

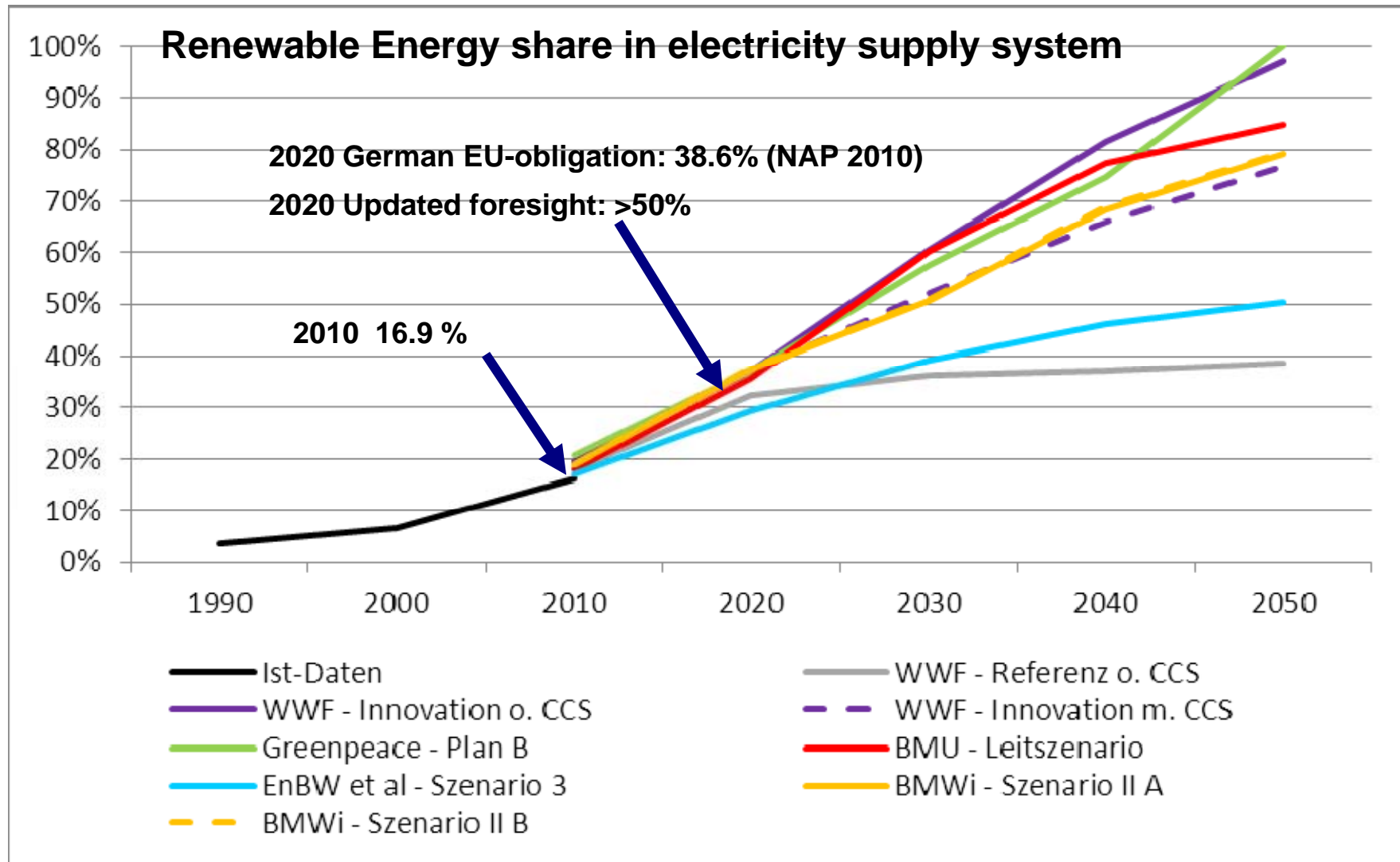
Wuppertal Institute
for Climate, Environment
and Energy

Integration of Renewable Energies into the Energy System – Requirements for System Integration by the Example of Germany

LCS-R Net 3rd Annual Meeting
14 October 2011, Paris

Dr. Peter Viebahn
Prof. Dr. Manfred Fishedick
Research Group 1:
“Future Energy and Mobility Structures”

In Germany in the electricity sector renewable energies are supposed to be a major future contributor



Nuclear phase out strategy in Germany will further accelerate renewable energy extension

Scheduled shut-down of nuclear power plants in Germany



How to shape the transition process?

