



School of
Management and Law

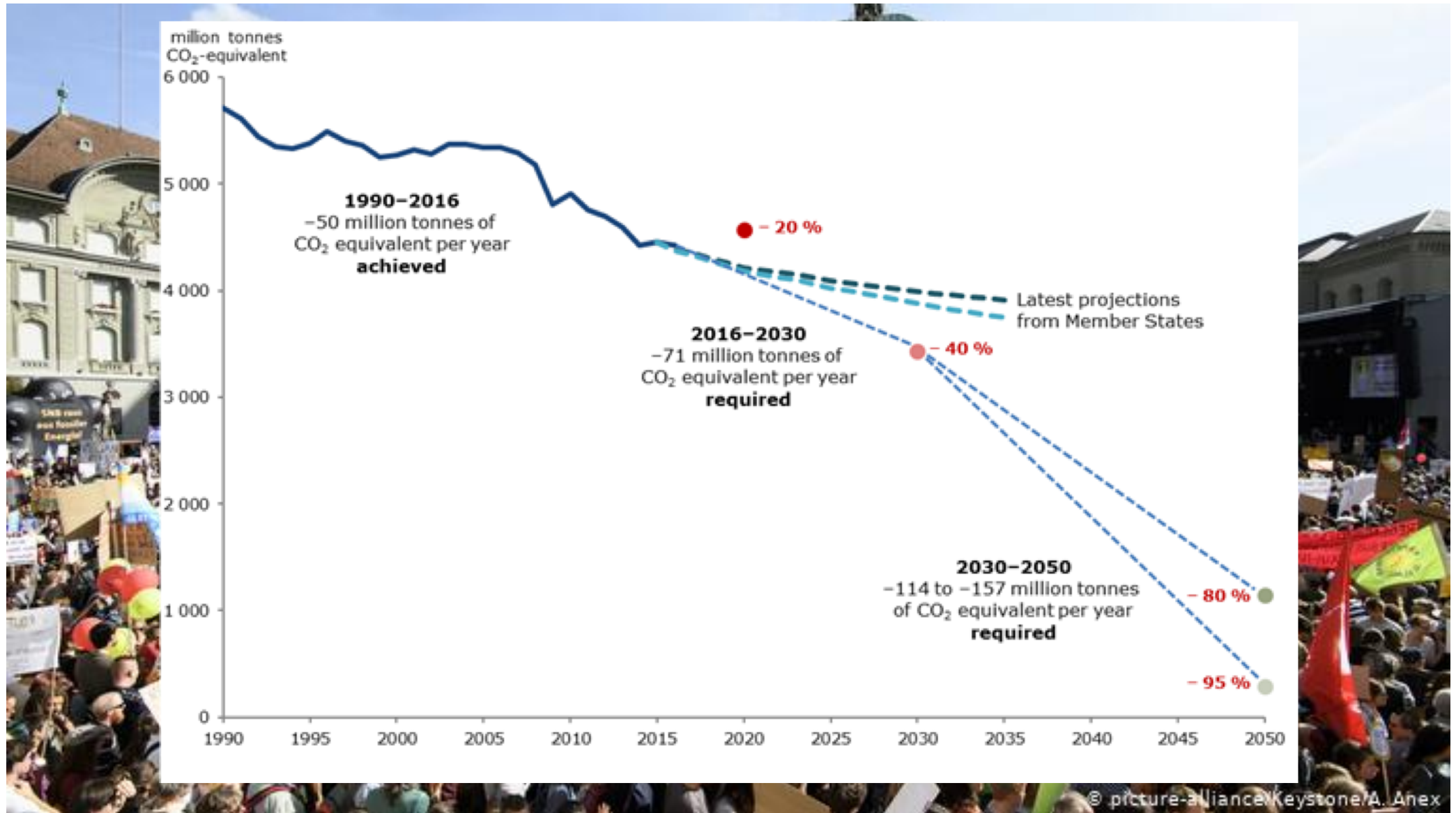
The Cross-border Merit-order Effect: Impacts of German Renewable Promotion on Neighboring Countries



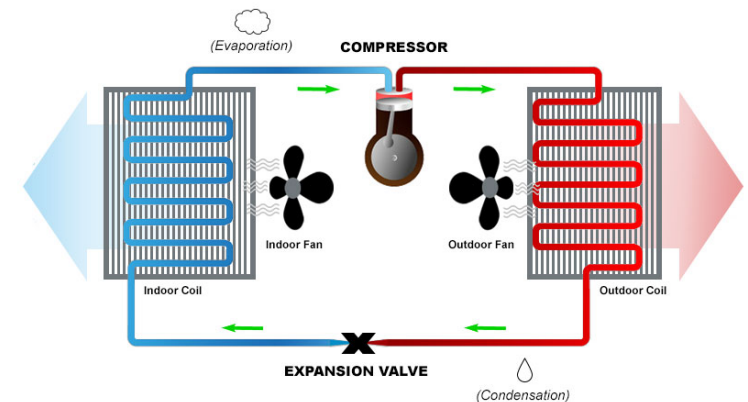
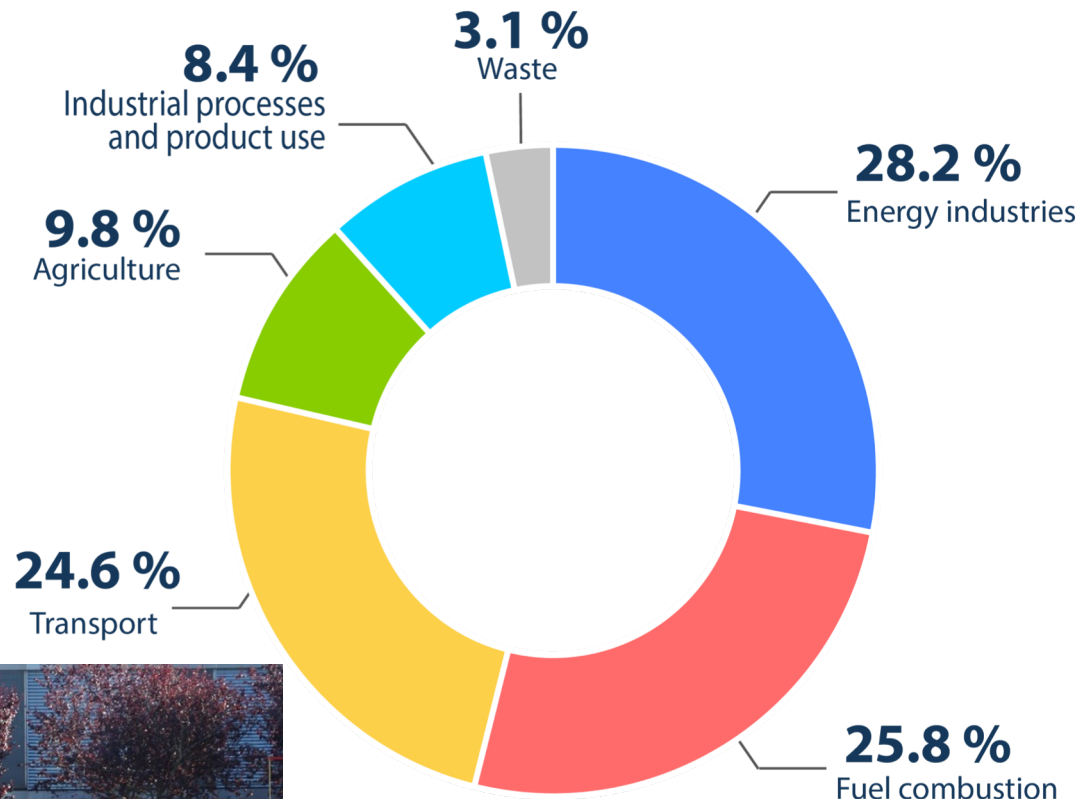
Mirjam Kosch, Jan Abrell

24.1.2020, Energieforschungsgespräche Disentis

Climate change...



