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Alliance ENERGY-TRANS

Socio-technical scenarios and sustainability: towards an integrative approach

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Motivation

Requirements to manage a transition process (in a nutshell):

- Knowledge of the aims
- Knowledge of ways and means
- Knowledge of the frame and its dynamic interdependencies (→ socio-technical systems)

➡ Methods to provide the required knowledge considering the aims

➡ Objective:
Discussion of integrated socio-technical scenario approach

Note: On-going research within ENERGY-TRANS

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Basic understanding

Thesis 1:

A (double) integrated scenario approach is required, to support transition processes of socio-technical systems towards more sustainability:

- Integration of social, economic and technological perspectives, (→ socio-technical scenarios)
  plus
- Integration of an appropriate (sustainability) assessment tool into socio-technical scenarios
  (→ *integrated* socio-technical scenarios)

Thesis 2:

Integrated socio-technical scenarios can be neither merely explorative nor merely normative

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The approach

Step 1:
Determination of relevant socio-technical system characteristics

Step 2:
Development of socio-technical scenarios

Step 3:
Development and application of sustainability indicators

Step 4:
Reflection

[Step 5:
Development of recommendations for action]

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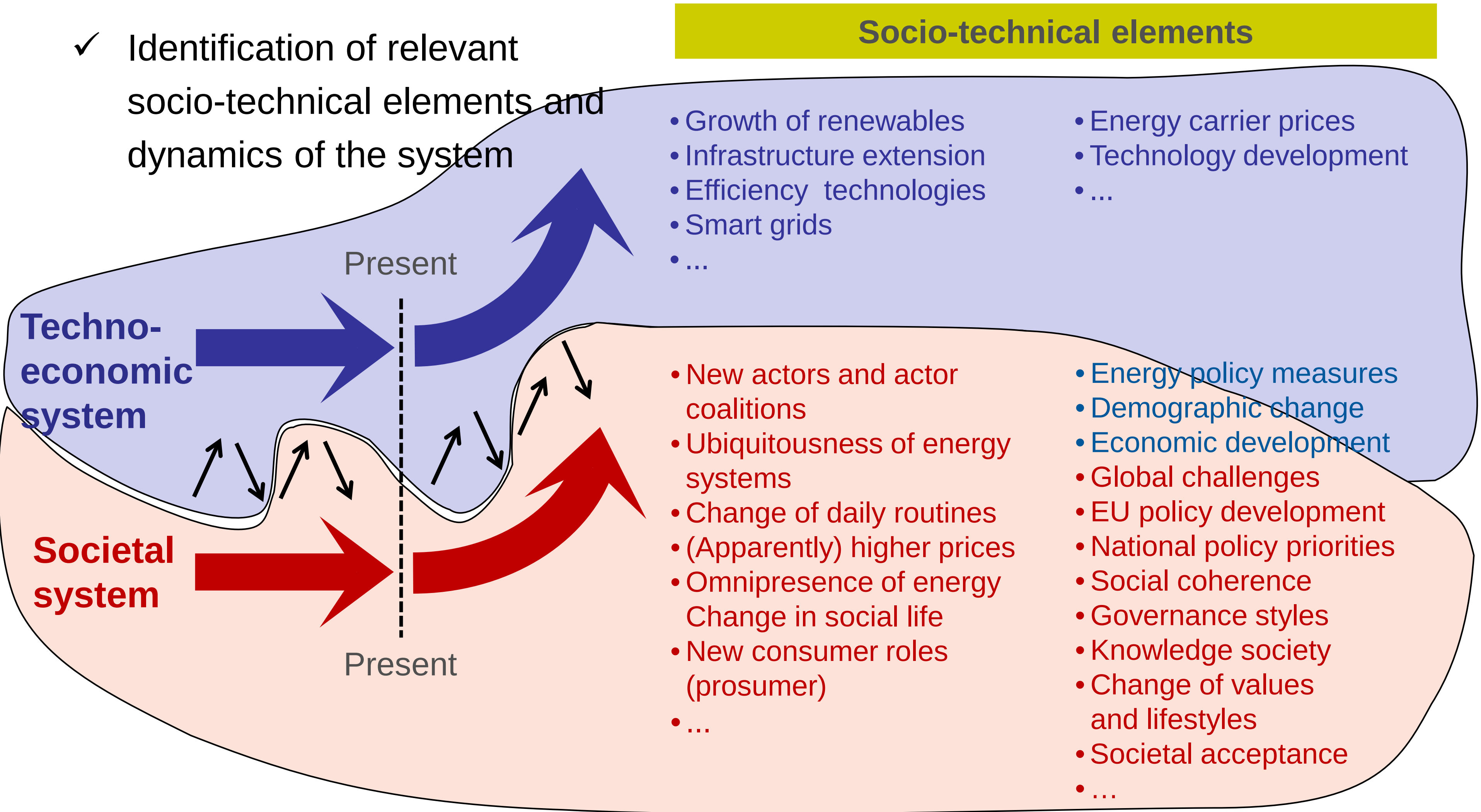
Step 1: Socio-technical system characteristics

