The plunge in German electricity futures prices – Analysis using a parsimonious fundamental model

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Motivation: German wholesale power prices have dropped

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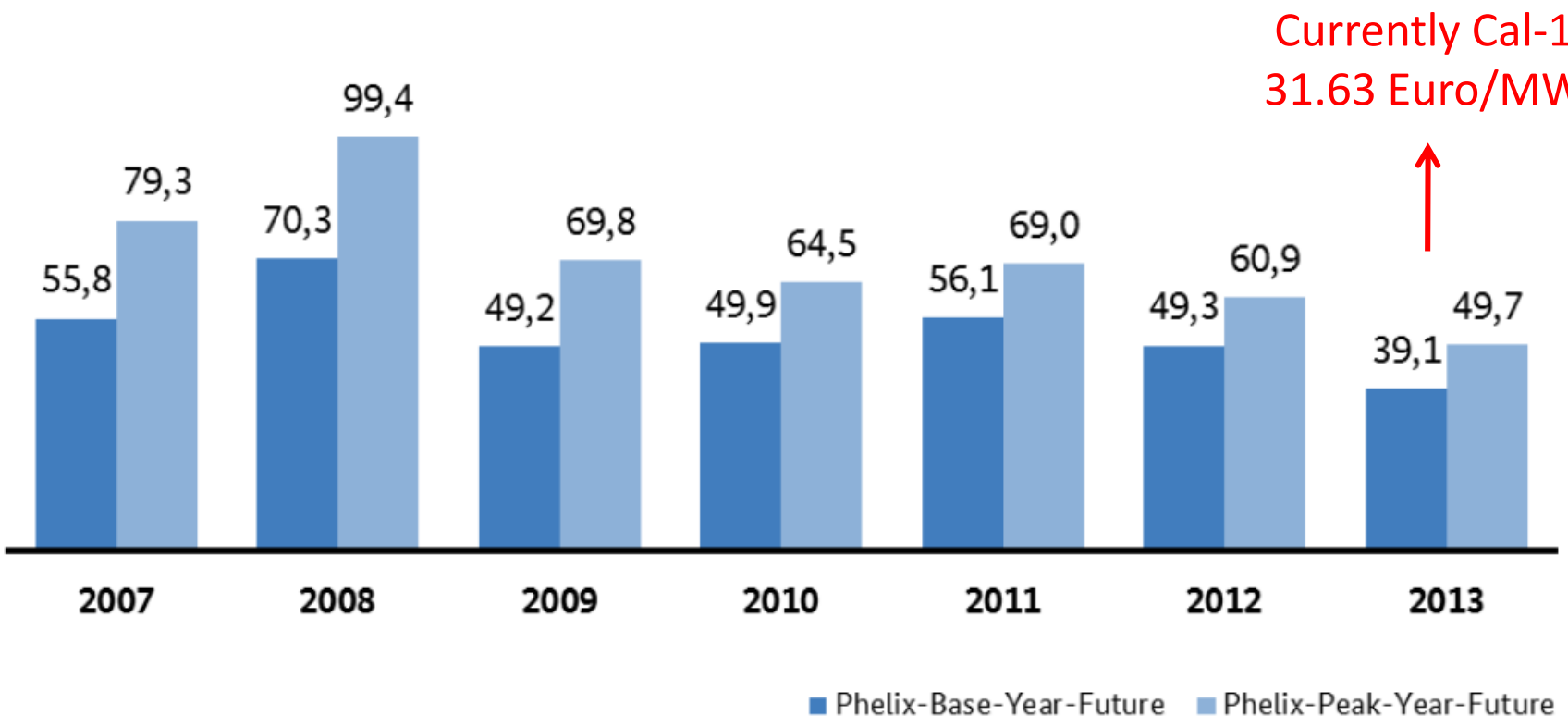
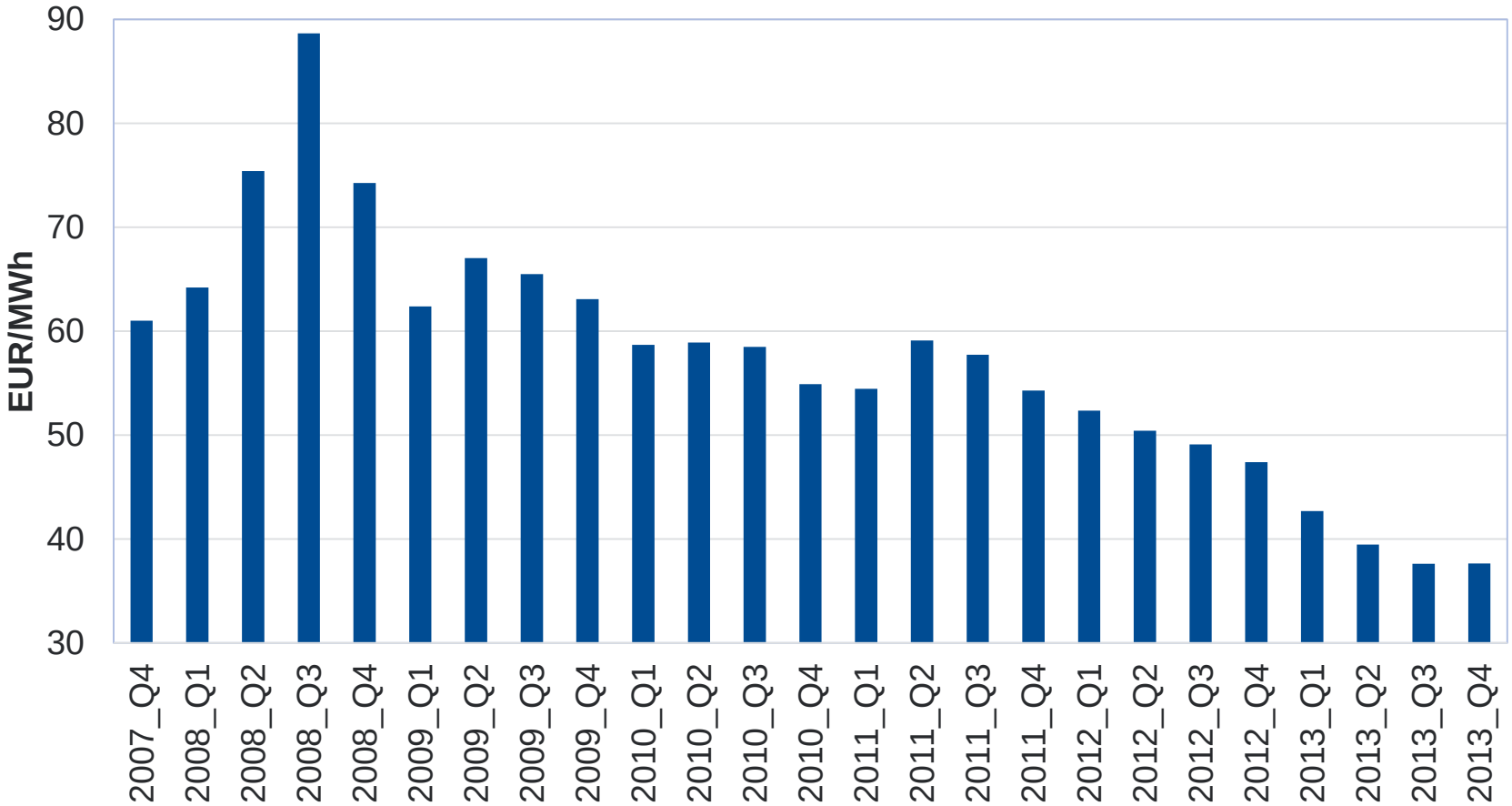