Electricity Sector – Why is it important



European Climate Policy

EU Emission Trading System



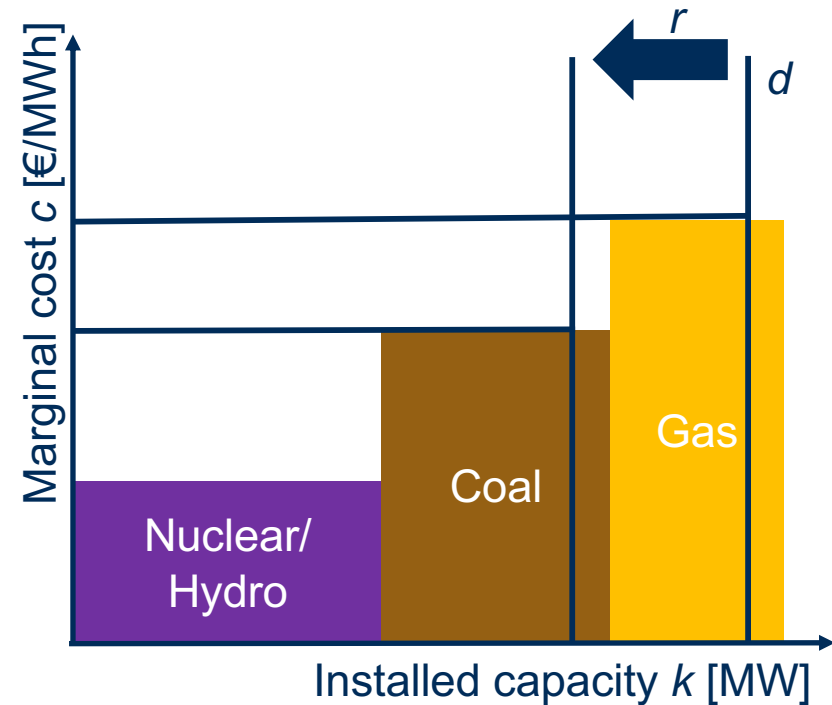
Renewable Promotion



What is the impact of (unilateral) renewable energy promotion schemes on neighboring countries?

Impacts of Renewable Energy Support

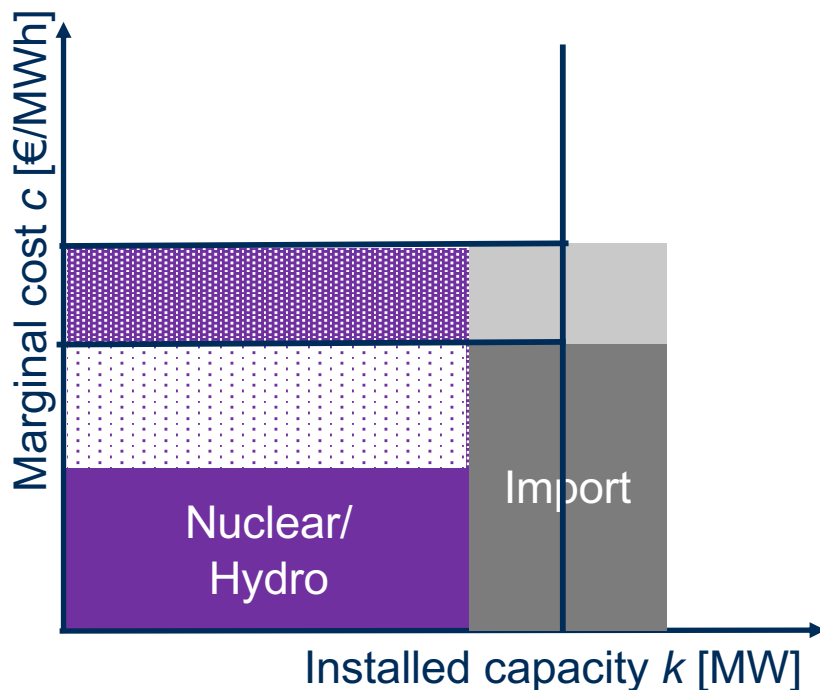
- Lower conventional generation
- Lower wholesale market prices
«merit-order effect»
- Higher exports
- Lower prices in neighboring countries
«cross-border merit-order effect»
- Shift from producer to consumer rent



Impact on Rents: The Case of Swiss Hydro (and Nuclear)

Subventionen auch für Wasserkraftwerke

Der Ständerat will bestehenden Grosskraftwerken in wirtschaftlicher Notlage unter die Arme greifen. Die Eigentümer und der betroffene Kanton müssen sich beteiligen.



- Renewable promotion in Germany (financed by German consumers)
- Cross-border trade leads to decreasing electricity prices in Switzerland
- ➔ Lower rents for Swiss producers
- ➔ Lower cost for consumers (on wholesale markets)

Existing Literature

Impacts of renewable generation r

→ Lower conventional generation

(Abrell et al. 2019; Kaffine et al. 2013; Novan 2015; Cullen 2013)

→ Lower wholesale market prices «merit-order effect»

(Abrell et al. 2019; Cludius et al. 2014; Wuerzburg et al. 2013)

→ Lower prices in neighboring countries «cross-border merit-order effect»

(DE-DK: Mulder&Scholtens 2016; DE-FR: Phan&Roques 2015)

Three research questions

1. **Merit-order effect**

What is the impact of RE generation on the domestic electricity price?

2. **Cross-border merit-order effect**

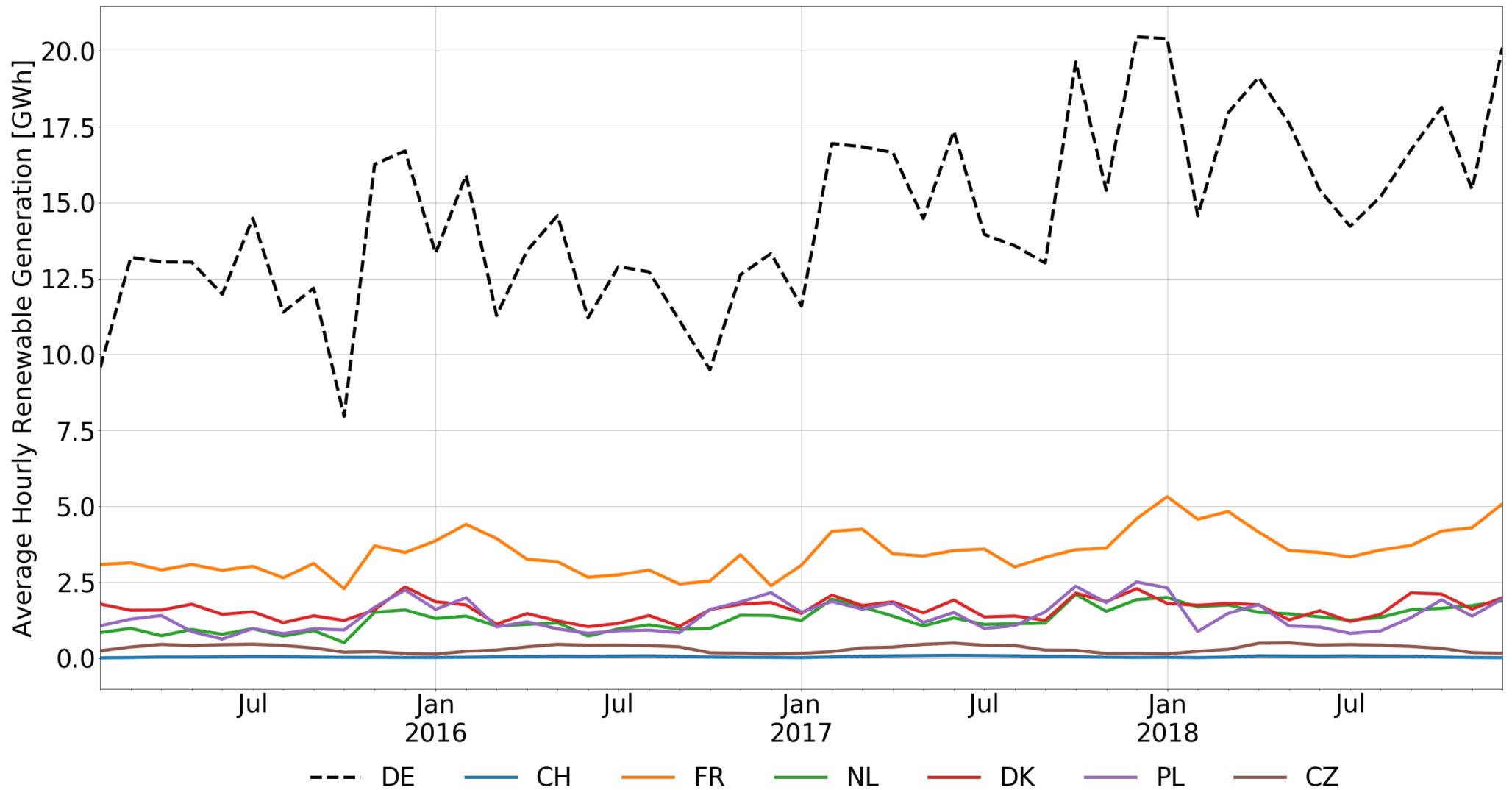
What is the impact of RE generation on neighboring electricity prices?

