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Allianz ENERGY-TRANS

DLR Deutsches Zentrum für Luft- und Raumfahrt

zirius Center for Interdisciplinary Risk and Innovation Studies

Actors organise energy system transition: business cases for storage technologies

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Final Conference of the Helmholtz-Alliance ENERGY-TRANS

14th / 15th of March 2016, Berlin

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Innovations in Energy Transitions

- Technological innovations
- Social innovations
- Business models for new technologies
- New roles/tasks for old technologies

Actual Phase of Energy Transition and its Challenges

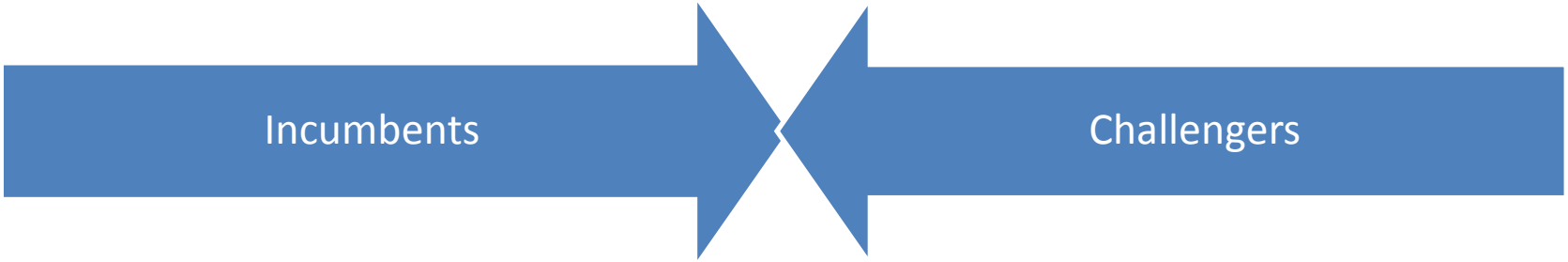
- Increasing share of electricity from variable renewable energy sources implies
  - decreasing share of assured capacity
  - necessity of improved coordination of supply and demand

- Possible solutions
  - Grid expansion
  - Demand side management
  - Sector coupling
  - Storage

} High uncertainty

Actors and Storage Technologies

- Diffusion of new storage technologies and adoption of new roles and tasks for old technologies depend on actor types and their strategies



- Differences in
  - Background
  - Motivation
  - Strategies

- Future characteristic of transition pathway depends on

- Actors
- (Storage) technologies

Actors and Storage Technologies

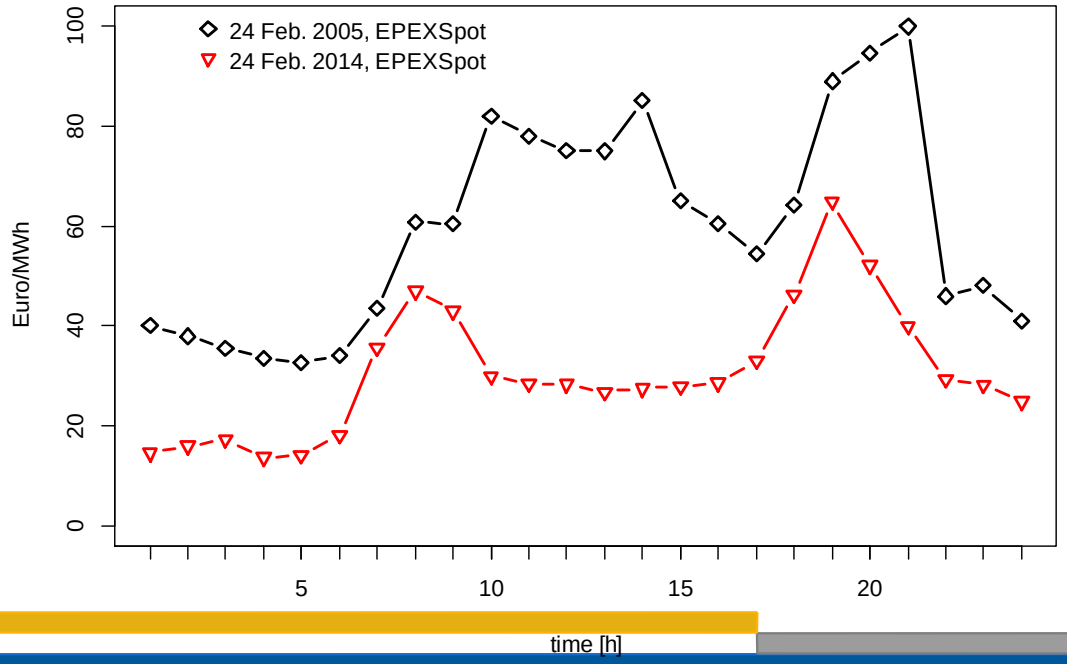
Resources	Incumbent	Challenger
limited	•Problem-driven •rural municipal utility •options for grid stabilisation •no business model	•Innovation-driven •Green electricity providers •Business models in the residential sector
many	•Multi-optional (Innovation- and problem-driven) •Big 4 •Innovation-Units for new technologies and applications •New business models for pumped storage technologies	•Multi-optional (all innovation-driven) •Innovative municipal utilities, project developers •Business models in the residential, commercial and utility sector for new technolgoies

Zooming-in: Incumbents and Pumped Storage Technologies

- Yesterday
  - Must run capacities of nuclear and lignite power plants
  - Portfolio optimization of fossil power plants using price spreads at day-night-cycle operation of storage

