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INFLUENCE OF ENVIRONMENTAL POLICY AND MARKET FORCES ON COAL-FIRED POWER PLANTS EVIDENCE ON THE DUTCH MARKET OVER 2006-2014

MACHIEL MULDER
University of Groningen

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Outline

1. Motivation
2. Research question, method and data
3. Results ex post
4. Looking forward: what to do?
5. Conclusions



2 policy domains affecting electricity industry

1. Markets

- *decentralized* decision making
- decisions of firms based on input and output prices

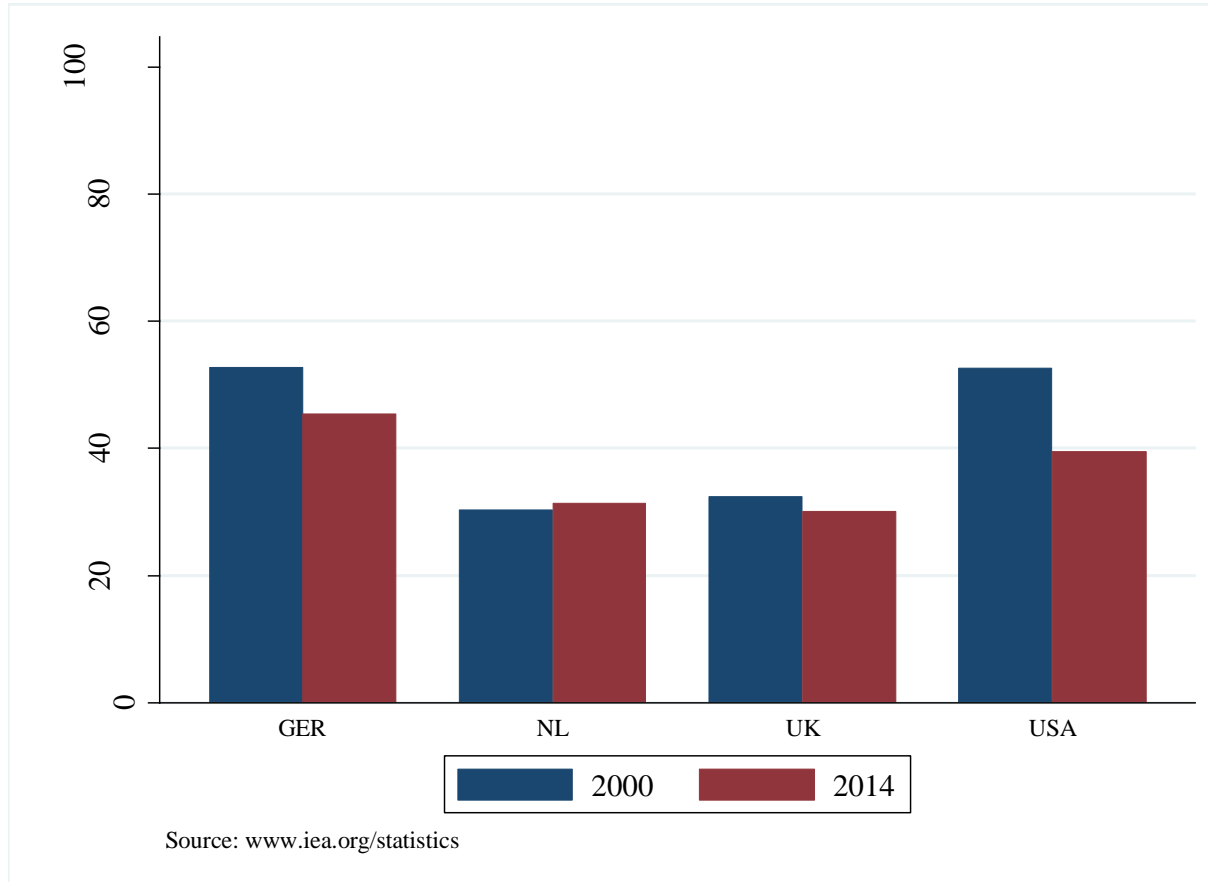
2. Climate policy

- *centralized* objectives
- decisions of firms/consumers have to be influenced



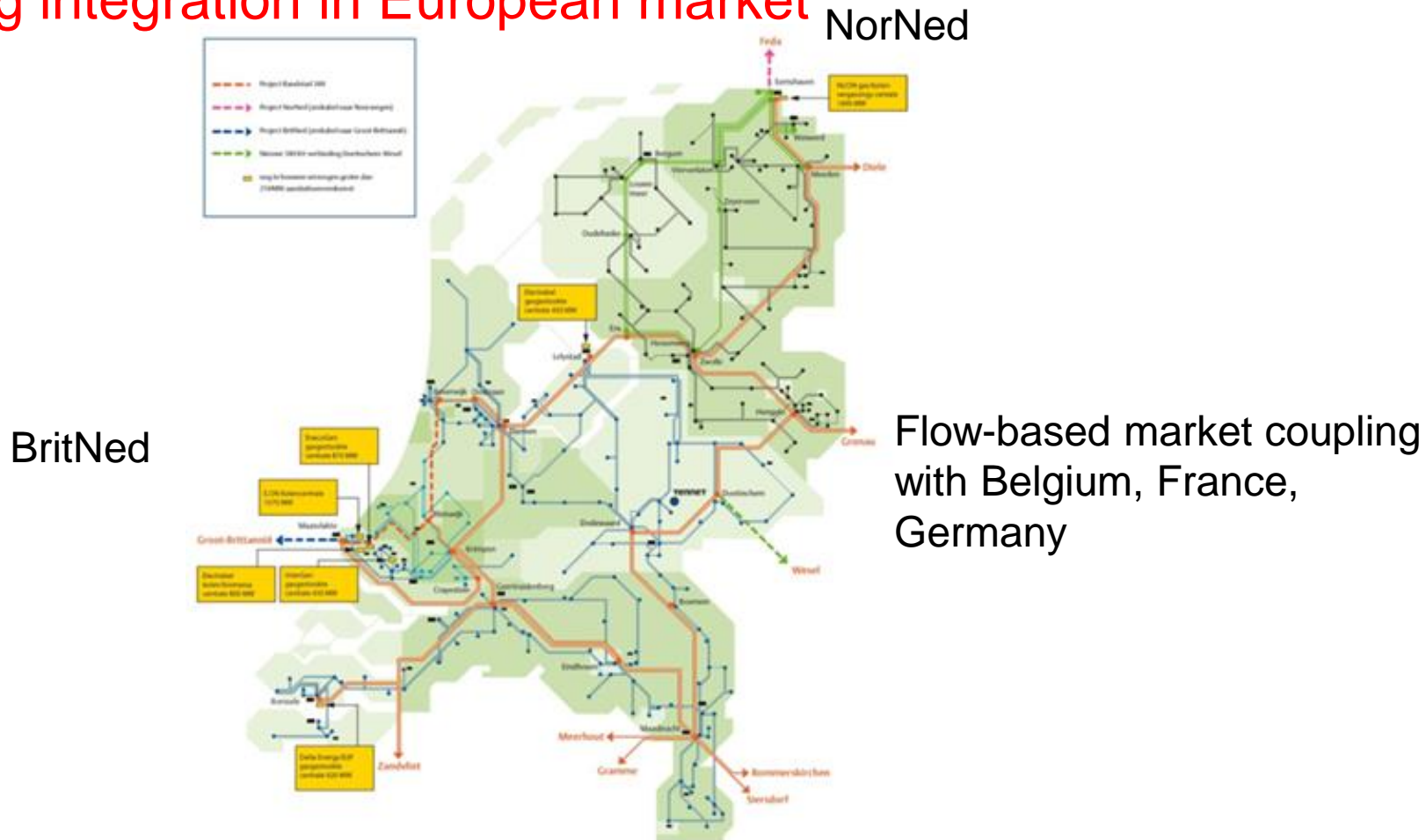
Climate policy challenge:

Governments want to reduce role of coal-fired power plants, but these generate still 30 to 40% of electricity



Power market policies in Dutch market

- unbundling, privatisation of production
- strong integration in European market





Dutch climate policy measures

1. EU Emissions Trading Scheme

- electricity firms participate since start in 2005

2. Support for renewable energy projects

- onshore wind, solar, biomass
- offshore wind

3. Closure of old coal-fired plants

- part of agreement with industry
- deal: no coal tax for new plants



Research question

How has role of coal-fired power plants in Dutch wholesale market evolved in response to climate policy and market forces?

