IMPLEMENTATION OF EXPERIENCE CURVES IN ENERGY MODELS

Workshop on Learning Curves, 08.11.2017, Karlsruhe

■ Implementing experience curves in an optimisation model – example of ELTRAMOD

- Step wise approach for non-linear function
- Max. cumulative capacity defining indirectly floor cost
- Worldwide learning how to consider in regional models
- What is the starting point for capacity technical learning

- FORECAST
  - Bottom-up final energy demand model (Focus)
  - Investment decision on total cost of ownership

Problems
  - Learning takes place outside the model boundaries
  - Problem to find cost data in different countries
  - Complexity of model
  - Looking at incremental costs
  - Global learning: impact of large shares of capacity addition in Europe on global scale capacity and learning rate

Solution
  - Exogenous approach – (is it justified)
  - How to use a general approach for simplifying learning rates for a bundle of technologies

REflex
Analysis of the
European Energy System

■Solutions?

Input presentations

- TE3
  - Global market dynamics for electric vehicles are important to understand European development
  - Historic cumulative battery production (exogenous)
  - EU-sales from ASTRA (endogenous), initial battery cost for first unit
 - Large impact of small variance in initial set-up on total outcome

■PowerAce

- Agent based model (hourly resolution)
- Initial investment for investment decision is dynamic in case of experience curves are applied

REflex
Analysis of the
European Energy System

- REMIX-model German aerospace institute
- IEA optimisation model (times model)
- IER Times-PanEr (Pinar Korkmaz)
- Jülich (introduction strategies hydrogen infrastructure)
- Linz (Kepeler Uni) techno-economic assesment power to gas (learning curves for power to gas, component based)
- TU Munich (linear optimization power generation)
- DLR (agent based, market integration, investment decisions) maybe implementation of learning curves
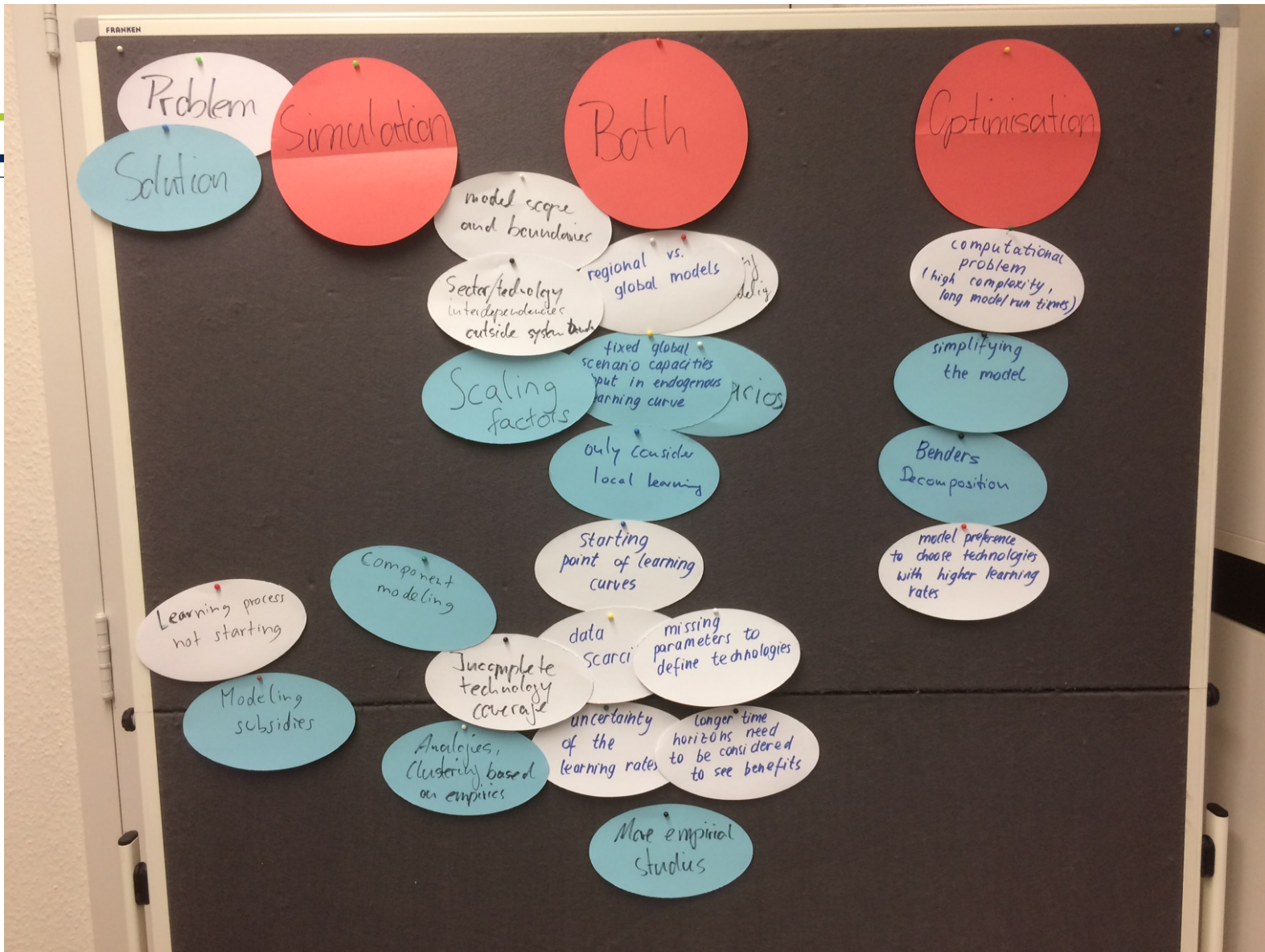
Summary of problems and solutions (independent of model concept)

- Learning takes place outside the model boundaries
  - How to integrate global learning in regional models
  - how to consider regional growth in global learning rates
  - Sector/technology interdependencies outside system definition
- ✓ Use scaling factors
- ✓ Use scenarios for global learning
- ✓ Only consider local learning and keep global learning fixed
- Data Scarcity, missing parameters to define technologies, incomplete technology coverage
  - Incomplete technology data
  - Uncertainties
  - Missing parameters
  - What is the starting point for the initial capacity/investment cost -> small variations can have a huge impact in the long run
  - Longer time horizons need to be considered to see benefits
- ✓ Data, data, data -> put more emphasis on collecting empirical data
- ✓ Component modelling
- ✓ Analogies, clustering based on empiric data

REflex
Analysis of the
European Energy System

Summary of problems and solutions (dependent of model concept)

Optimization model

- High computation time
  - ✓ Simplify model (reduce technologies, time steps, etc.)
  - ✓ Use Benders decomposition approach
  - Model preference to choose technologies with higher learning rates

Simulation models

- Learning process not starting (even with high learning rates)
  - ✓ Modelling subsidies/policies