Paks II

Economic feasibility, impact on competition and subsidy costs

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Contents

1. Introduction

1. Introduction

- Candole Partners were asked to review economic feasibility of Paks II project and to assess impact of Paks II on market competition.
- Economic feasibility assessment is based on project finance discounted cash-flow model.
- Forecasts are based on World Energy Outlook (2015) by International Energy Agency.
- Market competition assessment follows guidelines of EU and US competition authorities.

1. Introduction: About us

- Candole Partners is market and risk advisory company with particular focus on energy sector in CEE.
- Candole Partners advise strategic and financial investors into the energy sector on market, regulatory and policy risk to investment.
- Analytical work of Candole Partners is led by Jan Ondrich.
- Jan focuses on assessment of investment opportunities and market risk in European energy sector.
- Jan's assignments include advisory work for Europe's major utilities as well as infrastructure/private equity funds investing into the energy sector.

2. Economic assessment

Model inputs and outputs, results analysis

2. Economic assessment

Model inputs

Category	Input
CAPEX/kW	5,208
Lifetime	60 years
Depreciation	60 years straight line
WACC	7.0%
Fuel cost	€ 5 - 7.3/MWh
O&M	€ 8 - 25.3/MWh
Decommissioning	€ 1.7- 3.0/MWh
Avg. Load	90.7%

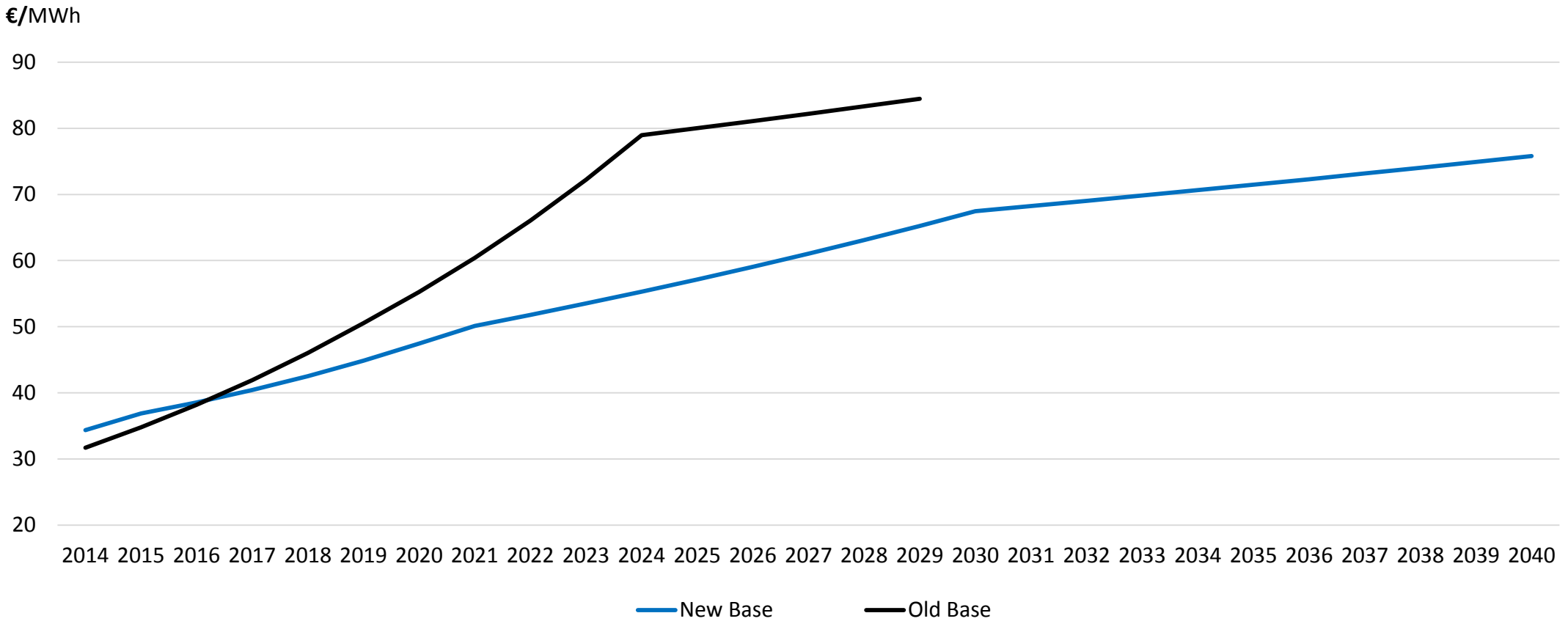
2. Economic assessment

Model inputs comparison

	Candole Partners	Rothschild	Court of Auditors	Aszódi
CAPEX	€ 5,208 /kW	€ 5,208 /kW	€ 5,300 /kW	€ 5,208 /kW
Fuel cost	€ 5.0 - 7.3/MWh	€ 5.0 - 7.0/MWh	€ 7.3/MWh	€ 6-7/MWh
O&M	€ 8.0 - 25.3/MWh	€ 8 – 17.0/MWh	€ 25.3/MWh	€ 15-17/MWh
Decommissioning	€ 1.7- 3.0/MWh	€ 2.1- 3.1/MWh	€ 1.7-3.4/MWh	€ 6-7/MWh
Load	90.7%	92.0%	85.0%	96.0%

2. Economic assessment

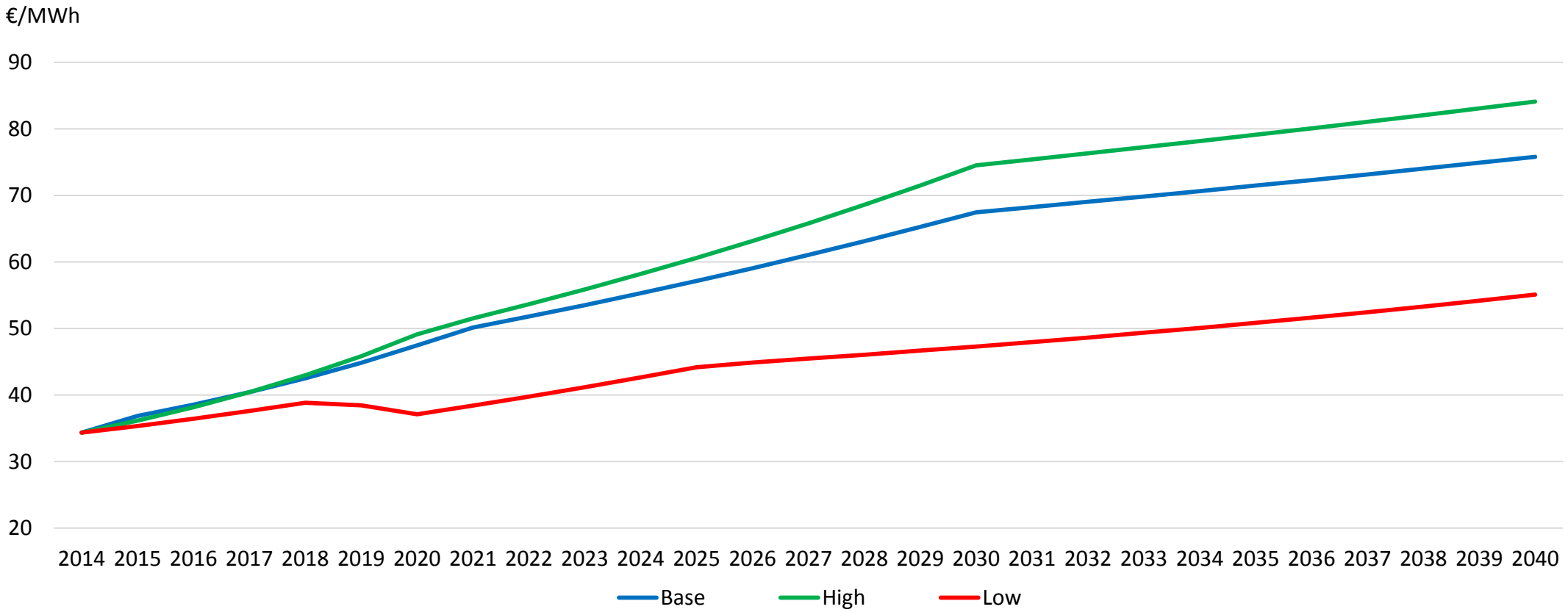
Electricity prices used in Rothschild & Candole Partners



