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Alliance ENERGY-TRANS

Future infrastructures for meeting energy demands.
Towards sustainability and social compatibility
Berlin, March 14-15, 2016

Session 1: A socio-technical perspective on energy futures:
Socio–technical energy scenarios and sustainability assessment

Integrative methods of energy scenario construction

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Integrative methods of energy scenario construction

Integration means:

- Integrating analysis about the future of the energy system and the future of the society.
- I.e. combining (qualitative) society scenarios and (quantitative) energy scenarios in an interdisciplinary framework.
- Result: (hybrid) socio-technical scenarios reflecting the interplay between societal and techno-economic developments.

Why?

The energy system is deeply embedded in society: Society*)

- provides its raw materials,
- develops its technologies,
- builds and operates its infrastructure,
- buys its products,
- absorbs its side effects,
- critically observes its operation,
- decides on its rules.

➡ Thesis: *It is difficult, to put it mildly, to contemplate energy futures without also contemplating the future of the embedding society*

*) In this presentation society is conceptualized as the junction between politics, economy, private life and culture

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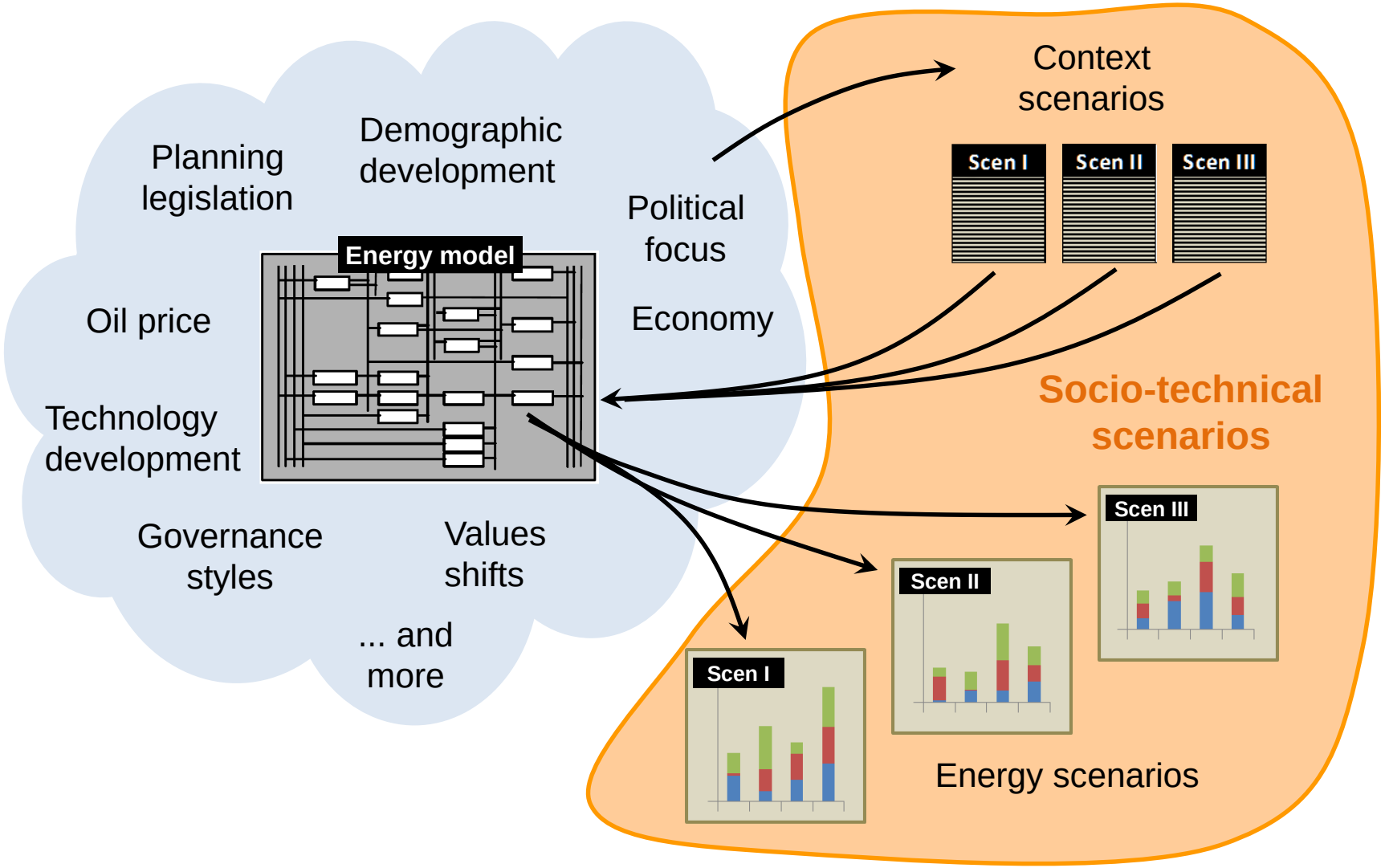
Coupling societal "context scenarios" and model-based energy scenarios



