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Universität Basel
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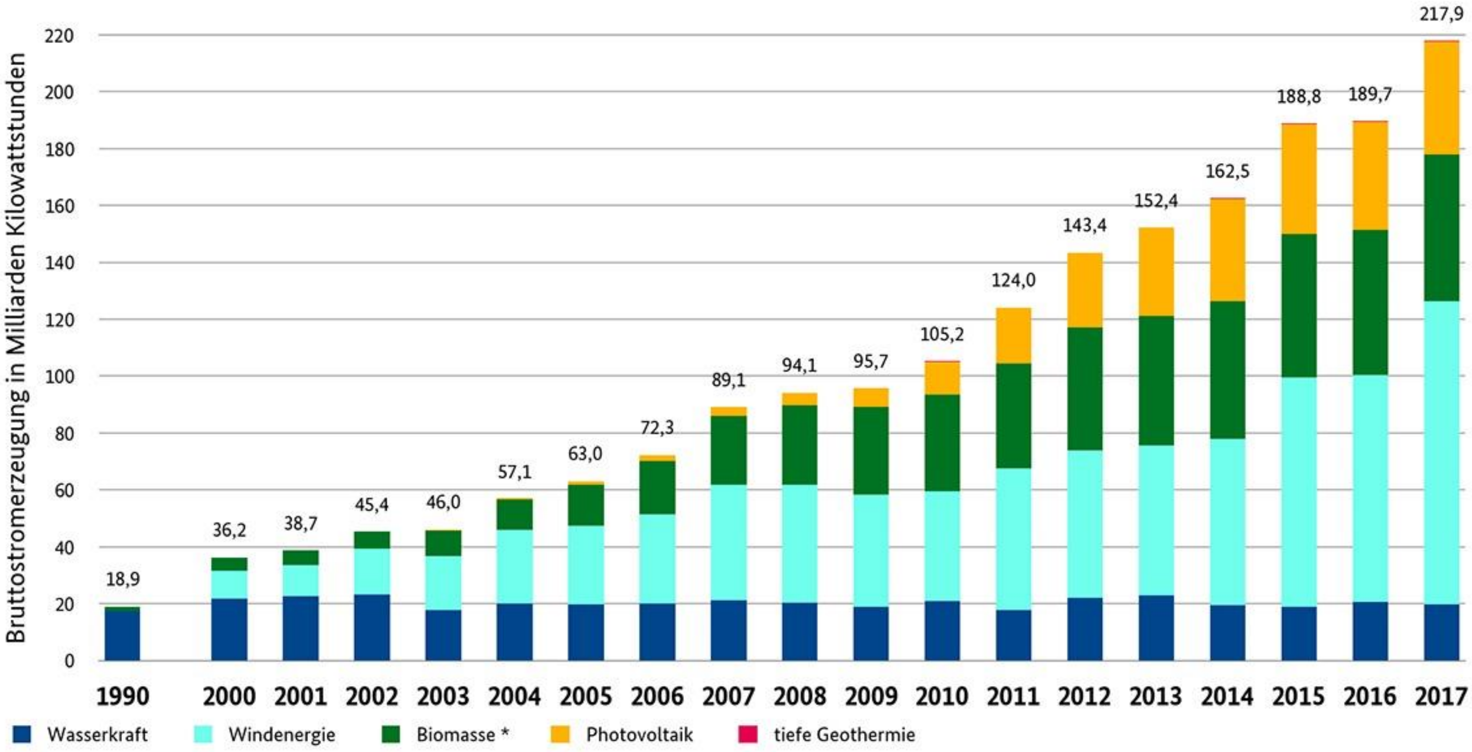
Forschungsstelle für Nachhaltige Energie- und Wasserversorgung

The Economic Benefit of Improved RES Forecasts

Jonas Savelsberg, Universität Basel
Dresden, 27.04.2018

1. Introduction
2. Forecast quality
3. Numerical Analysis
4. Economic benefit of improved forecasts
5. Conclusion

Introduction



* inkl. feste und flüssige Biomasse, Biogas inkl. Biomethan, Klär- und Deponiegas und dem biogenen Anteil des Abfalls, ab 2010 inkl. Klärschlamm; BMWi auf Basis Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat); Stand: Februar 2018; Angaben vorläufig