✓ Identification of relevant socio-technical elements and dynamics of the system



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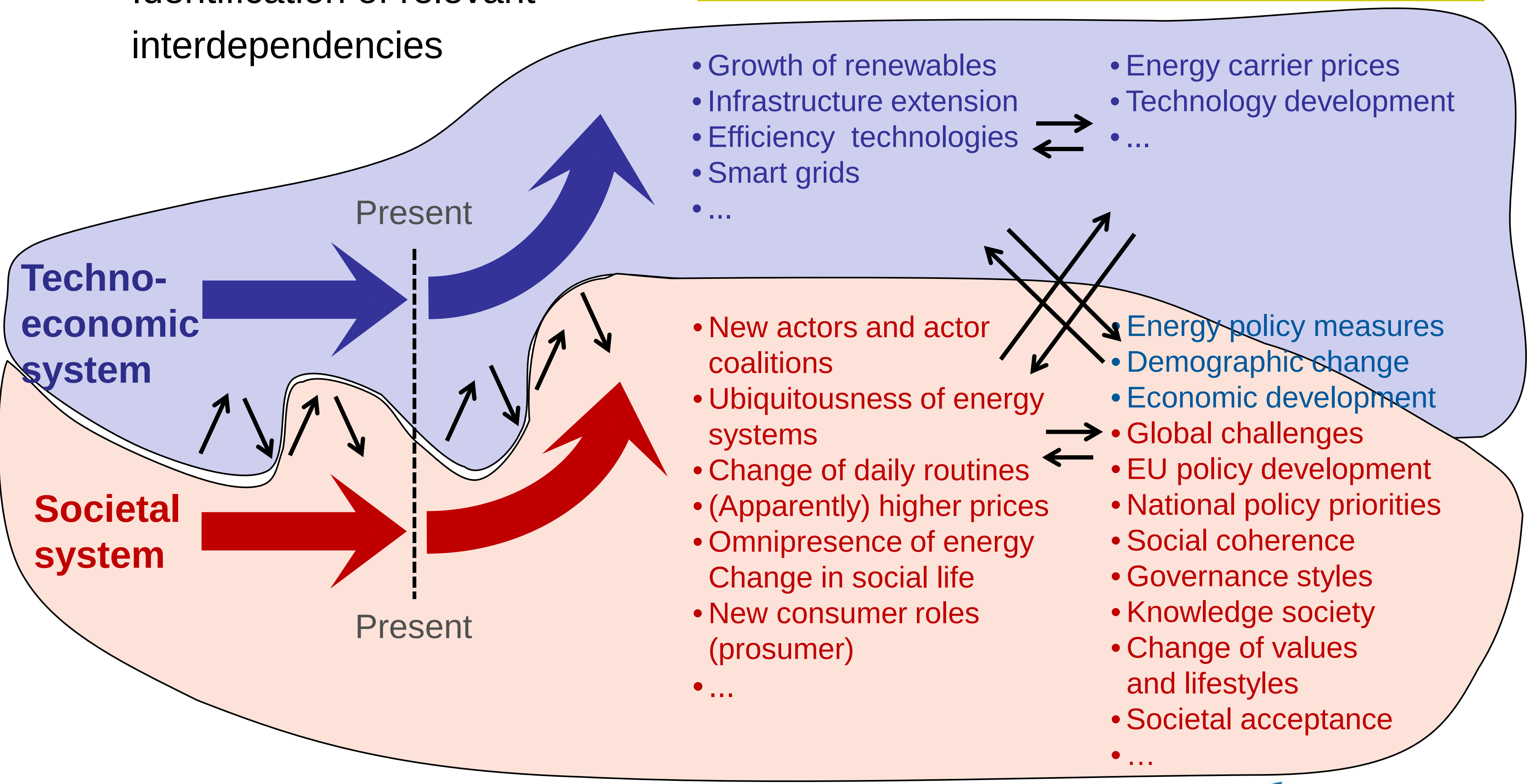
Step 1: Socio-technical system characteristics

