is possible" to more concrete topics concerning single technologies.

Current example:

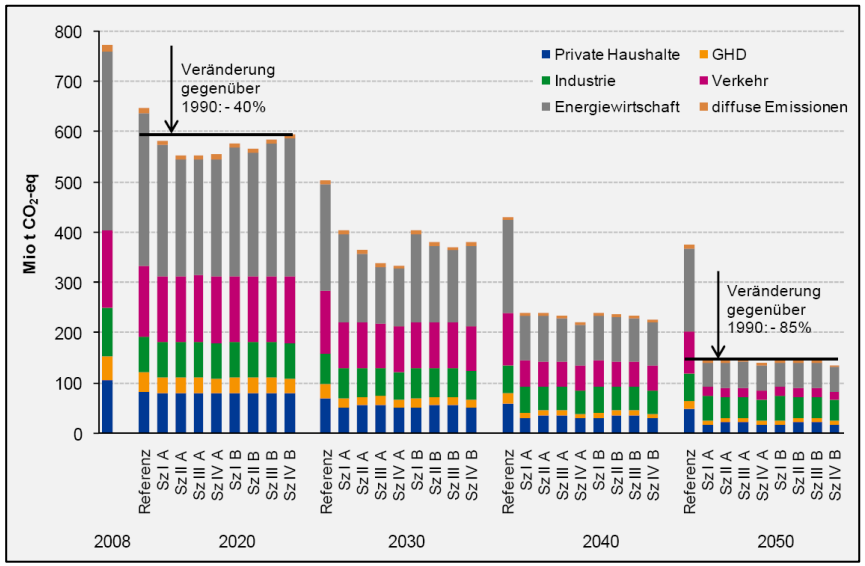
Study on extension of operation time of nuclear power plants in Germany


ewi gws prognos

Studie

Energieszenarien für ein Energiekonzept der Bundesregierung

Projekt Nr. 12/10



Schlesinger, Michael et al. (2010): Energieszenarien für ein Energiekonzept der Bundesregierung.

Initial problem:

- Scenario production **processes** are widely **intransparent**, e.g. role of client.
- Claims **for validity** and **the way the models are used to fulfil them** are largely unclear.

My PhD project

Initial question: How are energy scenarios constructed and what claims to validity are raised with them?

General approach: Explorative study of the construction practices on the micro-level in the field of energy-economic systems analysis in Germany

Method: Qualitative analysis on basis of semi-structured interviews in two waves

Sample: Eight experienced modellers, one per institute

Sampling strategy: Maximisation of variance in model types and context settings

Aim: Reconstruction of eight individual scenario construction processes, the mindsets, actors and contexts involved

