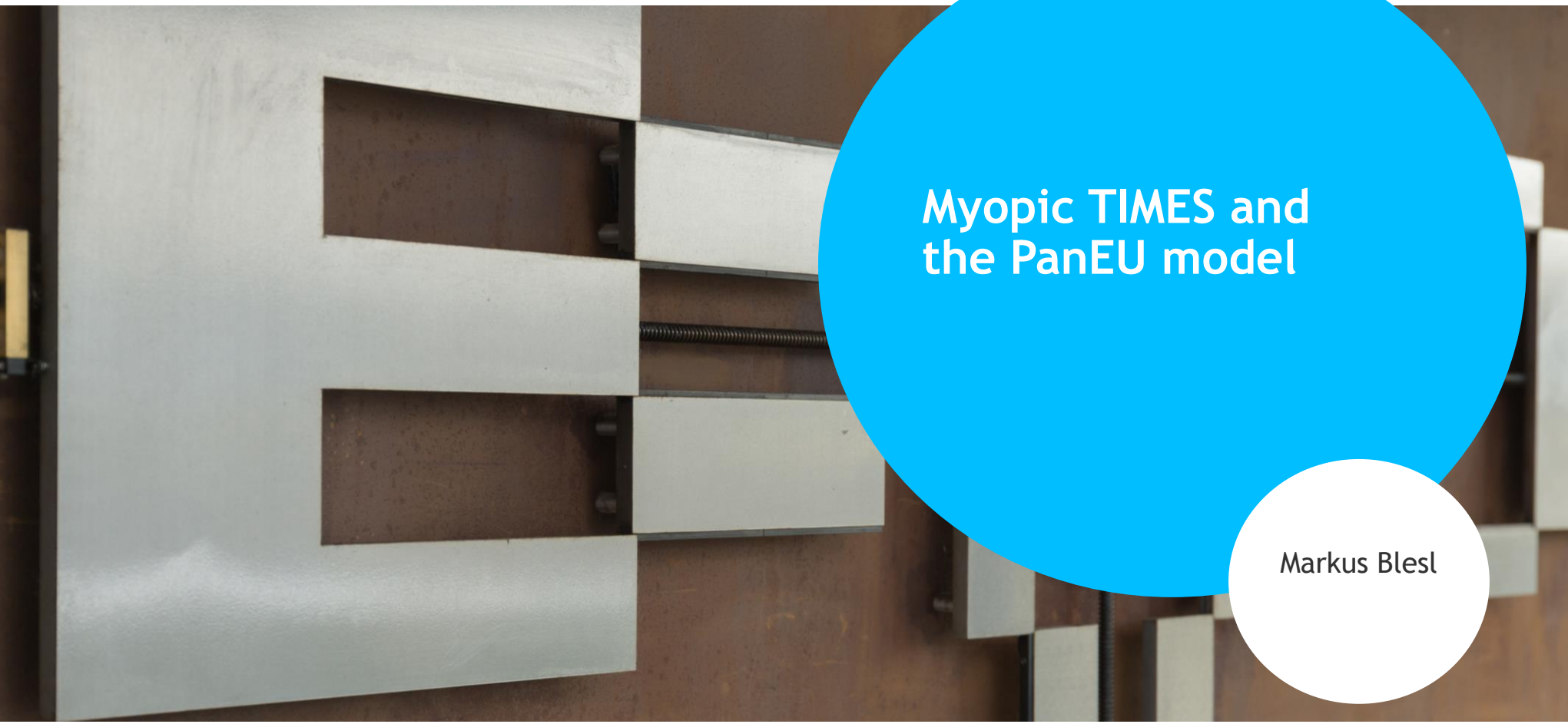
Universität Stuttgart
Institut für Energiewirtschaft und
Rationelle Energieanwendung (IER)



Myopic TIMES and the PanEU model

Markus Blesl

Agenda

- Motivation
- Types of uncertainties
- Myopic foresight and modifications
- Some experience
- Summery and outlook

Motivation

- Take uncertainties into account
- Modeling decision making in a more proper way
- Reduction of the model size

Types of uncertainties

- **At boundaries of energy system:**
  - Development of demand vector
  - Simultaneous factor for the different demands
  - Supply side:
    - Import/export prices
    - Domestic fossil reserves/resources
    - Renewable potentials – supply curves of renewables
- **Technology characteristics:**
  - Availability of technologies
  - Development of technical and economic properties
- **Policy uncertainties:**
  - Design and implementation of policy measures and targets

Options to handle uncertainty in TIMES

Marginal sensitivity analysis

Analyzing the effect of marginal changes in the model input data A,b,c on the solution