3. **Shift from producer to consumer rent**

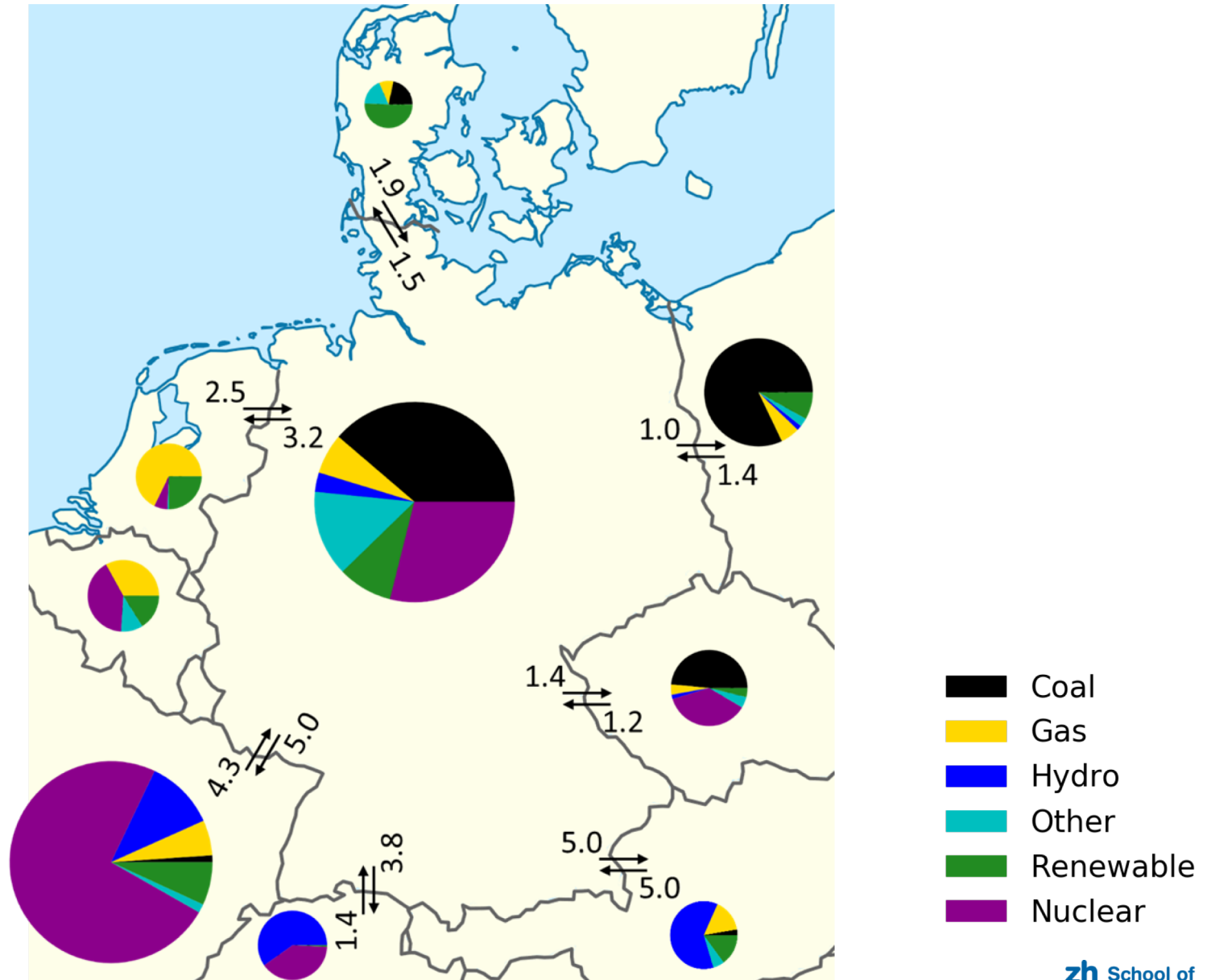
What is the impact of RE generation on (domestic and foreign) consumer and producer rents?

Germany and its neighbors

Renewable Generation – Germany versus the others...



German Electricity Trade Capacities and Generation Shares

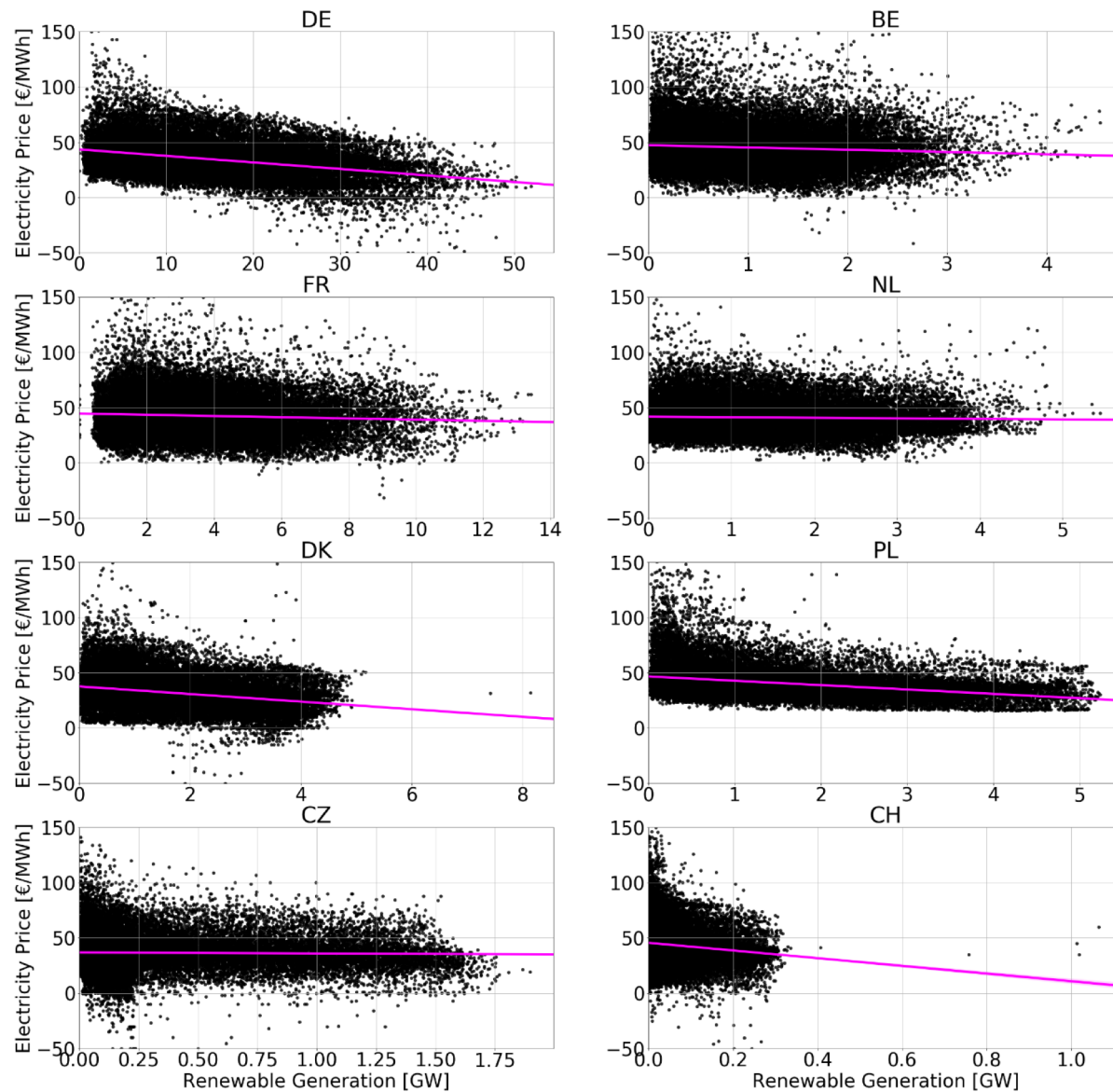


Note: Shown are NTC and generation shares. Area of pies provides total annual generation in 2018.