This talk

Diagnosis: energy scenarios play a **mediating role…**

…as a **core element of a consultation process** between science and politics

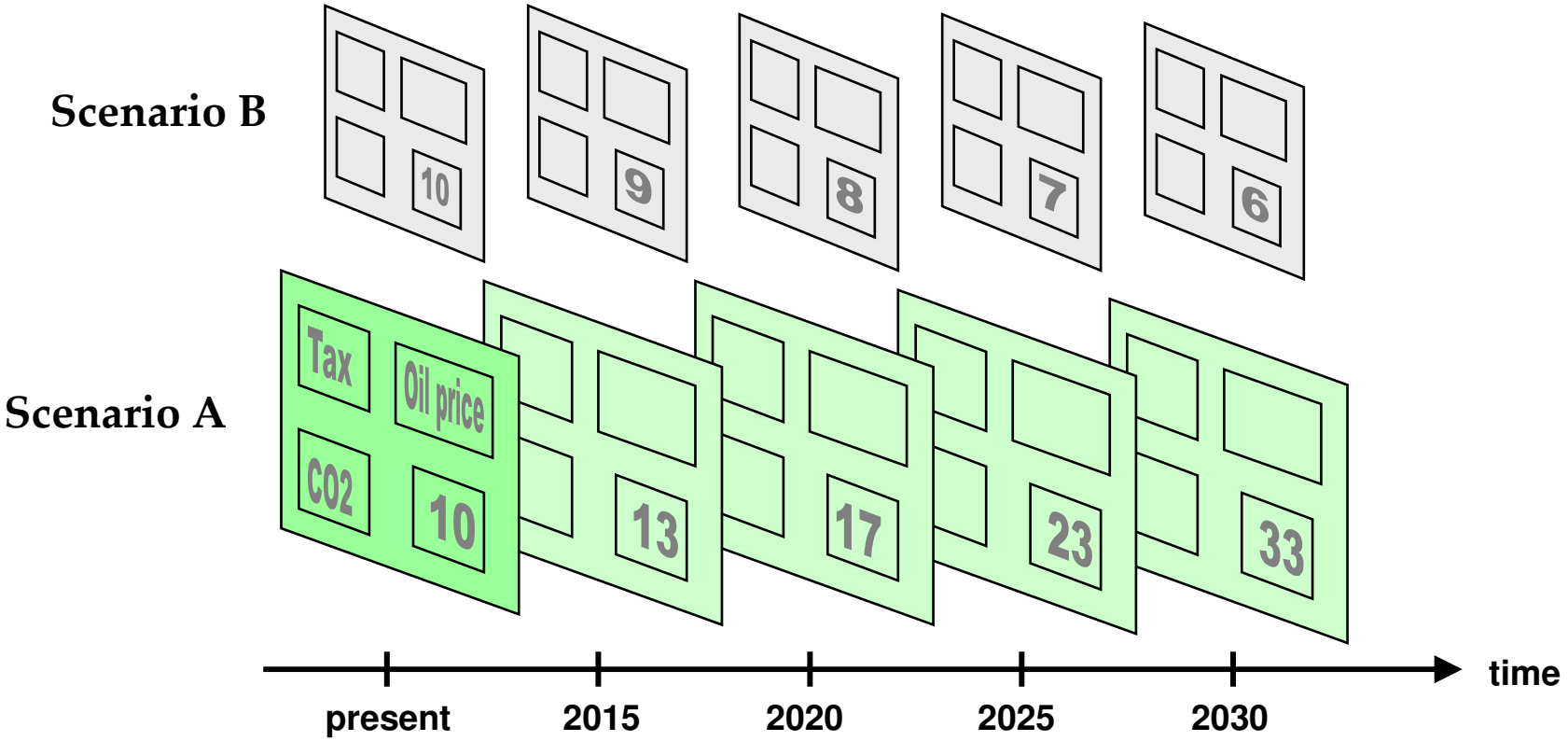
…as a **central element of the general public debate** on the future of energy supply

Aim of this talk: investigate this mediating role

Outline of this talk:
I. What are energy scenarios and how are they constructed with a computer model?
II. In which consultation practice does this take place (actors)?
III. Interpretations

I. What are energy scenarios and how are they constructed? Scenarios as present futures/future presents

An energy scenario can be understood as **the explication of a present future**. This explication takes place by formulating (quantitatively and qualitatively) **a chain of future presents** (Luhmann 1976).



One report contains a group of scenarios (rows of future presents).

The model as a representation of the world

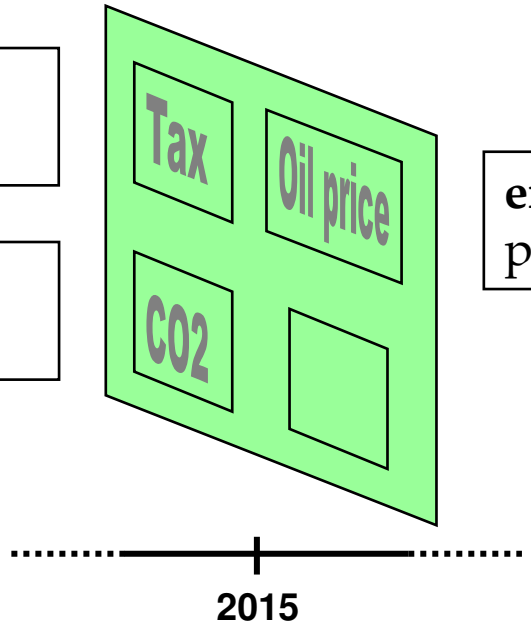
A **model** is a mathematical structure, realised as a computer program, to which a certain meaning is ascribed: it is supposed to **represent** a certain part of **the real world**.