✓ Identification of relevant interdependencies

Socio-technical elements



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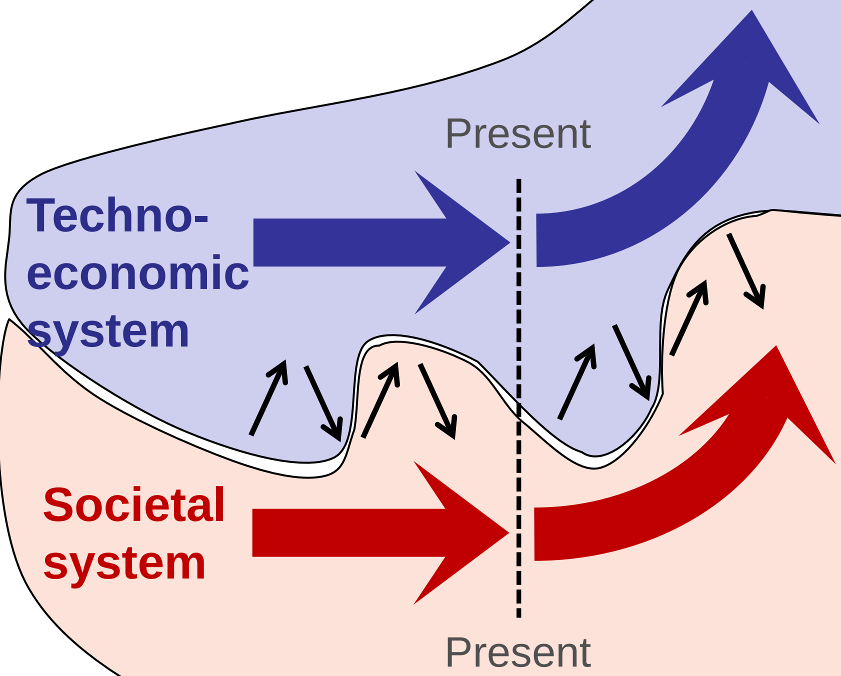
Step 1: Socio-technical system characteristics

✓ Translation into relevant drivers to describe scenarios



„Changes“

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

- New actors and actor coalitions
- Ubiquitousness of energy systems
- Change of daily routines
- (Apparently) higher prices
- Omnipresence of energy Change in social life
- New consumer roles (prosumer)
- ...

„Drivers“

- Energy carrier prices
- Technology development
- ...

- Energy policy measures
- Demographic change
- Economic development
- Global challenges
- EU policy development
- National policy priorities
- Social coherence
- Governance styles
- Knowledge society
- Change of values and lifestyles
- Societal acceptance
- ...