Zooming-in: Incumbents and Pumped Storage Technologies

- Yesterday
  - Must run capacities of nuclear and lignite power plants
  - Portfolio optimization of fossil power plants using price spreads at day-night-cycle operation of storage
- Today



Installed PV capacities [MW_{el}]
2005: 2056
2014: 38240
(AGEE-Stat, Stand Dez. 2015)

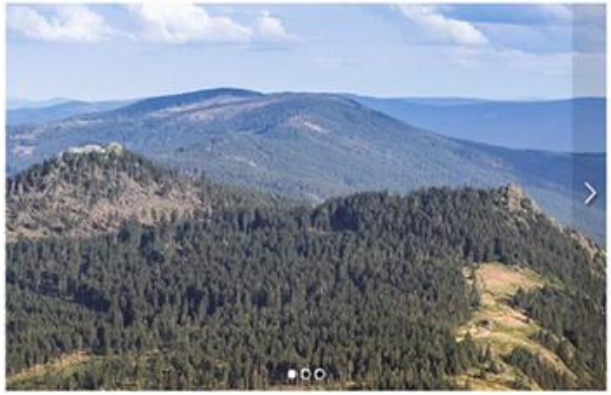
Zooming-in: Incumbents and Pumped Storage Technologies

- Technological: Efficiency, costs
  - Few (new pumped storage power plants already 80% efficiency)
- Lobbying
  - Regulative framework
- Search for business models for tomorrow

Pumpspeicherkraftwerk am Osser gestorben

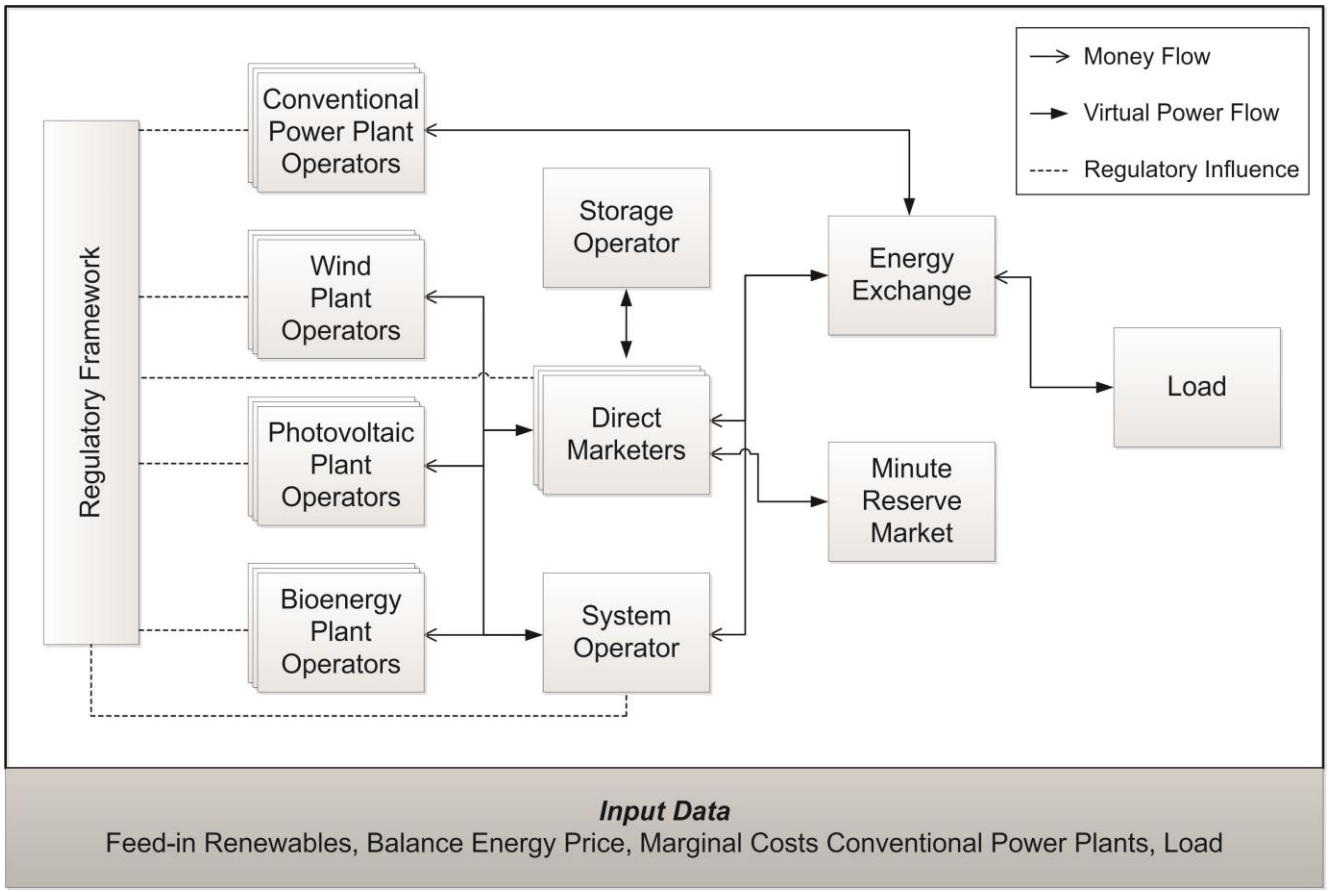
Ministerin Aigner beerdigt Pläne für neue Pumpspeicherkraftwerke im Freistaat. Eine Genehmigung für Investor Vispiron am Osser rückt in weite Ferne.