→ The model defines how the world is described in each future present, e.g. by which parameters .

Central distinction for representation of the world:

exogenous, controllable parameters (→ policies)

endogenous parameters (→ "effects")



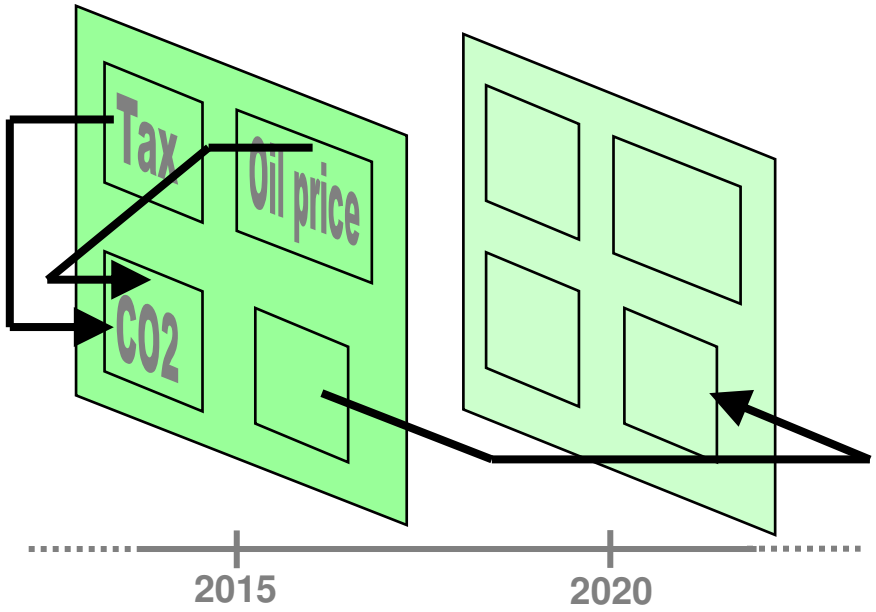
exogenous, not controllable parameters (→ environment)

The model as a calculation machine

The model is not just a theory, but a **"calculation machine"** for the endogenous parameters.

Example:

CO_2 is a function of Tax and Oil price



In "dynamic" models some endogenous parameters are "timely interdependent"

→ In each scenario the values for the **exogenous parameters are "assumed"** (forecasted, invented) for all time steps. From these, the values for the **endogenous parameters are derived via computer model** (Dissolving an equation system).

I. What are energy scenarios and how are they constructed?

In one expert's report different scenarios are produced by **varying the values** for certain parameters in between the scenarios.

3 types of parameter variation = 3 types of "questions" = 3 types of consultation contexts ?

a) Variation of exogenous, controllable parameters: What would be the effect of a certain policy intervention, e.g. a tax or extension of nuclear power plant operation time ?

→ **Impact assessment of a concrete steering attempt**

b) Variation of endogenous parameters (target scenarios): What possible "paths" do we have to reach a certain target, e.g. in CO_2 reduction?

→ **Development of policies/strategies**

c) Variation of exogenous, not controllable parameters: What effect has a change in the assumed environmental conditions, e.g. a very high oil price?

→ **Decision-making under uncertainty**

Hypothesis: Each type of parameter variation stands for a different consultation context

Intermediate conclusion

Because the model serves not just as a theoretical justification, but as a template in the calculation for future presents, **the model limits ex ante the range of imaginable future presents**.

Given the high relevance of the energy scenarios in the public and political discourse, the **models** (amongst others) **predetermine what can become a topic in the discourse**.

Energy scenarios are not just "some possible" present futures. Being constructed by modelling, they **represent certain, limited perceptions** of the future.

II. In which consultation practice does this take place? Analytical perspective

Reconstruction of scenario construction process by:

- Reconstruction of **working steps** along the process
- Focus on mechanisms of **construction and selection**
- Distinction of **two actors**: **"modeller"** on the side of contracting institute and **"client"** on the side of political institution
- The two actors are part of two different social systems

II. In which consultation practice does this take place?
The first steps

Background of the consultation project
Energy scenarios are **not** produced **in a "vacuum"**, but…
… in the context of a major (political, scientific, public…) discourse on the future energy system.
… are a response to a (more or less) concrete client's demand for advise.