Method:

- descriptive statistics
- panel regression
- as-if analysis

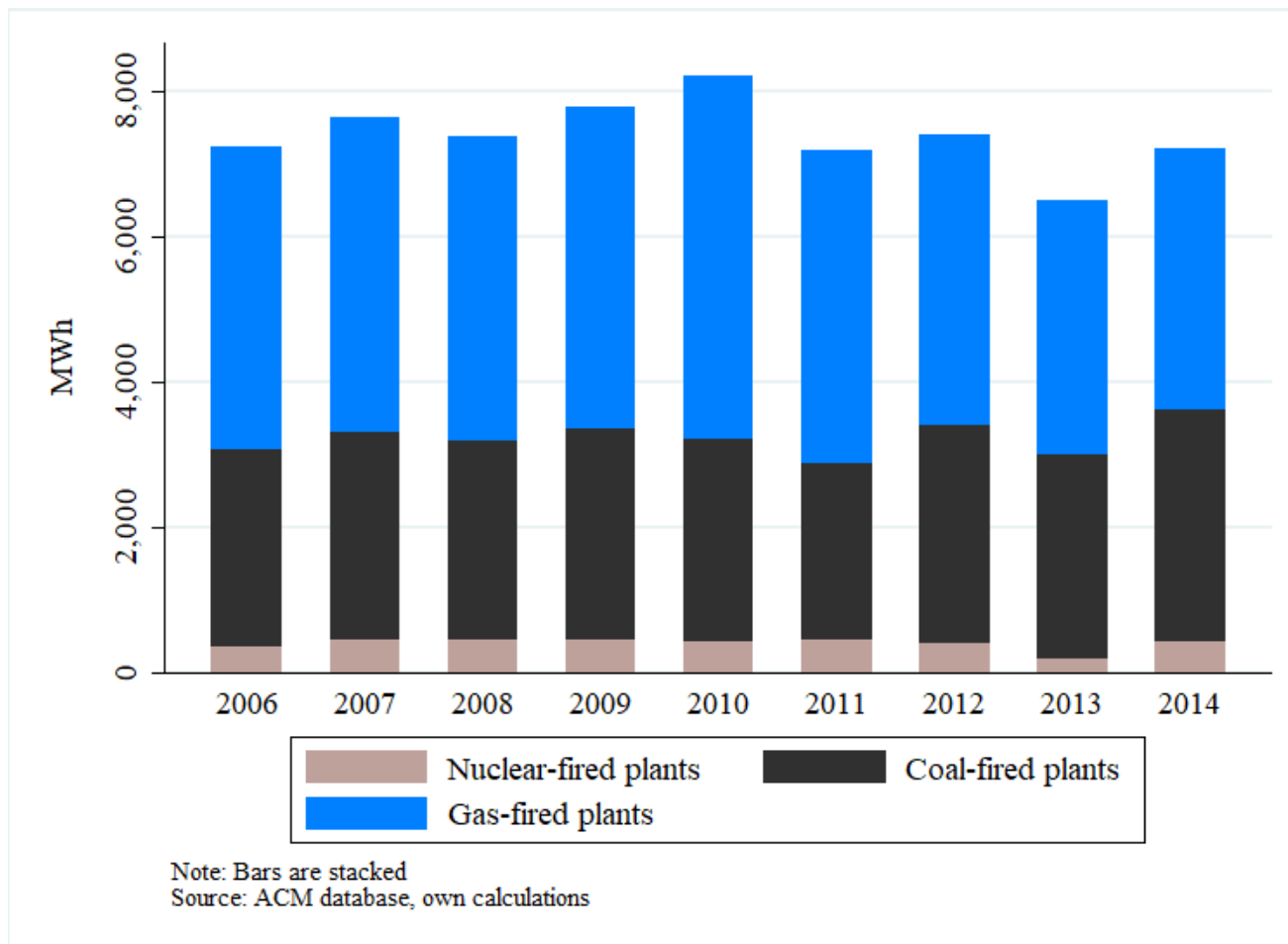
Data