Source: IEA (2013) & (2015), own calculations

2. Economic assessment

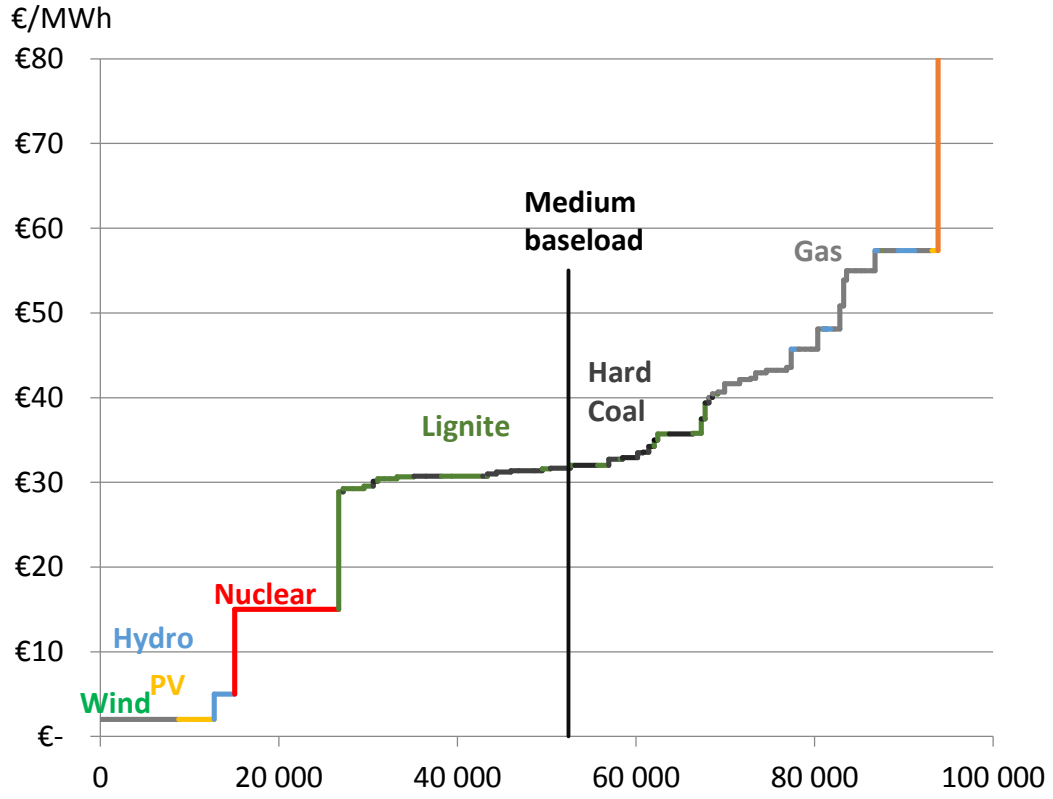
Electricity prices used in study



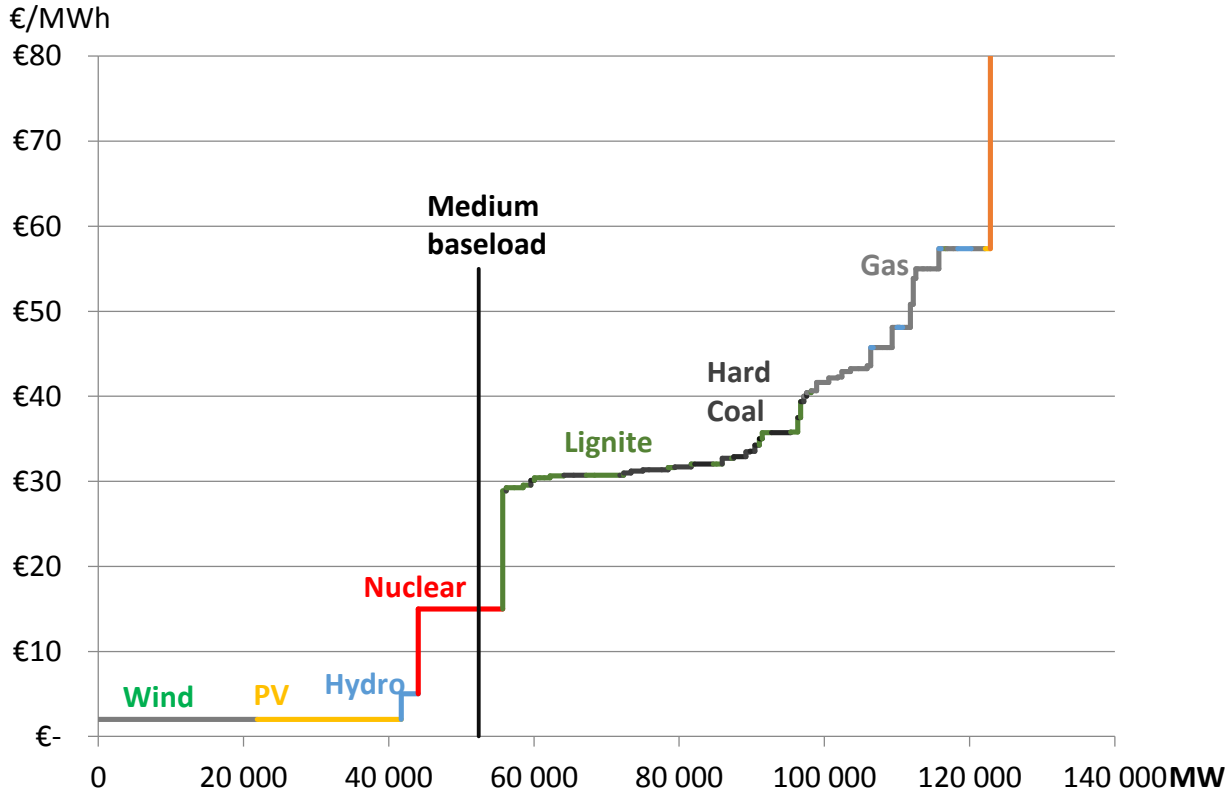
Source: IEA (2015), own calculations

2. Economic assessment

German merit order with low RES



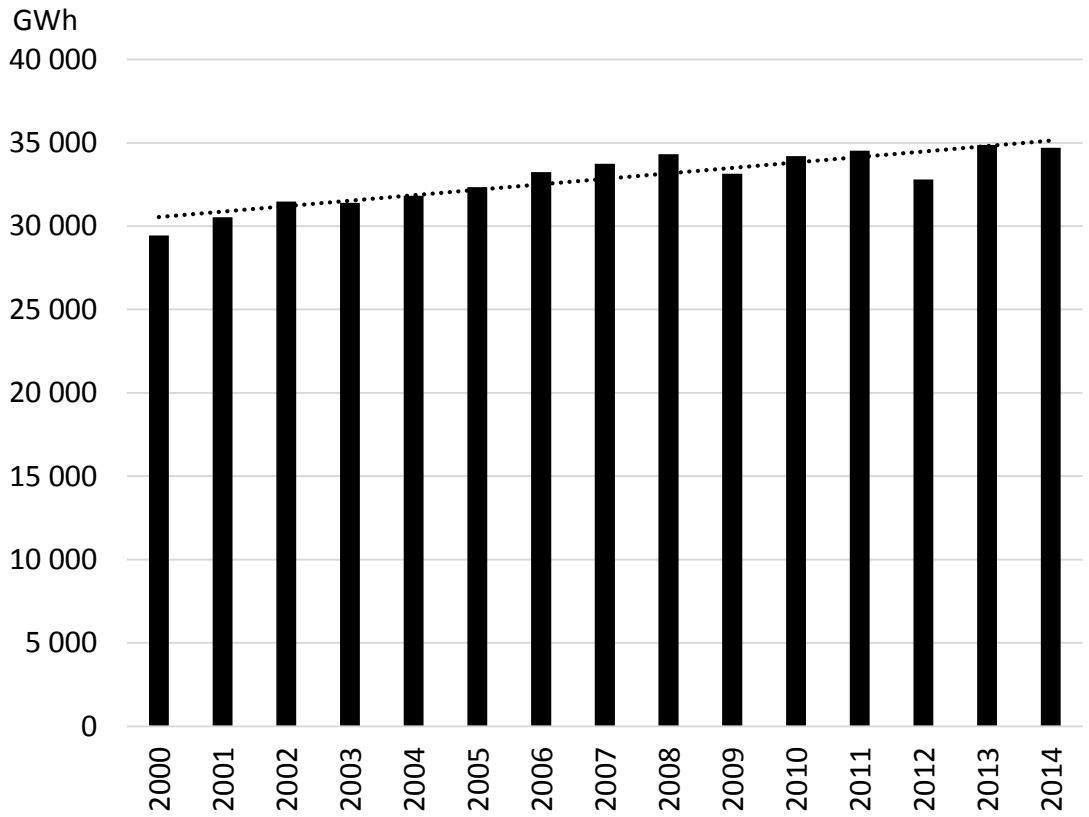
German merit order with high RES



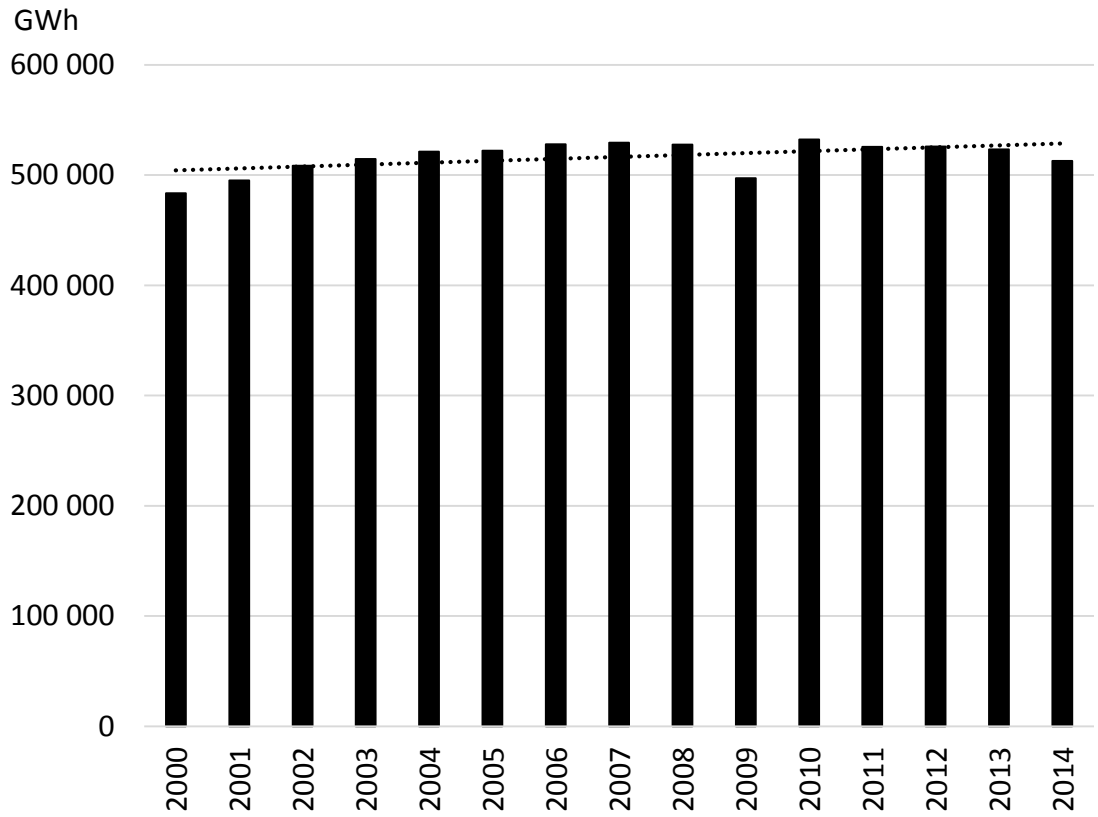
Source: Own calculations

2. Economic assessment

Annual consumption in Hungary



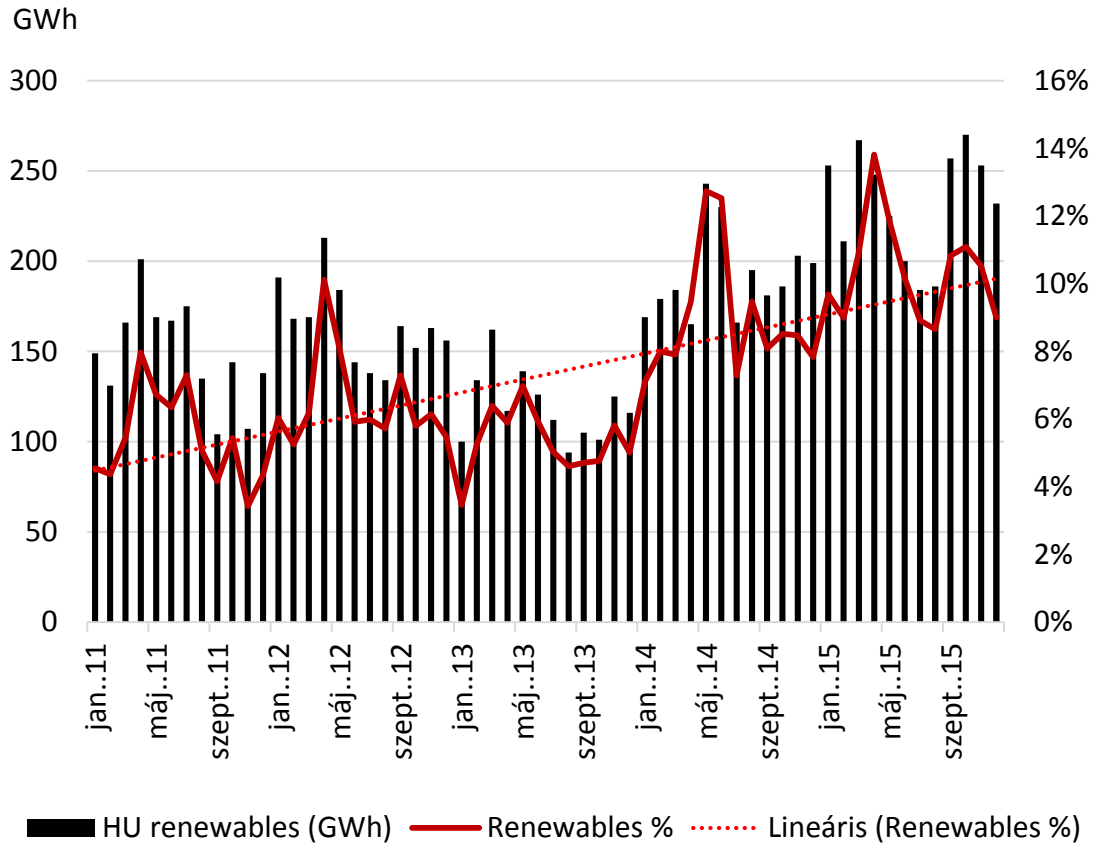
Annual consumption in Germany



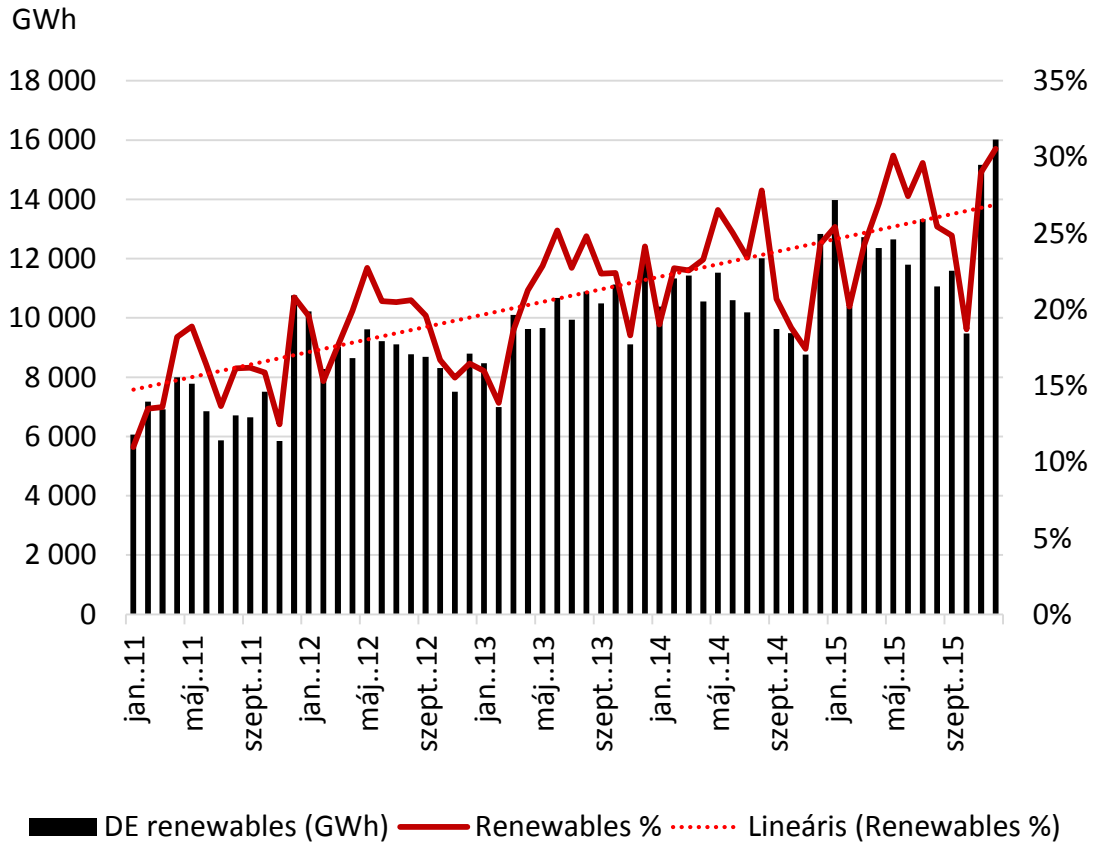
Source: Eurostat (2016)

2. Economic assessment

Renewables production in Hungary



Renewables production in Germany



Source: ENTSO-E (2016)

