

IV GENERATION NUCLEAR POWER PLANT IN THE INTEGRATED NORDIC POWER MARKET

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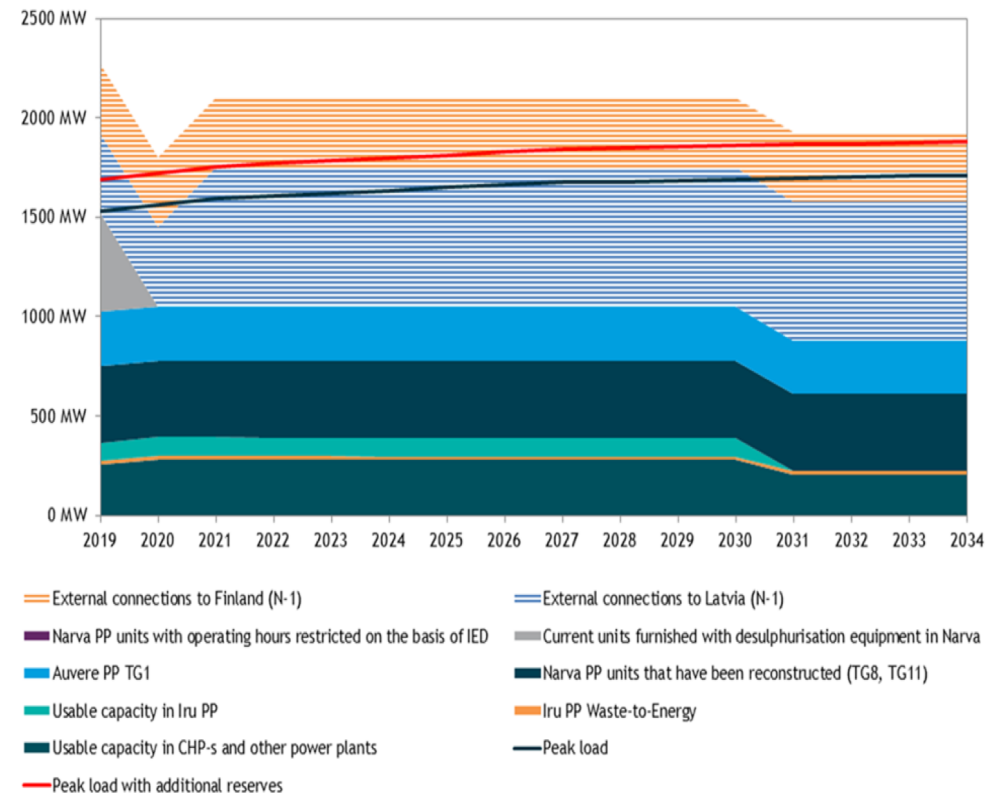
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BACKGROUND

- Electricity produced in Europe is mainly affected by the climate commitments
- Several trends in the Estonian power system motivate the need for new investments in zero or low-carbon generation capacity
 - Gradual market-based phase-out of oil shale
 - Greatly increased carbon price
- IV generation nuclear power plant opens a new opportunity for Estonia, due to their much smaller size and overnight investment cost compared to the existing ones

Security of Supply in Estonia



PURPOSE OF THE STUDY

- Investigate the competitiveness of an NPP in the regional electricity market in 2030-2040, taking into account regional security of supply and climate policy objectives
- The functioning of the electricity market and the behavior of the NPP in the market was analyzed with different future scenarios focusing on the following market outputs:
 - the impact of the NPP on the regional electricity market
 - revenue from electricity production
 - operational costs

METHODOLOGY

- IRR and NPV for financial feasibility assessment
- Balmorel market model
 - Power system analysis and NPP revenue assessment
 - Balmorel is a partial equilibrium model for analysing the electricity and combined heat and power sectors in an international perspective
- Balmorel advantages:
 - Large user base
 - Open source (the code can be verified and updated);
 - Several international and local studies: BENTE, Flex4RES, ENMAK etc.