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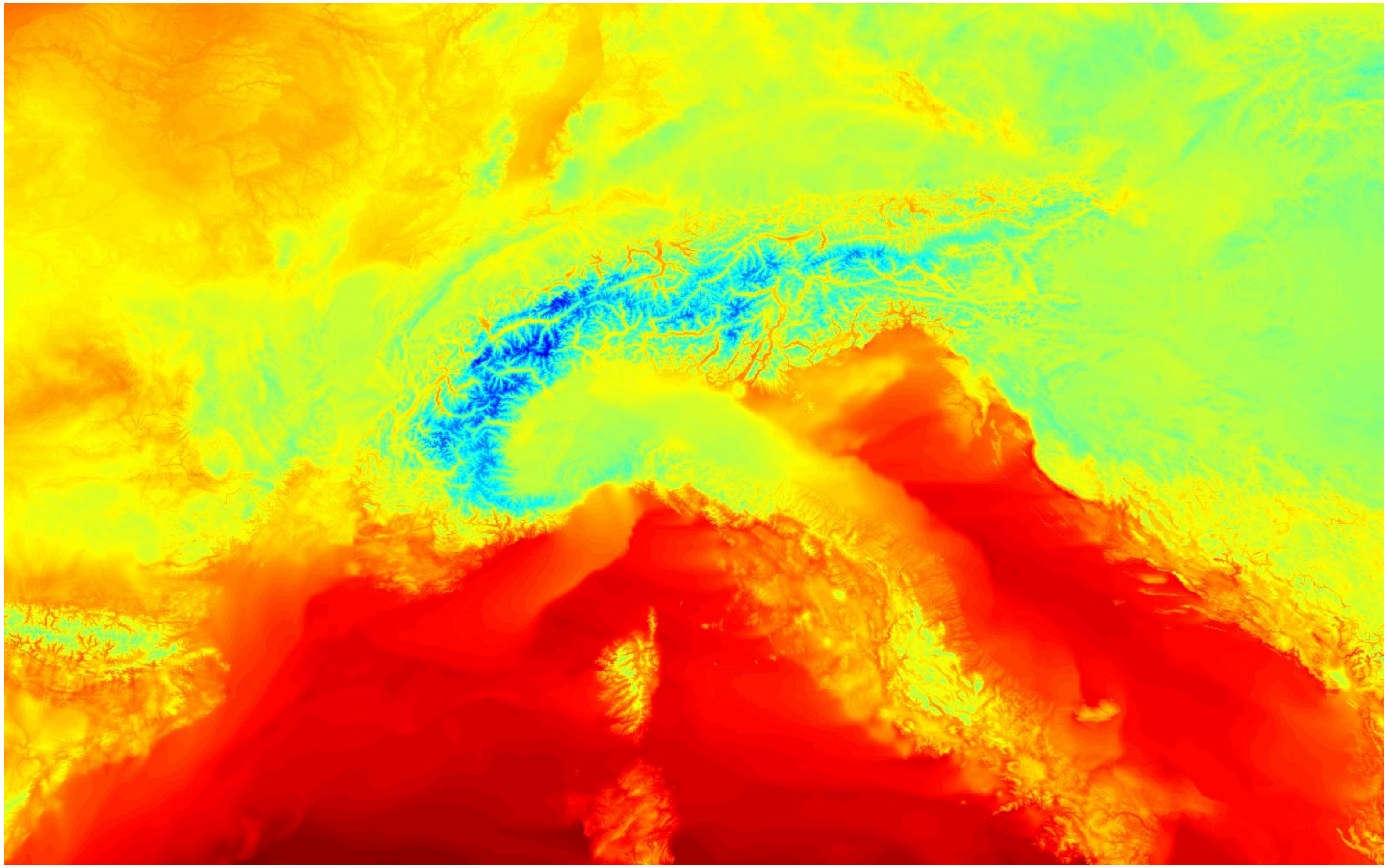
Introduction