2. Economic assessment

Result summary

Scenario	Base	Low	High	EPR Base	EPR Low	EPR High
IRR	**6.1%**	**4.4%**	**6.7%**	**4.4%**	**1.7%**	**5.2%**
NPV	€ -1,266m	€ -3,231m	€ -419m	€ -3,270m	€ -5,762m	€ -2,349m
Avg. revenues/MW	€ 574,600	€ 421,900	€ 645,400	€ 574,600	€ 421,900	€ 645,400
Avg. costs/MW	€ 117,300	€ 117,300	€ 117,300	€ 268,200	€ 268,200	€ 268,200
Avg. EBITDA/MW/year	€ 457,300	€ 304,600	€ 528,100	€ 306,400	€ 153,700	€ 377,200
Avg. spread	€ 55.3	€ 37.1	€ 63.5	€ 36.0	€ 17.8	€ 44.2

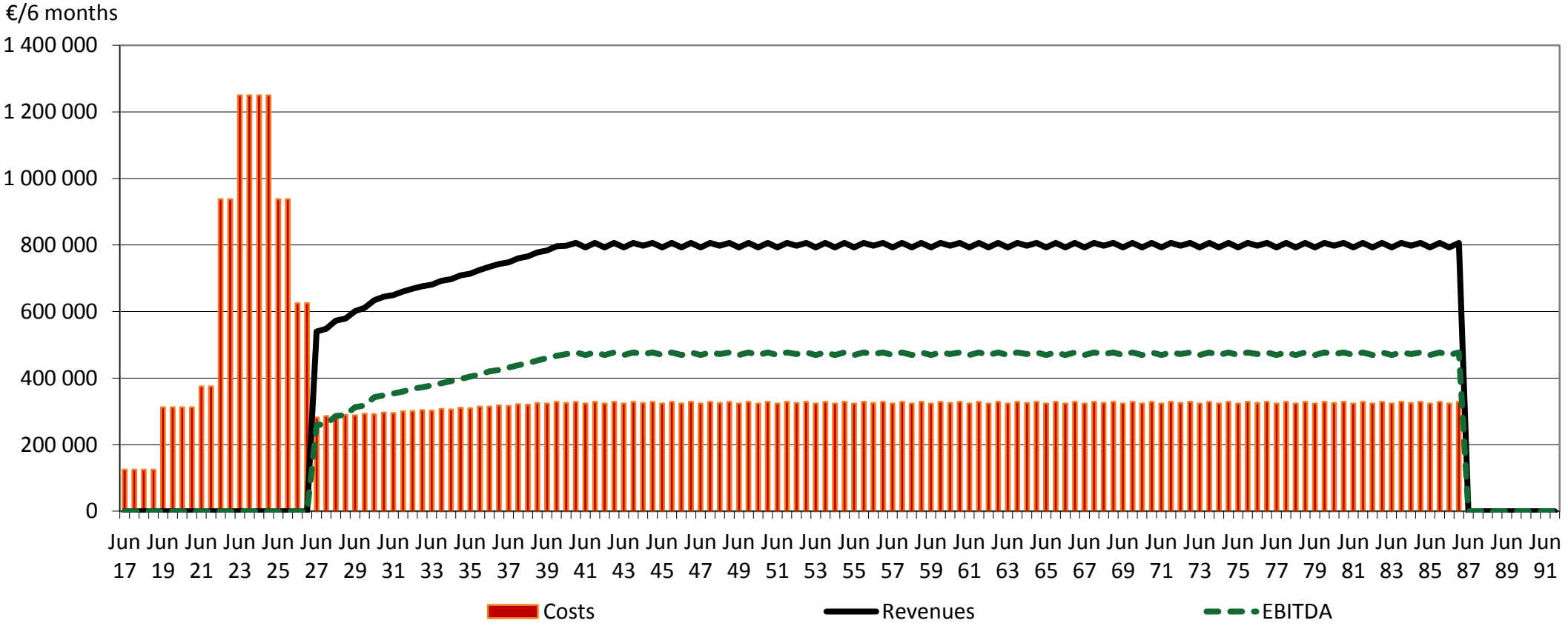
EPR scenarios assume different costs from Rothschild study:

- Uranium price of €7.3/MWh (vs. €5.0/MWh)
- Variable O&M of €25.3/MWh (vs. €8.0/MWh)
- Decommissioning costs of €1.7/MWh (vs. €2.0/MWh)