STUDIED SCENARIOS

Base scenarios

- Sustainable Development (SD)
 - high carbon prices
 - lower fossil fuel prices
- Current Policies (CP)
 - low carbon prices
 - higher fossil fuel prices

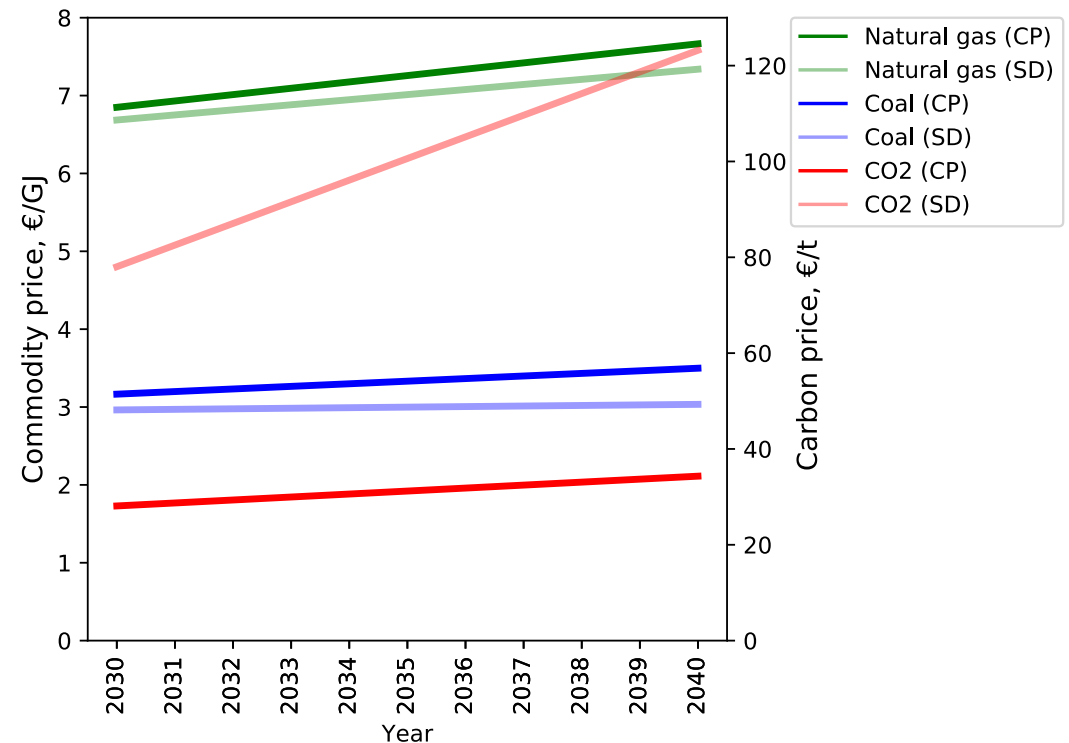
NPP scenarios

- 300 MW NPP
- 300 MW NPP with 300 MW storage

MAIN ASSUMPTIONS

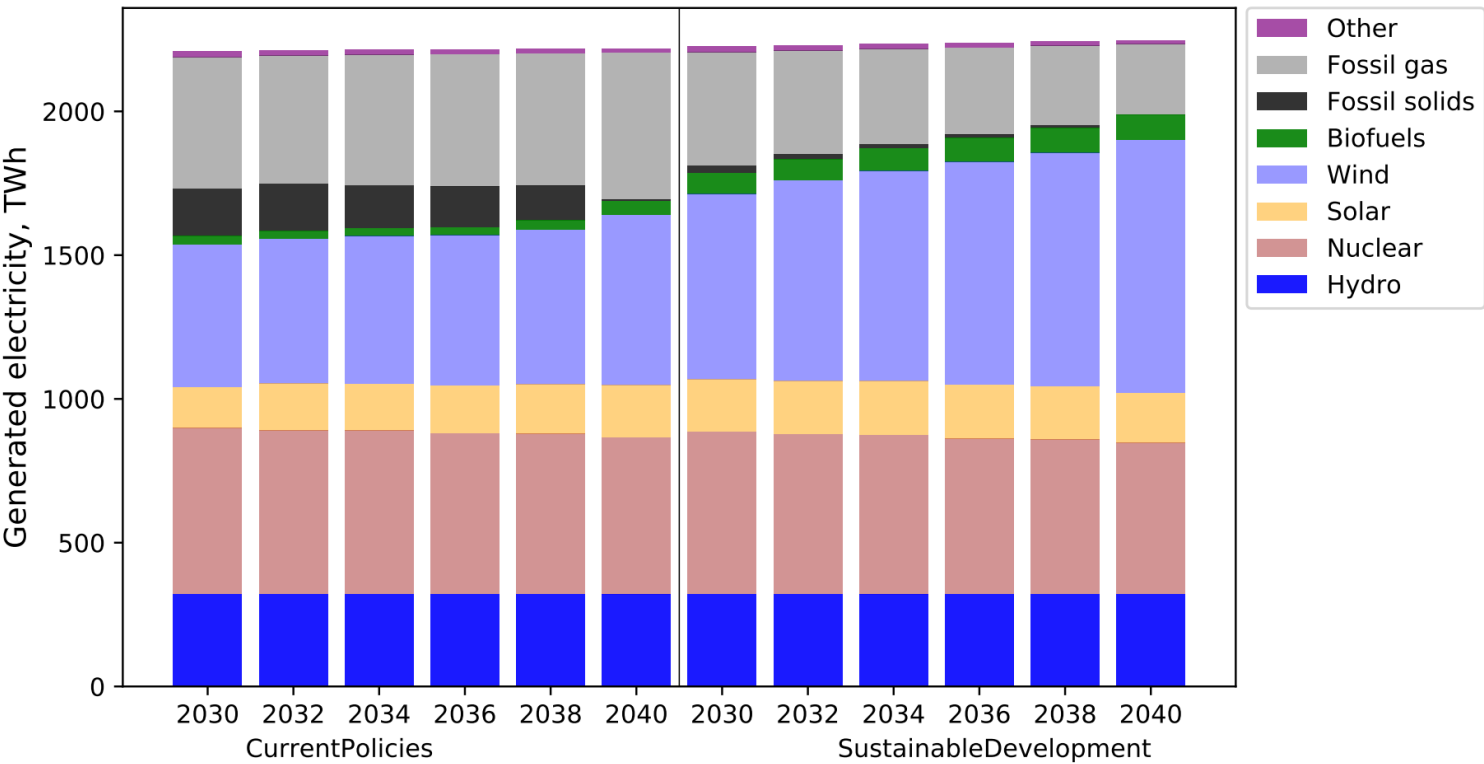
- Generation portfolio data from the Flex4RES Project
- Technology data and prices from the Danish Energy Agency, „Technology data for generation of Electricity and District Heating“
- Commodity and carbon prices from IEA's World WEO2018 (*Current policies* and *Sustainable development*)
- Transmission capacities from ENTSO-E TYNDP 2018
- NPP investment and operational costs from Fermi Energia OÜ