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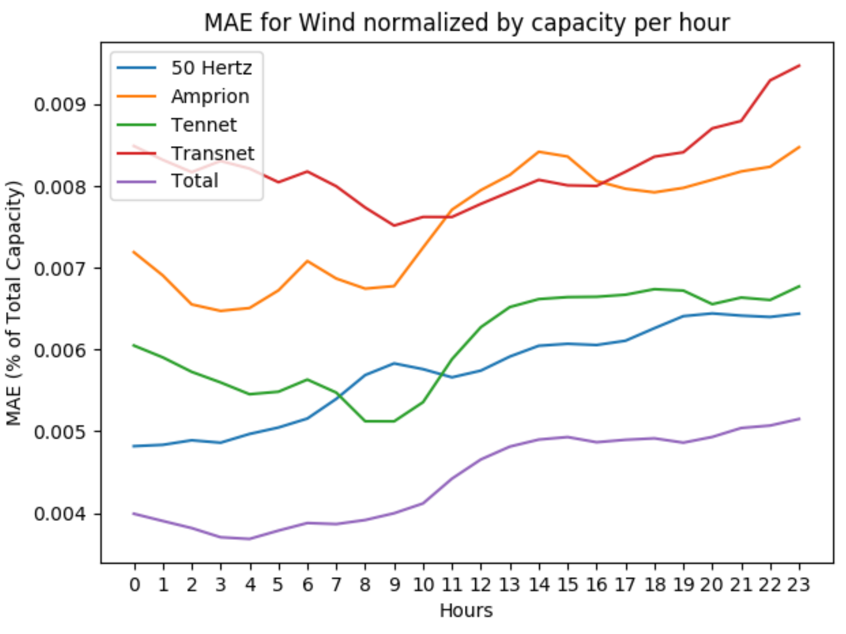
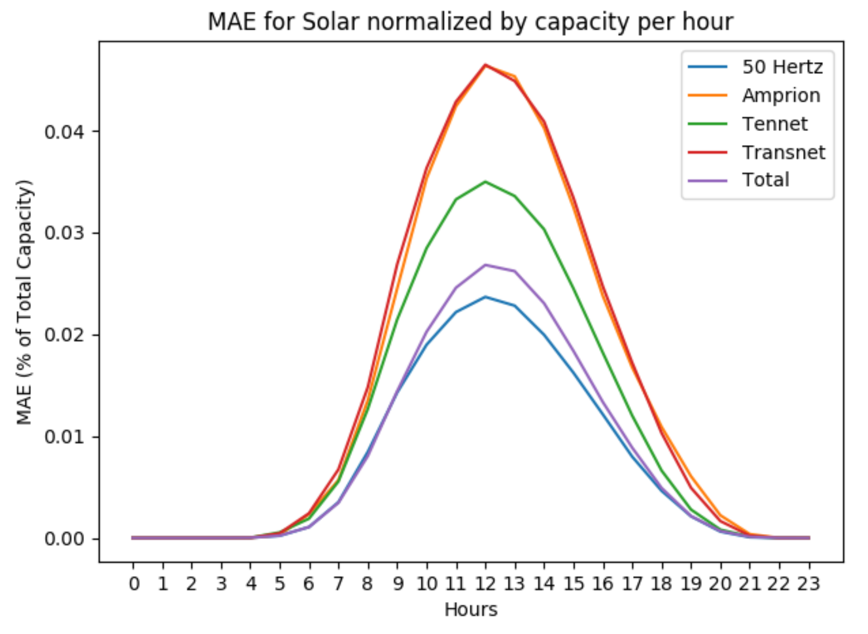
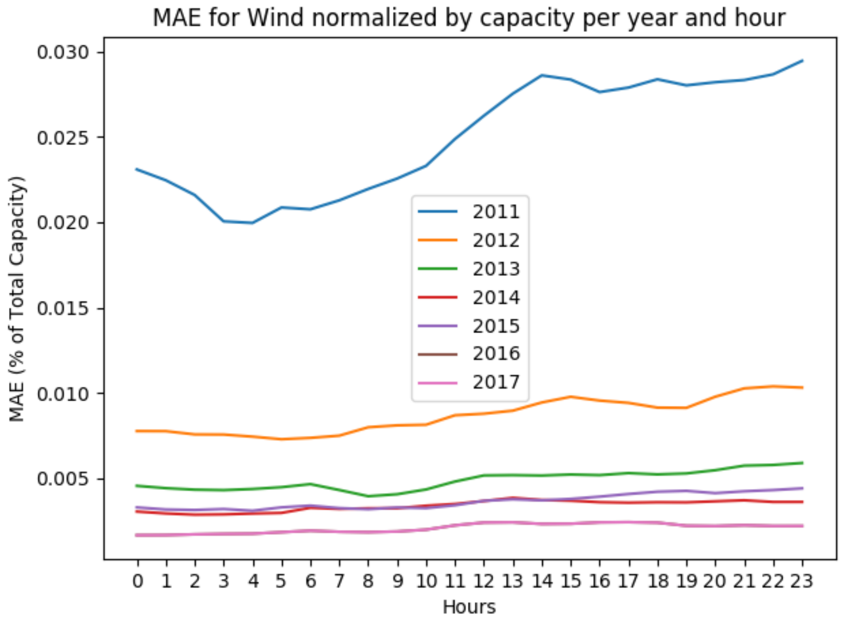
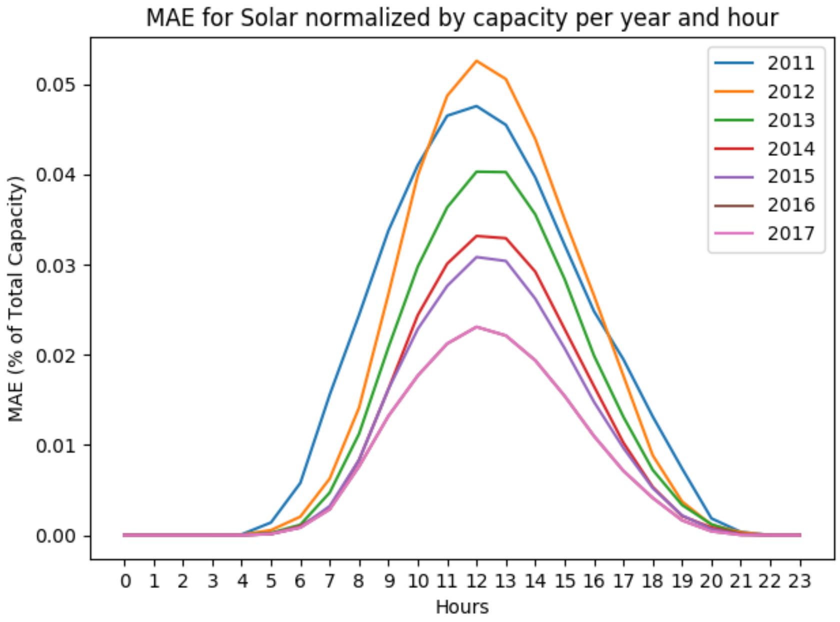
Data on forecasts in Germany





Development of forecast quality





Hourly dispatch model with unit commitment

- **Objective function**

  Minimize total costs = Short-term/variable costs
  - operationcost
  - start-up costs
  - cost of using water from storage
- **Energy balance**

  Demand = Net-generation including res-infeed and forecast error
- **Capacity restrictions**