System integration of renewable energies as illustrative example:

Future tasks and chances of a non self-dynamic process (1)

- **Technology challenge:** further development of system integration technologies (e.g. storage and hybrid systems, prognosis methods, smart grid)
- **Compatibility challenge:** cooperation between conventional and new technology options
- **Capital challenge:** covering investment needs (early investment: pay now – earn back money later)
- **Infrastructure challenge:** further development of appropriate infrastructure (e.g. smart und super smart grid)

How to shape the transition process?

System integration of renewable energies as illustrative example:

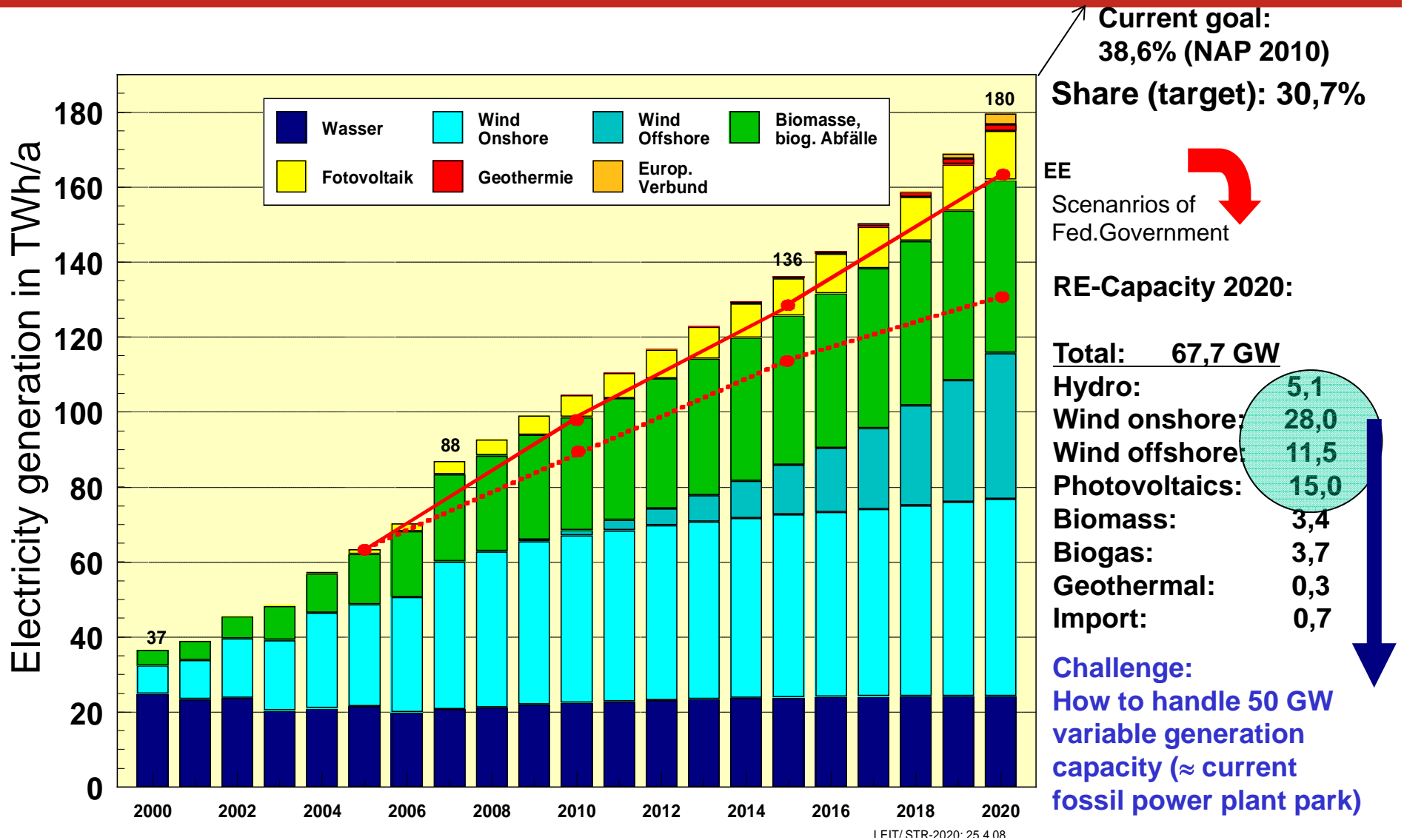
Future tasks and chances of a non self-dynamic process (2)