Source: Own calculations

2. Economic assessment

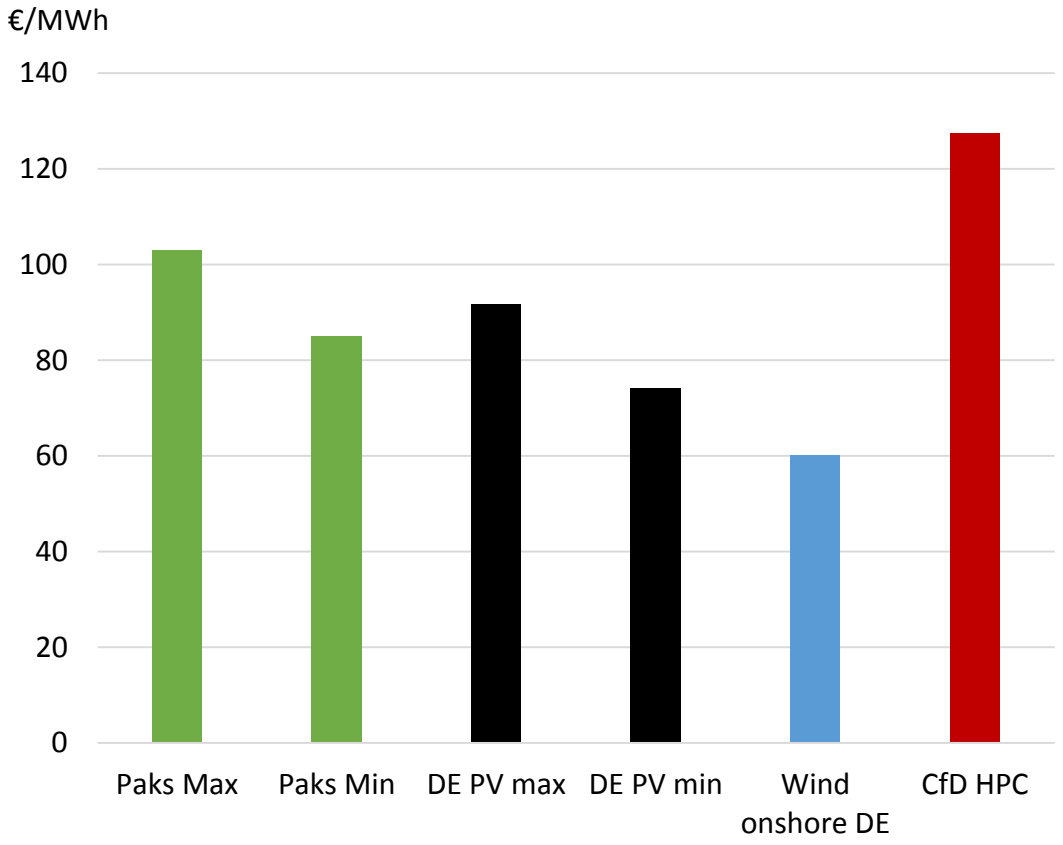
CAPEX, costs and revenues during lifetime