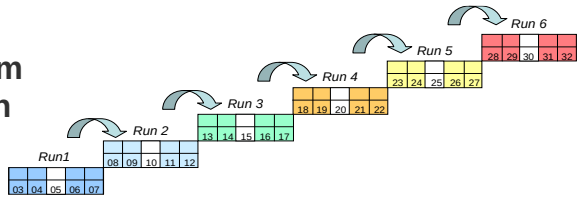
$$\begin{aligned} &Min \quad c^T x \\ &\text{s.t.} \\ &Ax \geq b \\ &x \geq 0 \end{aligned}$$

Parametric Programming

Variation of model input data A,b,c over larger value ranges

Myopic vs. clairvoyant

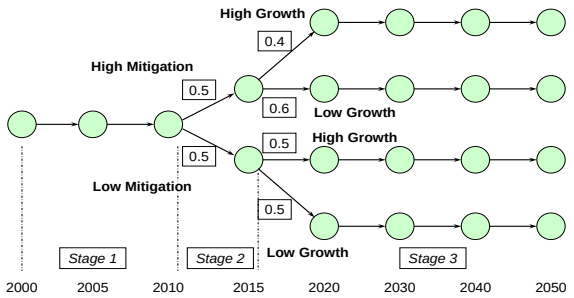
Analyzing the impact of short-term vs. long-term planning horizon on the decisions



Stochastic programming

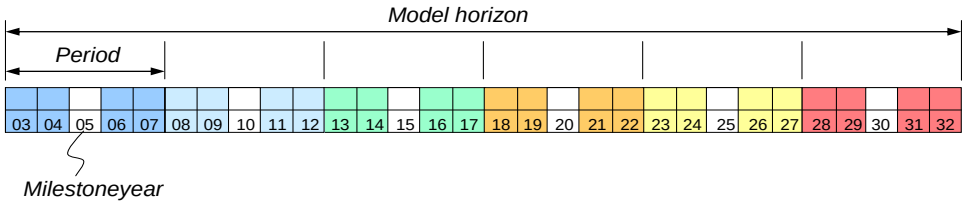
Multi-stage stochastic programming to develop hedging strategies for uncertain future

Stochastic TIMES – Example



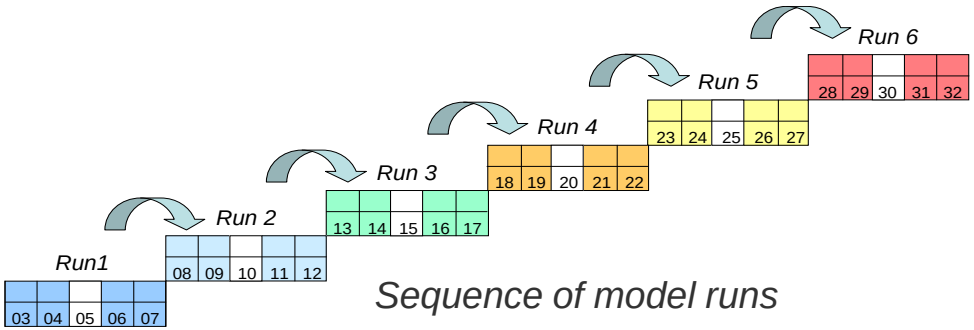
Myopic foresight

Perfect foresight



One optimization run over entire horizon

Myopic foresight
(Dynamic-recursive)

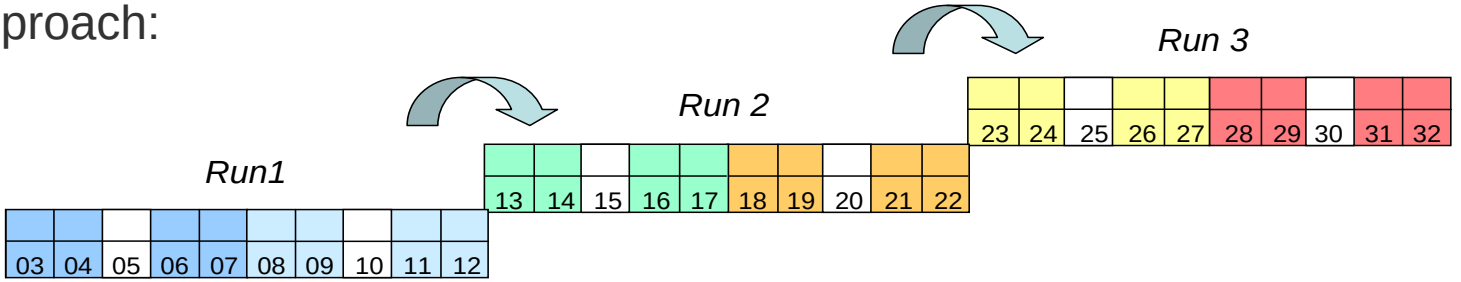


Sequence of model runs

- Perfect foresight:
  - Decisions take into account entire future model horizon
  - Model gives optimal strategy under assumed conditions
- Myopic foresight:
  - Decisions are based on only limited knowledge of the future
  - Implicitly assumed that current conditions will last forever; to some extent ignorant about future