- **Resource challenge:** avoid negative resource impacts (critical resources, toxic materials)
- **Stakeholder challenge:** persistence forces of established stakeholder
- **Social challenge:** Public perception and societal acceptance (incl. infrastructure measures and paradigm shift: renewable energies are no more only decentralized technologies)
- **Policy challenge:** Integrated regional, national and international policy initiative (multi-level approach)

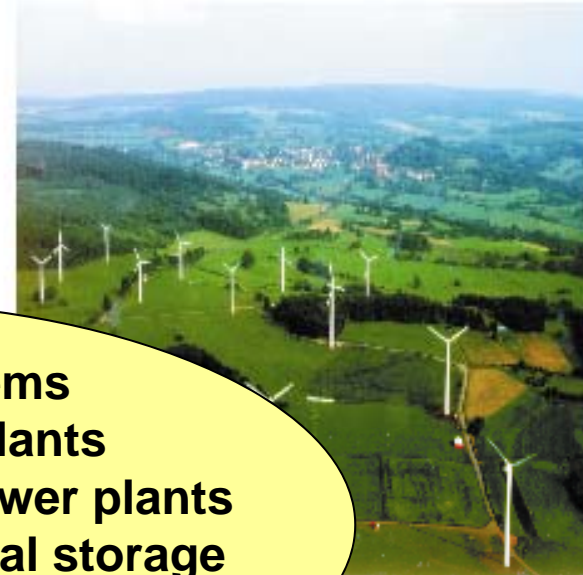
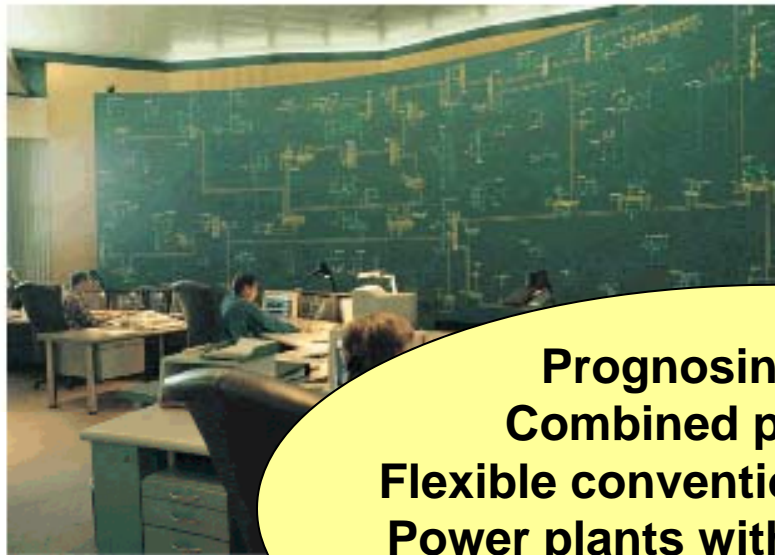
How to shape the transition process?

- **Technology challenge: further development of system integration technologies**
- **Compatibility challenge: cooperation between conventional and new technology options**
- Capital challenge: covering investment needs
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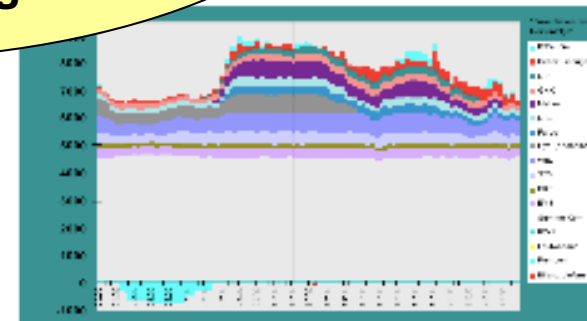
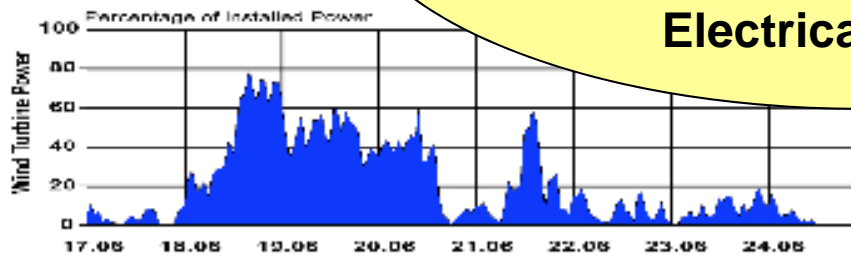
Technological challenge of system integration of renewable energies: How to deal with variable supply characteristic?