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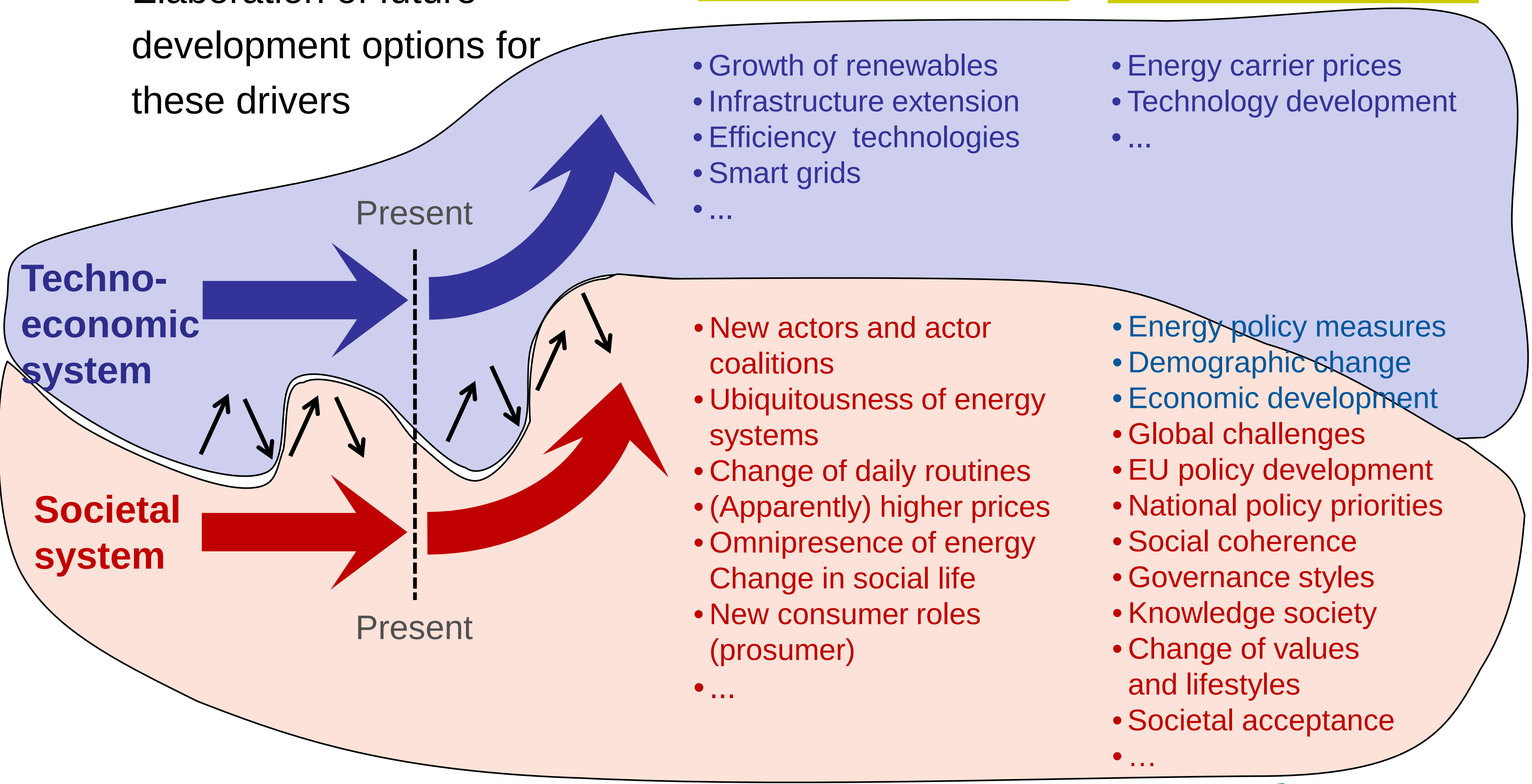
Step 1: Socio-technical system characteristics