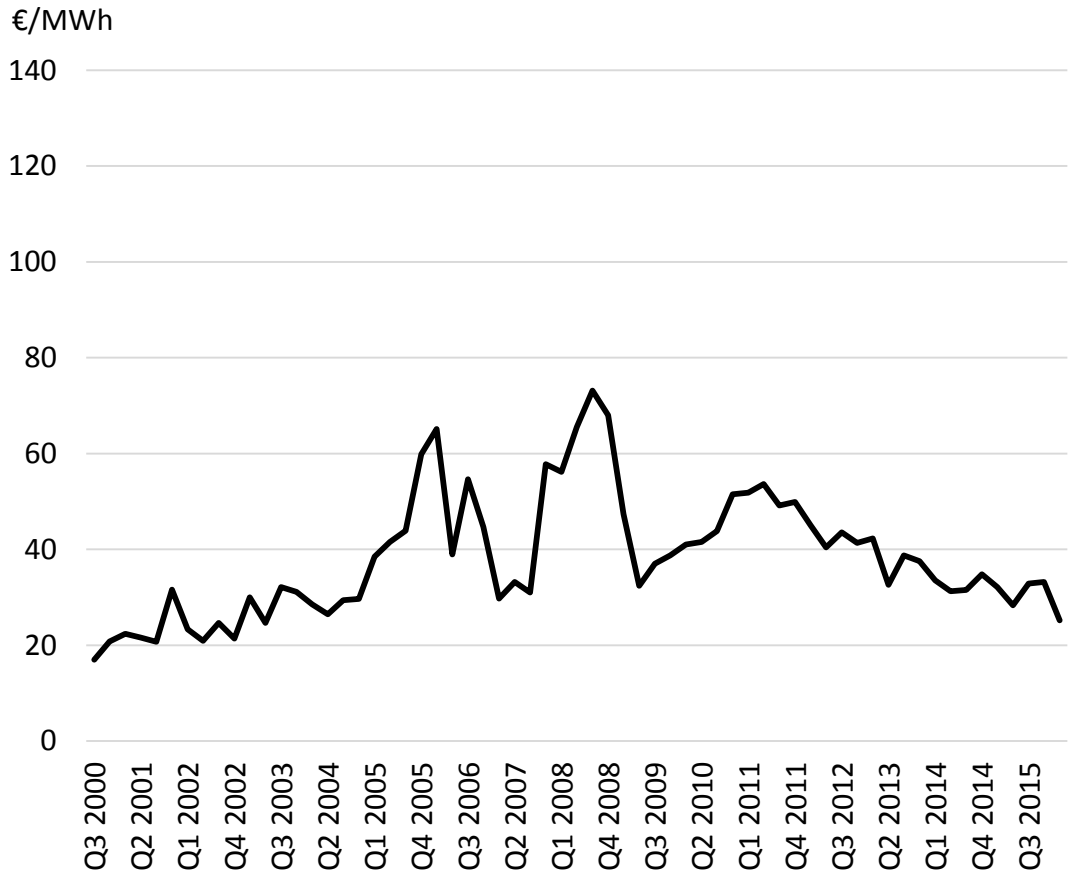
Source: Own calculations

2. Economic assessment

Break-even price for Paks and other projects



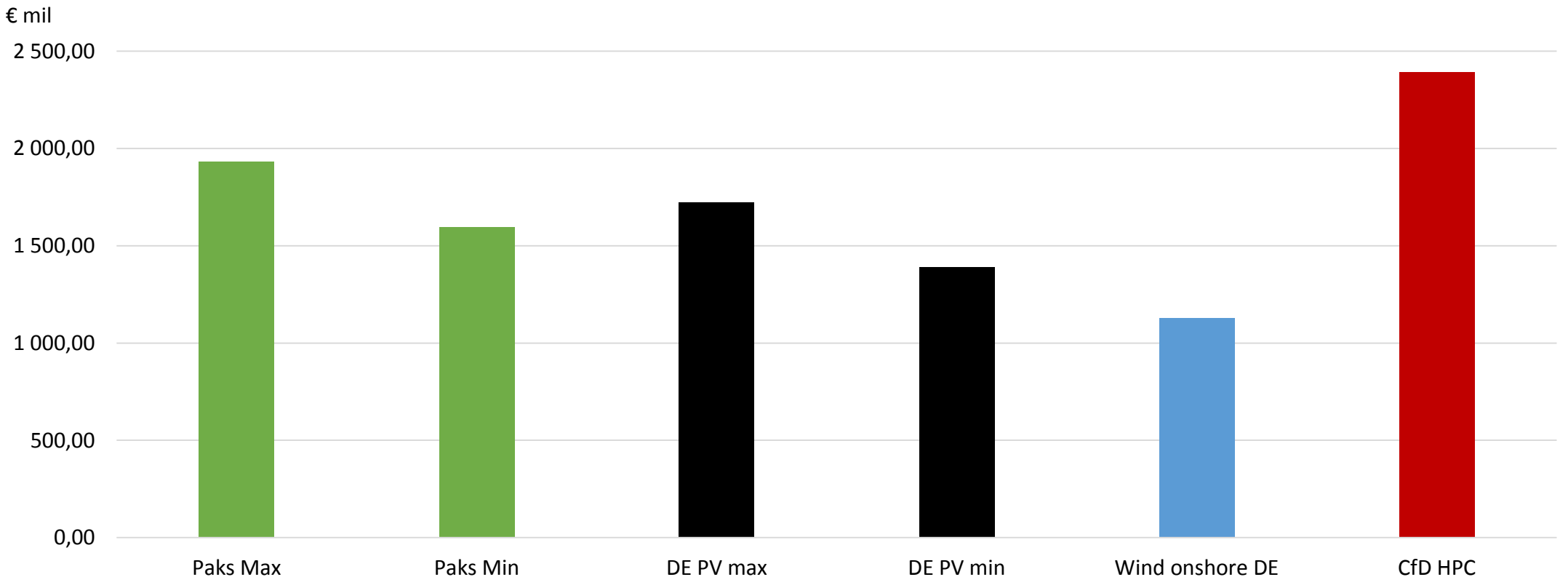
Historical EEX D-A price



Source: EEX (2016), own calculations

2. Economic assessment

Total annual costs for various support schemes



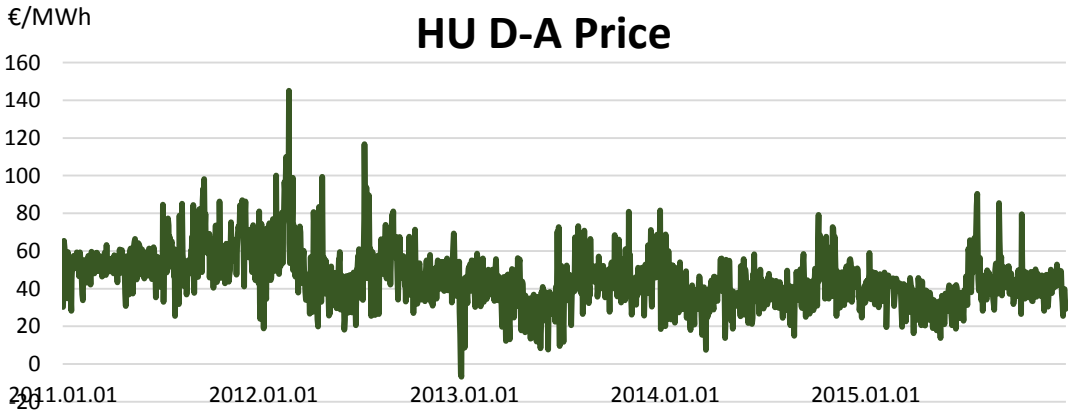