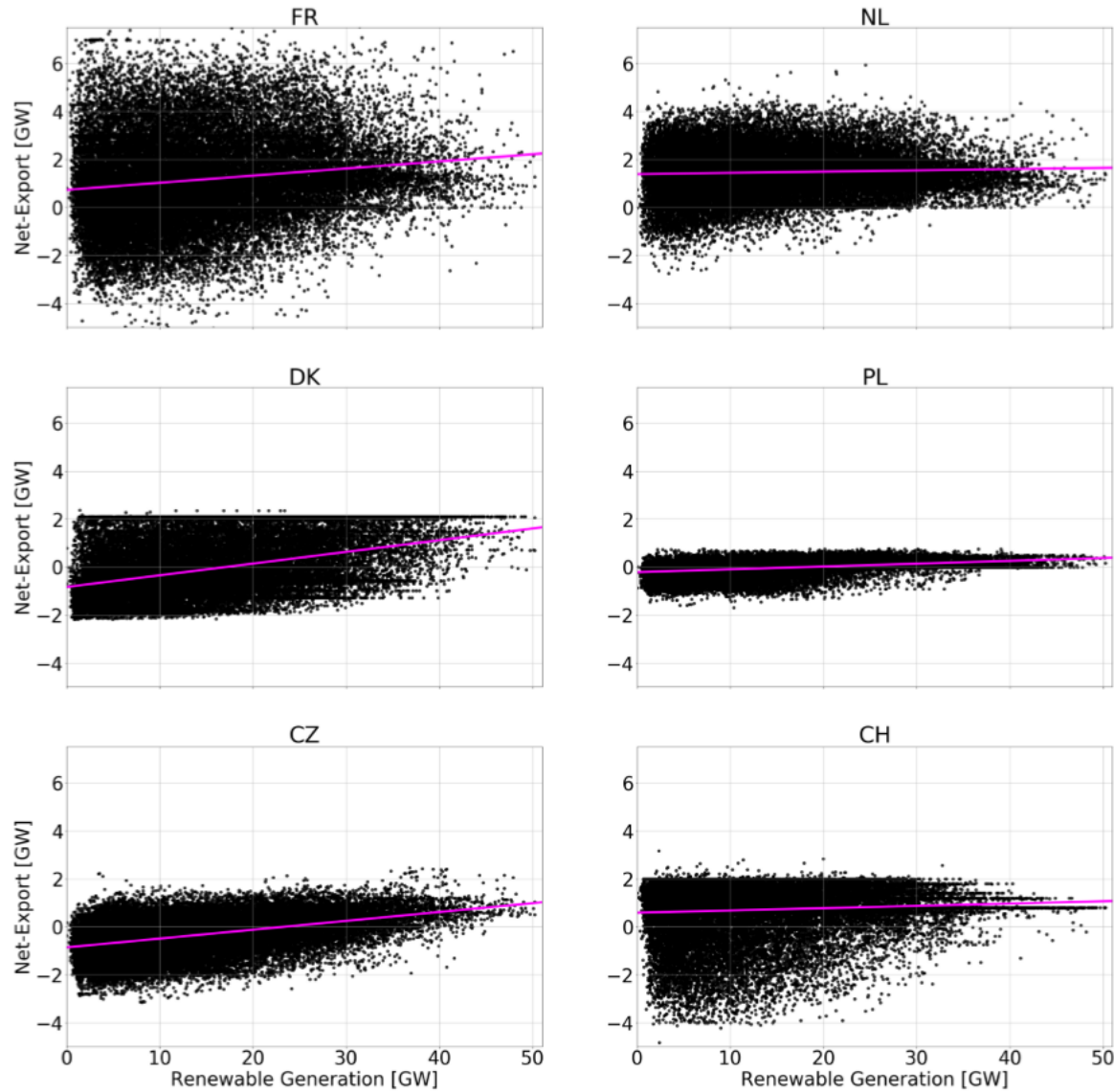
Sources: NTC: BNetzA, 2019, Generation: ENTSOE, BFE