Extension of renewable energies requires additional technological and structural measures



**Prognosing systems
Combined power plants
Flexible conventional power plants
Power plants with thermal storage
Load management
Electrical storage**



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DENA study predicts additional demand for 3.600 km high voltage power lines for RE system integration



Grid extension could be the crucial bottleneck.

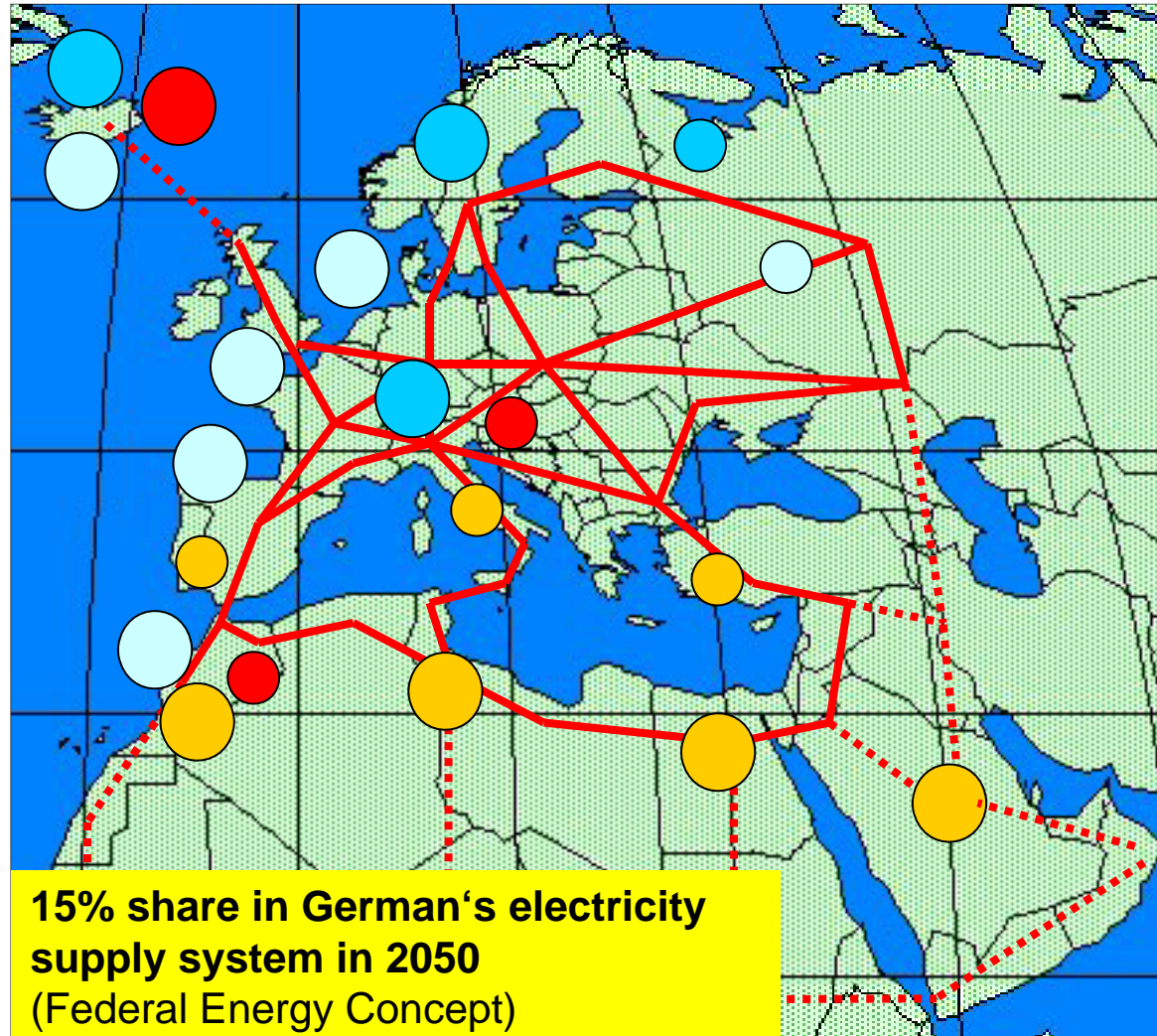
- Increasing RE share requires grid extension and retrofit/reinforcement
- Current construction of new high voltage power lines is extremely limited (90 km from 2005 to 2010)
- Compensation mechanism become highly important