Source: Own calculations

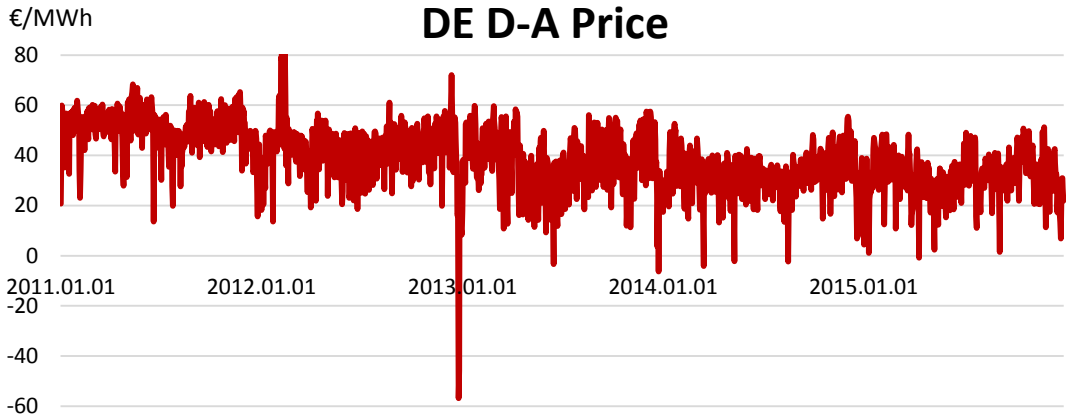
3. Impact on competition

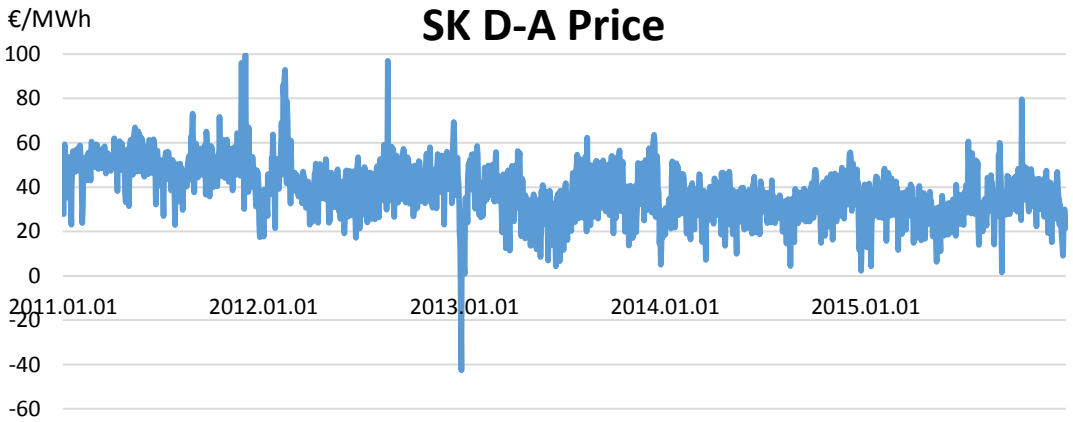
Relevant market and market concentration analysis

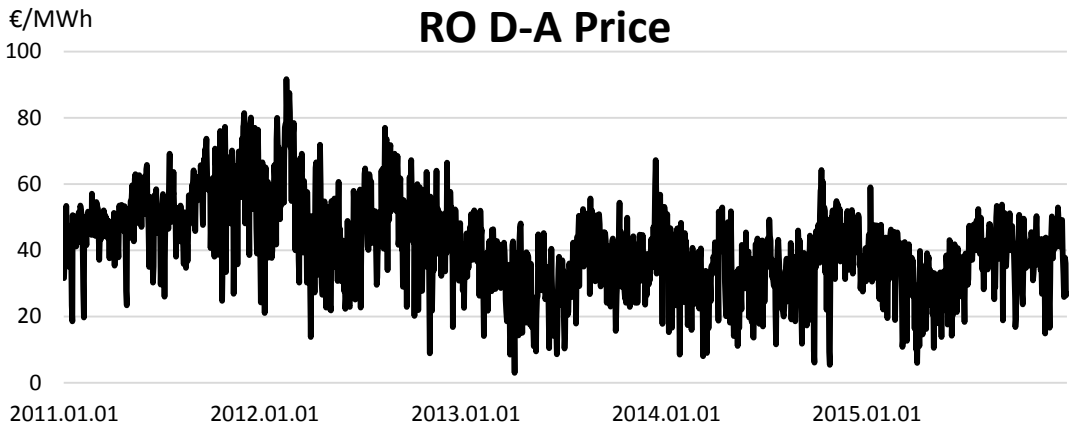
3. Competition impact

Regional D-A prices in 2011-2015





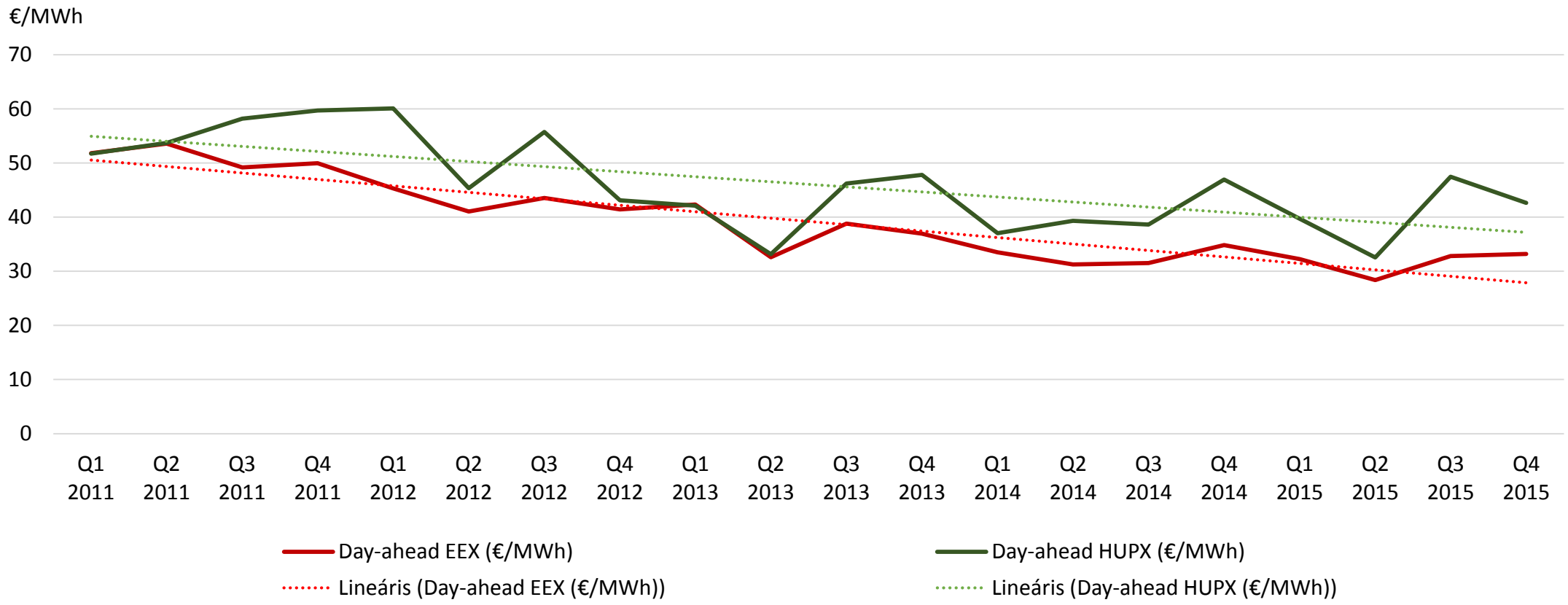




Source: HUPX, EEX, OKTE, OPCOM (2016)