Von Fritz Winter und Stefan Weber, MZ



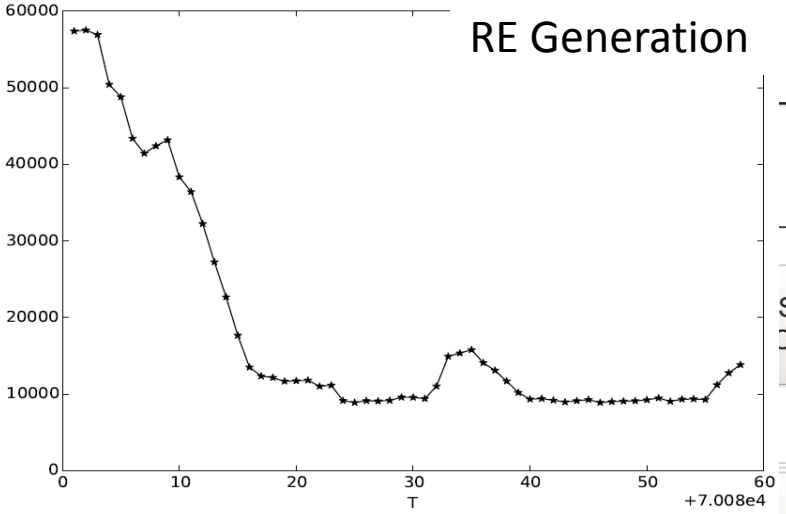
wird nicht kommen. „Das Projekt ist eigentlich gestorben" verlautete am Wochenende aus dem Umfeld der bayerischen Wirtschaftsministerin Ilse Aigner (CSU). In einem Interview hatte Aigner gesagt: „Die Frage nach einem Neubau von Pumpspeicherkraftwerken stellt sich in Bayern und eigentlich in ganz Deutschland derzeit nicht. Es gibt dafür einfach kein Geschäftsmodell". Damit hatte sie aktuell auf

