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Sustainability assessment of the German energy system and of socio-technical energy scenarios

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Background

- In 2012, the German Federal Government established the energy transition monitoring process “Energy of the future”
- Monitoring indicators are mainly addressing ecological and macro-economic issues
- Social aspects (e.g. public acceptance, support and participation) are missing, but have to be considered (see also: IASS 2013, Löschel et al. 2014, Fraunhofer ISI 2015)
- The concept of Sustainable Development provides the framework for a comprehensive assessment of current and future states

Objectives of Energy-Trans Sustainability group

- Development of a sustainability indicator (SI) system for assessments
  → improvement of existing indicators systems
- Proposal of new SI to address social issues,
  such as public engagement for and participation in the energy transition
- Sustainability assessment of
  - the German energy system and its transition (national / regional scale)
  - socio-technical energy scenarios (developed by ZIRIUS)

Methodology: Development of the SI System

The Integrative Sustainability Concept

Substantial Rules		
Securing human existence	**Maintaining society's productive potential**	**Preserving society's options for development and action**
(1) Protection of human health	(6) Sustainable use of renewable resources	(11) Equal access for all to information, education and occupation
(2) Satisfaction of basic needs (e.g. nutrition, housing)	(7) Sustainable use of non-renewable resources	(12) Participation in social decision-making processes
(3) Autonomous subsistence based on income from own work	(8) Sustainable use of the environment as a sink for waste and emissions	(13) Conservation of cultural heritage and cultural diversity
(4) Just distribution of opportunities to use natural resources	(9) Avoidance of technical risks with potentially catastrophic impacts	(14) Conservation of the cultural function of nature
(5) Reduction of extreme income or wealth inequality	(10) Sustainable development of man-made, human and knowledge capital	(15) Conservation of social resources (e.g. tolerance, solidarity)

Instrumental Rules	
(1) Internalization of external social and ecological costs	(6) Society´s ability to respond
(2) Adequate discounting	(7) Society´s ability of reflexivity
(3) Limitation of public debt	(8) Society´s capability of self-management
(4) Fair international economic framework conditions	(9) Society's ability to self-organization
(5) Promotion of international co-operation	(10) Balance of power between social actors

Results: indicator set including different types

- **“Classical” SI**
  - Share of Renewable Energy
  - Energy Efficiency
  - GHG Emissions
- **Sustainability topics under discussion in the scientific community**
  - Energy Poverty: Expenditures of low-income households (proposal)
  - Land use: Area under cultivation of energy crops (proposal)
- **New SI**
  - Share of households buying renewable electricity
  - Number of energy cooperatives
  - Fulfillment of participatory minimum requirements in energy related legal regulations
  - Internalization of external costs
- **New sustainability topics (no indicator yet)**
  - Impacts on biodiversity