→ Power prices declined by up to 40 %
→ Apparently only brief impact of nuclear policy reversal after Fukushima

Second look: a steep decline in the value of the Cal-14 future



→ How did expectations change between 2007 and 2013?

→ Is this development driven by the increase in renewable generation?

Question: What has happened in the meantime?

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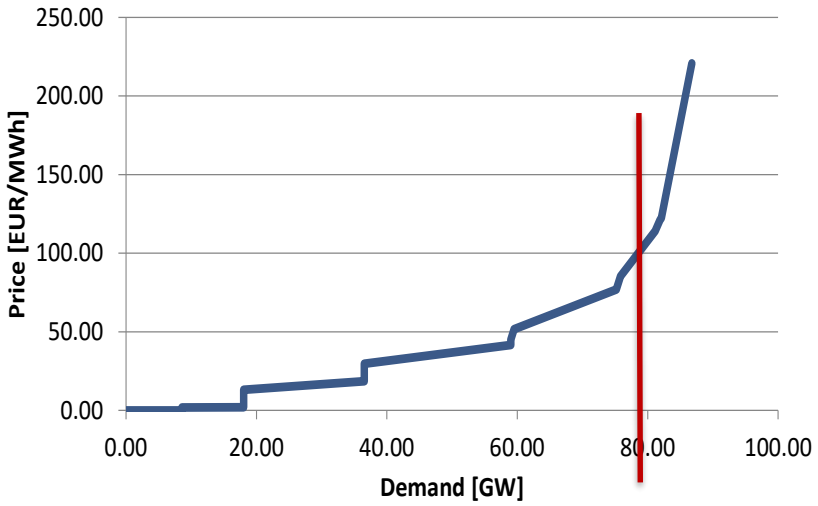
Goal: Reconstruction of Q4 2007 and Q4 2013 prices for Cal-14

- Use of a parsimonious fundamental model
- Determine 2007 and 2013 expectations for fundamentals' values in 2014
- Decomposition of price impacts due to changes in
  - Renewable penetration
  - Conventional capacities
  - Fuel prices
  - CO2 prices
  - Demand

Parsimonious fundamental model

- Computation of expected hourly prices
- Demand side
  - Hourly demand profile with constant shape scaled with annual demand
  - Subtraction of renewable hourly profiles scaled with annual amounts
- Supply side
  - Piecewise linear supply stack
  - Based on estimates of minimum and maximum efficiency per technology class
  - Correction for must-run, partly temperature dependent CHP production
- Exports/Imports
  - Regression-based hourly estimates: demand, RES infeed, plant availability



➢ Intersection of supply and demand yields price set by marginal plant

Reconstruction of expectations

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- Demand
  - Extrapolation of demand growth of preceding three years
- Renewables
  - Mid-term forecasts of grid operators
- Conventional capacities
  - BMU Leitstudie 2007, manually adjusted for nuclear phase-out
- Fuel and CO2 prices
  - Myopic expectations beyond the far end of the forward curve

		Q4 2007	Q4 2013
Information basis:		2007	Q4 2013
Expectation for:		2014	2014
Load	TWh	621	599
Solar	TWh	5,93	36,60
Wind	TWh	53,92	69,59
Cap	GW	115,9	118,3
Coal	EUR/MWh	10,19	8,70
Gas	EUR/MWh	27,31	29,37
CO2	EUR/t	24,92	4,90

Validation of Parsimonious Model

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Information basis	Q4 2007	Q4 2013	
Expectations for:	2014	2014	
Phelix Base Future	68,63	41,35	EUR/MWh
Fundamental Model Price	65,69	38,82	EUR/MWh