Forecast of carbon and fuel prices in the baseline scenarios

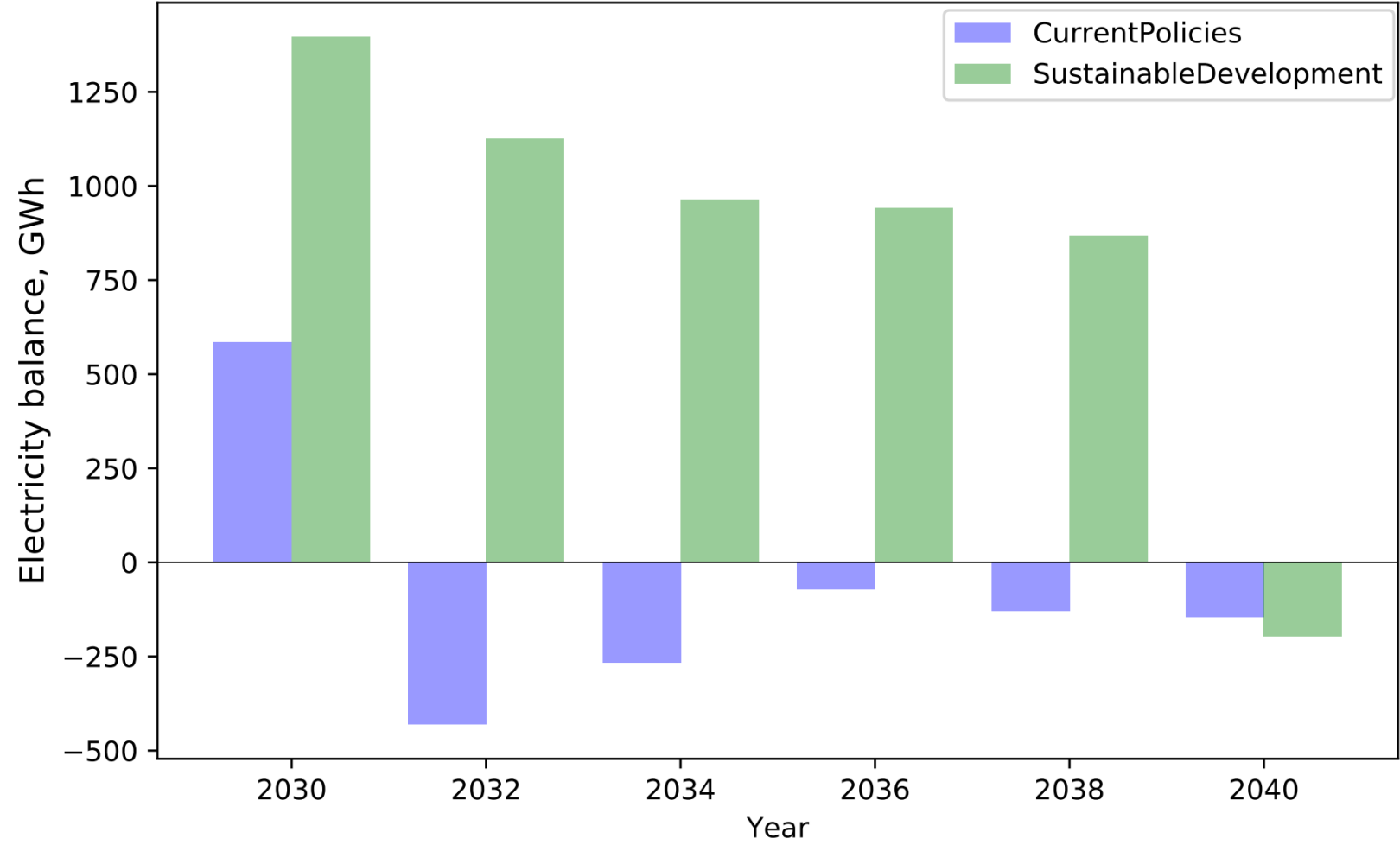