- ✓ Elaboration of future development options for these drivers

„Changes“ | „Drivers“



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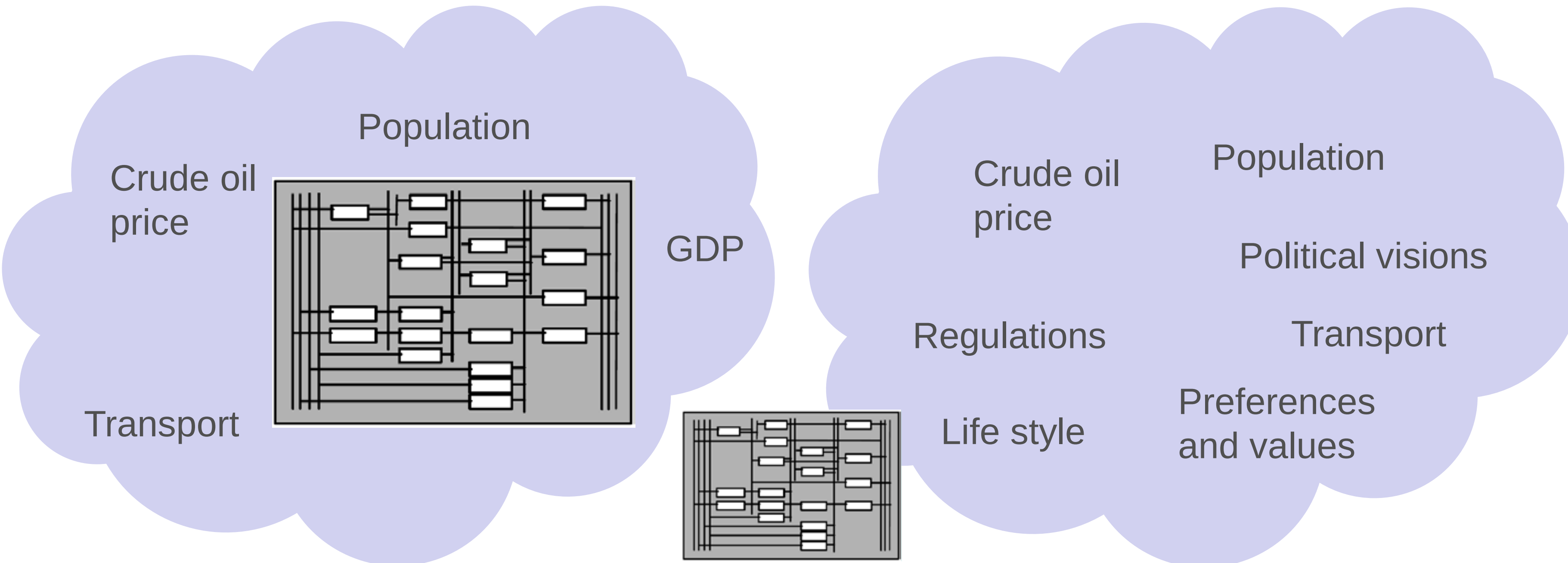
Step 2: Socio-technical scenarios

Normative-explorative (energy) scenarios

Context scenarios



Potentials and advantages

- Improved understanding of socio-technical system development
  - ✓ Systematic revealing of interdependencies between drivers of development
  - ✓ Combination of interdependencies into consistent scenarios
  - ✓ Quantification of changes of underlying interdependencies

- Improved quality of findings
  - ✓ Enhanced transparency of societal / institutional framework conditions
  - ✓ Improved consistency
  - ✓ Increased robustness of transition path proposals

➡ Improved orientation knowledge for decision-makers

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Step 3: Sustainability indicators

- Methodological requirements
  - A sound theoretical and conceptual basis (→ criteria)
  - A translation of criteria into suitable sustainability indicators, considering context conditions, socio-technical elements, etc.
  - An appropriate application of criteria / indicators to assess scenarios

- Methodological approach:
  Integrative Sustainability Concept of the Helmholtz Association with its substantial sustainability rules (→ criteria)
  - Securing human existence
  - Maintaining society's productive potential
  - Preserving society's options for development and action

  - Institutional rules

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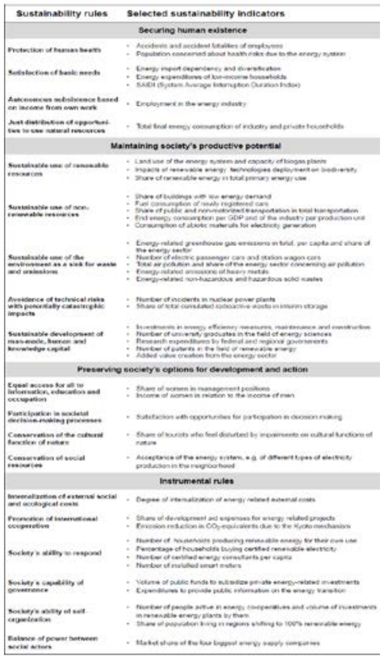
Step 3: Sustainability indicators