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Using context scenarios for constructing socio-technical energy-scenarios*): Looking back to the roots

- Story-And-Simulation (SAS) in environmental and climate research (Alcamo 2001)
- Storylines in energy scenario construction (e.g. Mander et al. 2008, Trutnevyte et al. 2014)
- Recent discussion in climate research: Alternative (more systematic) ways of storyline construction? CIB? (Schweizer and Kriegler 2012, Schweizer and O'Neill 2014, Lloyd and Schweizer 2014)

*) Weimer-Jehle, W.; Buchgeister, J.; Hauser, W.; Kosow, H; Naegler, T.; Poganietz, W.; Pregger, T.; Prehofer, S.; Rieder, A.; Schippl, J.; Vögele, S.: Context scenarios and the construction of socio-technical energy scenarios. Submitted to ENERGY.

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Schweizer, V.; Kriegler, E. (2012): Improving environmental change research with systematic techniques for qualitative scenarios. In: Environmental Research Letters 7 (4), S. 44011. DOI: 10.1088/1748-9326/7/4/044011.

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Lloyd E.A., Schweizer V.J. (2014): Objectivity and a comparison of methodological scenario approaches for climate change research. Synthese, Vol. 191(10), 2049-2088.

CIB: Weimer-Jehle, W. (2006): Cross-impact balances: a system-theoretical approach to cross-impact analysis. In: Technological Forecasting and Social Change 73, 334–361. DOI: 10.1016/j.techfore.2005.06.005.. See also: www.cross-impact.de.

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Systematic storyline construction using CIB*)

I. Select scenario factors

- EU integration
- Energy policy stability
- Social welfare state design
- Renewable electricity expansion
- Public attitude towards the 'Energiewende'
- Media discourse
- Value shift
- ...
- ...

II. Represent future uncertainty

Alternative futures of:

Energy policy stability

- decreasing stability ?
- constant stability ?
- increasing stability ?

III. Identify interdependencies

Impact Assessment (Expert A)

Energy policy stability	Renewable electricity expansion: - weak (4 TWh/a)	- moderate (8 TWh/a)	- strong (15 TWh/a)
- decreasing stability	+2		-2
- constant stability	-1	+2	-1
- increasing stability	-2		+2

+: promotes
- : restricts
1/2/3: weak/moderate/strong

Expert A: *„Large renewable projects (such as wind offshore projects) would play an important role in strong expansion pathways. However, they critically depend on stable framework conditions, i.e. policy stability…"*

IV. Calculate context scenarios

Scenario no. 1:

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....

EU integration	: EU Renaissance
Energy policy stability	: Constant policy stability
Social welfare state design	: Liberal welfare state
Renewable electr: expansion	: Moderate expansion
Publ. attitude t. 'Energiewende'	: No clear trend
Media discourse	: Tabloidization
Value orientation	: Materialism+performance

....