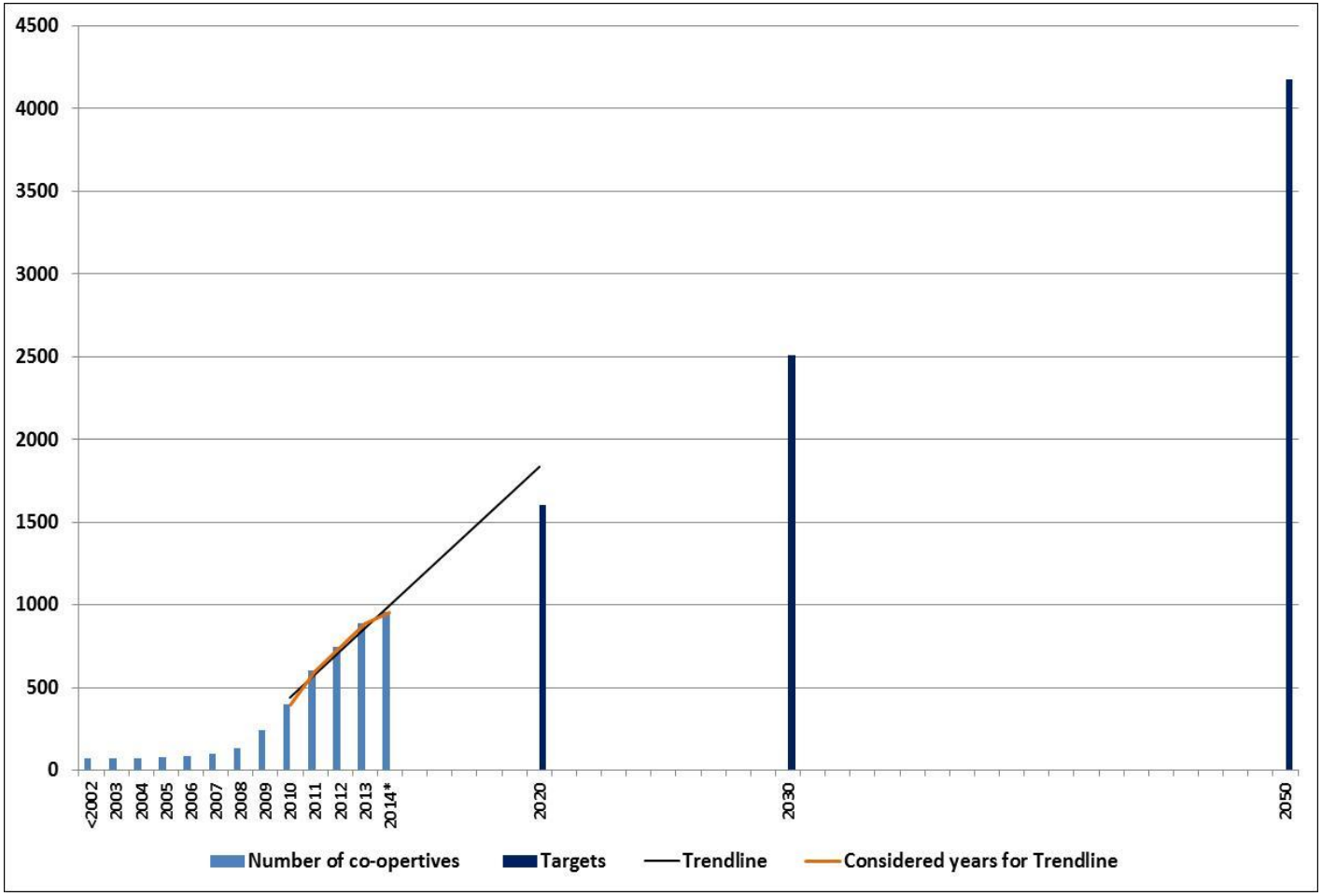
Methodology: Sustainability Assessment

- Distance-to-Target considerations
  - Determination of targets for 2020, 2030 and 2050 (different sources)
- Assessment (analogously to the approach of the monitoring process)
  - Calculation of a trend line over previous five years with data
  - Linear extrapolation of this trend until 2020
- Evaluation
  - Deviation of the extrapolated value for 2020 from the 2020 target

Green:	Distance to target	< 5 %	
Yellow:	Distance to target	5 to 40 %	
Red:	Distance to target	> 40 %	