Extended foresight horizon

- Initial approach:



Drawback: Unequal foresight within a run

- Solution: Overlapping model runs

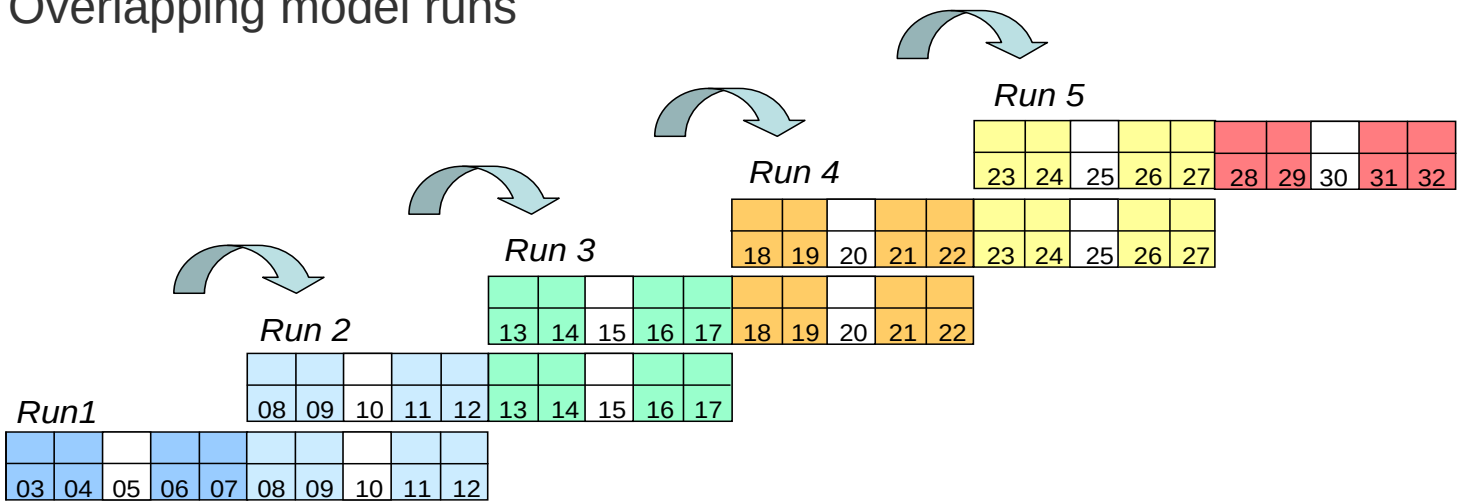
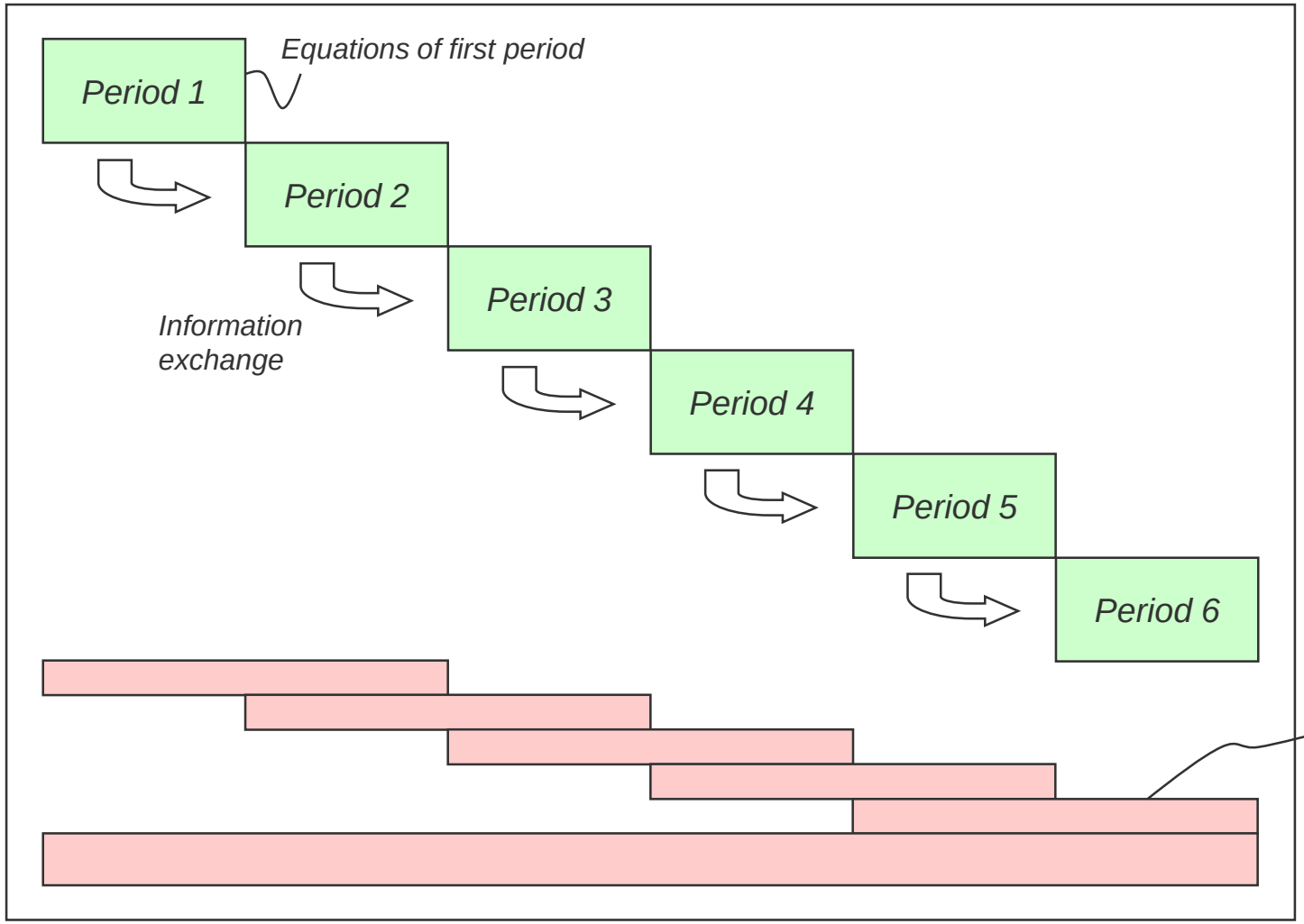