challenges:

- Underground transmission lines
- Wind electricity cut offs
- High Voltage DC Overlay Grid
- Energy storage
- Load management
- Non electricity transport (H2, CH4)
- ...

The next generation challenge

Trans-European Transmission Grid based on renewable energies



-  Solar
-  Wind
-  Hydropower
-  Geothermal
-  EURO-MED
-  possible further connections

Technological potential
North Africa

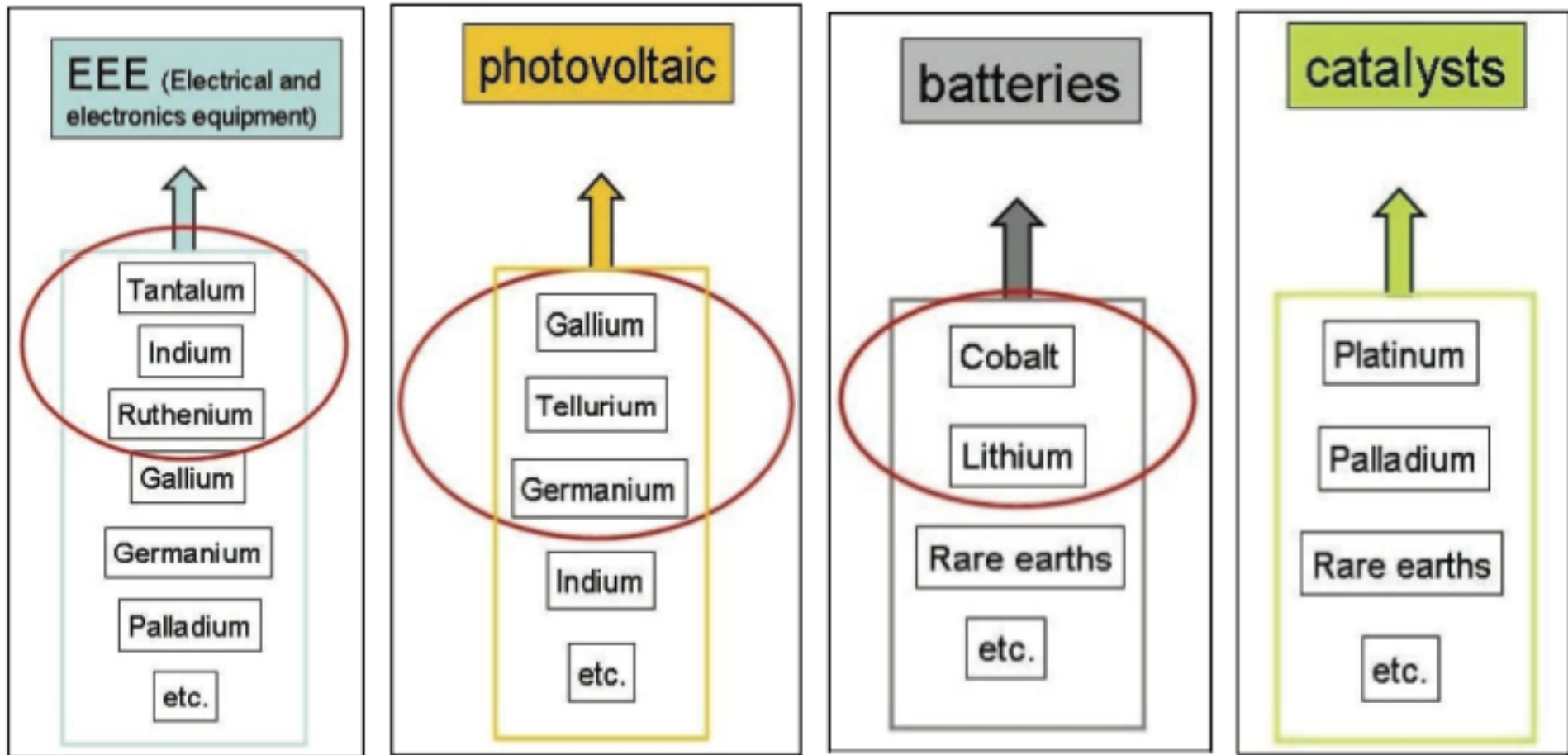
1.360.000 TWh
(ca. 100* current global
electricity demand)