AMIRIS – Electricity Market Model

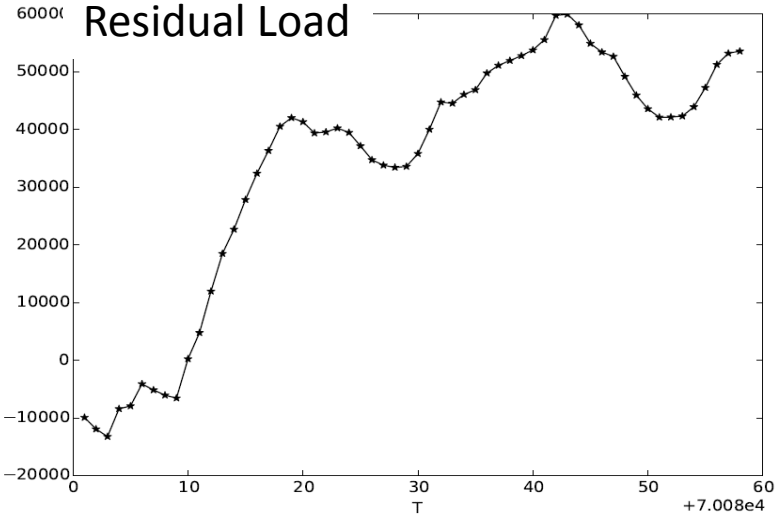


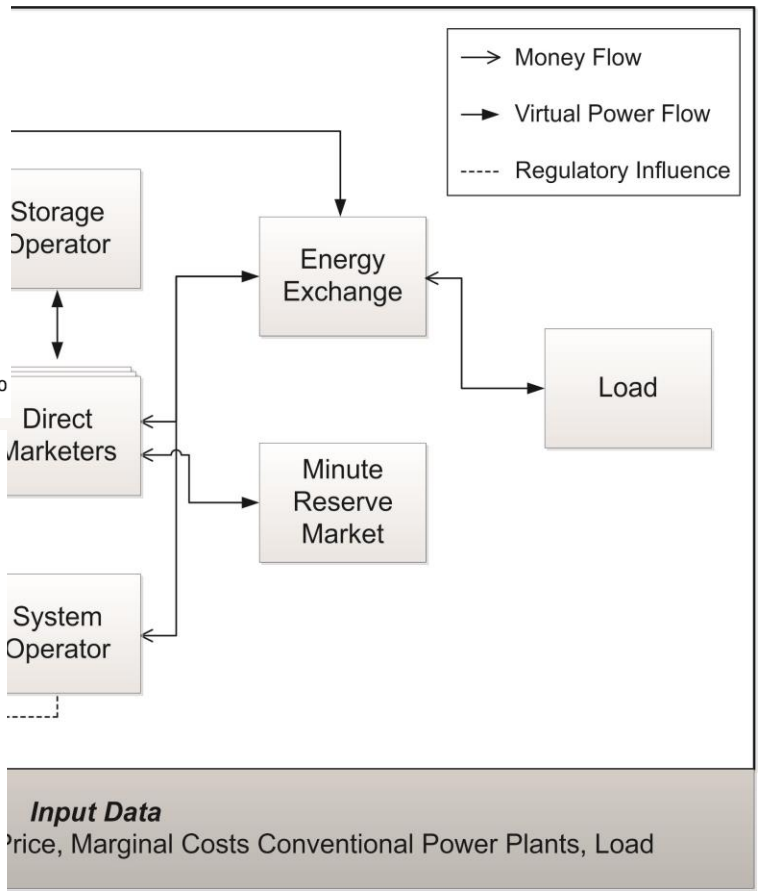
AMIRIS – Electricity Market Model

RE Generation



Residual Load





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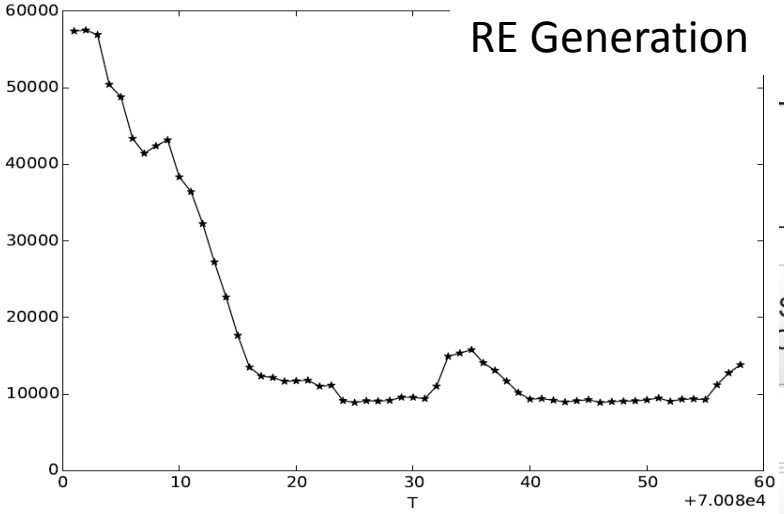

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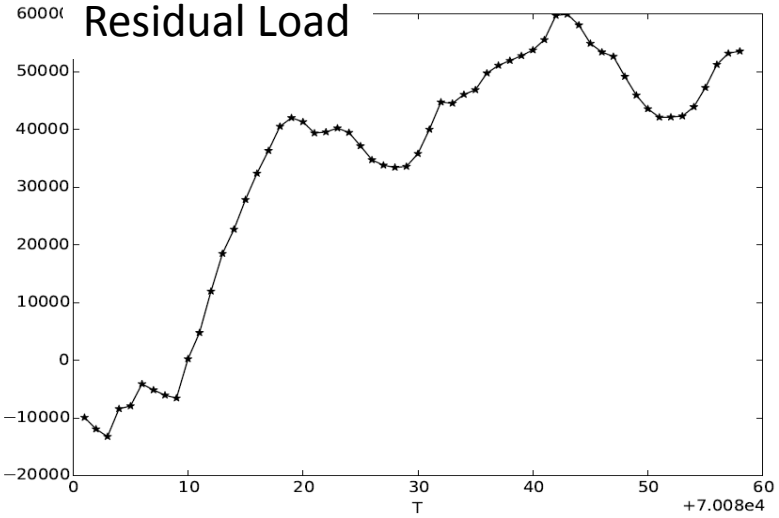
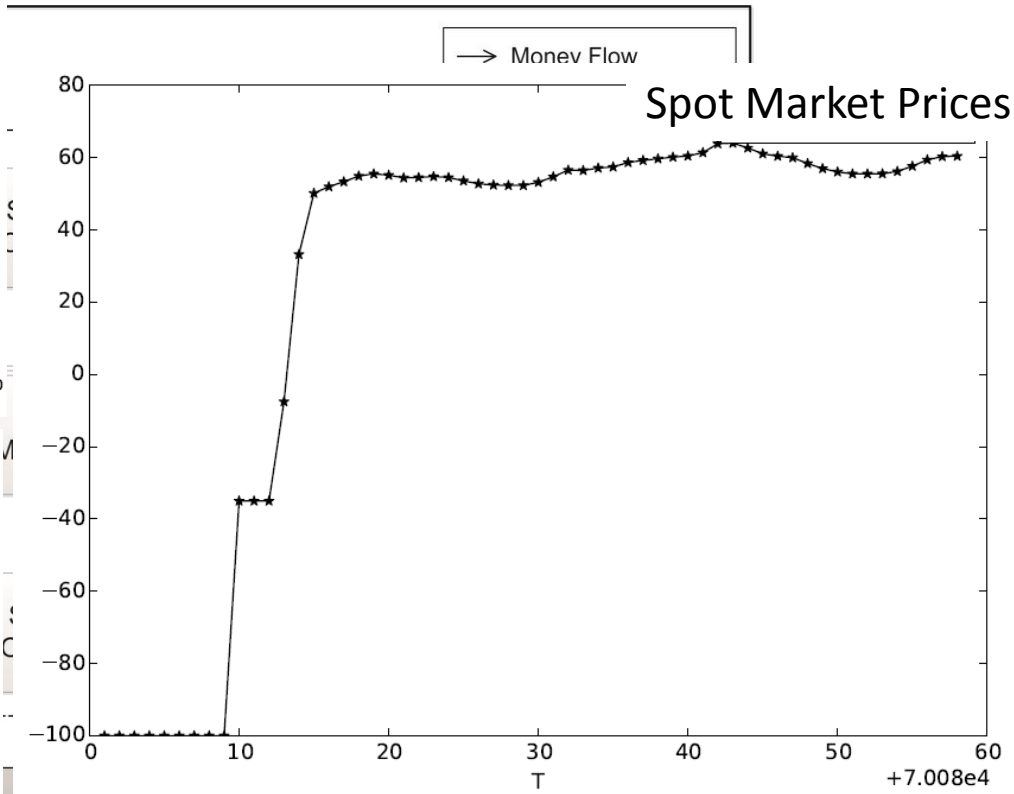