Set of about 40, preferred spatial, indicators, which could be assigned to the criteria and to institutional rules

- ✓ Mainstream (total energy use, energy efficiency, share of renewables, …)
- ✓ Not yet established socio-technical (societal concerns regarding health risks due to the energy system, acceptance in the neighborhood, installed smart meters, energy cooperatives, …)
- ✓ Not yet established ecological-economic (capacity of biogas plants per km^2 agricultural land, degree of internalization of energy-related external costs, …)

Sustainability rules	Selected sustainability indicators
Securing human existence	
Protection of human health	• Accidents and accident fatalities of employees • Population concerned about health risks due to the energy system
Satisfaction of basic needs	• Energy import dependency and diversification • Energy expenditures of low-income households • SAIDI (System Average Interruption Duration Index)
Autonomous subsistence based on income from own work	• Employment in the energy industry
Just distribution of opportunities to use natural resources	• Total final energy consumption of industry and private households
Maintaining society's productive potential	
Sustainable use of renewable resources	• Land use of the energy system and capacity of biogas plants • Impacts of renewable energy technologies deployment on biodiversity • Share of renewable energy in total primary energy use
Sustainable use of non-renewable resources	• Share of buildings with low energy demand • Fuel consumption of newly registered cars • Share of public and non-motorized transportation in total transportation • End energy consumption per GDP and of the industry per production unit • Consumption of abiotic materials for electricity generation
Sustainable use of the environment as a sink for waste and emissions	• Energy-related greenhouse gas emissions in total, per capita and share of the energy sector • Number of electric passenger cars and station wagon cars • Total air pollution and share of the energy sector concerning air pollution • Energy-related emissions of heavy metals • Energy-related non-hazardous and hazardous solid wastes
Avoidance of technical risks with potentially catastrophic impacts	• Number of incidents in nuclear power plants • Share of total cumulated radioactive waste in interim storage
Sustainable development of man-made, human and knowledge capital	• Investments in energy efficiency measures, maintenance and construction • Number of university graduates in the field of energy sciences • Research expenditures by federal and regional governments • Number of patents in the field of renewable energy • Added value creation from the energy sector
Preserving society's options for development and action	
Equal access for all to information, education and occupation	• Share of women in management positions • Income of women in relation to the income of men
Participation in societal decision-making processes	• Satisfaction with opportunities for participation in decision making
Conservation of the cultural function of nature	• Share of tourists who feel disturbed by impairments on cultural functions of nature
Conservation of social resources	• Acceptance of the energy system, e.g. of different types of electricity production in the neighborhood
Instrumental rules	
Internalization of external social and ecological costs	• Degree of internalization of energy related external costs
Promotion of international cooperation	• Share of development aid expenses for energy related projects • Emission reduction in CO_2-equivalents due to the Kyoto mechanism
Society's ability to respond	• Number of households producing renewable energy for their own use • Percentage of households buying certified renewable electricity • Number of certified energy consultants per capita • Number of installed smart meters
Society's capability of governance	• Volume of public funds to subsidize private energy-related investments • Expenditures to provide public information on the energy transition
Society's ability of self-organization	• Number of people active in energy co-operatives and volume of investments in renewable energy plants by them • Share of population living in regions shifting to 100% renewable energy
Balance of power between social actors	• Market share of the four biggest energy supply companies