Results

Example 1: Number of Energy Cooperatives Engaged in RE Plants



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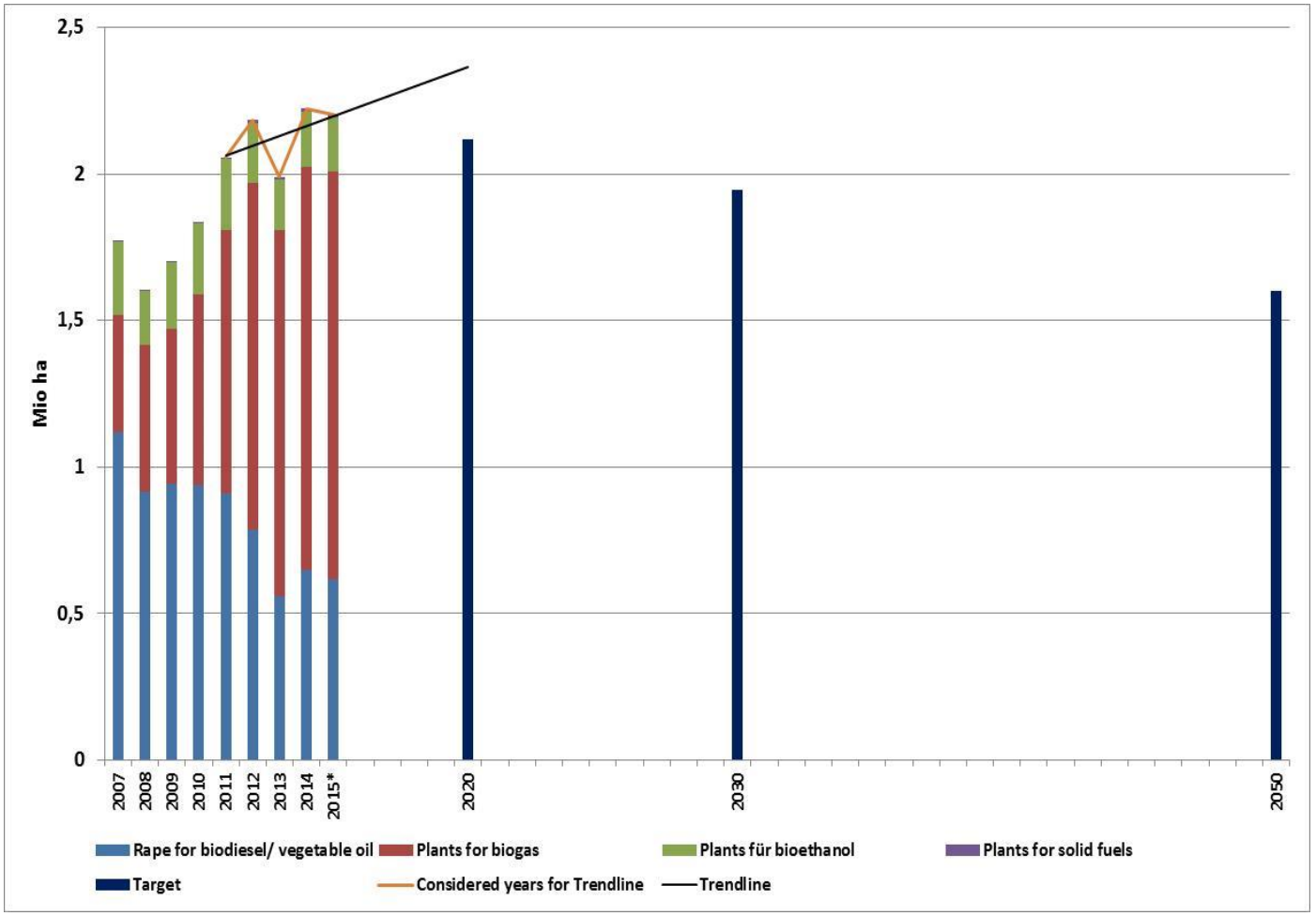
Results