MODELLING RESULTS – SYSTEM DEVELOPMENT

Fossil vs wind



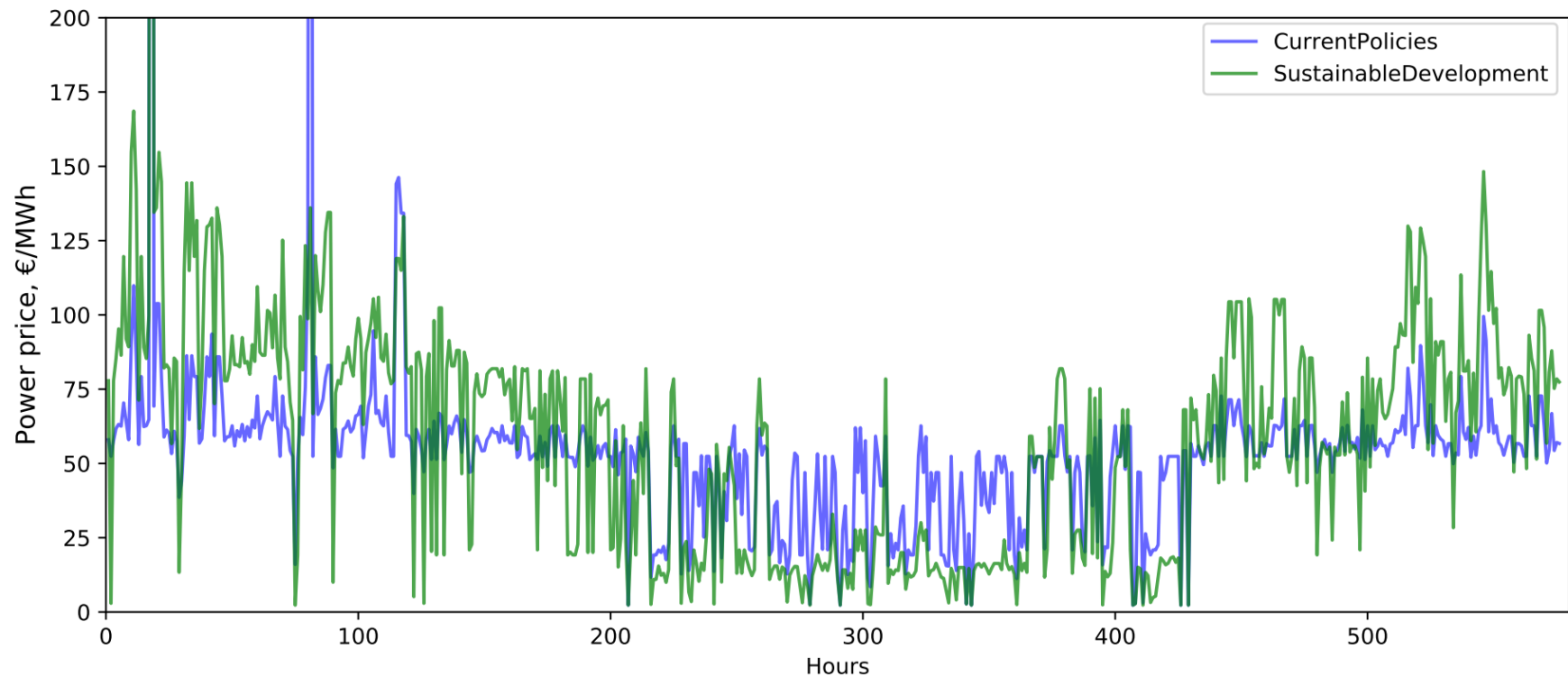
RESULTS - ESTONIAN POWER BALANCE



