Is long-term planning socialism?

Large Scale Grid Integration of RE in India, 7. September 2017, New Delhi, India
IS LONG-TERM PLANNING SOCIALISM?
List of possible planning mistakes

I. How large is the energy consumption really?

2004: *Energiewende* = German electricity sector: 550 TWh

2010: *Energiewende* = Electricity + Heat: 850 TWh

2013: *Energiewende* = Electricity + Heat + Mobility: 1000 TWh

2017: *Energiewende* = Electricity + Heat + Mobility + planes + ships + chemistry: 1300 TWh
List of possible planning mistakes

II. Dismantling the balancing power plants
List of possible planning mistakes

III. Ignoring the necessity of the electric counter-load => the CHP-mistake
List of possible planning mistakes

IV. Underestimation of market dynamics
What is at the core of long-term planning?

Systemic difference between a conventional and a Renewable energy system

1. Technical Design quantities of a renewable energy system
   1) Mixture ratio of RE-sources (PV, Wind, Water, ...) and ...
   2) Absolute value of the RE-sources
   3) Tank size of the storage
   4) Charging power
   5) Discharging power

2. Economical Design quantities
   1) Rate of change
   2) Relative weight of energy sector
What is at the core of long-term planning?

Optimization problem:

\[
\text{cost} = \sum_i c_i^P \cdot P_i + \sum_j c_j^E \cdot E_j \rightarrow \text{min}
\]

(Power-related and Energy-related cost components)

Boundary condition (supply condition):

\[
P_{\text{res}}(t) = P_{\text{load}}(t) - \left( P_{PV}(t) + P_{\text{max}}^{\text{Wind}}(t) + P_{\text{balancing}}(t) \right) = 0
\]
Which of these quantities are harder and which easier to predict?

\[
\text{cost} = \sum_{i} c_i^P \cdot P_i + \sum_{j} c_j^E \cdot E_j \rightarrow \min
\]

(Power-related and Energy-related cost components)

Powers:

Load: Population growth, energy consumption per capita
Generation: Solar and wind hours

Energies:

Storage size: Characteristics of residuum signal

Cost:

Price development for technologies
Price development for fossile energies (gas, coal, oil)
Price development for CO2
Parametric studies of future energy systems

Isolines for different ratios of specific cost for storage and generation technologies (green and red lines)

\[ \text{cost} = \sum_i c_i \cdot P_i \]

Non-linear dependence of generation on storage power for different values of return efficiency of storage (blue lines)
Expectation range of installation for battery based and hydrogen Storage technologies depending on specific cost assumptions
Total generated RE-Energy normalized to End energy (consumption)
Development of the registered cars 2013 - 2050

- Diesel
- Gasoline
- Hybrid-Diesel
- Hybrid-Gasoline
- Battery electric vehicle
- Range extended electric vehicle
- Plugin hybrid electric vehicle
- ... & hybrid
- Internal combustion with Natural Gas
- H₂-Fuel cell electric vehicle
Mix of electricity generation and share of RE in the European energy market in 2050
**Is Long-term Planning Socialism?**

**Investment security:** is most important to realize sustainable development

**Societal impact:** has to become part of the cost functions

**Speed of change:** S-curve dynamics of macroeconomic development

**Interconnections:** Coupling of time and climate zones relaxes the efforts

**Smoothness of minima:** design parameters of target system are soft

**Rolling planning:** adapts to changes in parameter expectations

**Using statistics:** instead of time series gives more generalizable results
Energy transition hub

Data acquisition
- Renewable potential
- Existing infrastructure

Best practice sharing
- German Energiewende
- Transition hub partners

Target scenarios
- Best technology mix
- CO₂-reduction targets

Process supervision
- Develop local expertise
- Incorporate new developments

Transition paths
- Installation rates
- Development of markets and infrastructures
Network of Energy transition hubs

- Center for global energy transitions
- Communication hubs for distributed work of industrial and scientific partners
- Supervision of Energy system transformations at dialogue stakeholders

Let’s form a team!