Impact of renewable generation: Descriptive evidence

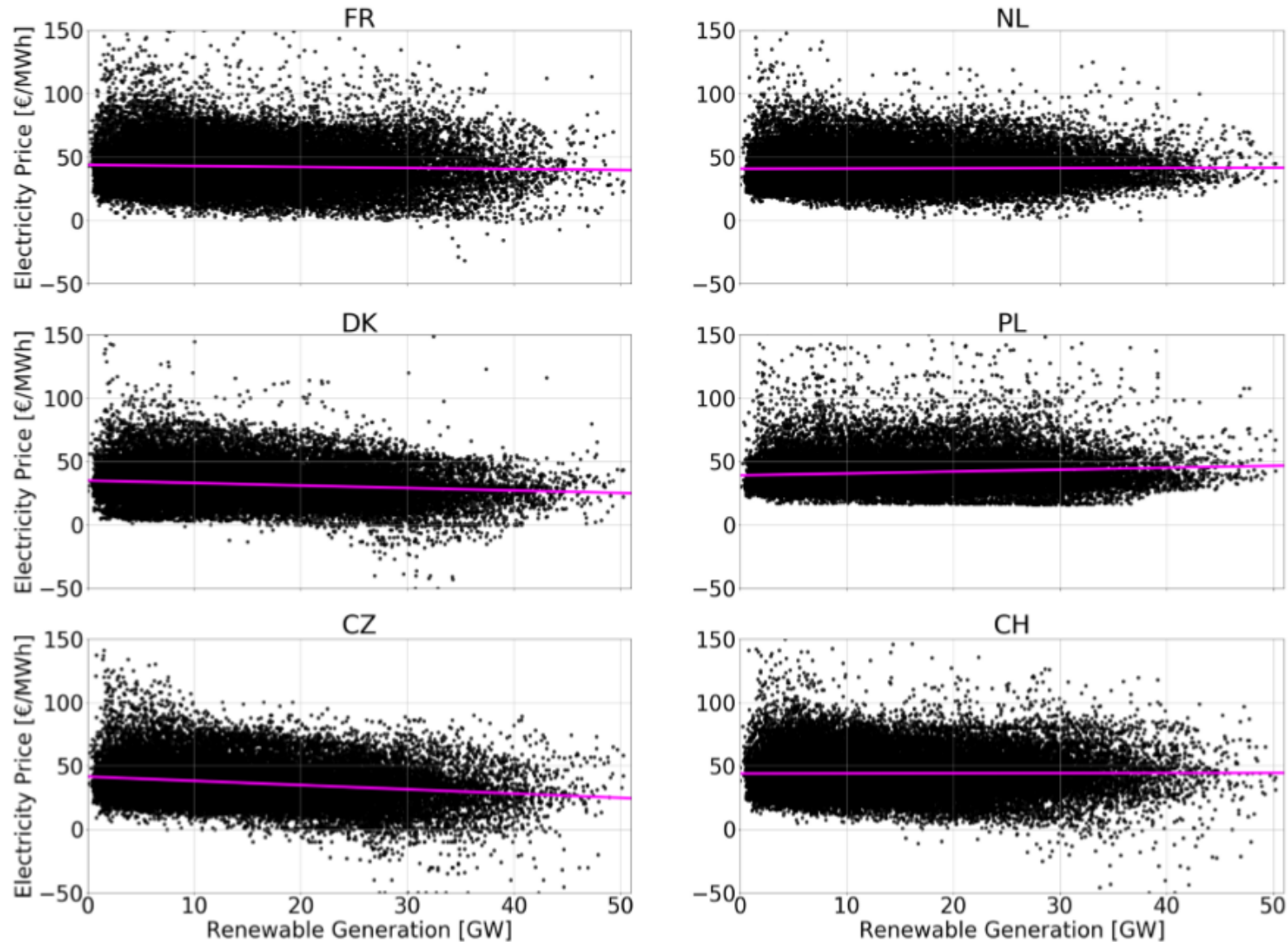
RE generation and day-ahead prices



German RE generation and net exports

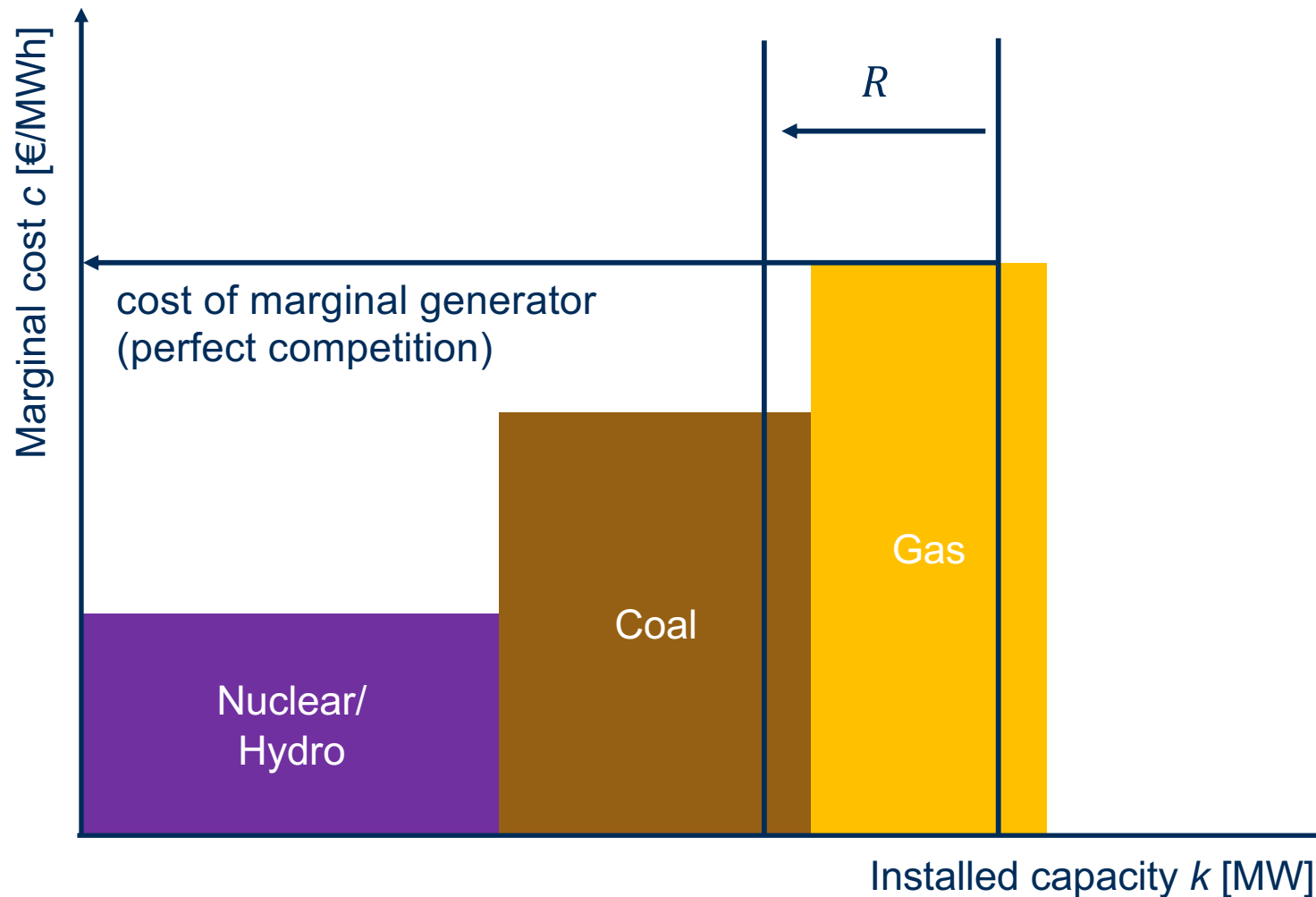


German RE generation and neighbors' day-ahead prices



Estimation model

What determines the electricity market price?



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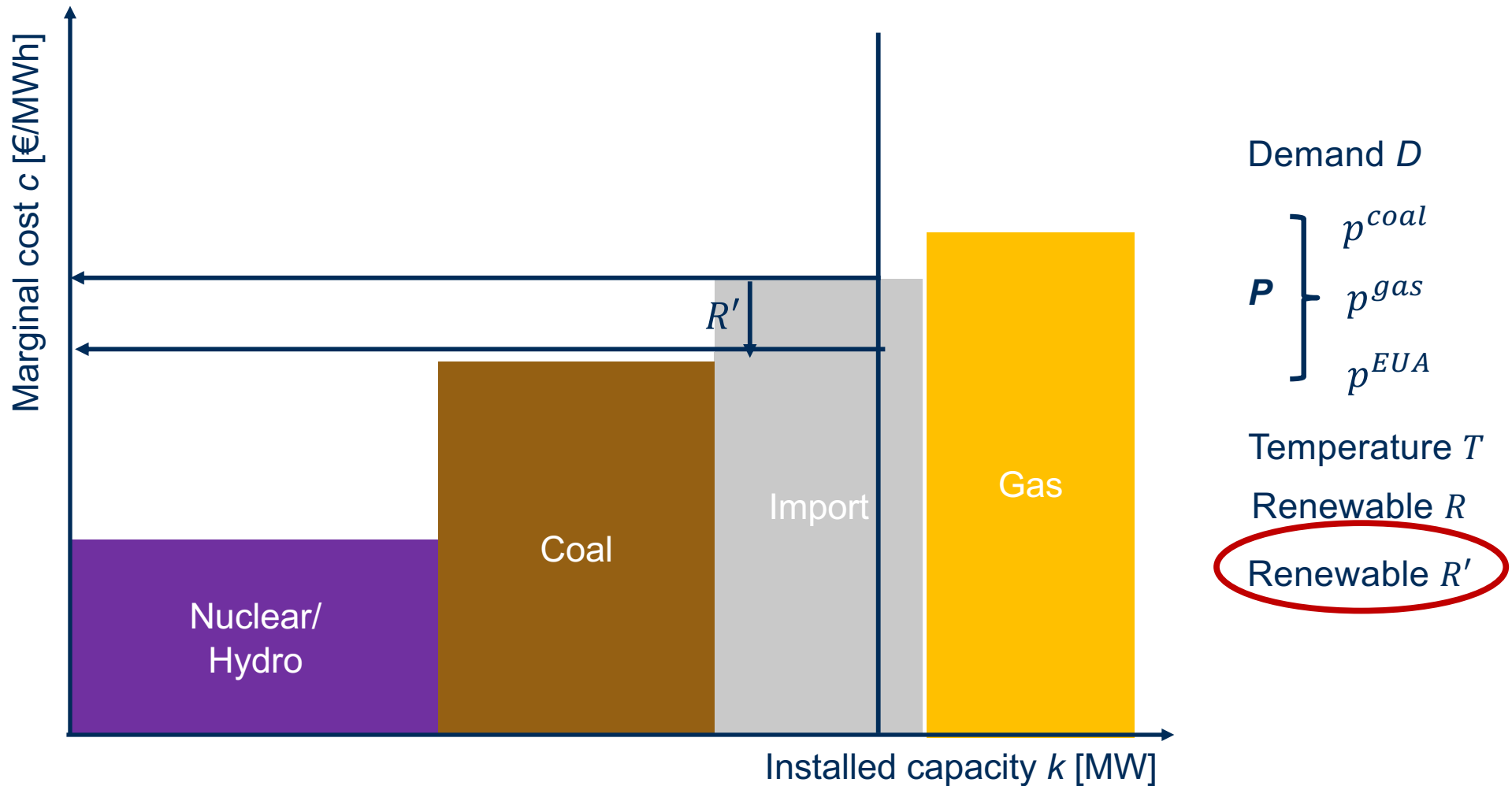
P $\left\{ \begin{array}{l} p^{coal} \\ p^{gas} \\ p^{EUA} \end{array} \right.$