Illustration at problem matrix



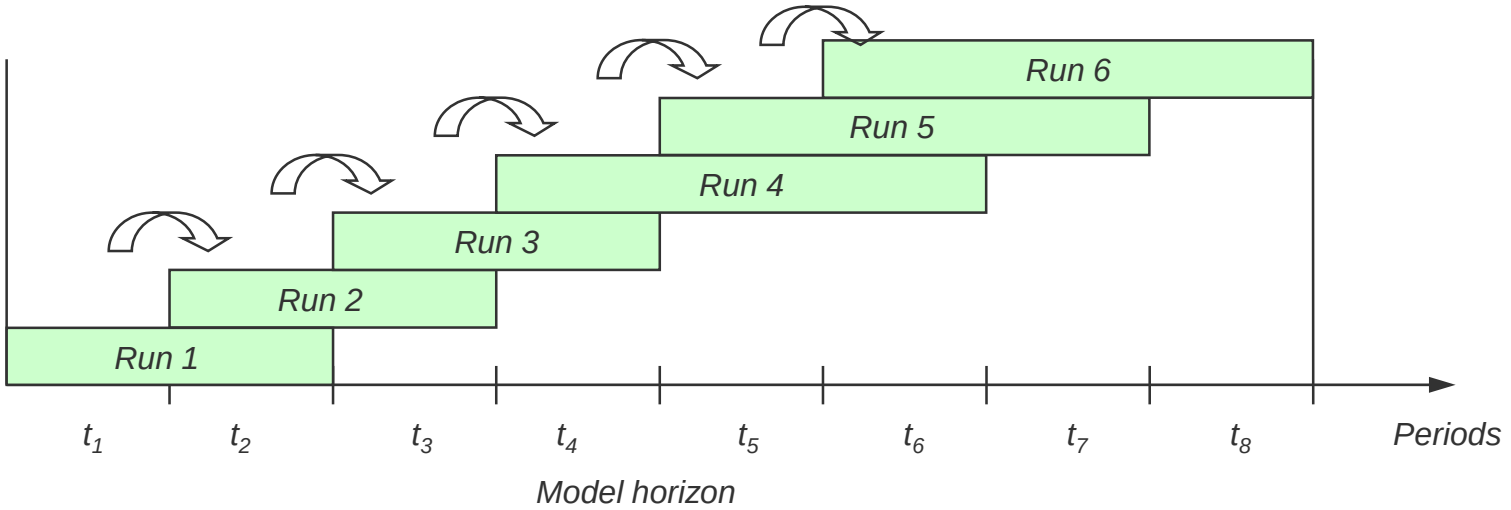
Structure of problem matrix

Intertemporal Constraints:

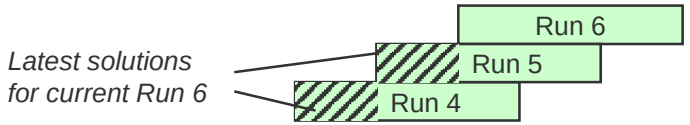
- *Capacity linkage*
- *Cumulative constraints*
- *Growth constraints*
- *Stockpilling*