  Generation ≤ Capacity * Availability

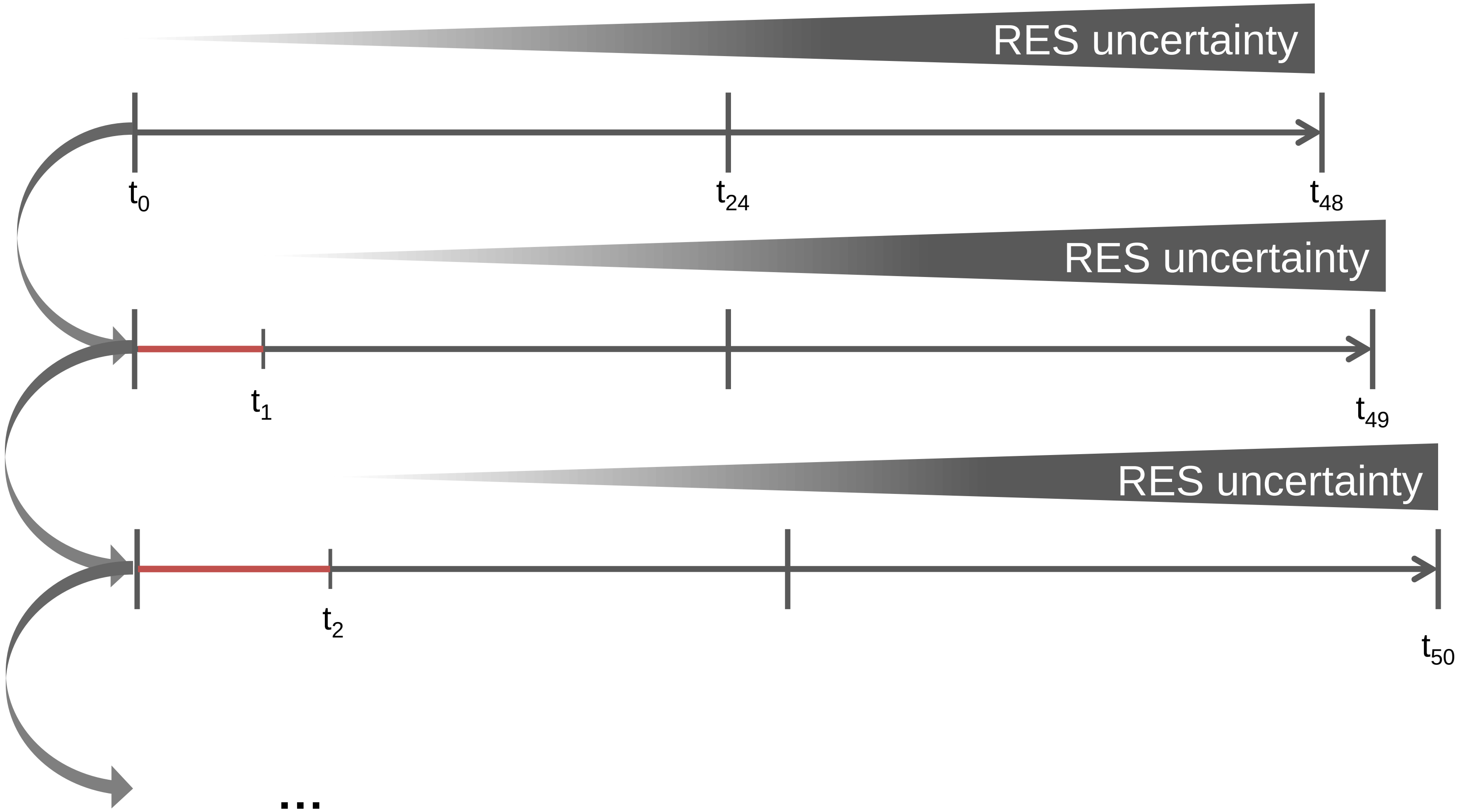
  Generation ≥ Minimum generation

  Pumping ≤ Pumpcapacity
- **Storagebalance**

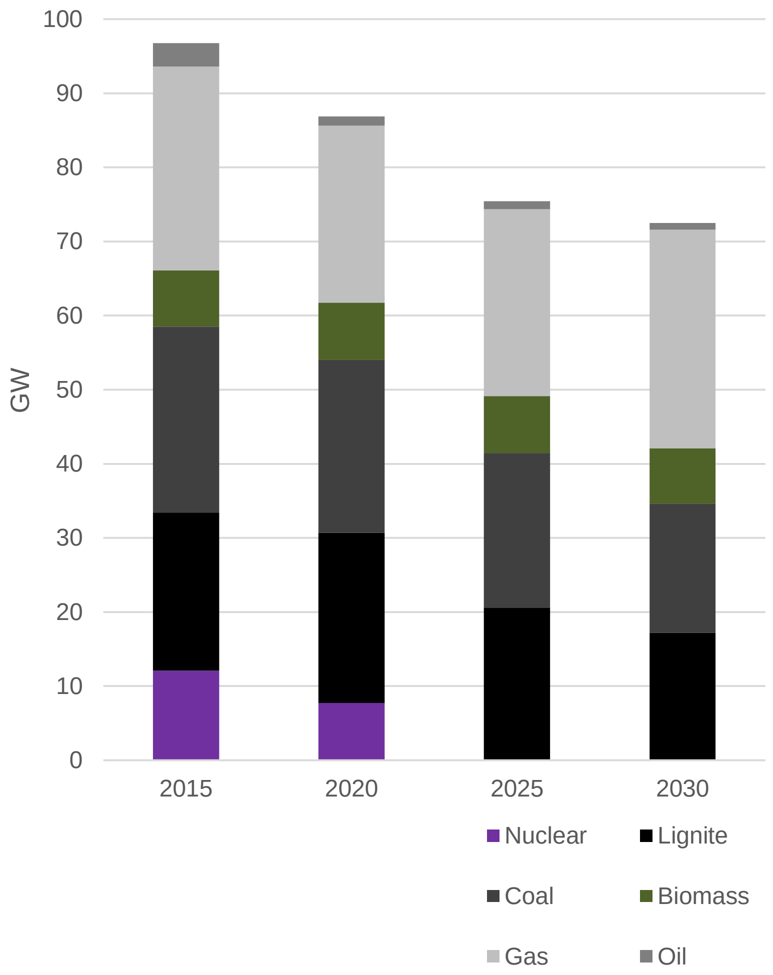
  Storageinflow = Storageusage + Storagedelta

