Integrated scenario building in energy transition research

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Energy transition – Driving forces (I): Climate change

http://www3.epa.gov/climatechange/kids/scientists/clues.html; 07.12.2015
Energy transition – Driving forces (II): Anti-nuclear movement

http://historyofnonviolence.wiki.lovett.org/Anti-Nuclear+Movement; 07.12.2015


Climate neutral energy system
Scenarios (I)

- Main questions
  - Q1: How it could look like?
  - Q2: How to transform to such an energy system?

- Main approach: scenarios
  - General aim: describing of “potential futures”, i.e. ways and means over a desired time horizon
  - Different purposes
    - improving the understanding of possible cause-effect relations
    - to trigger or structure a debate on certain issues
  - Different systems boundaries and assumptions
Scenarios (II)

Techno-economic system

„Changes“
• Growth of renewables
• Infrastructure extension
• Efficiency technologies
• Smart grids
• ...

„Drivers“
• Energy carrier prices
• Technology development
• Energy policy measures
• ...

Societal system

„Changes“
• New actors and actor coalitions
• Ubiquitousness of energy systems
• Change of daily routines
• (Apparently) higher prices
• New consumer roles (prosumer)
• ...

„Drivers“
• Demographic change
• Economic development
• Global challenges
• EU political development
• National political priorities
• Social coherence
• Governance styles
• Knowledge society
• Change of values and lifestyles...
Scenarios (II)

"Changes"
- Growth of renewables
- Infrastructure extension
- Efficiency technologies
- Smart grids
- ...

"Drivers"
- Energy carrier prices
- Technology development
- Energy policy measures
- ...

How to link both systems?

a. Developing comprehensive scenarios, combining societal system with techno-economic system

b. Integrating societal scenarios into techno-economic scenarios

=> socio-technical scenarios

- National political priorities
- Social coherence
- Governance styles
- Knowledge society
- Change of values and lifestyles...

- New consumer roles (prosumer)
- (apparently) higher prices
- ...
Socio-technical scenarios – Concept

Population

Crude oil price

Transport

GDP

Global development

Price of oil and other energy carriers

Political priorities

Population

Economic growth

Planning legislation

Acceptance energy turnaround

Infrastructure extension

Industrial energy savings

Mobility

Domestic energy savings

Growth of renewable energies

Scen I

Scen II

Scen III
### CIB-based context scenarios Germany 2040: Descriptors and alternative futures

<table>
<thead>
<tr>
<th>A. Global development</th>
<th>A1 convergence and prosperity</th>
<th>A2 divergence</th>
<th>A3 confrontation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Oil price</td>
<td>B1 moderate growth</td>
<td>B2 rapid growth</td>
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<td>L3 downscaling and e-cars</td>
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Using cross-impacts for expressing descriptor interdependence

H1: Convergence
H2: Divergence
H3: Confrontation

Global development

Price of oil and other energy carriers

H1: Convergence
H2: Divergence
H3: Confrontation

Impact Assessment*

H1: Moderate growth
H2: Rapid growth

Population

Planning legislation

Infrastructure extension

Industrial energy savings

Mobility

Acceptance energy turnaround

Domestic energy savings

Growth of renewable energies

Price of Oil

+: promotes
- : hinders

- : hinders
+ -

- -
+ +
## Context scenarios

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Model results

Energy balances 2040
Estimations based on DLR model

Remember:
Concept demonstration!
No final results.

S1: Consensus in a lucky environment
S2: D21 - Revolution from above
S3: “It’s the economy stupid“
S4: Stormy waters ahead
Concluding remarks

- Potentials
  - Improved understanding of socio-technical systems
  - Improved quality of the findings

- Methodological challenges
  - Methodological rigor of the societal scenarios
  - Accountability – Linking qualitative with quantitative information
  - …

- Outlook
  - Assessing scenarios?
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