Example 2: Area Under Cultivation of Energy Crops



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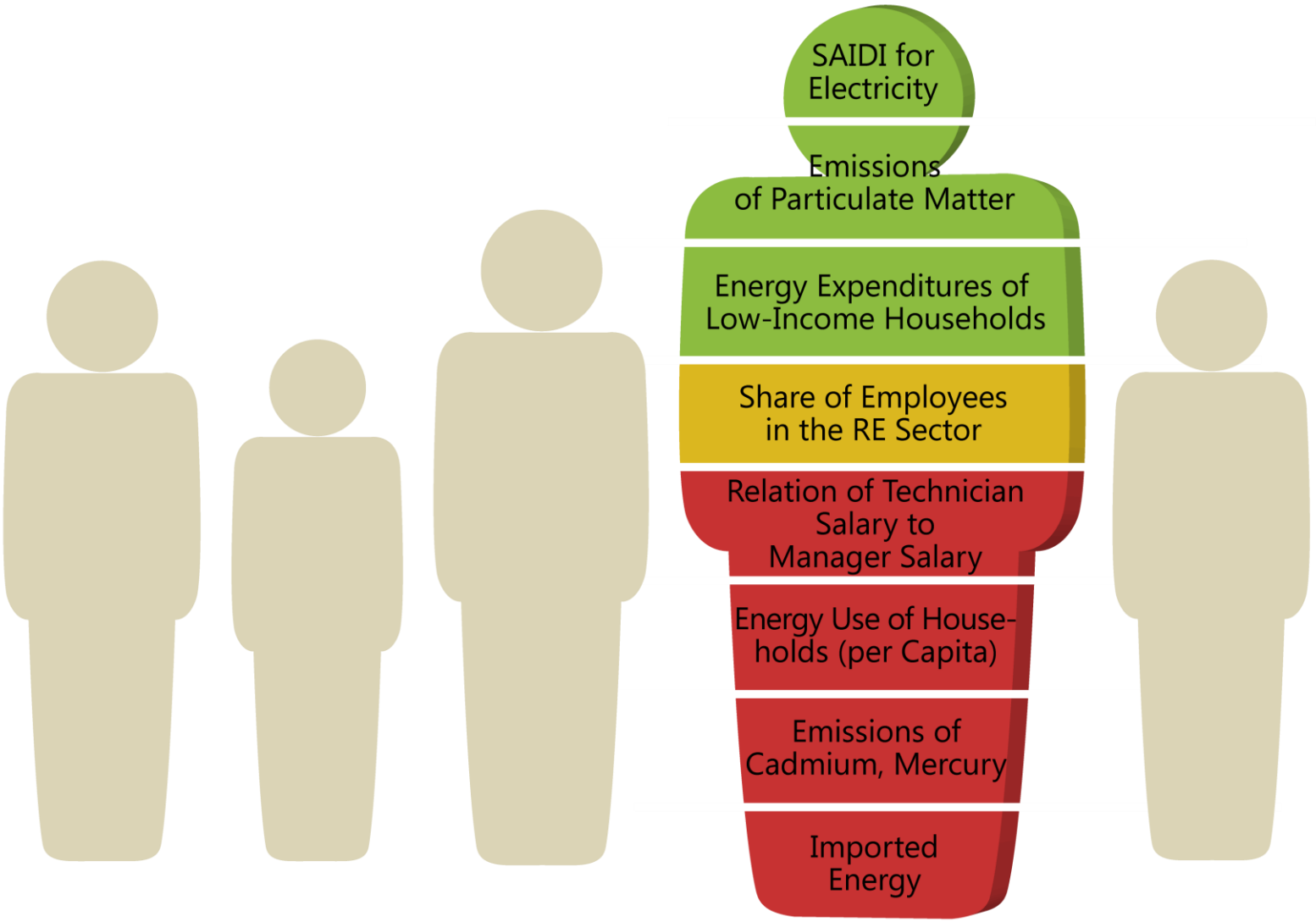
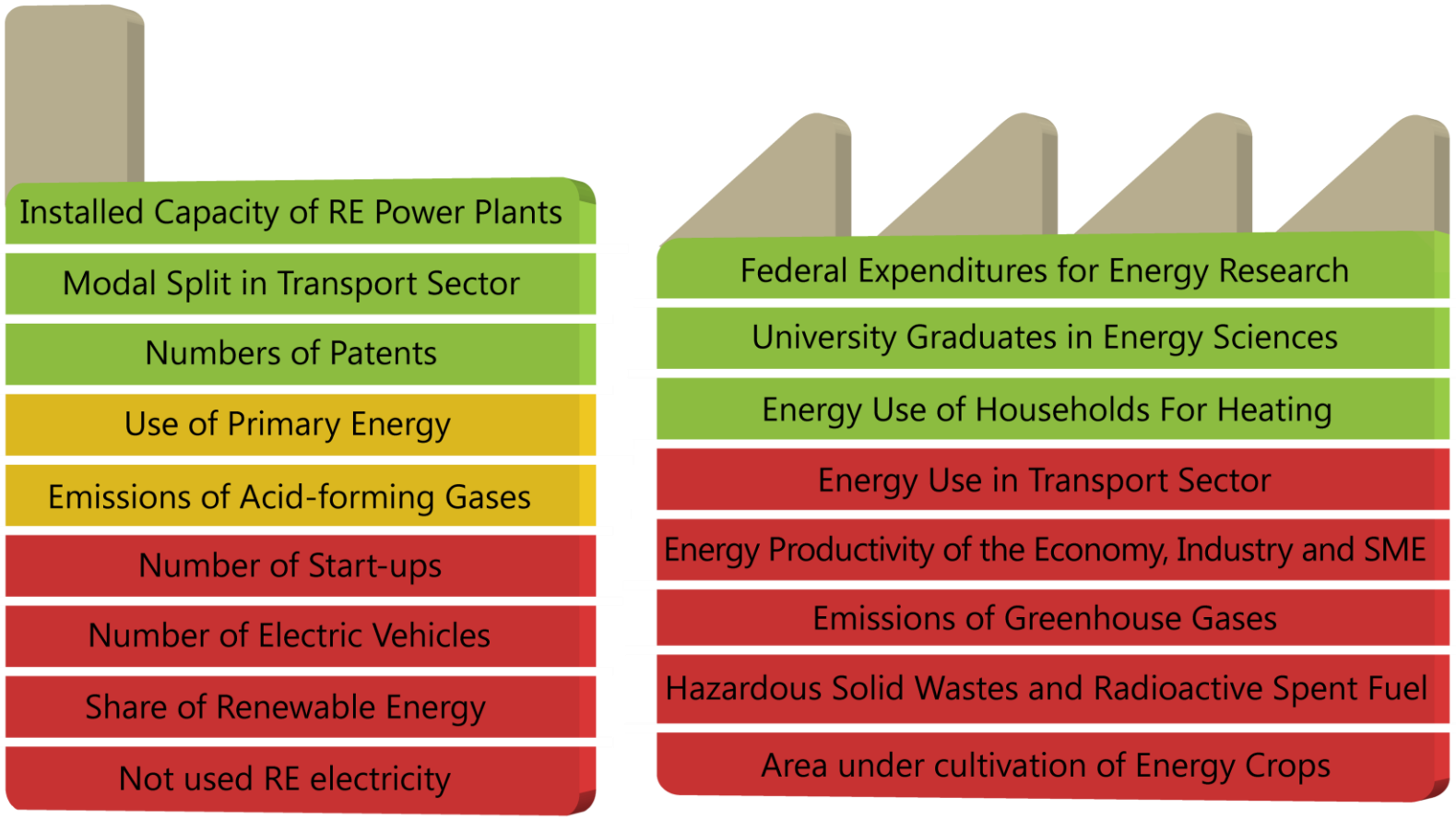