Myopic modelling allows to reduce the size of the matrix and to handle huge models

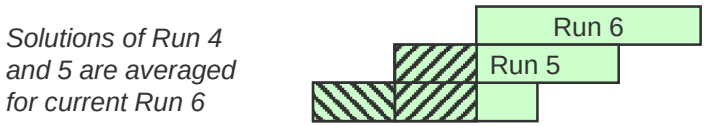
Modified myopic approach: Limited foresight result



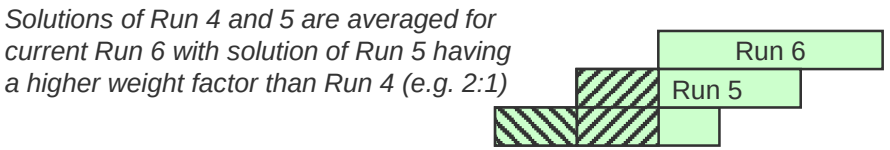
- Solution of past runs as input information for current run; due to overlapping more than one solution can exist for a previous period; Approaches:
  - Taking always the latest solution



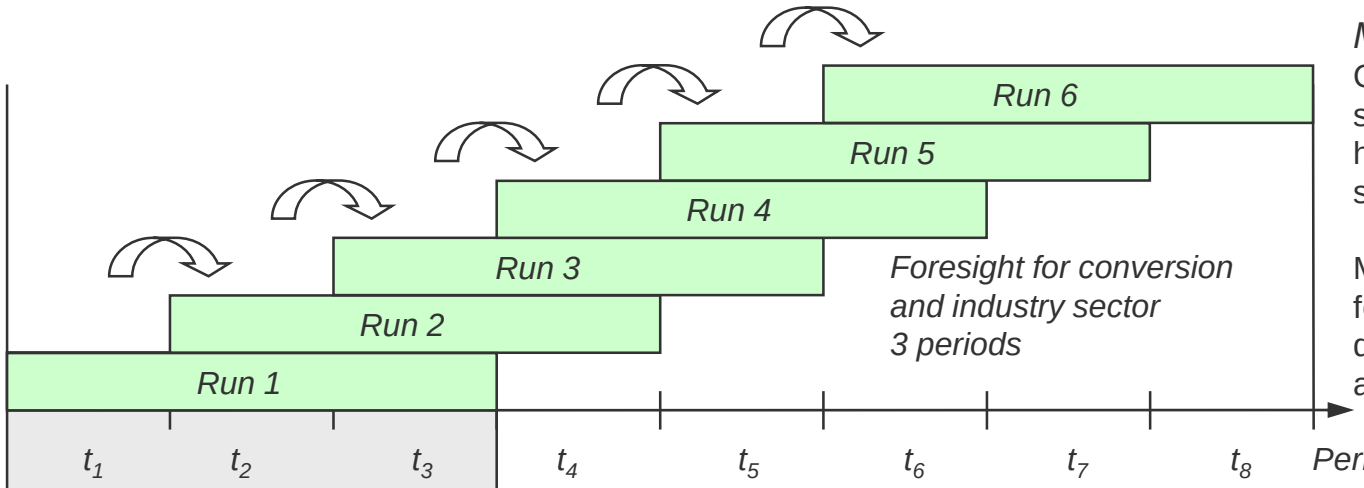
  - Averaging the solution over the runs