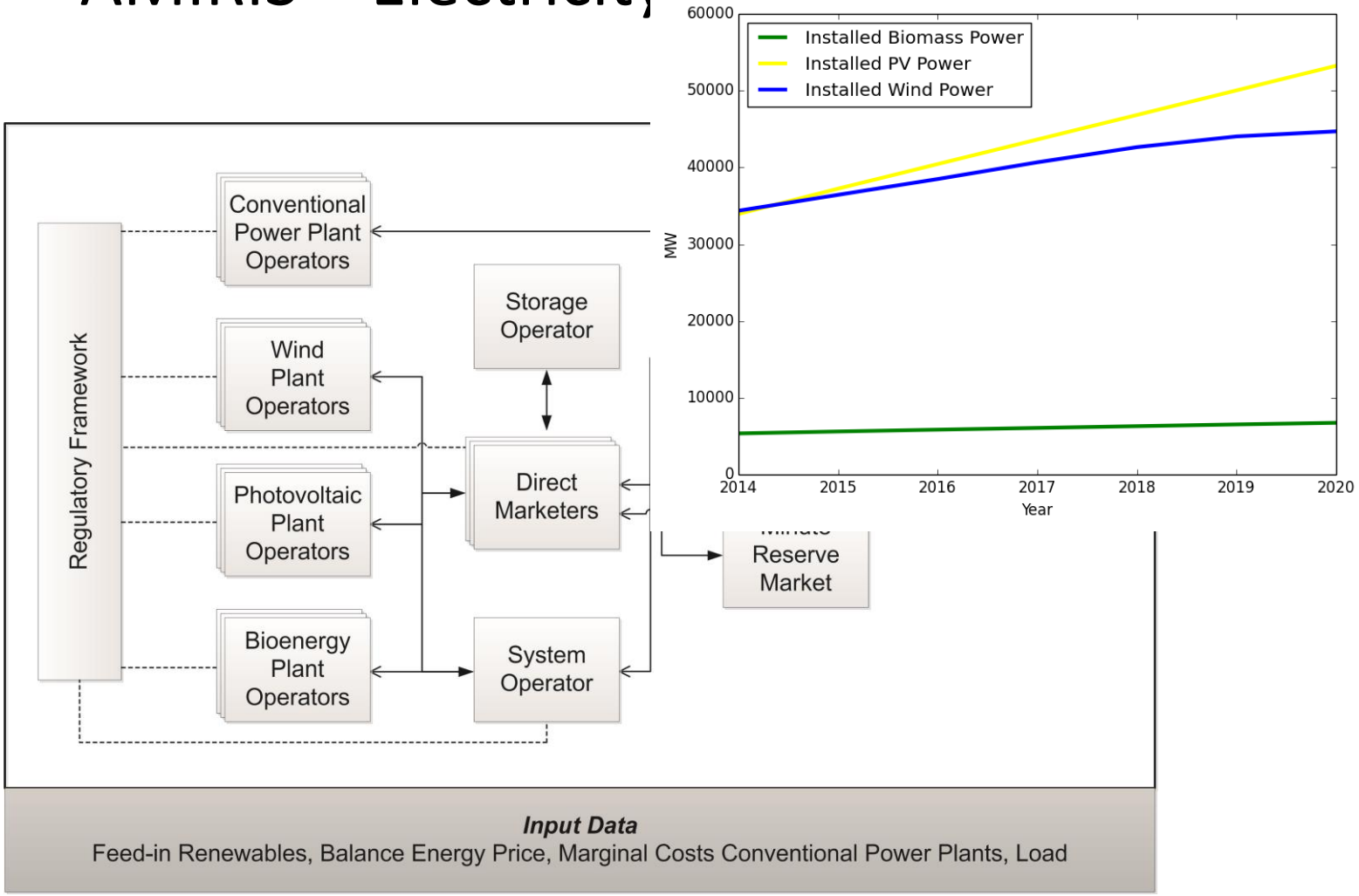
Spot Market Prices



Input Data

rice, Marginal Costs Conventional Power Plants, Load

AMIRIS – Electricity Market Model



Pumped storage and Business Cases

Power installation costs	€/kW	300
Energy installation costs	€/kWh	10
Fixed O&M costs	% Inv/a	1%
Capacity	kW	1.000.000
Energy capacity	kWh	1.000.000

Abitrage strategy

- Using price spreads at spot market (day-ahead) to gain profit

Imbalancing power:

- Optimize portfolio by reducing costs for balancing power
- Trade electricity at intraday market