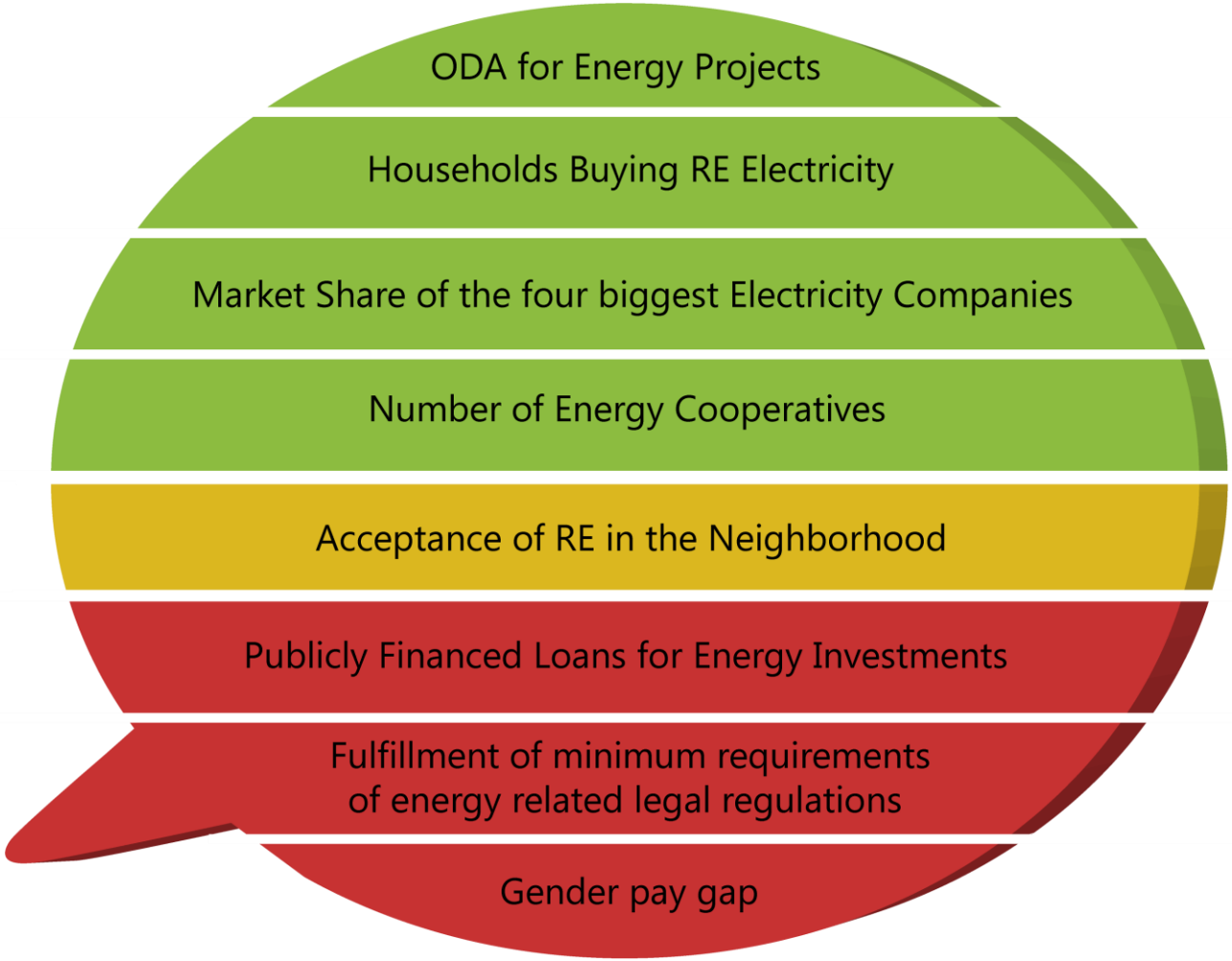
Results SI: Securing Human Existence