Temperature T

Renewable R

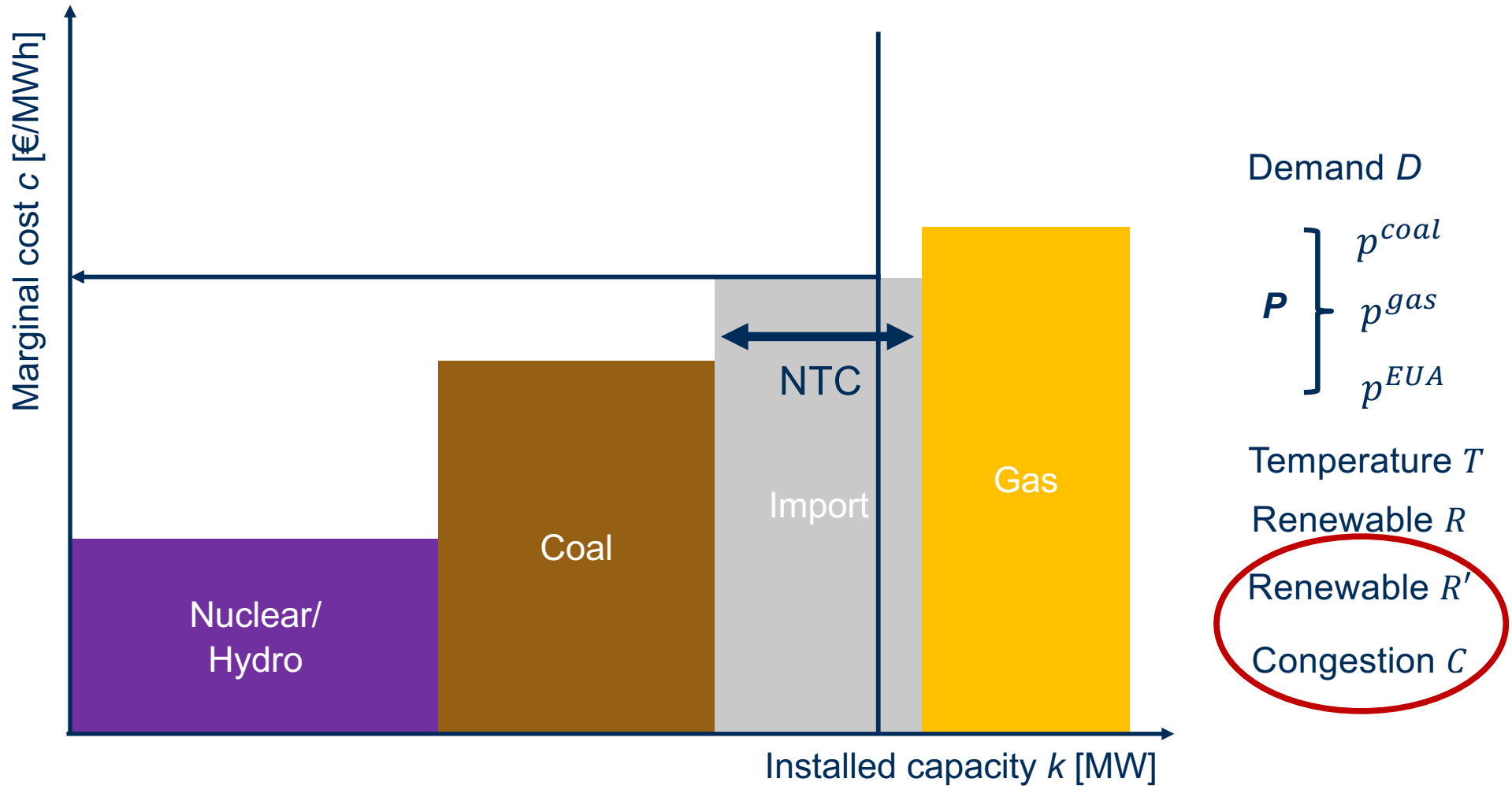
$$P_{tr}^{ele} = \alpha_r + \beta_{r1} R_{tr} + \gamma_{r1} D_{tr} + \gamma_{r2} P + \gamma_{r3} T_{tr} + D_t \delta_r + \epsilon_{tr}$$

What determines the electricity market price?



$$P_{tr}^{ele} = \alpha_r + \beta_{r1}R_{tr} + \beta_{r2}R_{tr}' + \gamma_{r1}D_{tr} + \gamma_{r2}P + \gamma_{r8}T_{tr} + D_t\delta_r + \epsilon_{tr}$$

What determines the electricity market price?

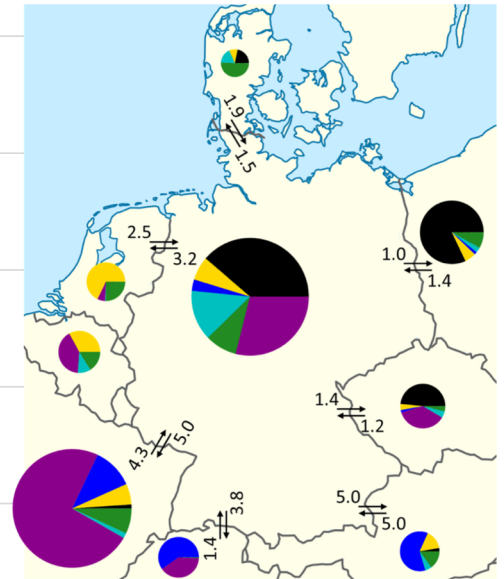
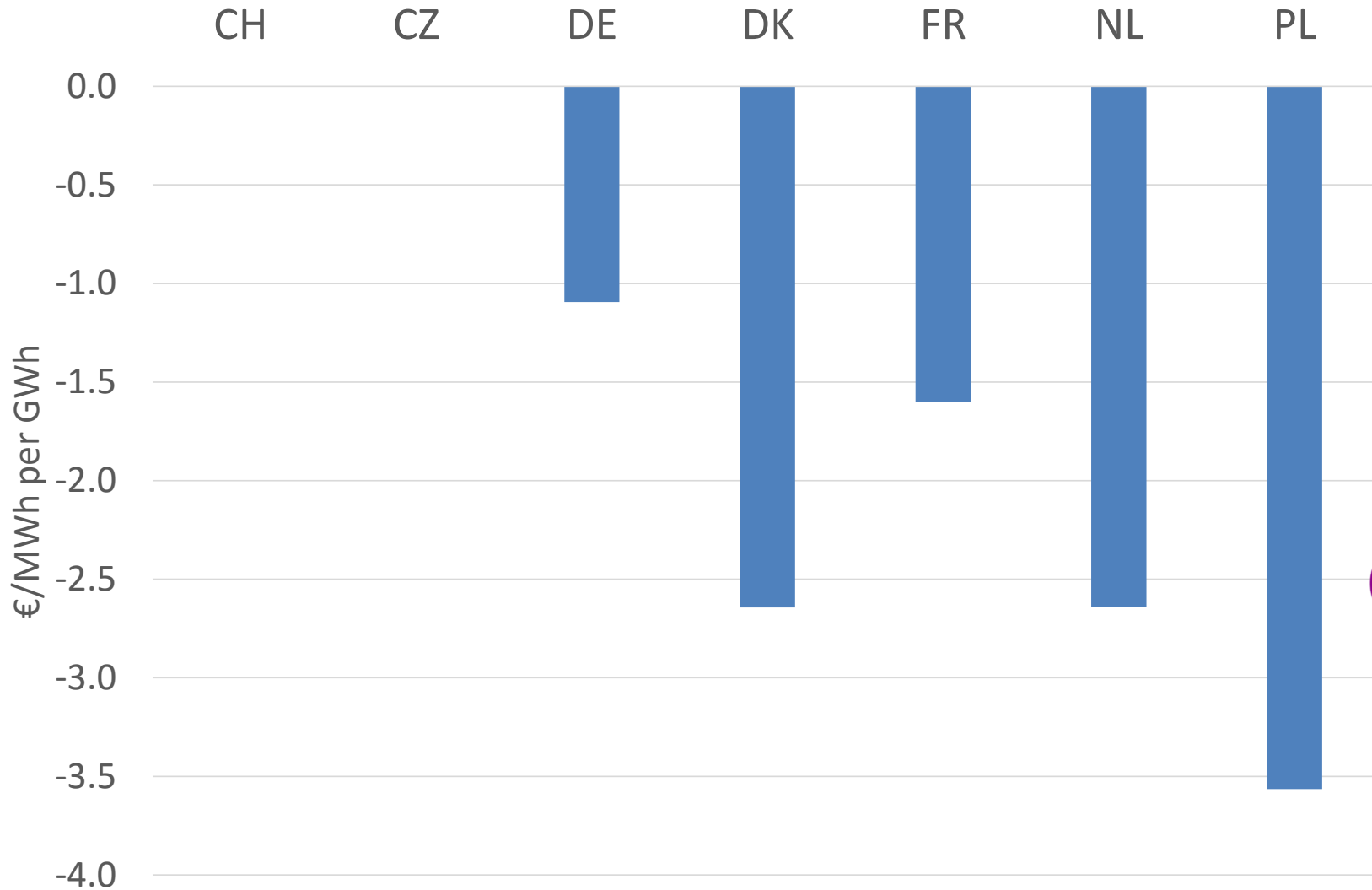