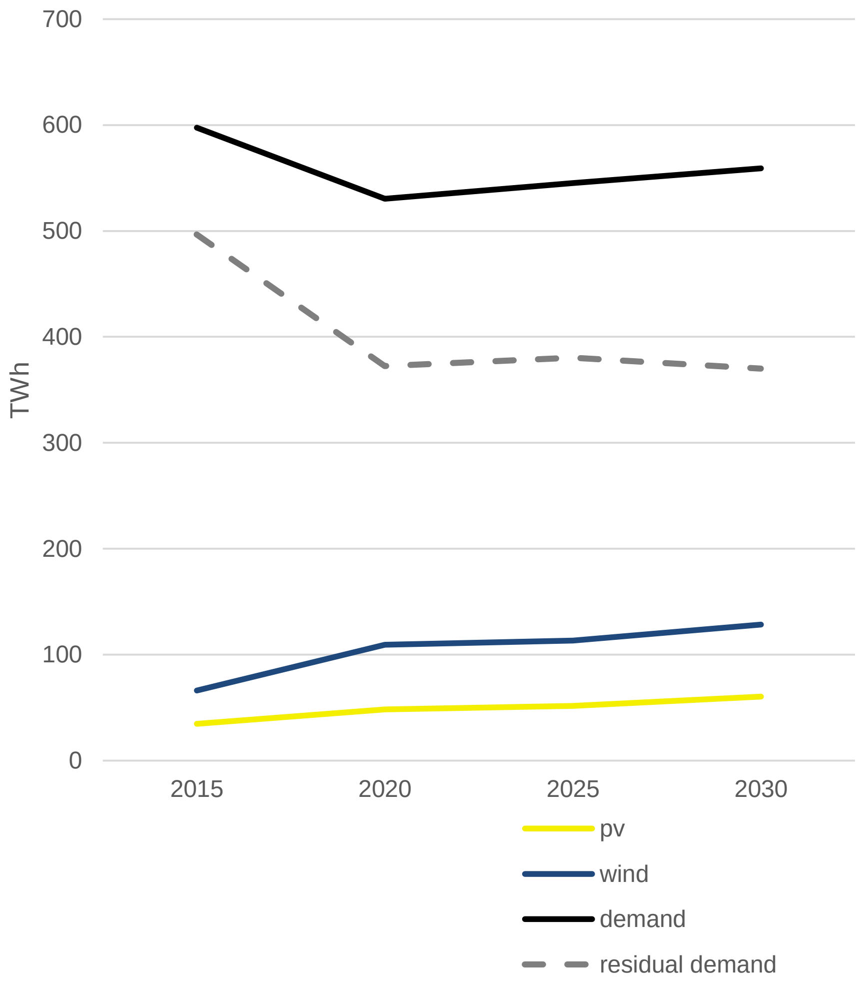
  Storagecontent ≤ Storage capacity

Rolling planning structure



Model inputs





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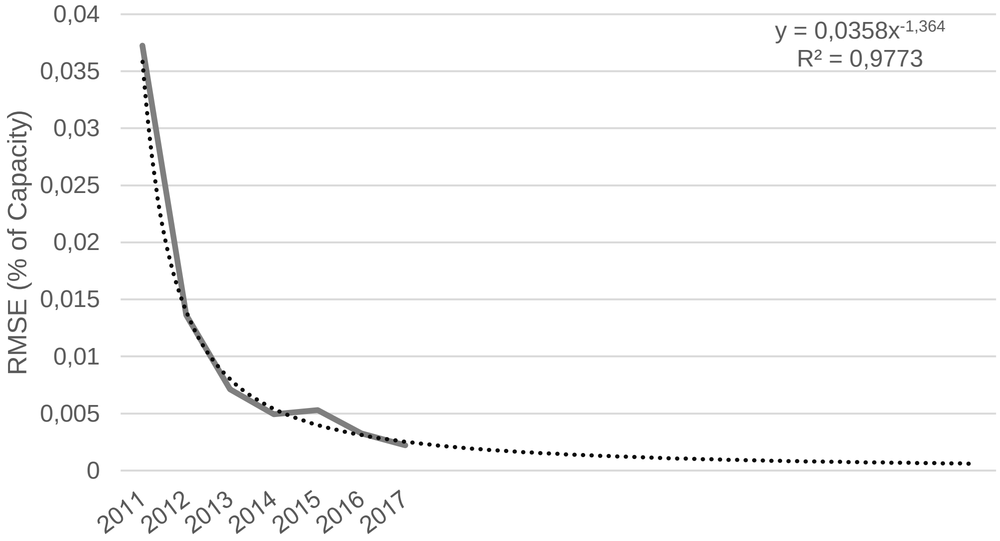
Scenarios