3. Competition impact

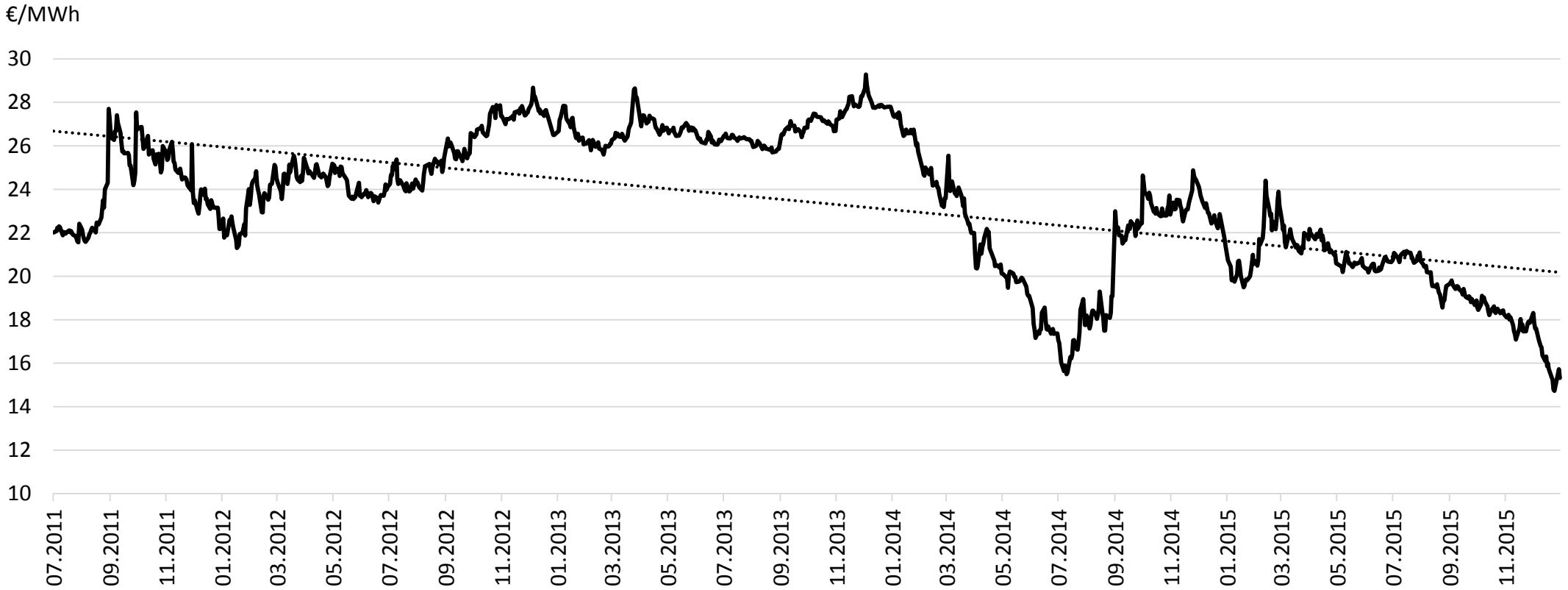
Downward trend of average quarterly day-ahead data



Source: EEX, HUPX (2016)

3. Competition impact

Downward trend of gas (NCG) prices

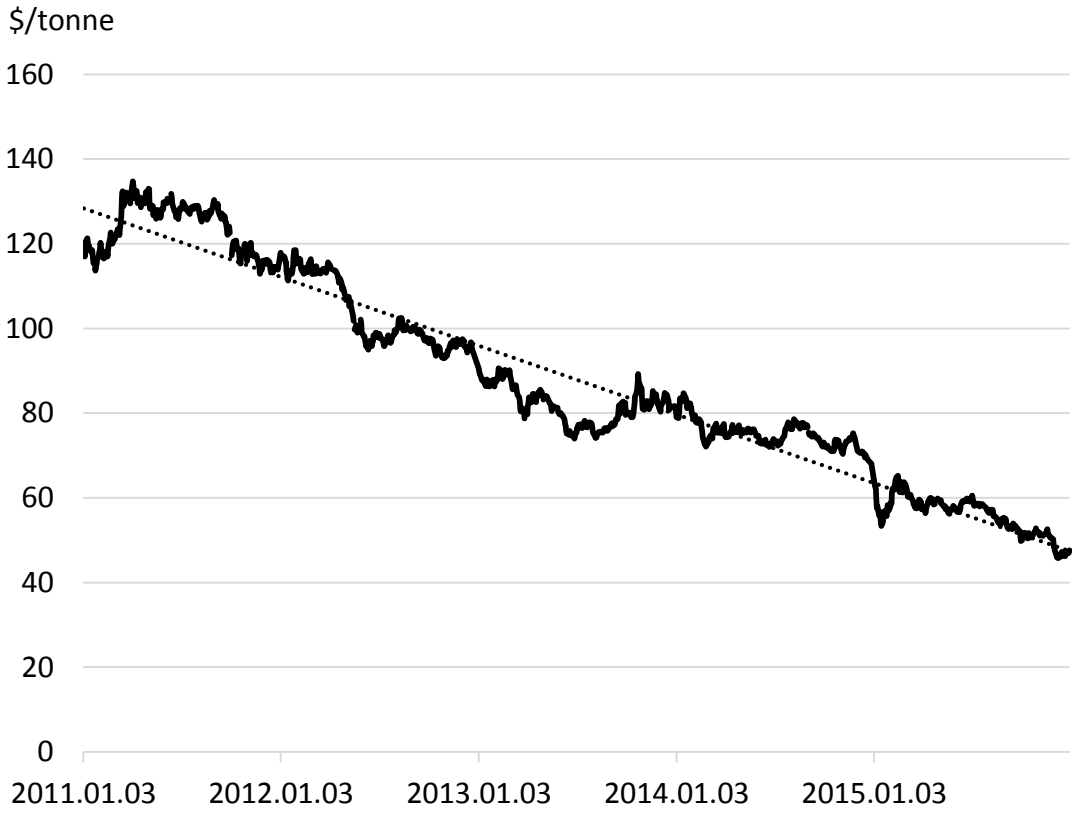


Source: EEX (2016)

3. Competition impact

Downward trend of CO2 prices

Downward trend of coal (ARA) prices



Source: EEX (2016)

3. Competition impact

Correlation coefficients

Year	HU-DE	HU-SK	HU-RO	CZ-SK
2011	0.51	0.56	0.64	0.94
2012	0.59	0.62	0.68	0.97
2013	0.52	0.65	0.51	0.98
2014	0.54	0.59	0.57	0.96
2015	0.53	0.66	0.70	0.93

Source: EEX, HUPX, OKTE, OPCOM, own calculations (2016)

3. Competition impact

HHI concentration indexes

Scenario	Moderate Concentration	High Concentration
European Commission	>1,000	>2,000
U.S. Department of Justice	>1,500	>2,500