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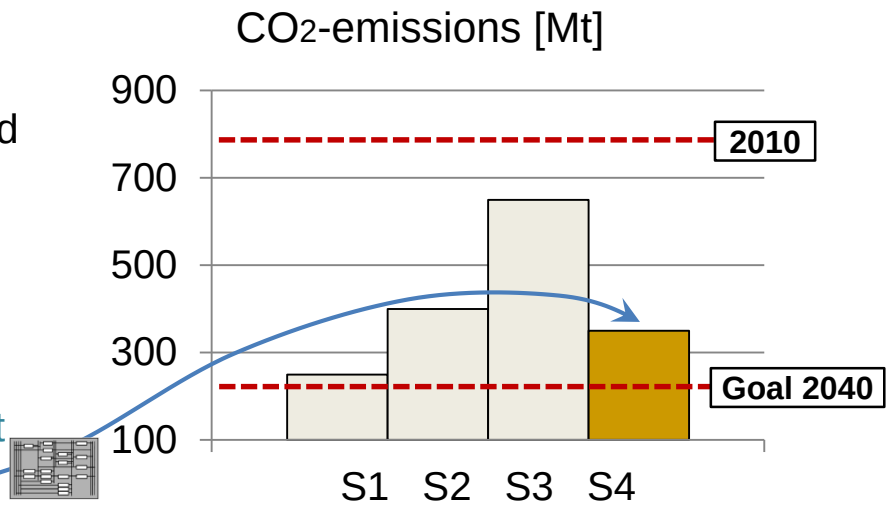
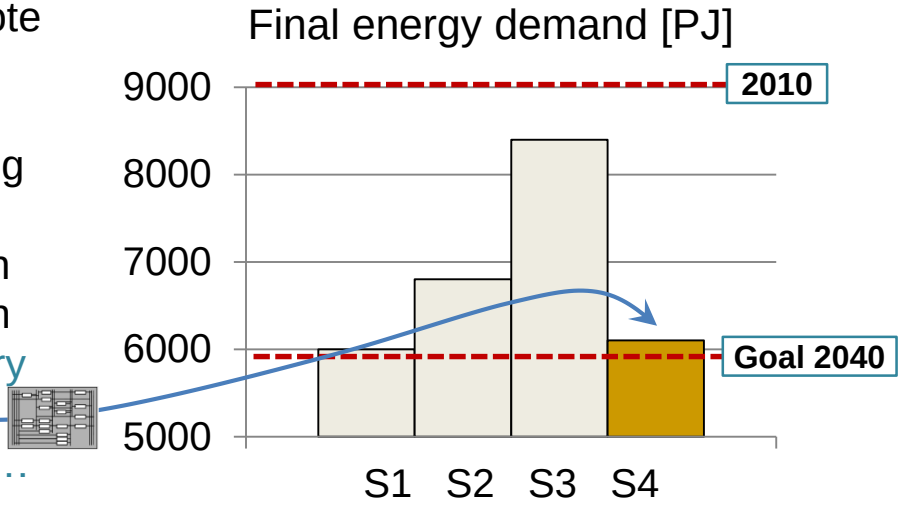
1
2
3

*) CIB: www.cross-impact.de

Exploiting socio-technical „hybrid“ energy scenarios: Example 1 (Demo): Analyzing a small set of individual scenarios

S4 “Stormy waters ahead”: This scenario clearly shows the least happy society. Economic and political imbalance between the regions of the world generates political conflicts, resulting in a rapidly growing oil price and weak economic growth in Germany (the latter also being slowed by a dramatically decreasing population). Security becomes the top concern for the government and the public. The envisioned energy transition project is downscaled to a project of national energy security instead of environmental protection. Planning legislation is advanced in order to promote the increase of the share of renewables, which is tolerated by the population following a public consensus (driven by deep concerns about coming threats) that gives collective needs priority over individual rights. This ensures security of supply in its technical dimension whereas energy security in its political meaning is low in this scenario. Industry makes a concerted effort to save energy in a move to cushion the effects of high energy prices…