Step 0: Prior to the project (client only)
- Client announces project → first specifications in terms of content and method
- Client selects contractor from range of applicants
→ Because one institute typically follows only one theory and model concept, **selecting the client means selecting the theory/model** (e.g. "neoclassical" vs. "Keynesian", "simulation" vs. "optimisation")

Step 1: Negotiation of project design (client and modeller interact)
- Determination of "what is relevant" (e.g. relevant economic sectors)
→ Adaptation and "closure" of model structure
- Basic definition scenario structure (e.g. number)
- Core element: semi-quantitative drafts of scenarios ("storylines")
→ **First constructive step** of energy scenarios

II. In which consultation practice does this take place?

The last steps

Step 2: First calculation of scenarios (modeller only)

- Translation of drafts ("storylines") into parameter values (→ 3 Types of variation)
- Iteratively: execution of model (computer program) and "adjustment" of parameter settings

→ Preliminary fixing of scenarios

→ **Main construction step**

(→ Critical (open) question: what exactly is iteratively changed in the model?)

Step 3: Intermediate report (modeller and client interact)

- Discussion of "first results"

→ Reconfiguration of preliminary scenarios

Step 4: Final calculation of scenarios (modeller only)

- Repetition of Step 2 under parameter reconfiguration

→ **Secondary construction step**

Step 5: Delivery and publication of expert's report

→ Scenarios enter "political game"

→ Scenarios enter major discourse

II. In which consultation practice does this take place?
Intermediate conclusion

In the process the **contingency of the future** (space of "socially possible" futures) is stepwise structured and thereby **transformed into a contingency of options** (space of accepted modelling results).

Central steps:
- Step 0: Selection of institute = selection of model
- Step 1-4: Co-construction of scenarios by iteratively reconfiguring parameter settings in a mixture of negotiation and "black-box modelling"

III. Interpretations
The construction process on the micro level

The construction process can be interpreted as a **cooperative work of actors representing two different social systems** (science and politics), with the aim of solving a common problem. This **problem** is the necessity to **construct a basis for decision-making in the face of the principle uncertainty** of the future. For both sides the problem bears different **threats**: for the modeller the loss of his "scientific neutrality" and for the political client the loss of his "power of decision". Nevertheless the investigated **practice** has been **successful** for decades and both sides have been able to "survive" in their systems.
→ **What is the "bridge" that enables this cooperation in practice?**

Hypothesis: The **"storylines"** (and equivalent "frames" for assumptions) are constructed and tended as **boundary objects** (Star & Griesemer 1989; Star 2010) by both sides. They are just as precise and at the same time interpretatively flexible as necessary and enable a separation of "scientific knowledge" from "political ideology".

To do: In-depth analysis of the negotiation of parameter settings between modeller and client

III. Interpretations
The consultation practice in society

Diagnosis: The reconstructed **consultation practice** of energy scenario co-production using computer models has reached great **stability** in energy politics.
→ **What is stabilising this practice in the (differentiated) society?**

Hypothesis:
A first precondition is **keeping the separation** of science from politics **alive** by:
→ permanently **renewed assignments** of system specifics
→ **institutionalisation**: role of client vs. role of contractor
→ **"black-boxing"** the model and strictly assigning it to the "scientific" side

A second precondition is the **acceptance of** the reconstructed **scenario-modelling practice as "legitimate paradigm"** by involved systems.

To do: Classify the investigated practice more precisely. What kind of knowledge production is this? "Mode 2" (Gibbons et al. 1994)?

III. Interpretations
Energy scenarios in societal communication

Diagnosis: Energy scenarios are an **established "phenomenon"** in the energy discourse (its centre piece?)
→ What is stabilising this phenomenon in the discourse?

Hypothesis: The phenomenon is stabilised by the ability to **decontextualise single scenarios from its expert's report** and integrate them into a discourse as one "possible future" among many others (→ n x m scenario plurality).
This is enabled by a **socially shared way to think of the future** as a space of designable contingency and the **standardisation** of the scenarios **by quantification** and related forms of presentation.

To do (not in my in PhD project): Analyse the role, reception, impact of energy scenarios in public, political, scientific discourse(s).

Thank you for your attention!

Literature:

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