		Electricity system	
		2015	2030
Forecast accuracy	reference*	Ref15	Ref30
	observed	Obs15	Obs30
	extrapolated	Ext15	Ext30

*perfect foresight

Scenario inputs

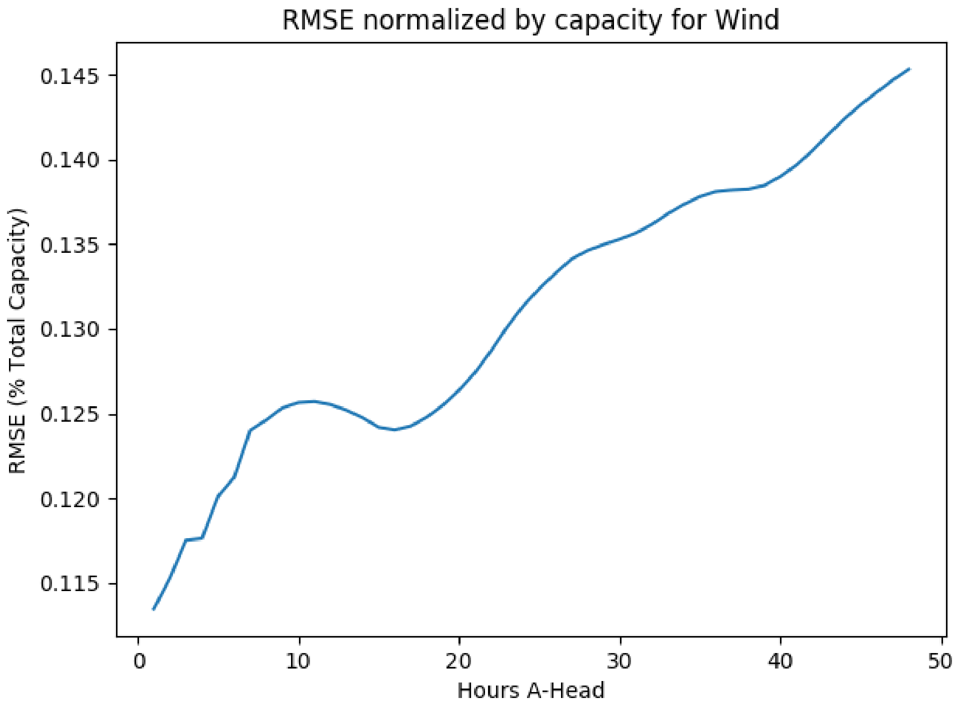
- Forecast improvement interpolation up to 2030:



Forecast Improvement	
2011 - 2015	86%
2011 - 2030	98%

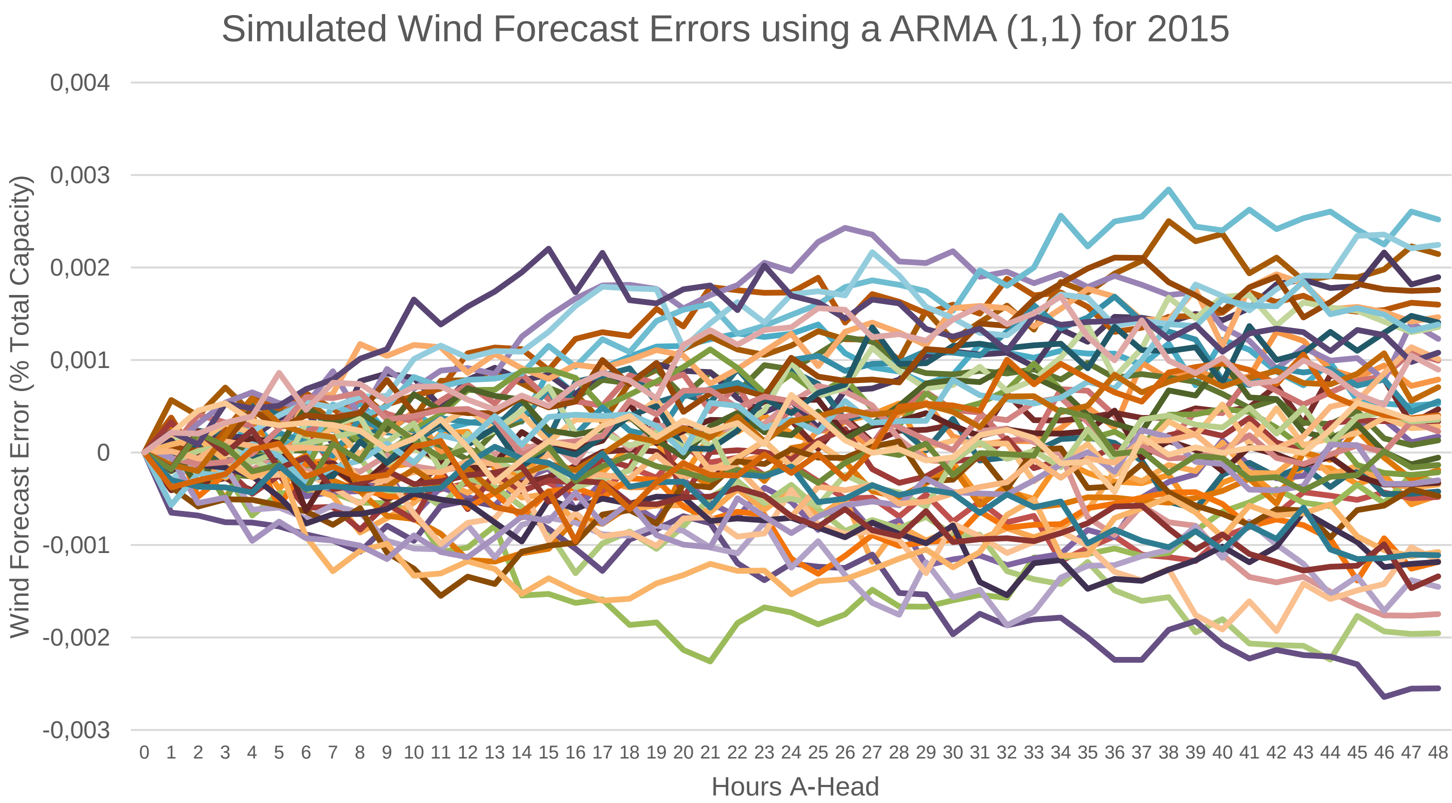
Scenario inputs

- Texas data from 2009 to 2010 on wind errors forcast up to 48 hours a-head.
- The simulation approach for wind forecast erros is based on an ARMA (1,1), using the Nelder-Mead optimization to derive the ARMA parameters α, β, σ.



$$Wind_{ft}^{err} = \alpha Wind_{ft-1}^{err} + Z_{ft} + \beta Z_{ft-1}$$
$$\alpha = 1.02, \qquad \beta = -0.33, \qquad \sigma = 0.014$$

50 simulated wind forecast errors



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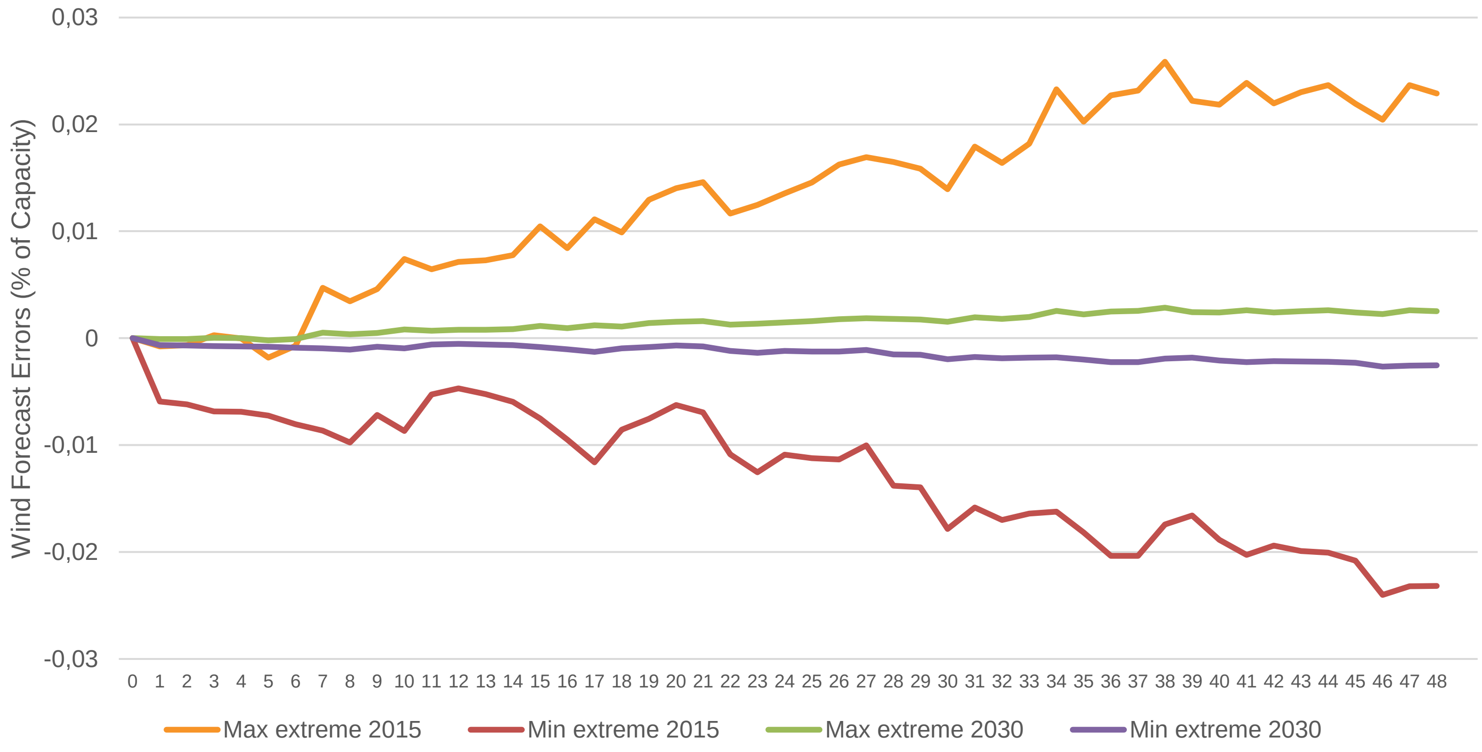
Extreme case scenarios