RESULTS – SPOT PRICES IN ESTONIA

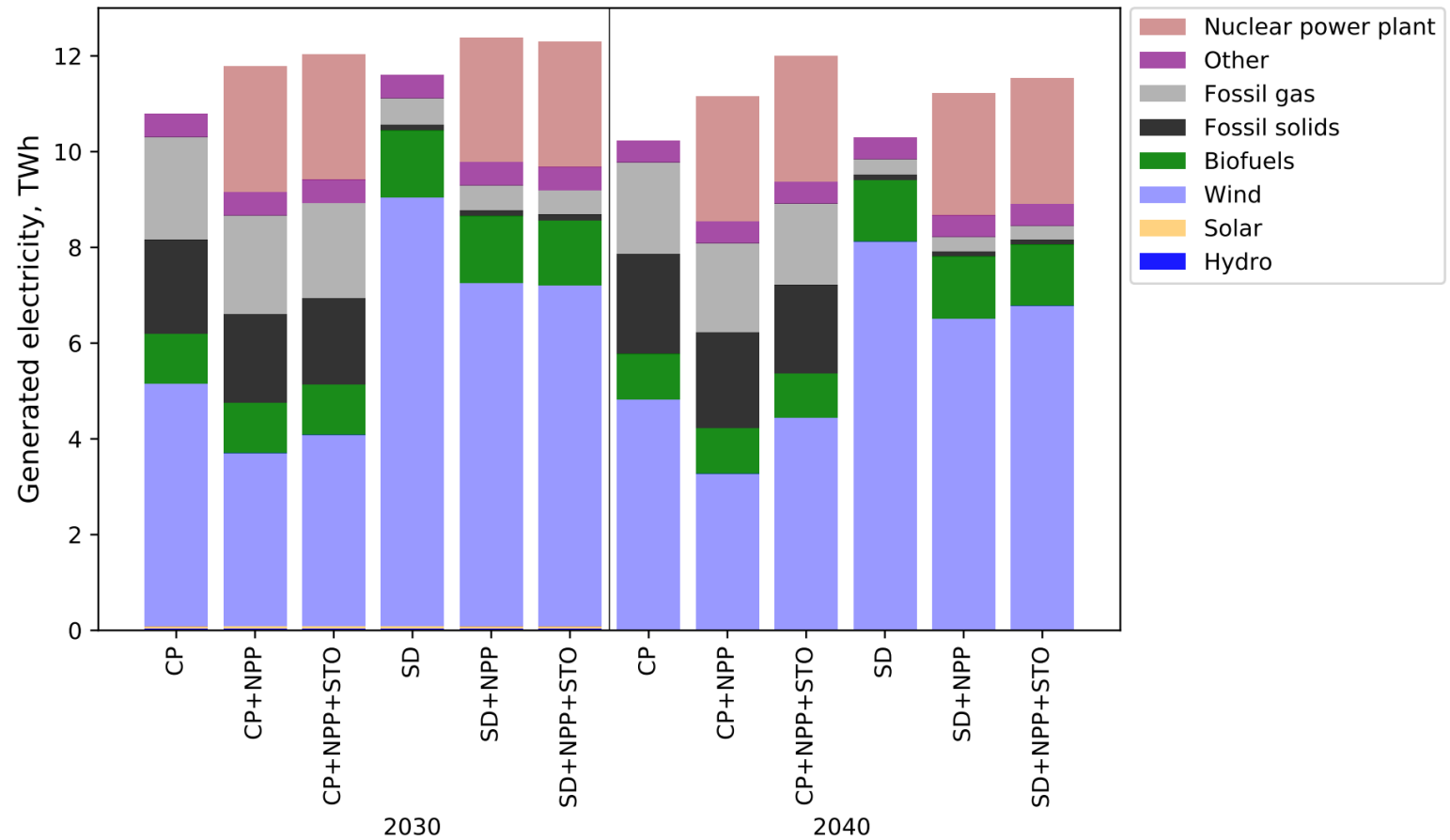
- Annual average prices:

- 43-56 €/MWh (CP)
- 48-60 €/MWh (SD)

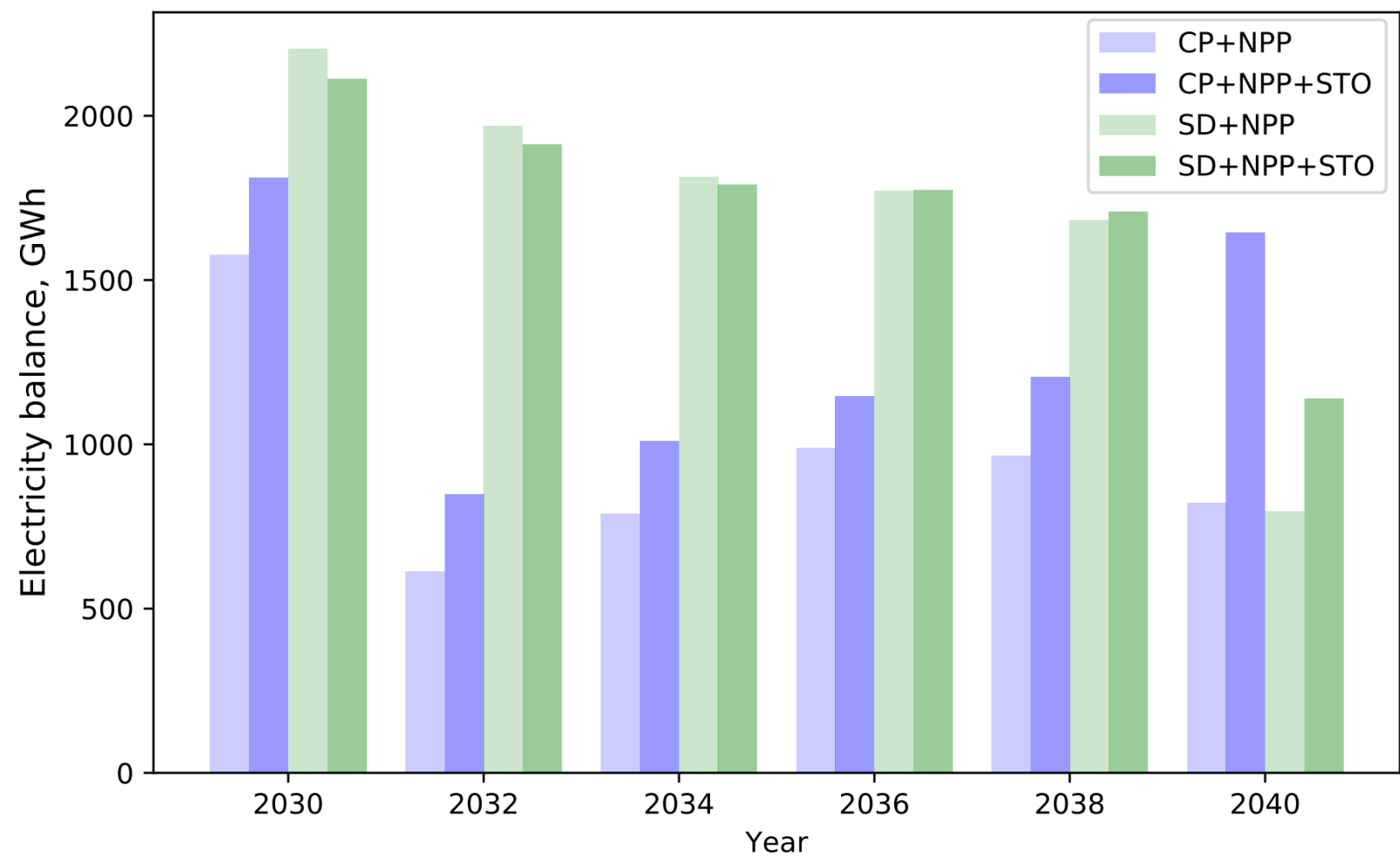


RESULTS - ANNUAL POWER