hourly data over 2006-2014

- plant level
- imports/exports
- prices of inputs and outputs

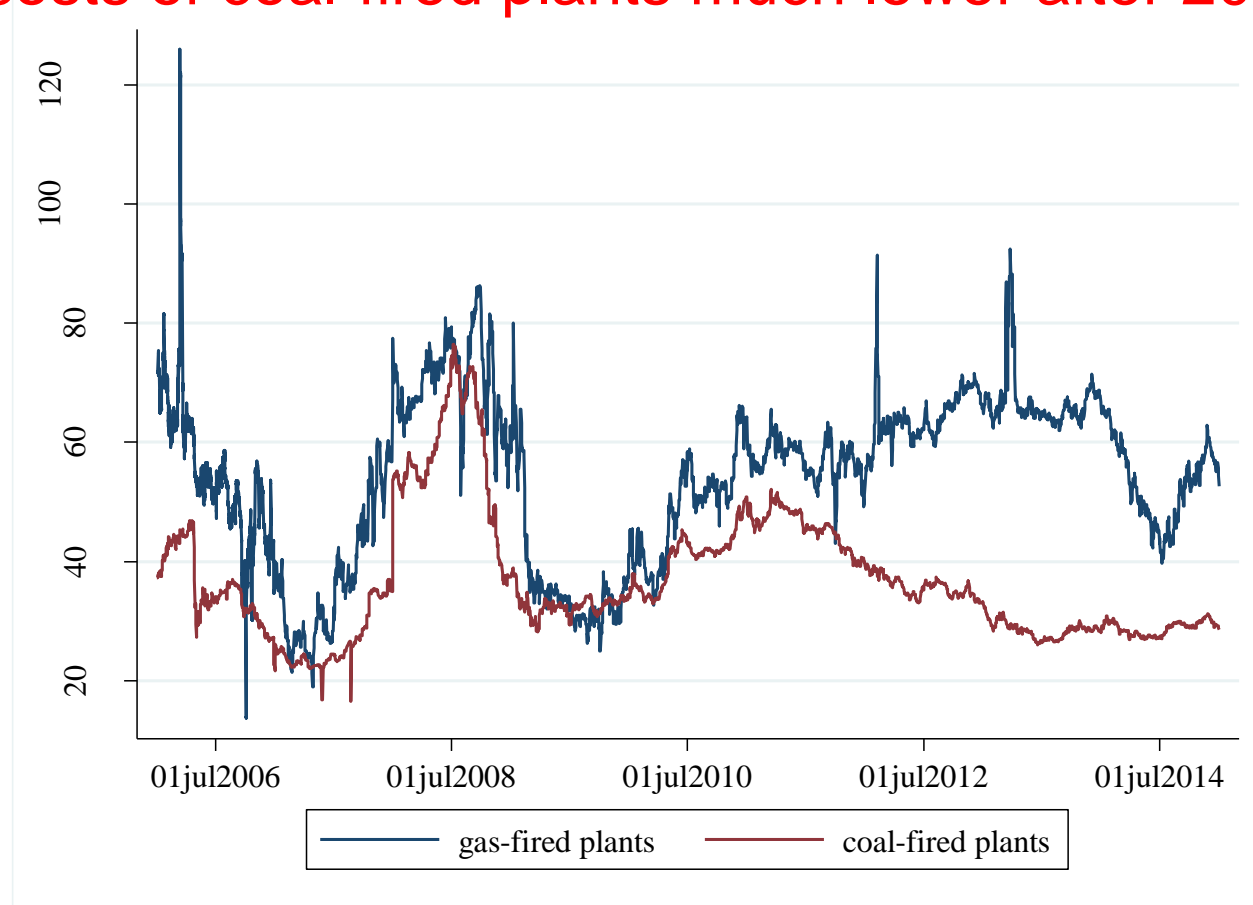