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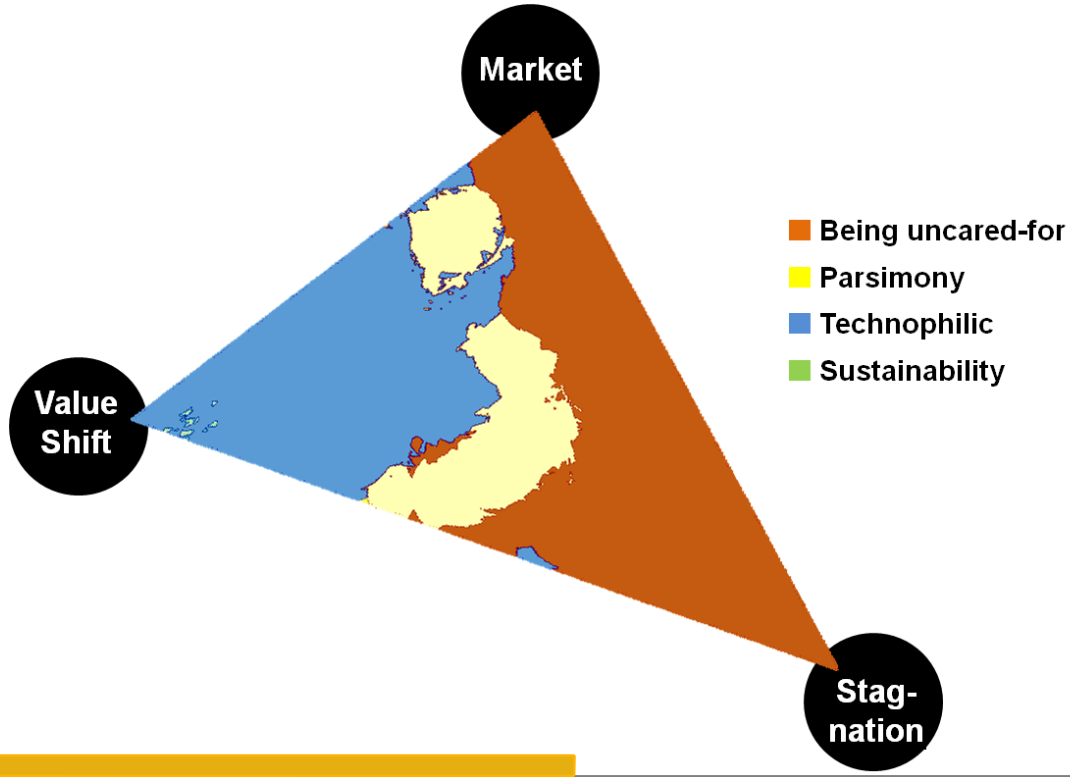
Exploiting socio-technical „hybrid“ energy scenarios: Example 2 (ET-A2): Statistical analysis of large scenario sets

Analysis: Arrange all context scenarios of a large set on a plane, proximity expressing similarity, and indicate scenario features by color.

- Scenario landscape generated by correspondence analysis
- Example: **Consumer attitude towards energy savings**
- In each point of the plane the color indicates the prevailing type of attitude



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Context scenarios: The “socio-part” of socio-technical energy scenarios

Value-added of context scenarios as an extension of energy scenarios:

- Revealing the range and impact of context uncertainties.
- Enriching systems analysis by adding social science insights to the construction of energy scenarios, i.e. generating more comprehensive energy futures using a broader scientific approach.
- Suggesting socio-technical “risk narratives” which may challenge the stability of the transformation process.
- Supporting a comprehensive sustainability assessment of energy futures.

Additional value of using formal methods of context scenario construction:

- More comprehensive consideration of factor interdependencies.
- Less risk of ignoring important context futures.
- Option to generate a large number of context scenarios (if needed).
- Construction process traceable and well documented.

Limitations of the concept

- Application of the concept requires significant time resources.
- Subjectivity in storyline construction is reduced - not eliminated!
- Perpetuates the conceptual separation of the ‘technical’ and ‘societal’ sphere.

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Concept applications in ENERGY-TRANS

- Project “Technology infrastructure transitions“ (FZJ):
  Multi-level analysis of private heat consumption
- Project “Integrated scenario construction“ (DLR, ZIRIUS):
  Socio-technical perspectives on national transition pathways
- Project “Regional modeling (ITAS, DLR, FZJ)“:
  Consistent framework assumptions in a multi-model analysis
- Project “External perspectives“ (DLR, ZSW):
  Consistency-proofed sensitivity analysis in EU power supply modeling
- Horizontal task “Sustainability monitoring“ (ITAS, ZIRIUS):
  Applying sustainability assessment to socio-technical scenarios
- Integrative key topic “Regulations, Instruments, Governance”:
  Analyzing electricity market reorganization options

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