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Resource Challenge

Critical metals are components of several promising energy technologies



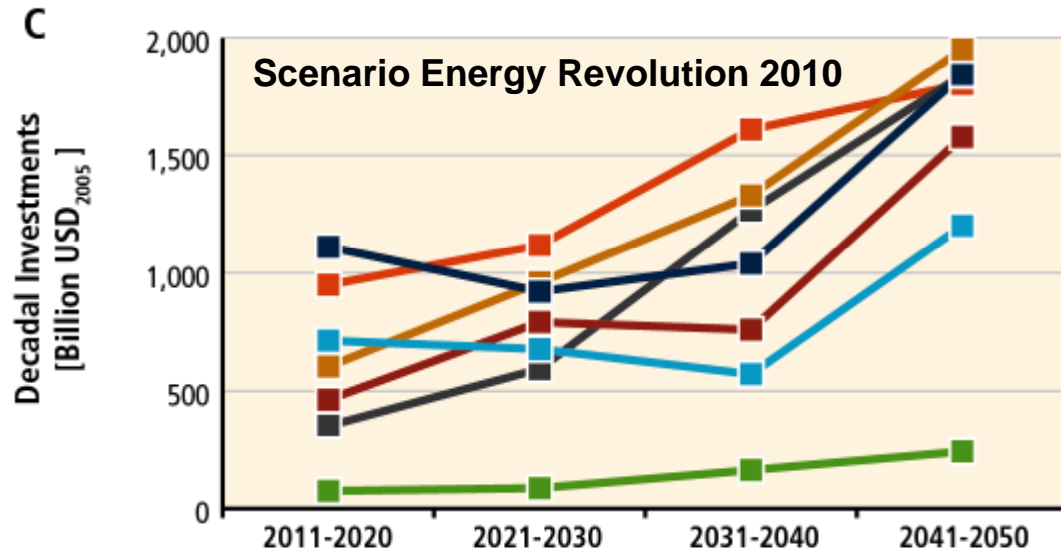
„...there is increasing evidence that resources in general, or at least some specific resources, may become quite scarce in the coming years“ (T. E. Graedel, Yale University 2008)

How to shape the transition process?

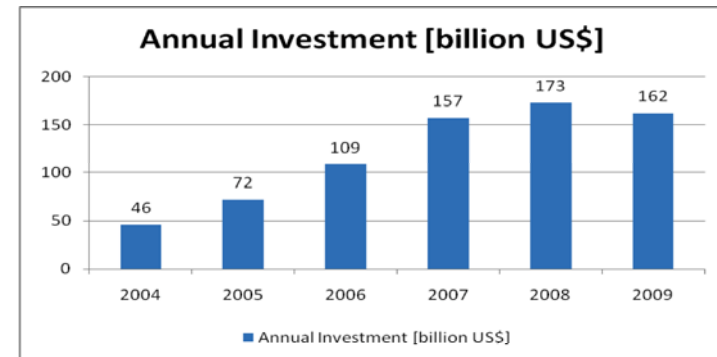
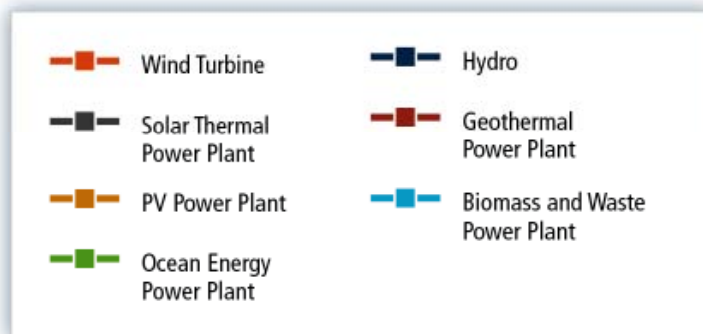
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 - **Energy utilities**
 - **Private consumer**
 - **Energy technology manufacturer**