Descriptives: annual volume of coal-fired production increased



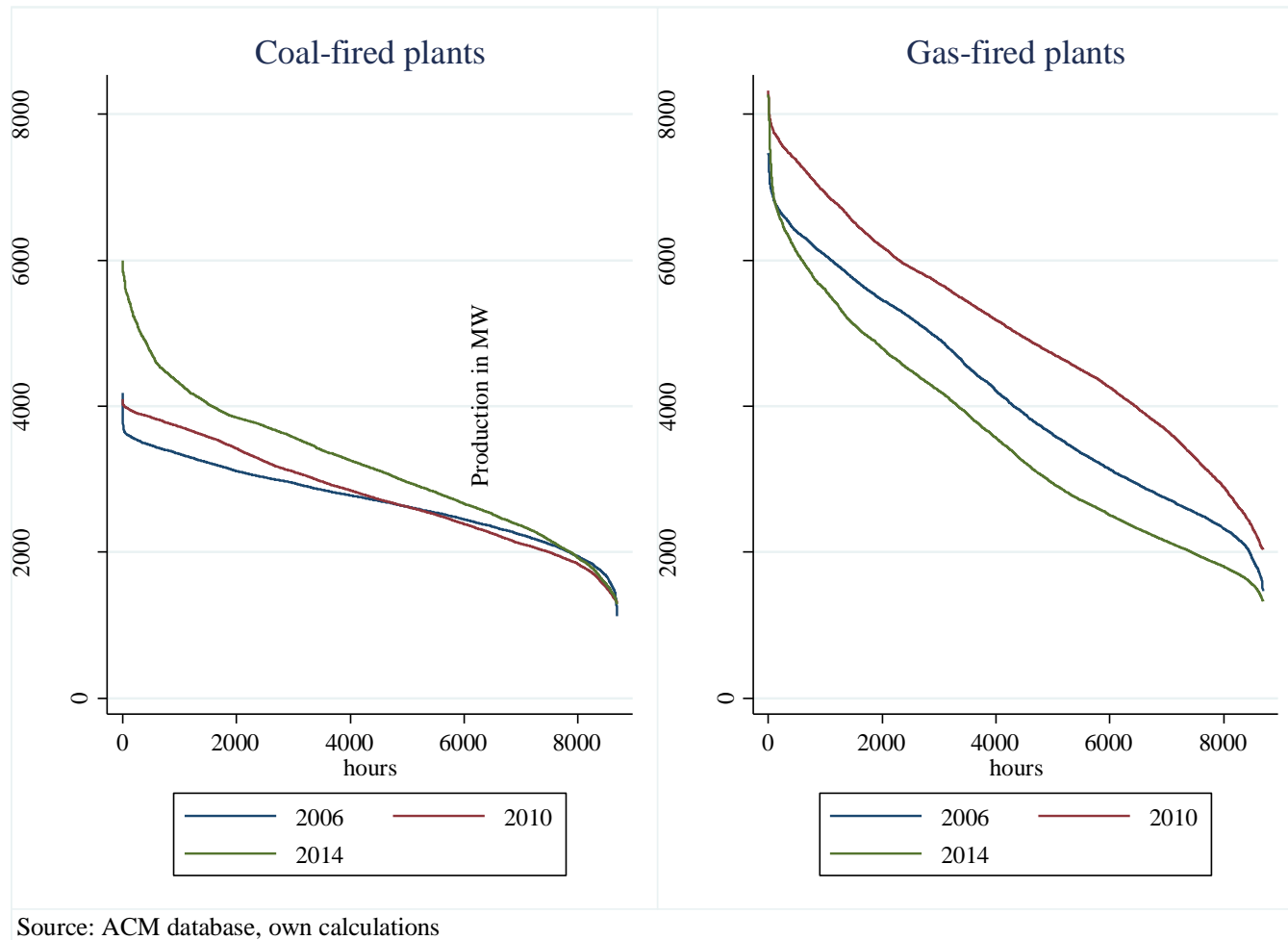
Descriptives:

marginal costs of coal-fired plants much lower after 2010



Descriptives: duration curves of production

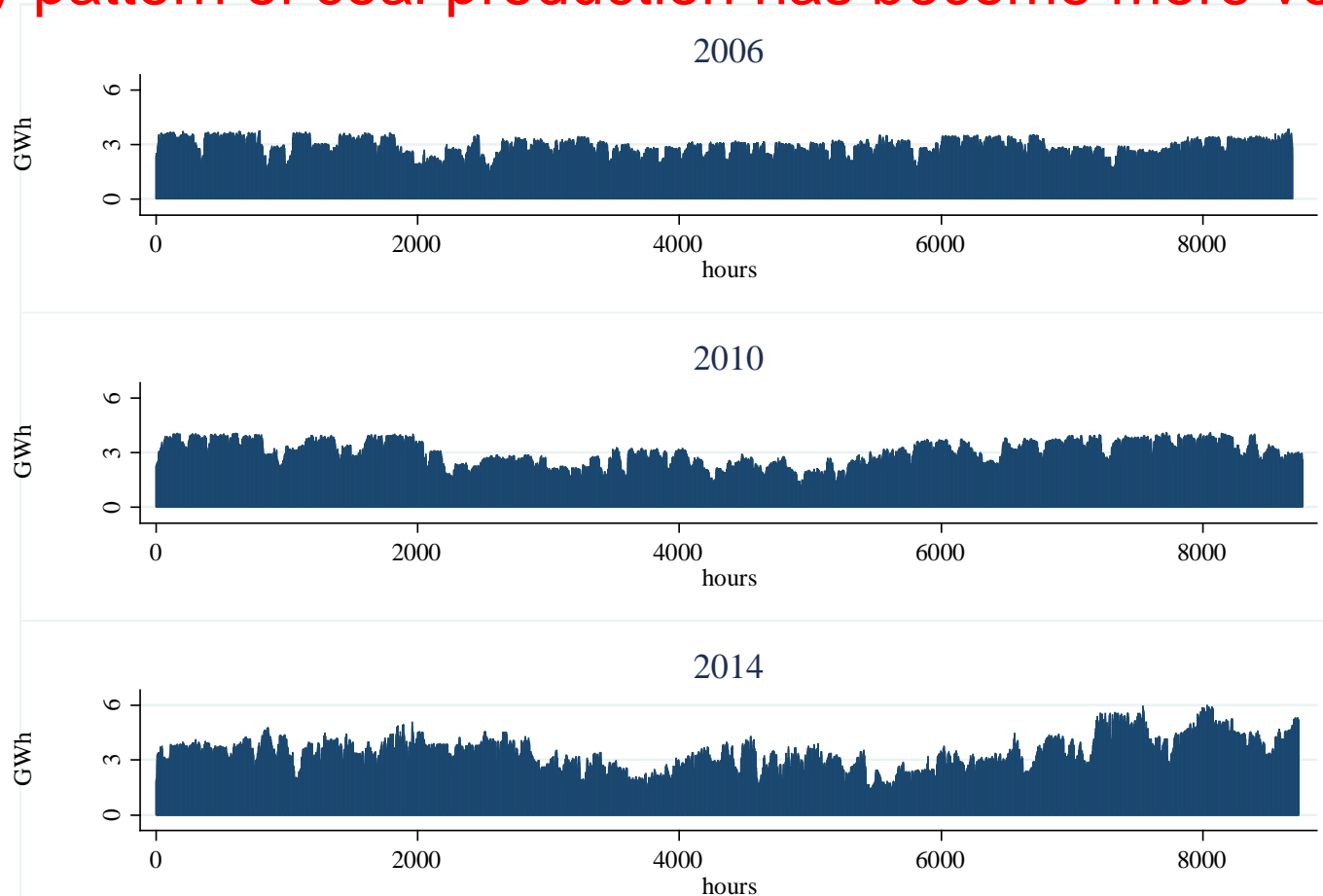
Coal plants increasingly offer flexibility





Descriptives:

Hourly pattern of coal production has become more volatile



Source: ACM database, own calculations



Analysis

panel regression on plant level, hourly data

$$Generation_{i,t} = \beta_{i,0} + \beta_1 Generation_{i,t-1} + \beta_2 Price_{gas,t} + \beta_3 Price_{coal,t} + \beta_4 Price_{CO_2,t} + \beta_5 Load_t + \beta_6 Temperature_t + \beta_7 RES_{NL,t} + \beta_8 Wind_{GER,t} + \varepsilon_t$$