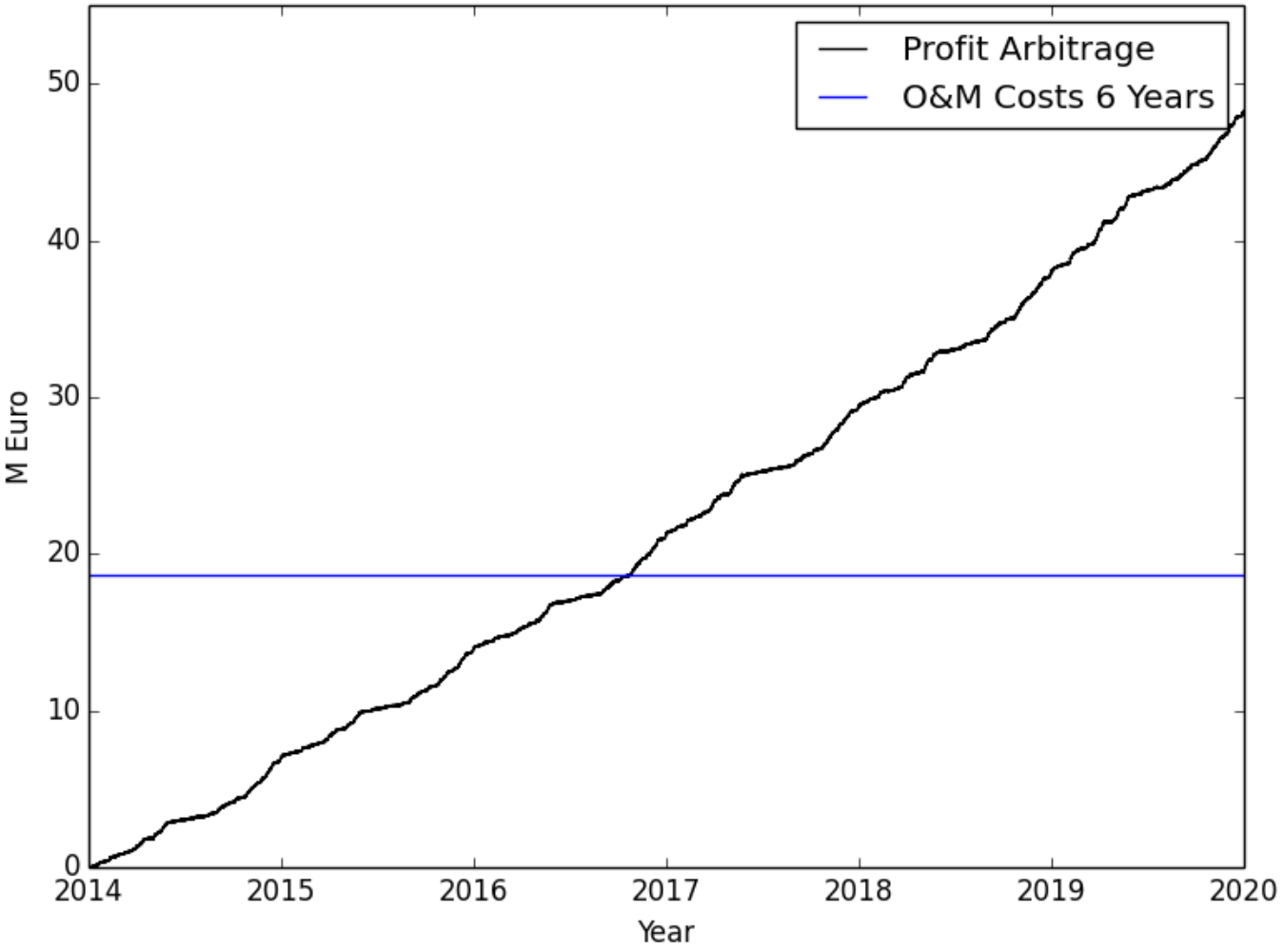
Results Arbitrage

Optimization algorithm calculates best hours for un/load storage

5978 cycles, ie about 2 per day

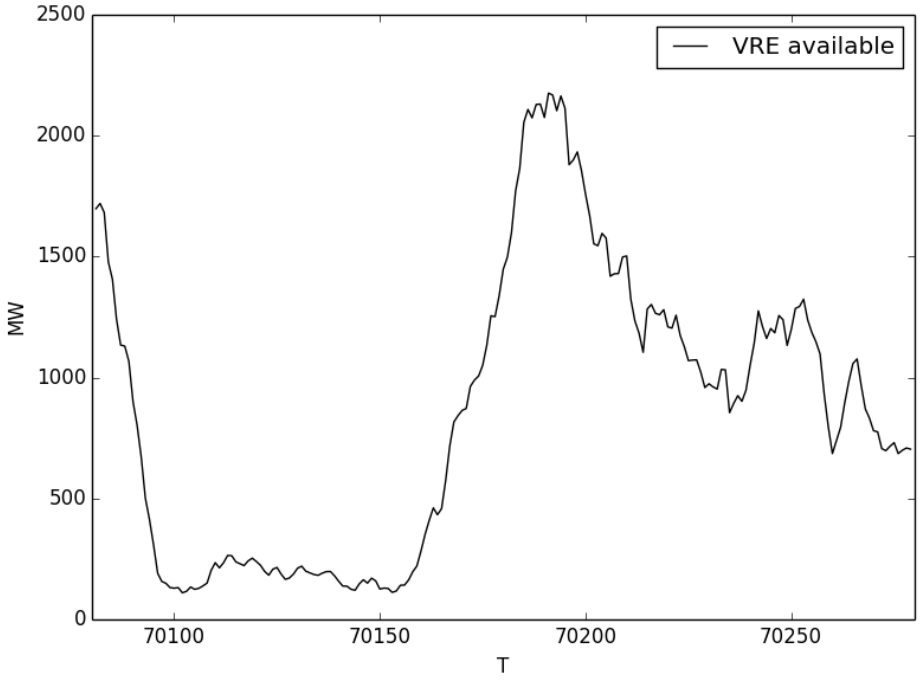
Investment costs about 310 M€

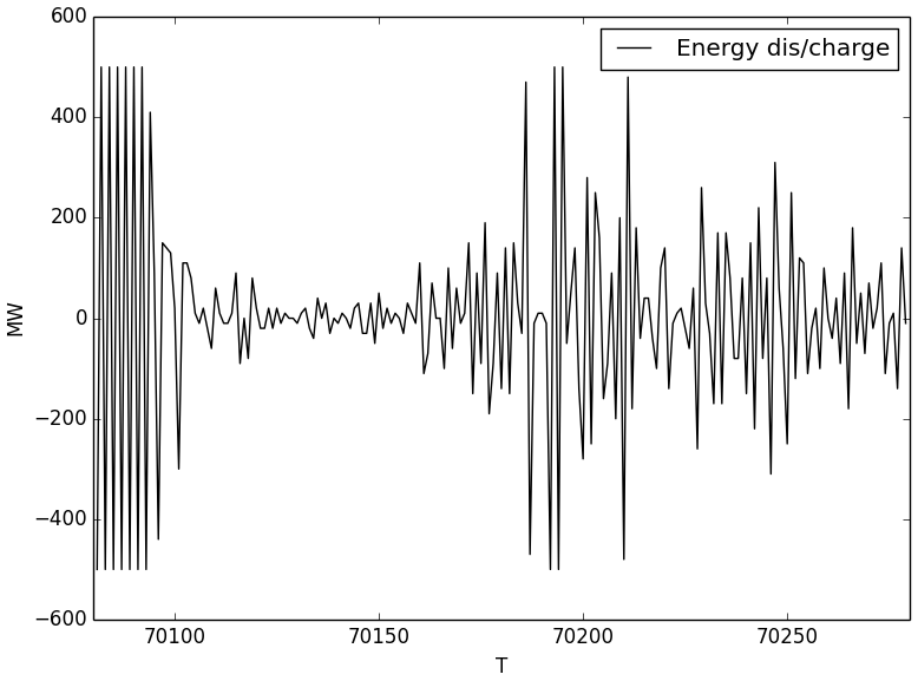