The manufacturer challenge

How to participate in growing world market



- Depending on assumptions annual RE investments might triple of increase by a factor of 5 compared to today's volume (162 Mrd. \$ (2009))



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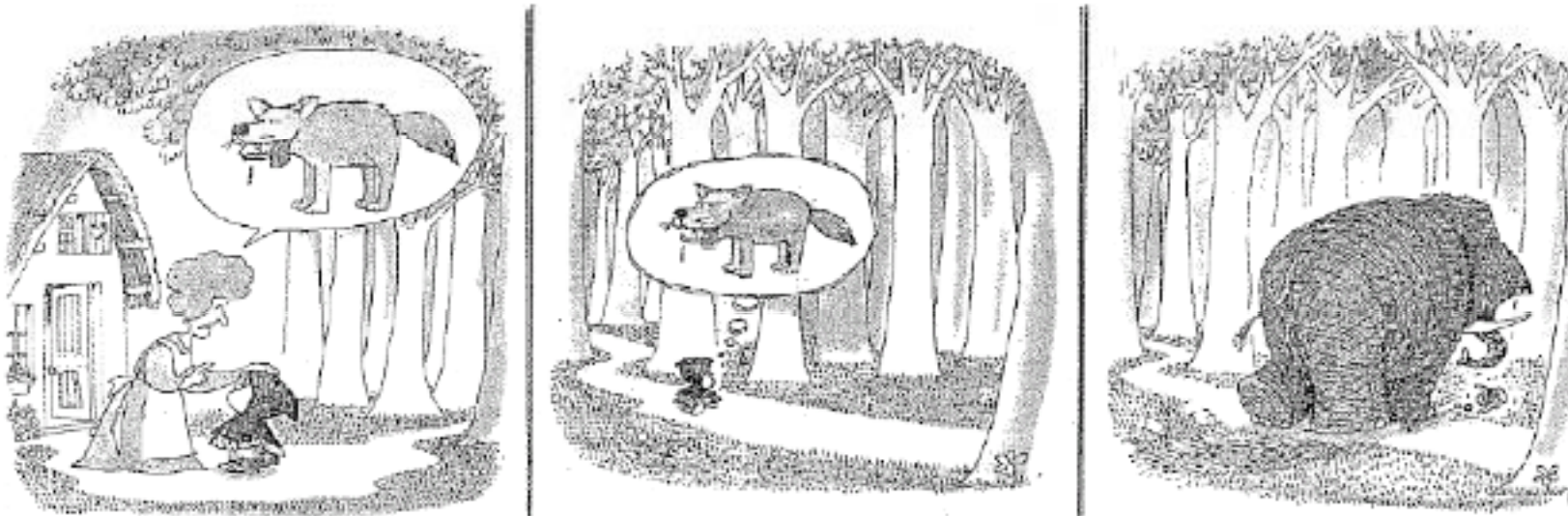
Experience – what does make social acceptance as difficult as it is?

Different perspectives, interests and background of stakeholder

- Policy decision maker
- Administration
- Initiatives and associations (e.g. environmental and industry associations)
- Commercial Companies
- Planning teams
- Investors
- Operators
- Manufacturer
- Scientific community
- Residents
-

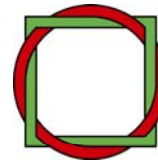
Conclusion

Huge and complex challenges for the energy future besides climate protection – avoid trade off's, look for synergies



Quino, Der große Quino, dtv 1466

- ➔ Cross sectoral, integrated perspective requested instead of looking for a partial optimum
- ➔ Don't focus on the wolf if there might be other dangerous animals around



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Thank you very much for your attention!



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