Results panel regression

fuel prices are key drivers

but also carbon price is relevant

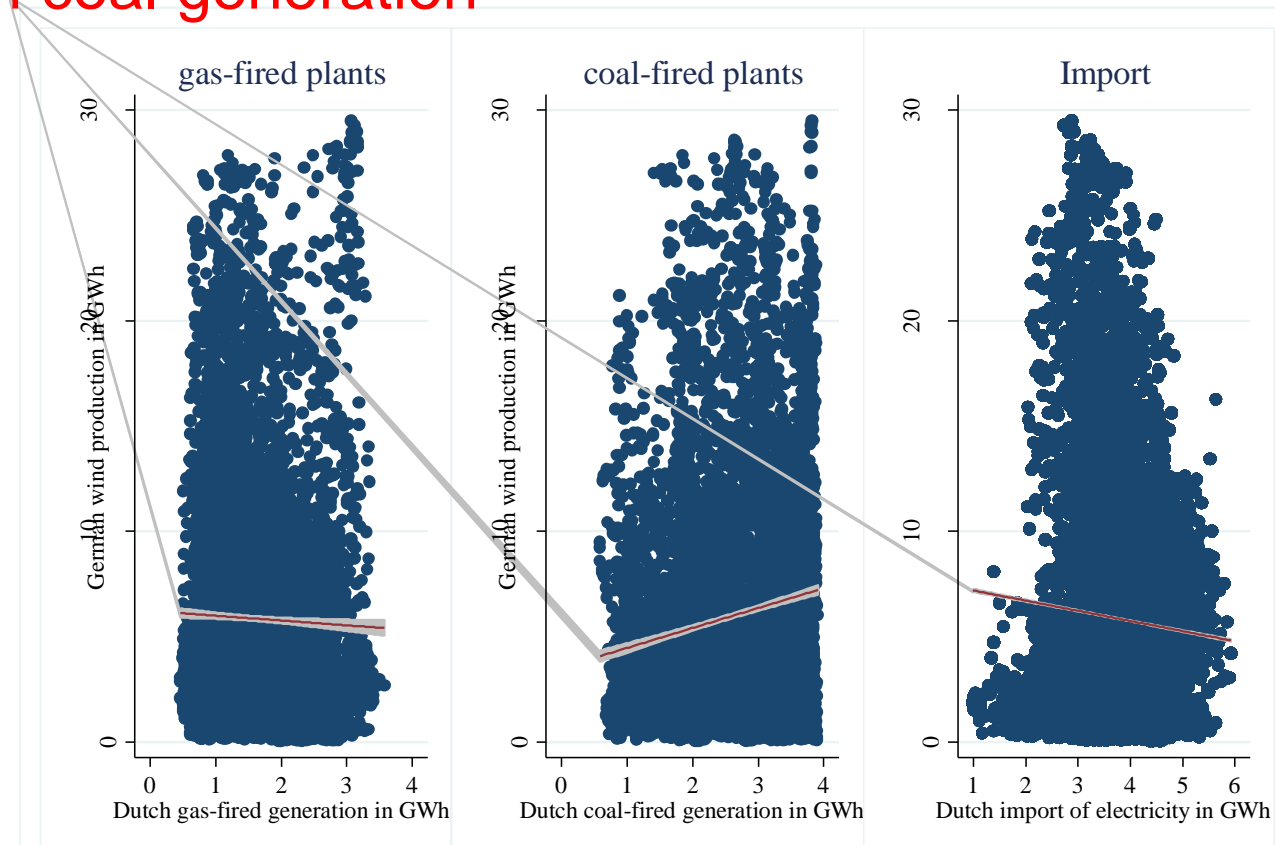
German wind energy results
 in higher fossil production in NL

Production per hour	Gas-fired plants	Coal-fired plants
constant	-9.005***	-20.46***
Production _{t-1}	0.97***	0.99***
Price _{gas}	-0.05***	0.04***
Price _{coal}	0.01**	-0.06***
Price _{CO2}	0.05***	-0.01
Load	0.0007***	0.0005***
Temperature _{NL}	-0.02***	-0.03***
RES _{NL}	0.01	-0.06*
Wind _{GER}	0.01**	0.04***
R ²	0.96	0.98
Observations	2,472,274	617,827
Number of plants	32	8