$$P_{tr}^{ele} = \alpha_r + \beta_{r1} R_{tr} + \beta_{r2} R_{tr'} + \beta_{r3} C_{trr'} R_{tr'} + \gamma_{r1} D_{tr} + \gamma_{r2} \mathbf{P} + \gamma_{r8} T_{tr} + \mathbf{D}_t \boldsymbol{\delta}_r + \epsilon_{tr}$$

Results

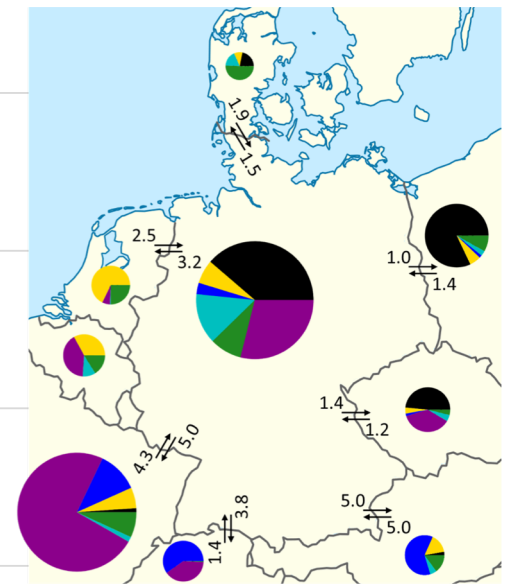
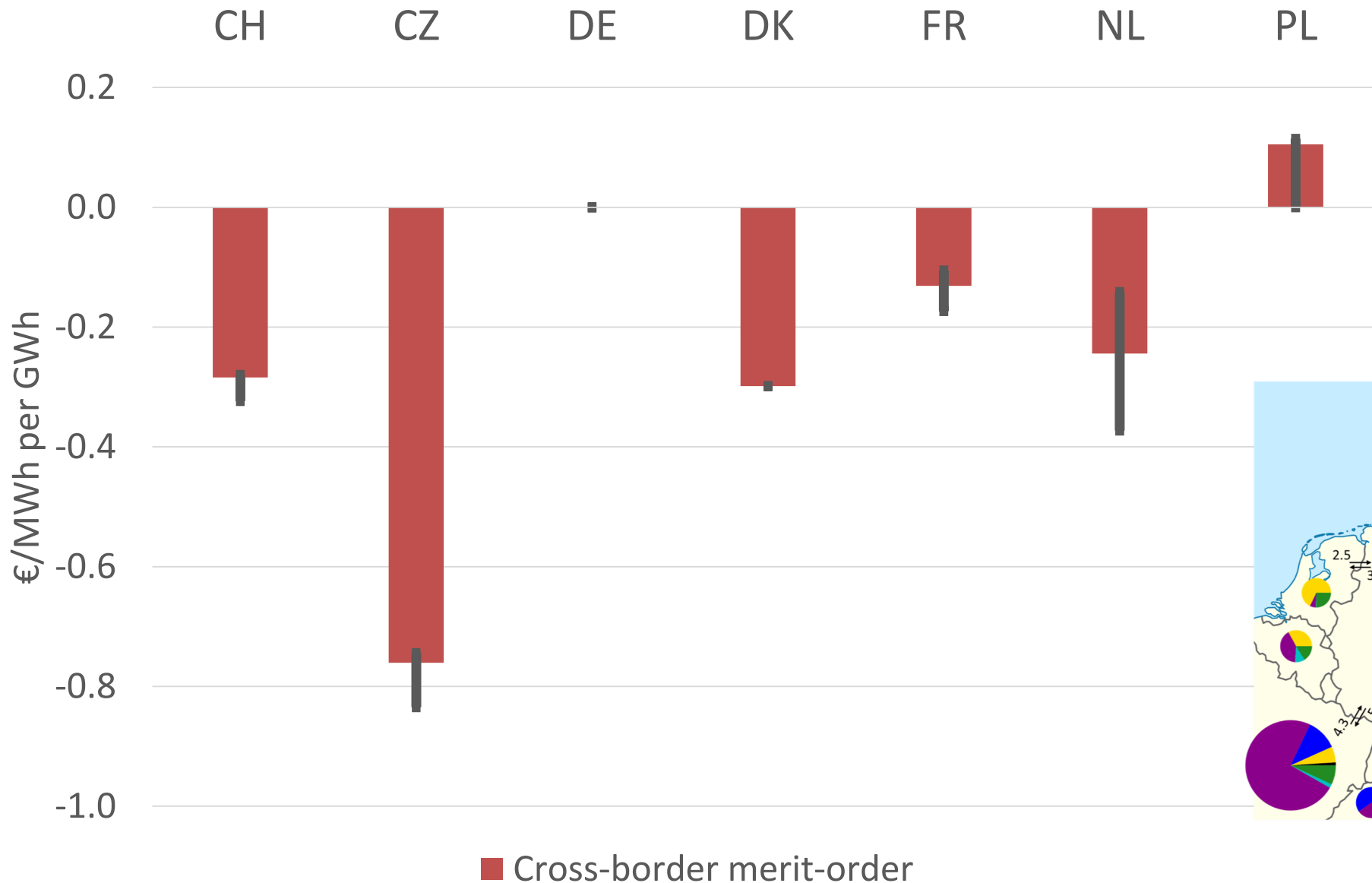
Merit-order effect

What is the impact of RE generation on the domestic electricity price?