Result: impact of expectation changes on base price

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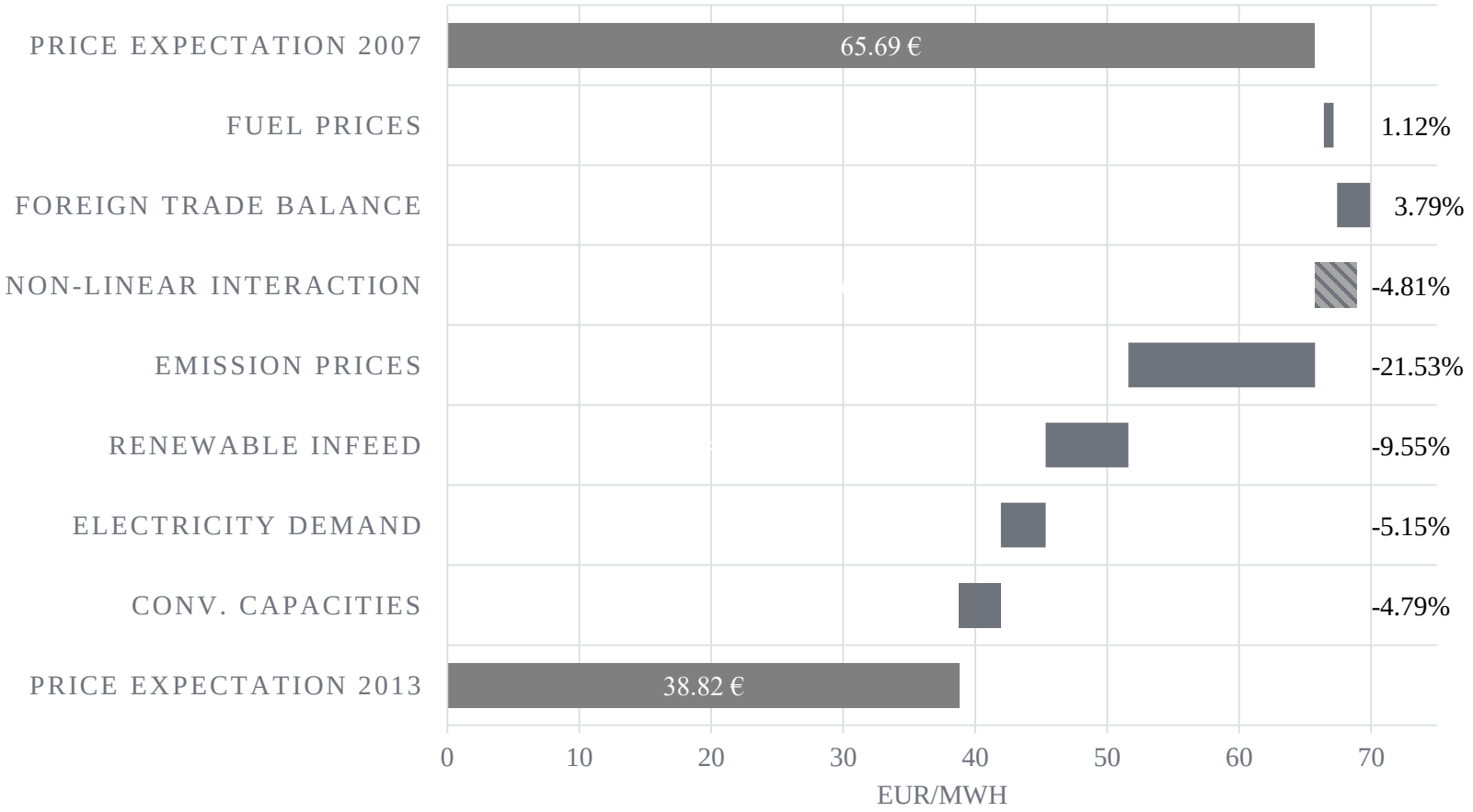
Ceteris paribus approach: individual factor updated from 2007 to 2013 value



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Result: operating margins of power plants