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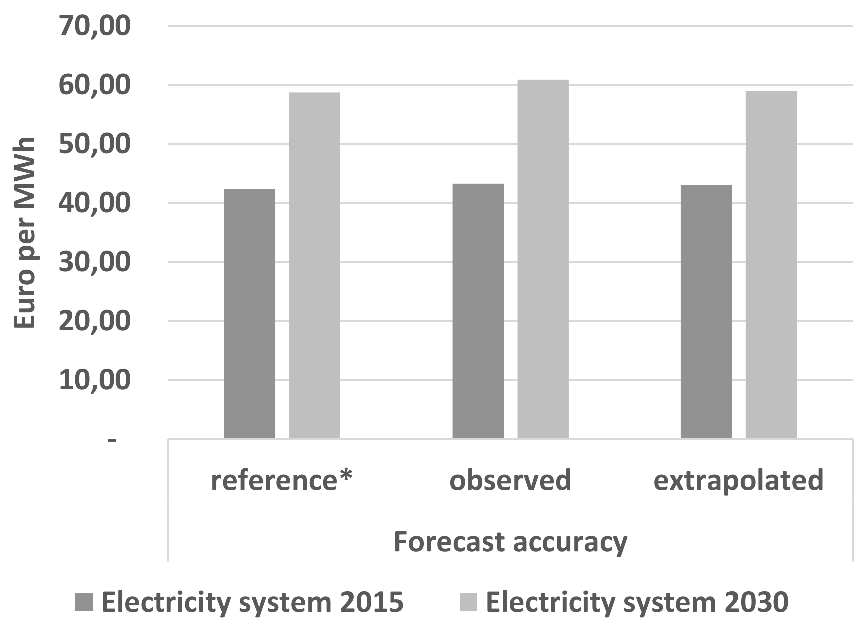
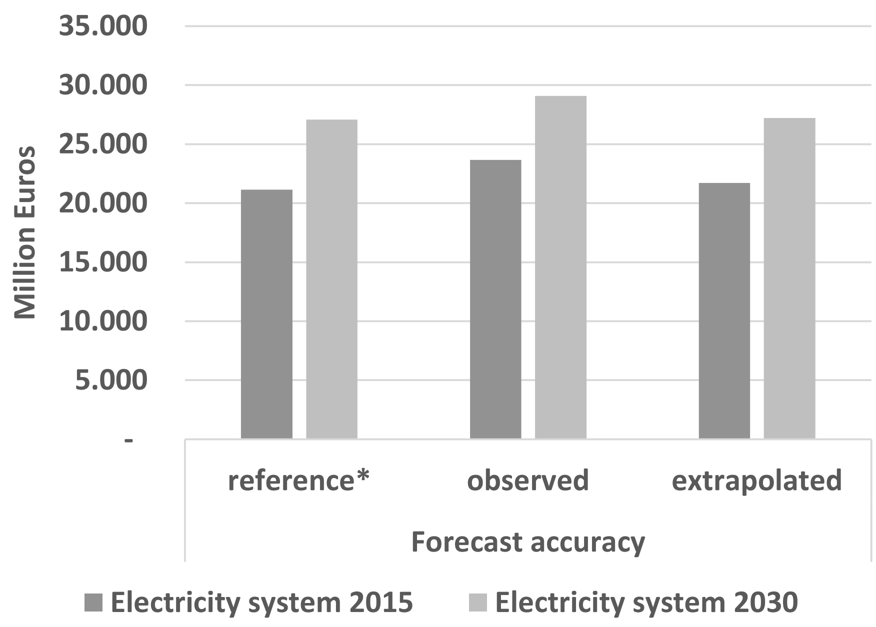
Results (preliminary) – electricity prices



*perfect foresight

	Electricity system 2015	Electricity system 2030
observed compared to reference	2.10%	3.52%
extrapolated compared to reference	1.67%	0.37%
observed compared to extrapolated	0.43%	3.16%

Results (preliminary) – system costs



*perfect foresight

	Electricity system 2015	Electricity system 2030
observed compared to reference	10.72%	6.91%
extrapolated compared to reference	2.58%	0.47%
observed compared to extrapolated	8.35%	6.47%

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Conclusion

- There has been a **strong trend in forecast quality improvements** in the past
- Even though it is uncertain how this trend will continue in the future, our preliminary results show an **impact of improvement in forecast accuracy**
- **This leads to lower electricity prices and lower system costs**

Outlook:

- Redo analysis with better data
- Include solar forecast errors
- Include balancing in modelling framework

Jonas Savelsberg
Energy Economics
University of Basel

jonas.savelsberg@unibas.ch

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