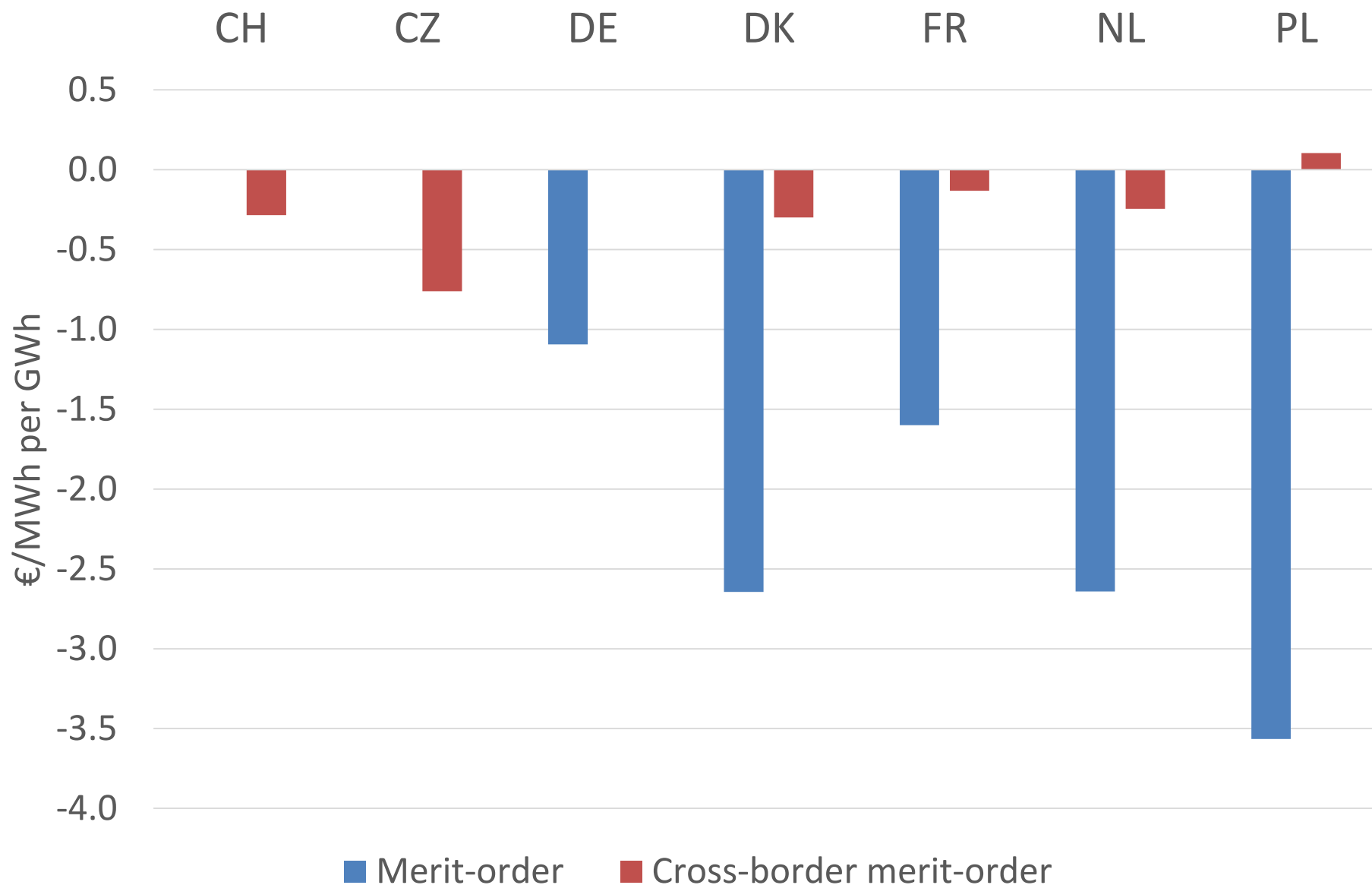


Cross-country merit-order effect

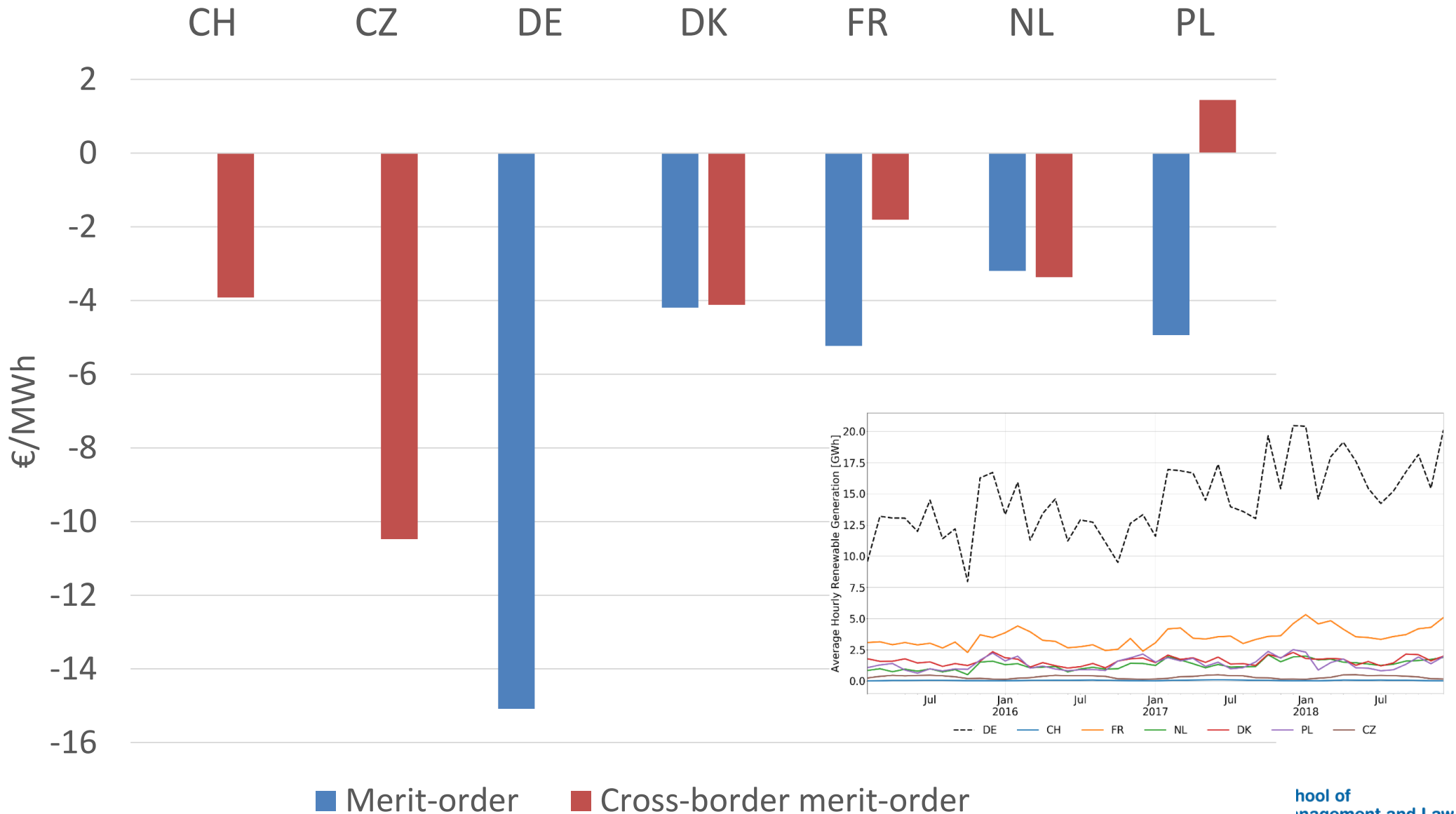
What is the impact of German RE generation on neighboring prices?



Domestic versus Cross-Border Merit-Order Effect: Impact per GWh of RE generation



Domestic versus Cross-Border Merit-Order Effect: Total impact on electricity prices



First conclusions, limitations and next steps

Decrease in electricity prices due to cross-border merit-order effect: 5-25%

- Producers suffer from 5-25% lower revenues
- Consumers benefit from 5-25% (wholesale market!) prices

Limitations and future work

- Impact on generation in neighboring countries currently neglected
- More than two countries