Inspecting hourly data

more German wind production coincides with

- less imports from Germany
- more Dutch coal generation



Source: ACM database, own calculations

Note: Lines are fitted based on OLS regression plus 95% confidence interval

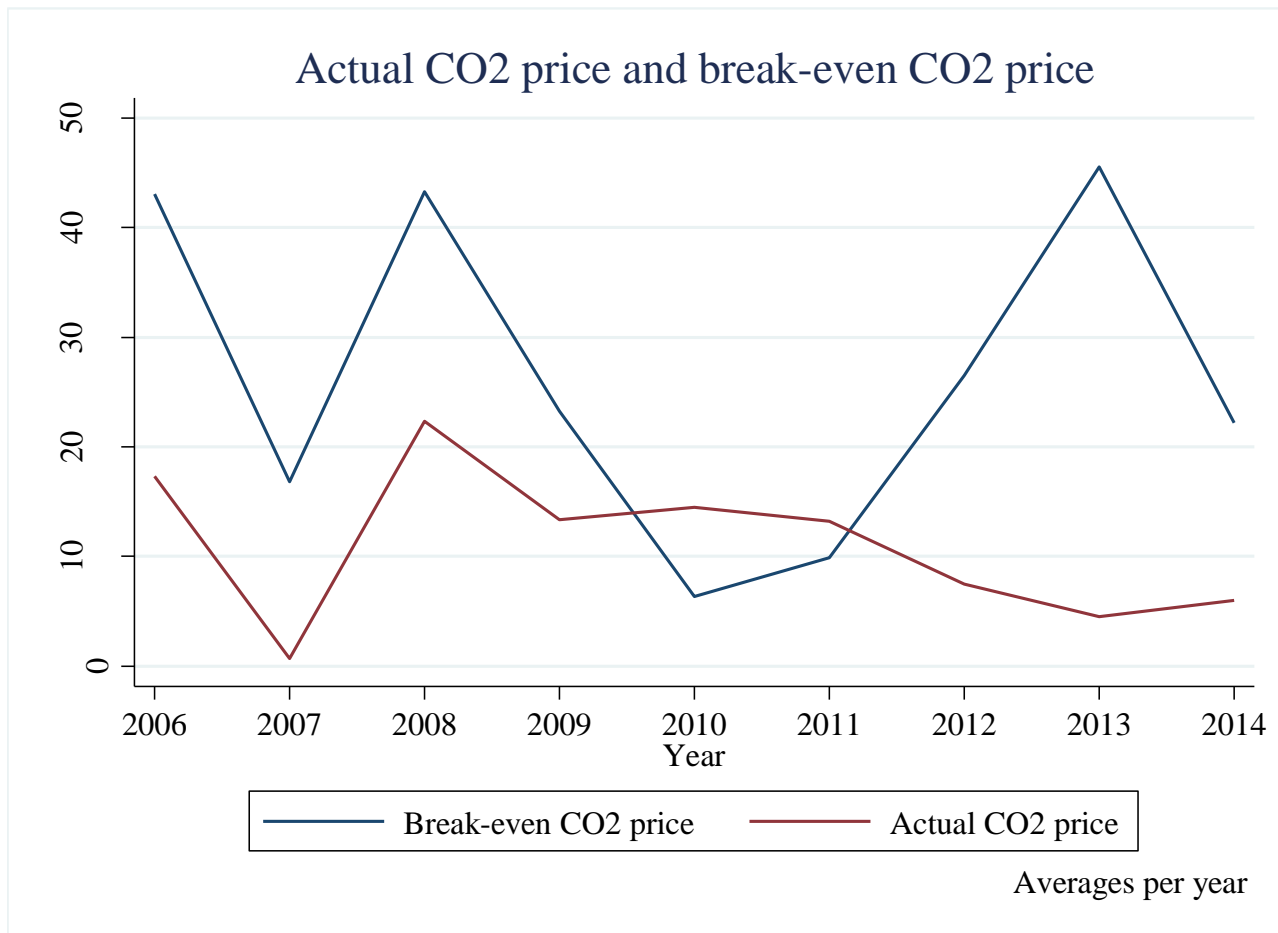
What to do next?

closing all coal-fired power plants, as proposed, has significant effect on Dutch merit order and would be at odds with market



How to align market forces and climate policy?

Raising carbon price by making ETS more tight





Conclusions

1. Decentralisation of electricity markets makes climate policy more challenging
2. In spite of climate policies, role of coal-fired power plants has become more important, also as provider of flexibility
3. Intervening in markets by forced closure of plants is expensive, and has no effect on carbon emissions
4. Making ETS more tight is more effective and efficient