Results SI (2): Maintaining society´s productive potential



Results SI (3): Preserving society´s options for development and action



Methodology: Scenario Assessment (1)

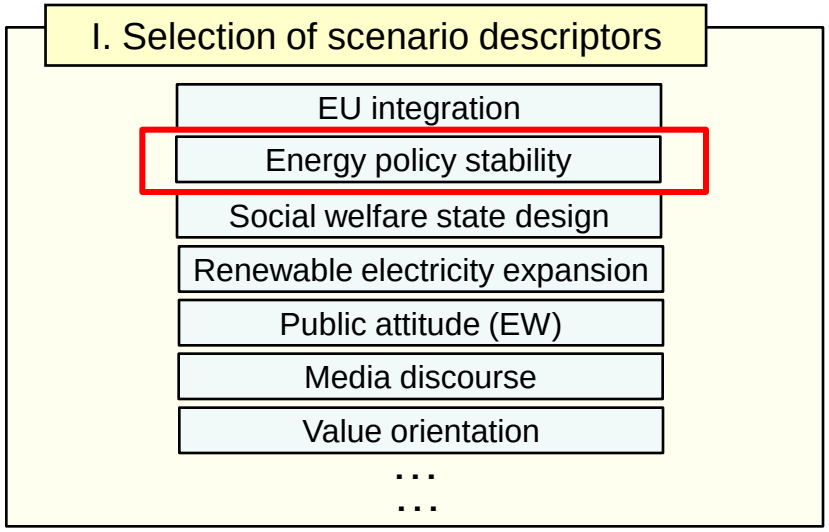
- Selection of socio-technical energy scenarios,
  developed in ENERGY-TRANS based on Cross-Impact-Balance method,
  in co-operation with ZIRIUS

- Assessment of SI within scenarios
  - partly quantitatively (model-based, by DLR),
  - partly assessment by experts

- Methodology for expert assessment:
  - Identification of scenario descriptors with influence on the SI
  - Assessment of particular impacts of descriptors
    (according to their determined manifestation in scenarios) on indicators

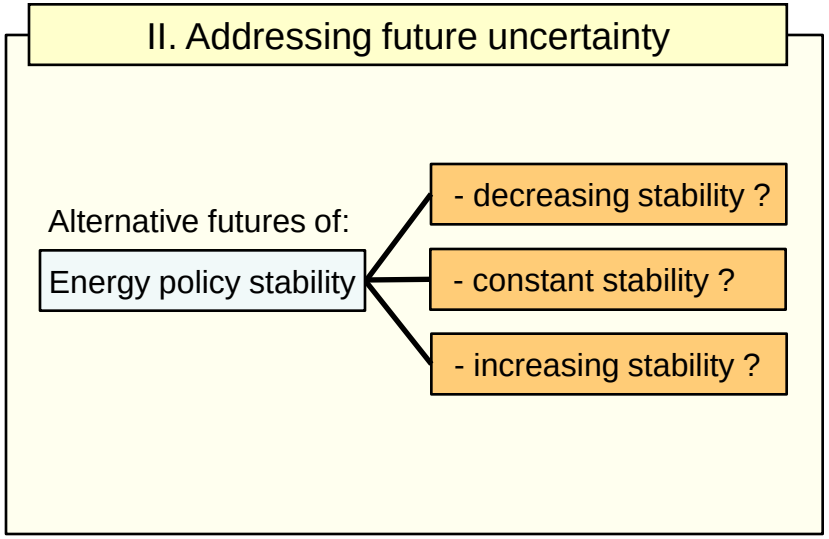
- Overall assessment of scenarios
  based on the assessment results of the indicators
  → sustainability pictures, consisting of “green”, “yellow” and “red” indicators

Methodology: Scenario Assessment (2)



No influence on any SI

Influence on one or more SI



Expert-based assessment how the future characteristics of the descriptor will influence the SI

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Conclusions

- Continuous monitoring and assessment of the energy system by SI is needed to support transition processes

- The existing monitoring approach has to be complemented by missing indicators addressing
  - socio-technical interfaces,
  - important environmental issues (e.g. land use, biodiversity)

- More inter- and transdisciplinary research and official statistical efforts are required to further develop the SI system and to fill data gaps

- Many further efforts are needed
  … to achieve the German political energy transition targets
  … to suitably address key sustainability conditions

Thanks for your attention!