Step 3: Sustainability indicators



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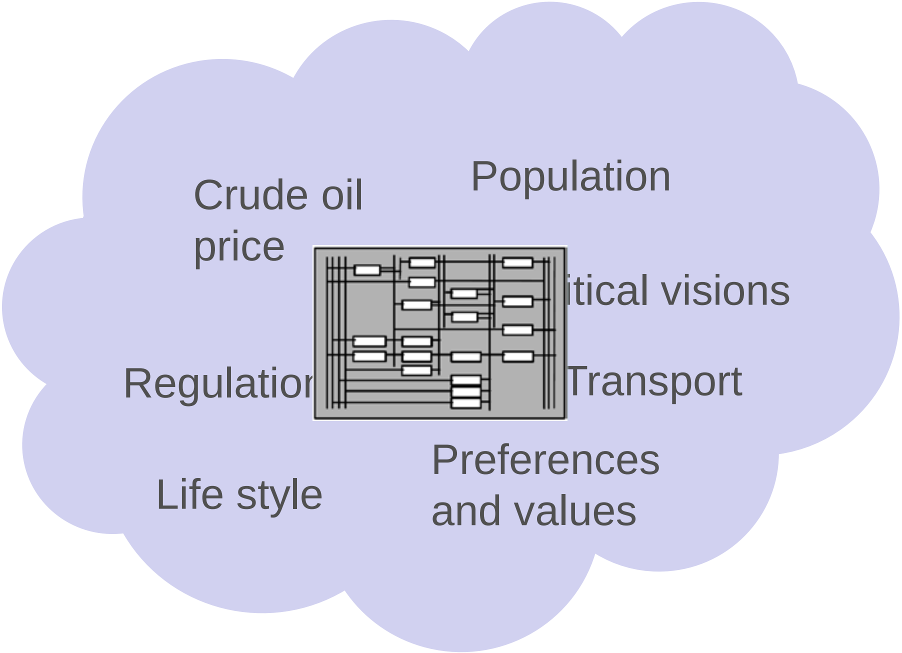

Matching indicators and socio-technical scenario variables

Case 1: Identical quantitative indicators and quantitative scenario variables

Case 2: Qualitative indicators could correspond to quantitative scenario variables

Case 3: No identical indicators and scenario variables

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Step 4: Critical reflection of method and results

- Motivation:
  - To make weak points and open questions transparent
  - Required to improve the methodology and the generation of orientation knowledge

- Main questions are:
  - Are the stories told correctly? If not, why not? Can it be changed?
  - Is the approach appropriately used:
    - Is each (sub-)approach – i.e. model-based techno-economic scenario; context scenario; sustainability indicators – consistently used?
    - Is the integration between each approach appropriate?
      If not, why not? Can it be changed?
      If yes, how it has to be changed?

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Conclusions – perspectives

- To support decision-makers with relevant knowledge regarding transition processes an integrative socio-technical scenario approach seems to be required
- In ENERGY-TRANS research is under way to develop such scenario approach

- More application experience and methodological research are needed to fully understand the strengths and limitations of the approach
- Applications in ENERGY-TRANS and accompanying research could lead to a blueprint for energy systems analysis in general

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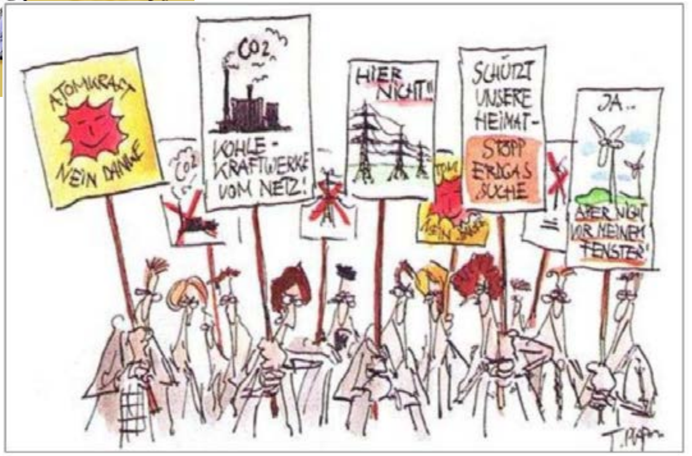
Source: http://andysrant.typepad.com/.a/6a01538f1adeb1970b017c370046b7970b-800wi; 28.05.2013



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