GENERATION IN ESTONIA

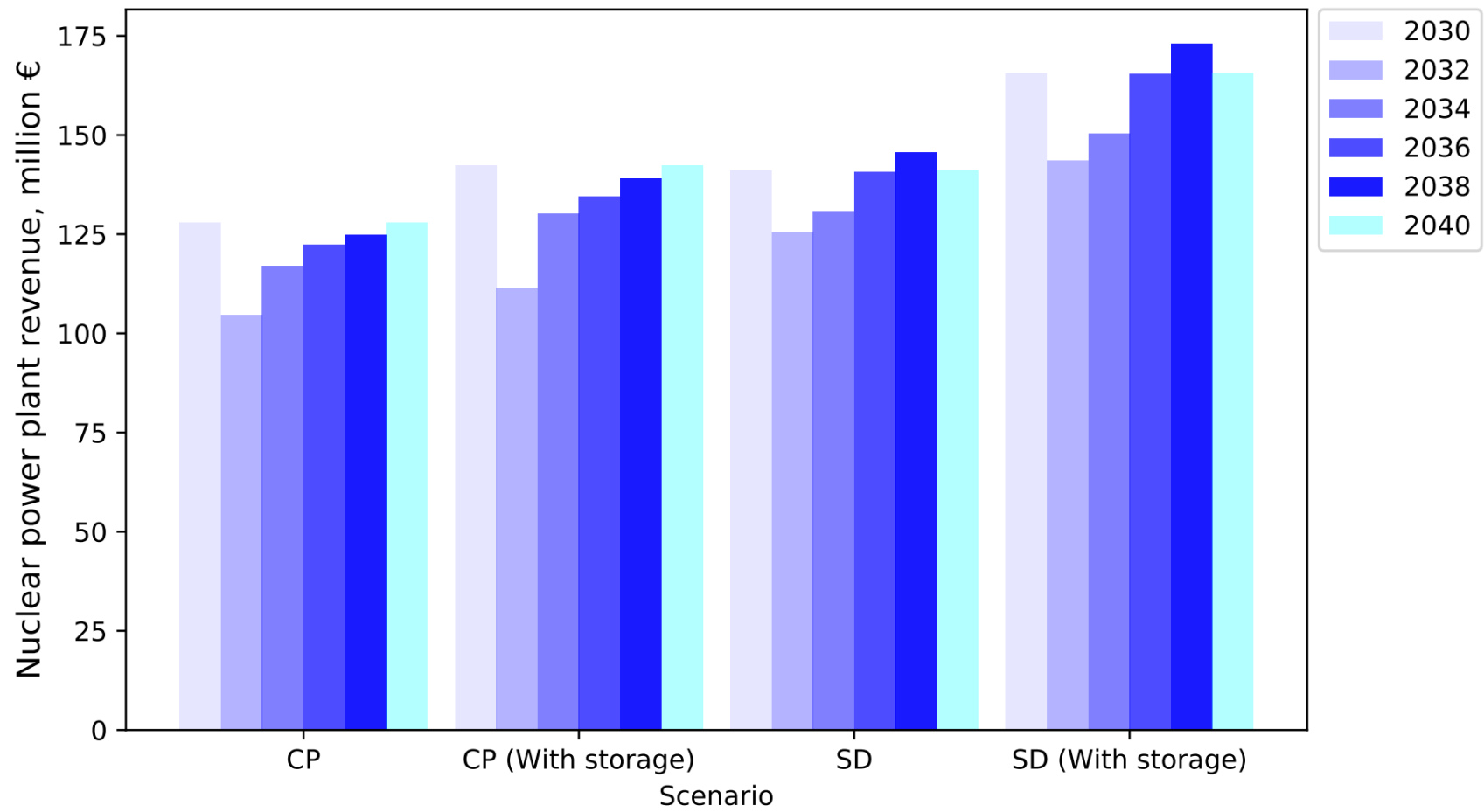
- Wind vs NPP
- Storage allows more wind