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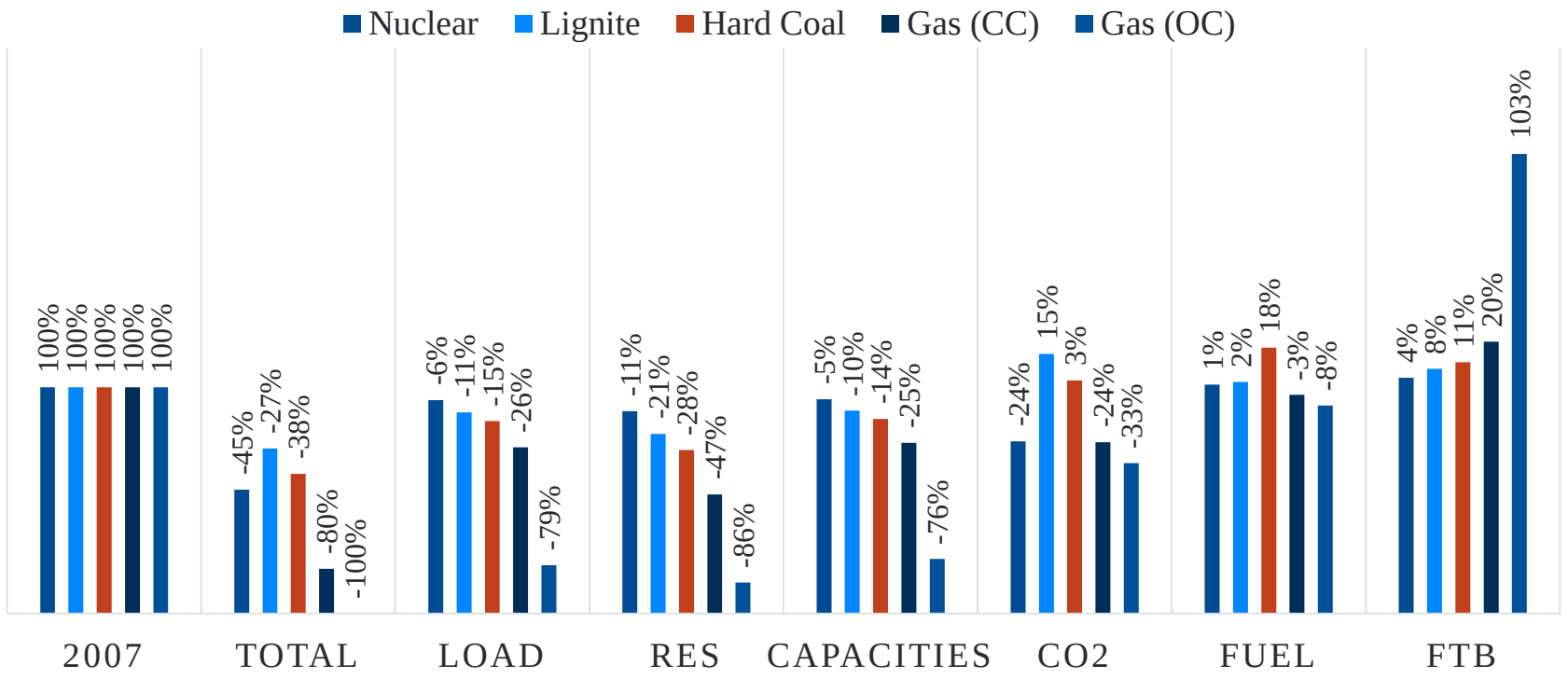
Power plants as strip of European options

without technical restrictions & personnel costs

Impact varies across considered factors:



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Conclusion

- The drop in 2007-2013 wholesale electricity prices driven by fundamentals
  - Model able to capture impact factors and replicate prices
- Analysis of individual factors finds
  - Emission price drop as largest single factor, demand and renewables follow
  - Combined effect of all factors larger than sum of individuals
  - Feedback effect between RES extensions and CO2 price drop?
- Slightly different result for plant operators
  - Load uncertainty large factor, fuel prices impact ambiguous
- Source of electricity price drop and loss of plant profitability not equivalent

Bibliography

Kallabis, T., Pape, C., Weber, C. (2016). The plunge in German electricity futures prices – Analysis using a parsimonious fundamental model. *Energy Policy, 95,* 280–290.

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