Calculated HHI index for Hungary in 2015

Country	Without imports	With imports
Hungary	3,481	2,594

Source: European Commission and U.S. Department of Justice and Federal Trade Commission (2010), MAVIR (2016), own calculations

3. Competition impact

Assumptions of Hungarian installed capacity in Nuclear-Green Scenario

Scenario	2010	2030	2040	2050
Nuclear	2,000 MW	4,400 MW	2,400 MW	2,400 MW
Coal	1,600 MW	0 MW	0 MW	0 MW
Natural gas	4,800 MW	5,600 MW	8,800 MW	10,800 MW
Renewables	600 MW	2,200 MW	3,000 MW	4,200 MW

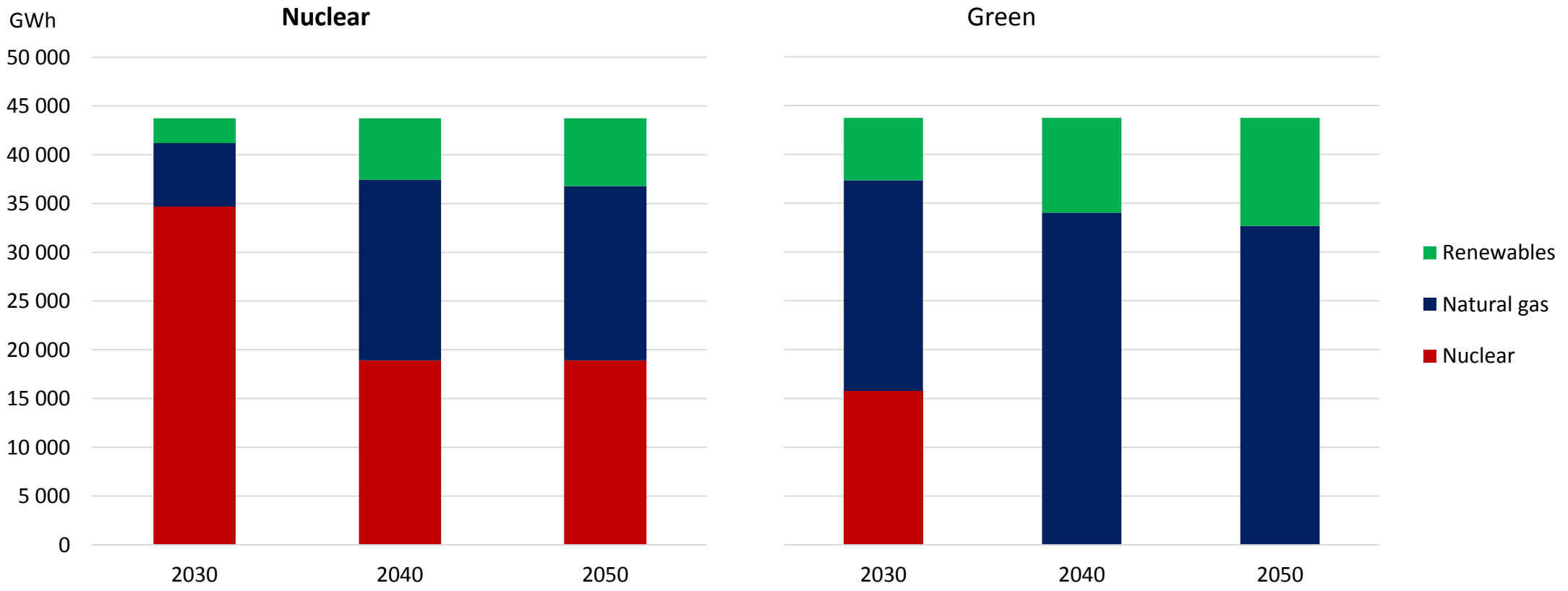
Assumptions of Hungarian installed capacity in Anti-Nuclear-Green Scenario

Scenario	2010	2030	2040	2050
Nuclear	2,000 MW	2,000 MW	0 MW	0 MW
Coal	1,600 MW	0 MW	0 MW	0 MW
Natural gas	4,800 MW	7,400 MW	10,500 MW	12,400 MW
Renewables	600 MW	2,200 MW	3,000 MW	4,200 MW

Source: Ministry of National Development (2012)

3. Competition impact

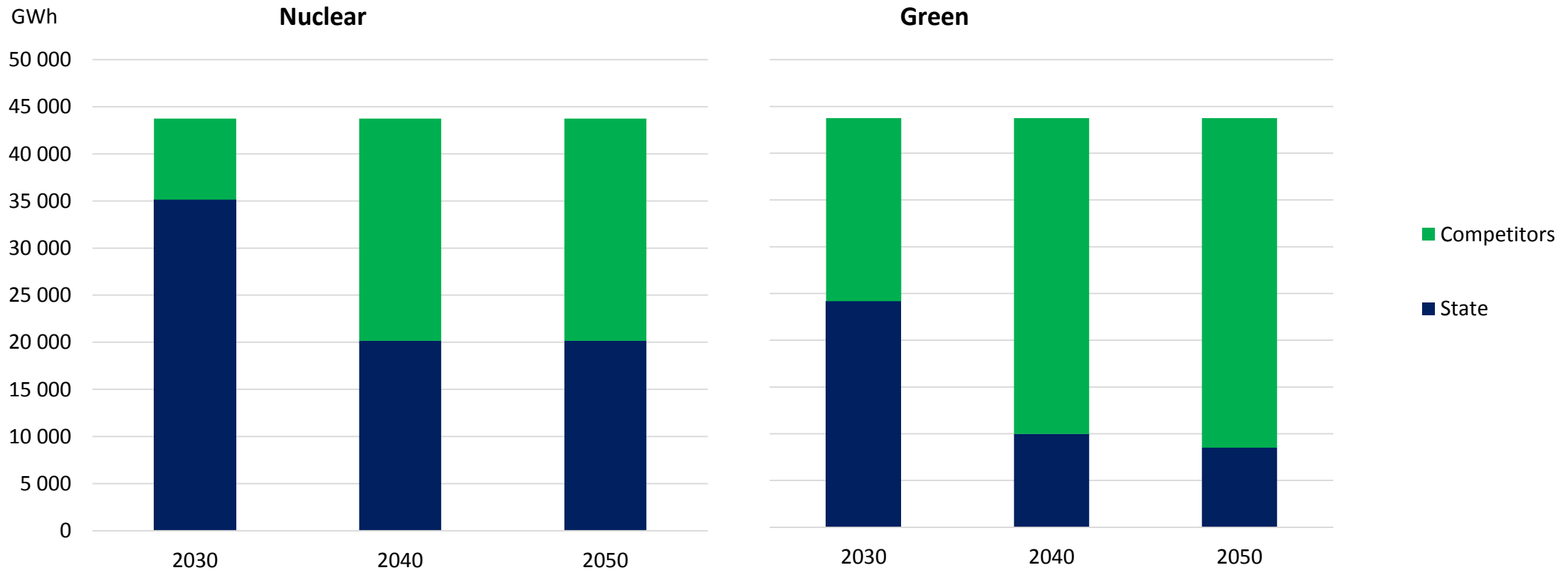
Generation by fuel for modelled scenarios



Source: Ministry of National Development (2012)

3. Competition impact

Generation by owner for modelled scenarios



Source: Ministry of National Development (2012)

3. Competition impact

Calculated HHI index for Hungary in 2015

Country	Without imports	With imports
Hungary	3,481	2,594

Future HHI index for Hungary in two modelled scenarios

Scenario	2030	2040	2050
Nuclear	6,889	2,582	2,582
Green	3,502	977	836

Source: Own calculations

4. Conclusion

4. Conclusion

- Paks II is not economically viable project without significant state aid.
- The project NPV is negative across all analysed scenarios, including those with most bullish power price outlook.
- The project would break even only if Hungarian government provided subsidy to the project equal et least to EUR 85/MWh in best case scenario and EUR 103/MWh in realistic scenario.
- The subsidy price is significantly higher than that needed to support alternative generation sources.
- Paks II would also have significant negative impact on market concentration.
- Dominance of state-controlled companies on in power generation sector would increase significantly compared to non-nuclear scenarios.

Thank you for your attention

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