  - Weighting the solution over the runs with higher emphasis on more recent runs



Hierachy of myopic runs

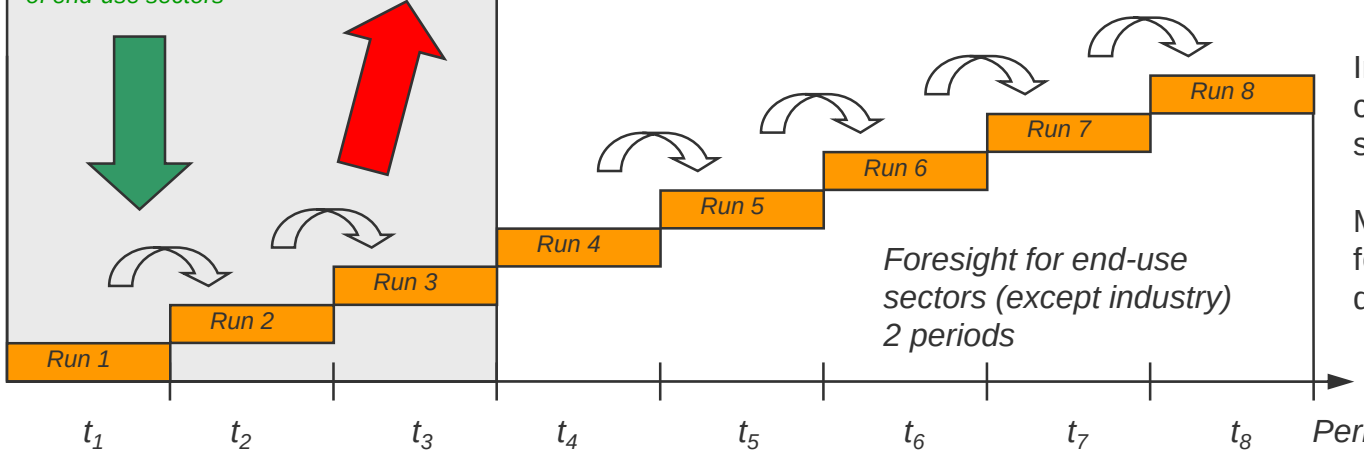


Motivaction:
Conversion and industry sector have longer planning horizon than other end-use sectors

Myopic runs with longer foresight to determine decisions in conversion and industry

Run 1 solution of conversion sector input for myopic Runs 1-3 of end-use sectors

Solution of end-use sector is input for myopic Run 2 of conversion sector



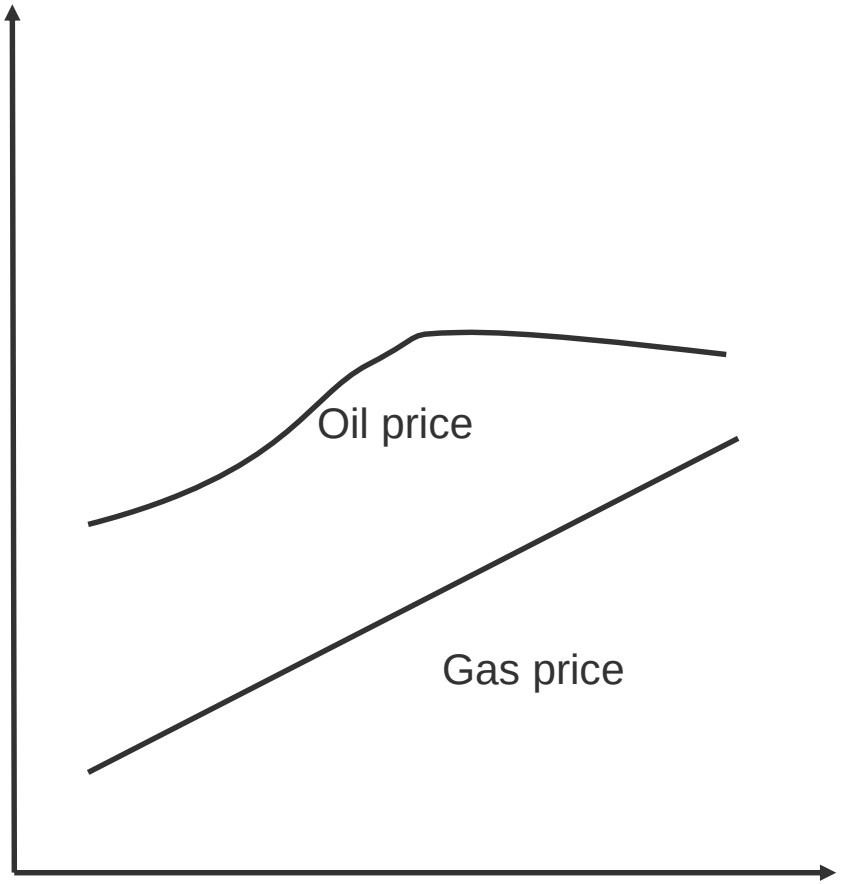
Investment decisions in conversion and industry sector fixed.

Myopic runs with shorter foresight to determine decisions in end-use sectors

Model horizon

Some general observation by comparing the results of Myopic and perfect foresight models