Yearly O&M costs 1% of Investment



Imbalancing Power

- Use own VRE generation to set storage load to 50% after each usage



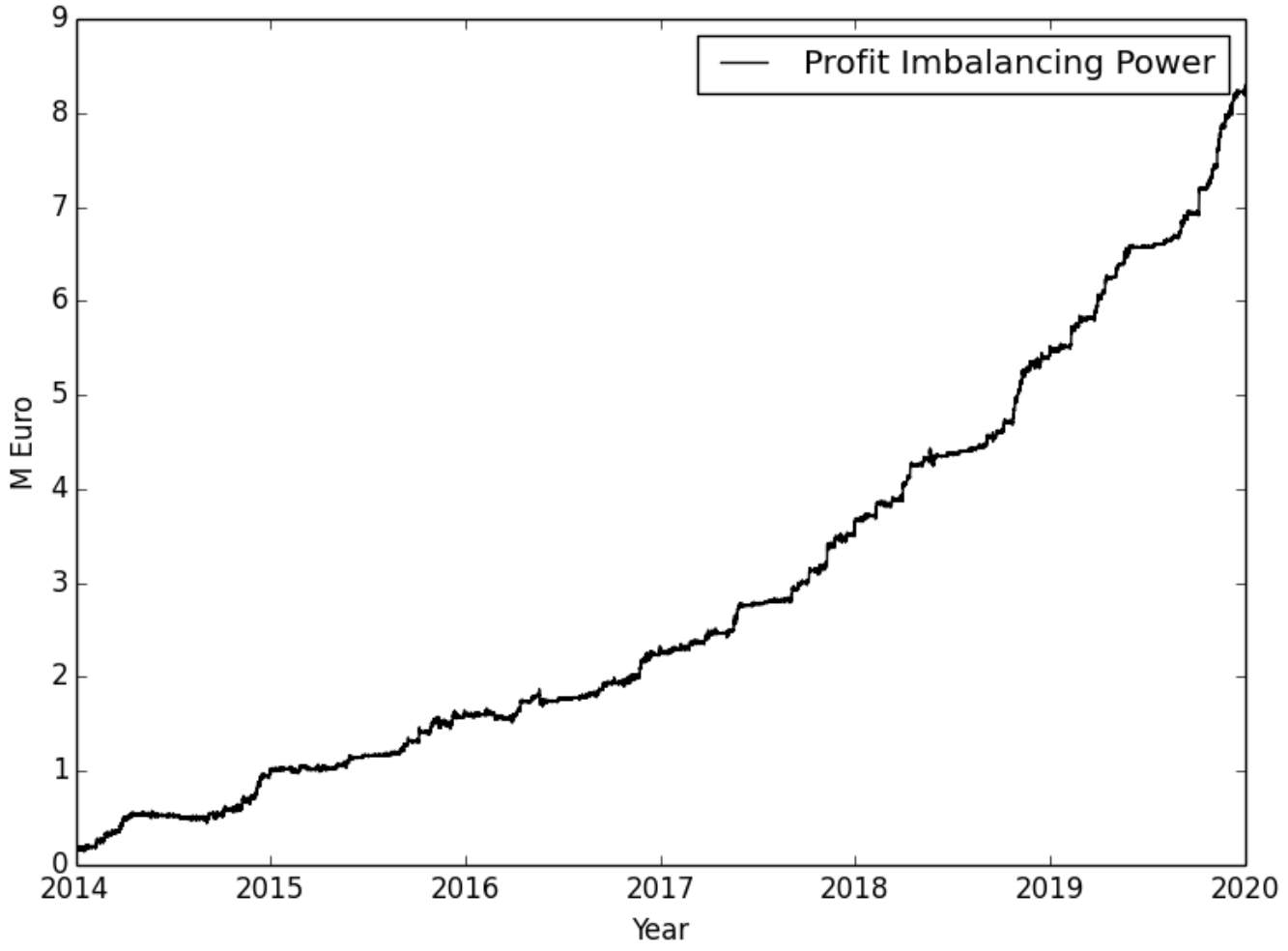


Results Imbalancing Power

Yearly O&M costs 1% of Investment (3.1 MEuro)