RESULTS - ESTONIAN POWER BALANCE WITH NPP



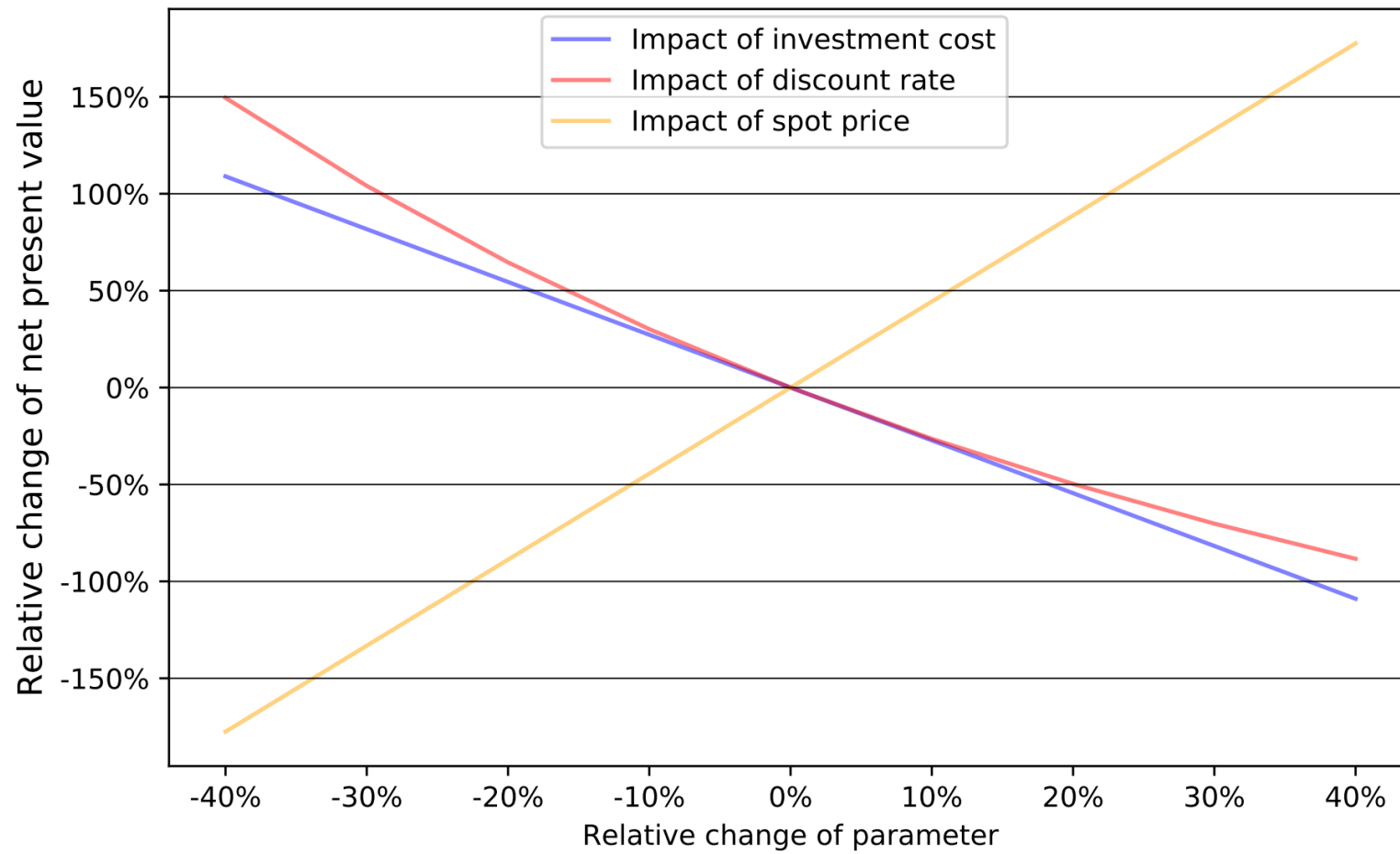
RESULTS - NPP REVENUES FROM THE DAY-AHEAD POWER MARKET



CONCLUSION OF THE FINANCIAL ANALYSIS

Scenario	IRR (%)	NPV (M€)
CP	12,0%	124
CP with storage	10,2%	13
SD	14,7%	250
SD with storage	13,5%	236

SENSITIVITY OF NPP NPV



CONCLUSION

- NPP ensures Estonia's position as a net exporter
- NPP has an impact on local security of supply and available capacities
- A more renewable future allows more opportunities for storage and storage enables more renewable energy
- The IRR and NPV show feasible financial result for NPP project
- Storage generates more revenues but does not pay in day-ahead market
- Further revenues could be generated through system services



THANK YOU FOR YOUR ATTENTION!

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