Impact of price assumptions



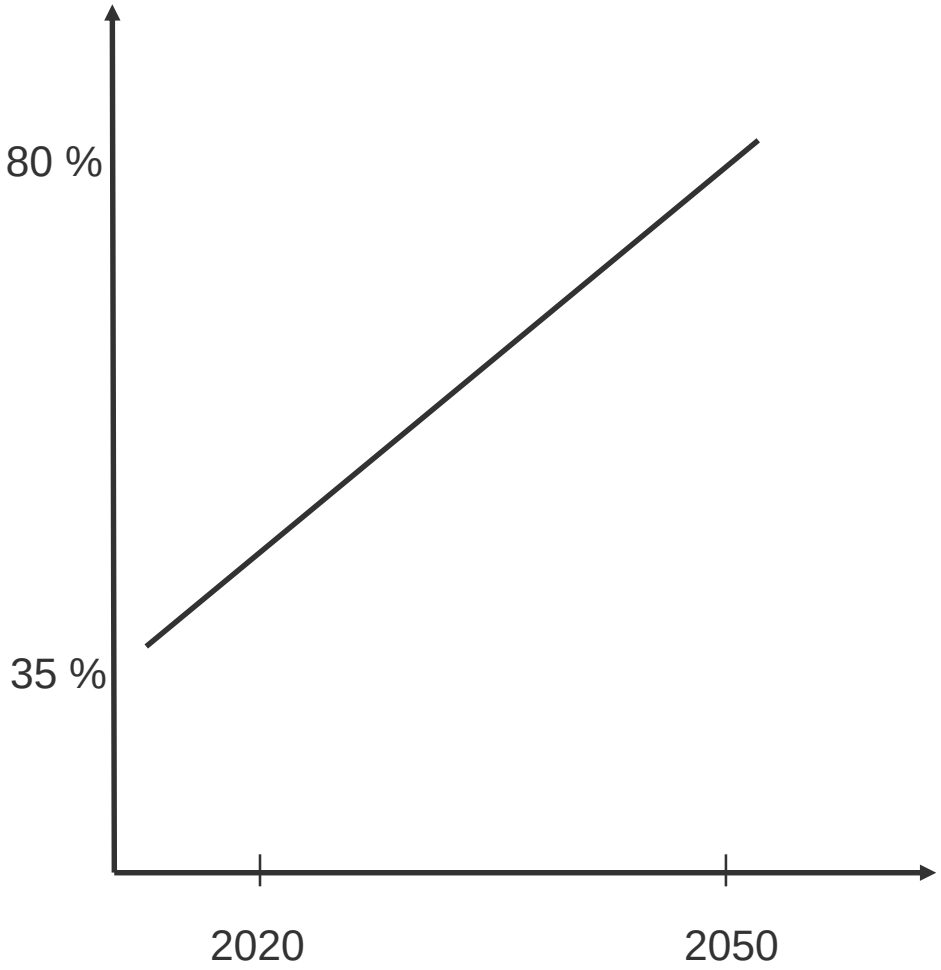
Myopic:

- Only in the last period oil technologies are going in solution all the other periods gas technologies are installed.
- If in the base year gas and oil technologies installed oil might be out of the solution in some periods.

Perfect foresight:

- Oil technologies are going in solution also in earlier periods.
- If in the base year gas and oil technologies installed there might be a mix of both all over the periods.

Impact of renewable targets



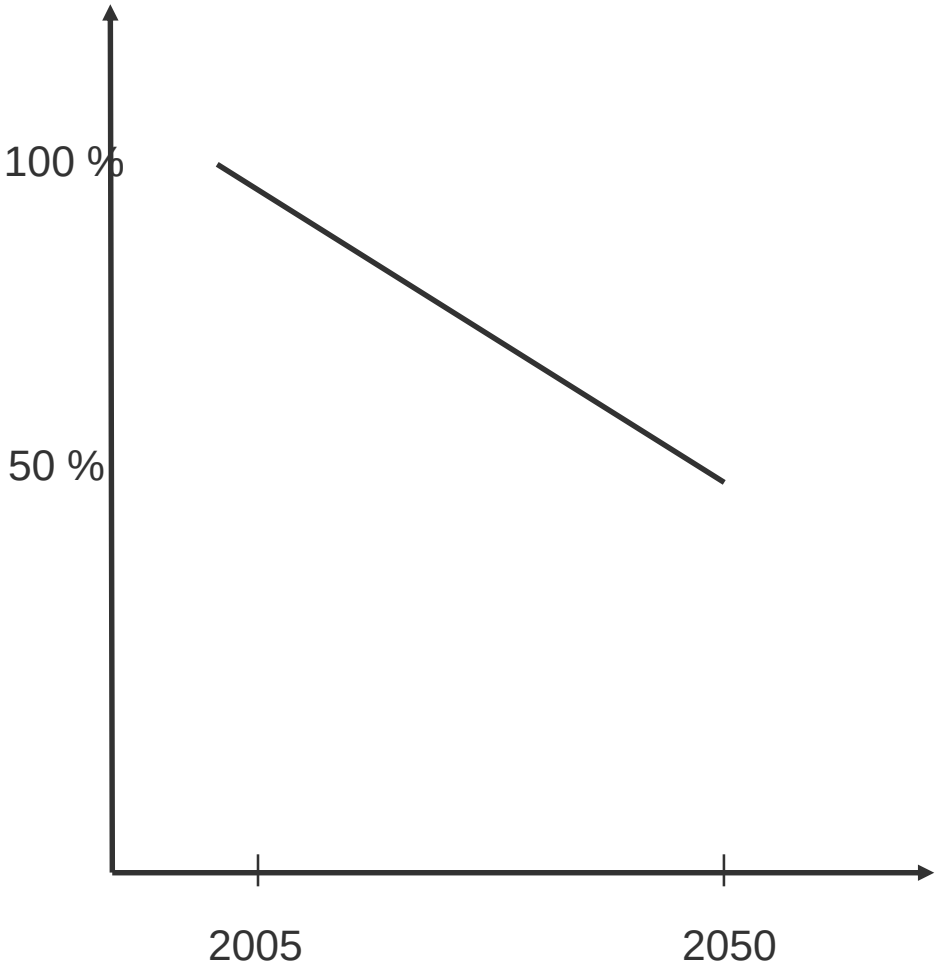
Myopic:

- Late install of storages.
- Building over capacities of conventional power plants.

Perfect foresight:

- Using all options (e.q. demand reduction in combination with optimal capacity building

Impact of efficiency targets



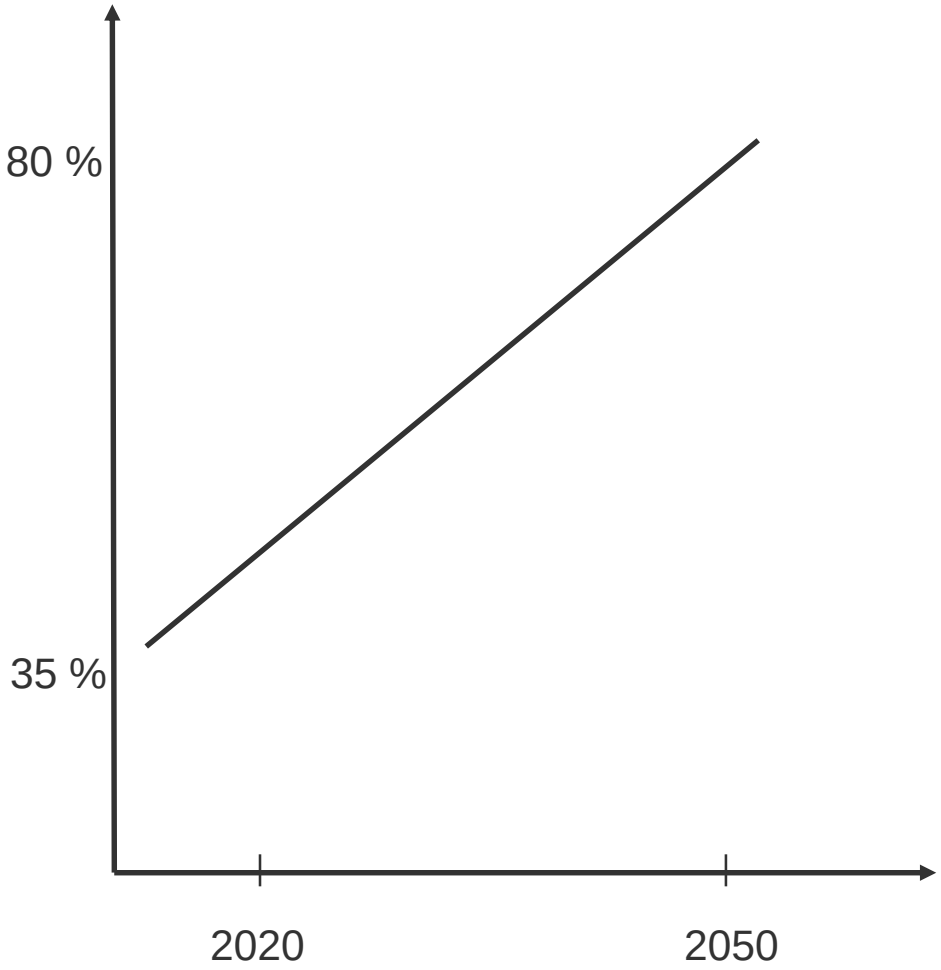
Myopic:

- Over capacities
- Lost opportunities in the previous periods
- infeasibilities

Perfect foresight:

- Balanced decisions but sometimes to early moving

Impact of GHG reduction targets



Myopic:

- Technology choices which will not be used
- In the future (e.q. coal power plants without CCS)
- Building over capacities of conventional power plants.

Perfect foresight:

- To early moving (e.q. installation of CCS Plant as early as possible)

Summary and outlook

- Myopic modelling:
  - Is only one approach to handle uncertainties
  - Doesn’t automatically makes a model more transparent
  - In some cases it pronounce or support the penny switching effect and reduce the different technology choices in the solution
  - Allows to run huge models (e.q. with high time resolution)
  - Was introduced in energy system modelling to take decision making into account
  - By having a limited view in the future but today we observe very often a delay in technology implementation or handling in the political world why not making a scenario analysis by taking in the scenario definitions the delay into account.

Thank you for your attention !

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