Total costs for balancing power about 80 MEuro

10% saving of balancing costs



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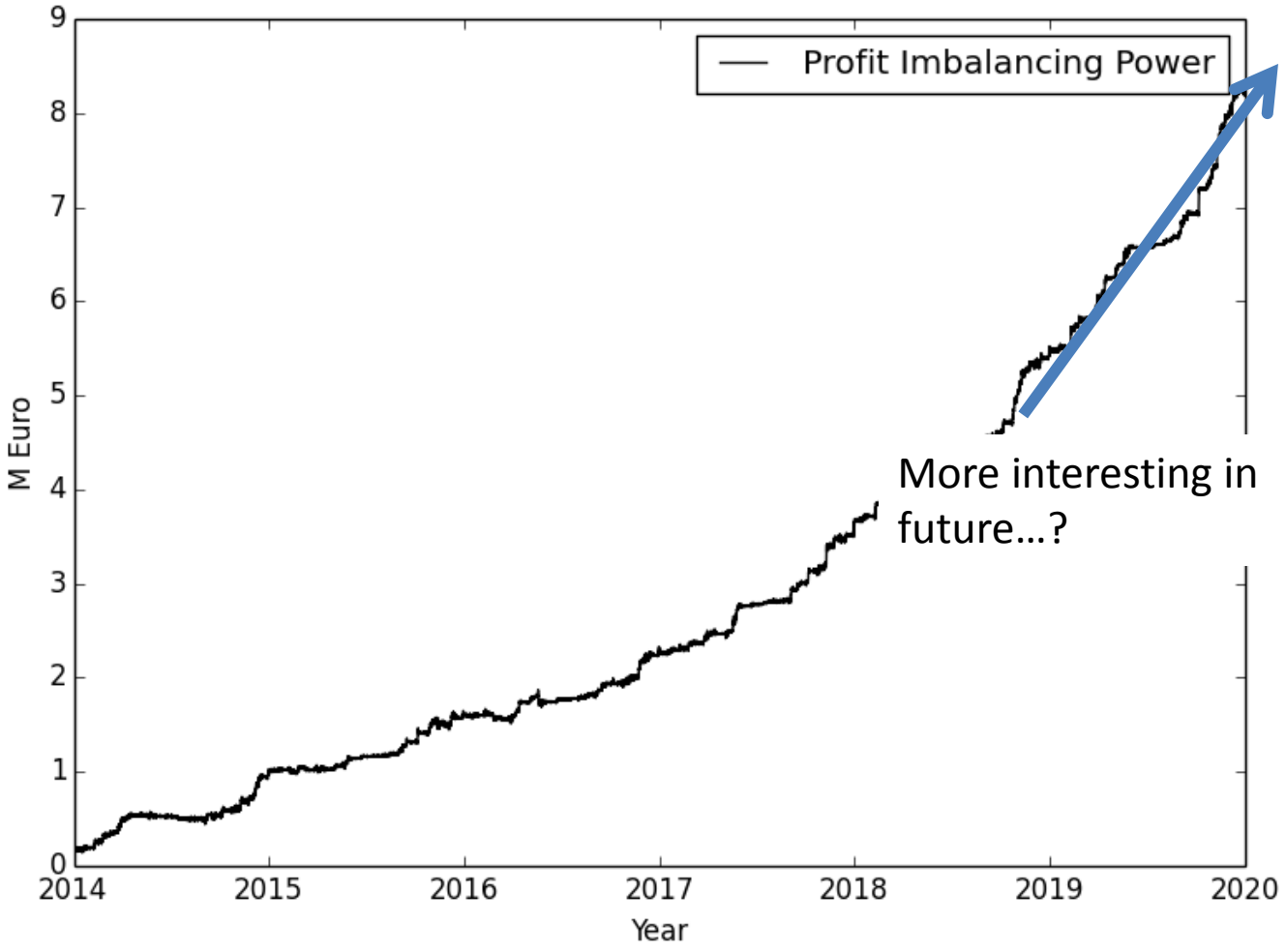

Conclusion

- Simulated business models are not profitable today but might be in the future

- Uncertain developments of
  - Regulative framework (prequalification condition for reserve markets, taxes, …)
  - Market players and competition
  - Market designs
  - Other flexibility options

- Uncertainties influence actors‘ strategies and behaviour: Especially the big incumbents keep up their multi-optional strategies in the current phase of the energy transition

- Many possible futures of flexibility option for the energy transition compete with each other

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Thank you!

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Type

Types of **direct marketers**

(1)	Big national utility	Good	Good
(2)	International utility	Good	Good
(3)	Big municipal utility	Medium	Good
(4)	Municipal utility “Pioneer”	Good	Good
(5)	Small municipal utility	Bad	Bad
(6)	Green electricity trader for households	Good	Medium
(7)	Green electricity trader for business/industry	Good	Medium
(8)	Specialised intermediary with experience	Good	Good
(9)	Specialised intermediary without experience	Medium	Medium