Leibniz Institute for Economic Research

Carbon Pricing and Competitiveness - A European perspective on the path to 2050

Michael Themann

Conference on „Clean Energy and Climate Policy in Canada and the EU: An exchange of experiences, views, and visions for the future“

Ottawa| February 9, 2018

EU climate policy framework

2020 climate & energy package

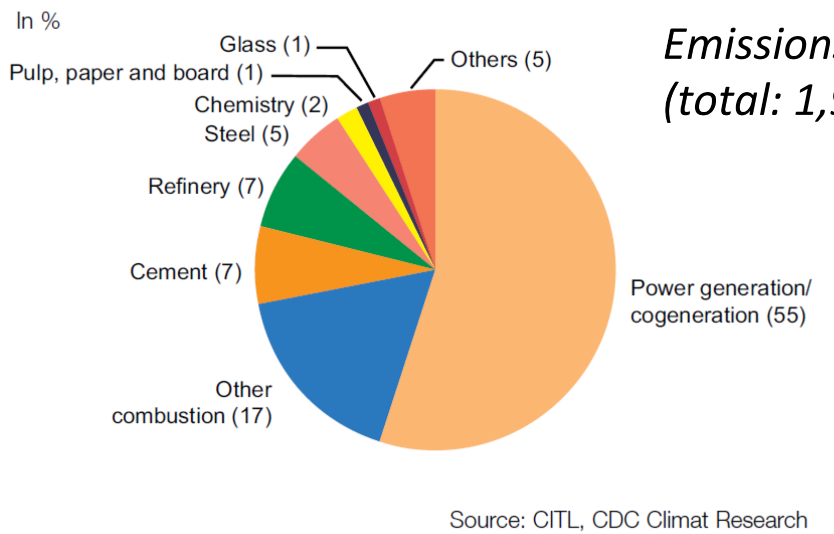
- 2020: 20% cut in greenhouse gas emissions (from 1990 levels)
- Also: 20% of EU energy from renewables; 20% improvement in energy efficiency

2030 climate & energy framework

- 2030: 40% reduction (vs. 1990) = 43% EU ETS (vs. 2005) + 30% non-EU ETS (vs. 2005)
- Also: at least 27% of EU energy from renewables; at least 27% improvement in energy efficiency
- 2050: 80-95% reduction (vs. 1990)

The EU Emissions Trading System (EU ETS)

- 45% of the EU's GHG emissions, 4% of global emissions: power, manufacturing
- 55% not covered: housing, transport, agriculture, waste (national “effort sharing”, EU car emission standards, etc.)
- In 31 countries: 28 EU Member States plus Iceland, Lichtenstein and Norway
- From more than 11,000 installations



Emissions by sector in 2013 (total: 1,925 Mt CO2e)

EU ETS: Cap and Allocation

Learning by doing process

<u>2003 EU ETS Directive</u>

- Phase I: 2005-2007 (trial phase)
- Phase II: 2008-2012 (Kyoto Protocol commitment period)
- EU ETS was a decentralized system: sum of 25 individual National Allocation Plans
- Allowances freely allocated based on historical emissions

<u>2009 Revised Amended Directive and 2030 climate and energy framework</u>

- Phase III from 2013 to 2020
- Adoption of an EU cap, declines annually by 1.74% p.a. (from 2021 on: 2.2%)
- Estimated 57% of all allowances to be auctioned (manufacturing: 70% in 2020)
- Exception: sectors at high risk of carbon leakage (0%)

Outline

Empirical Evidence on Benefits (Abatement, Innovation)

Empirical Evidence on Competitiveness and Carbon Leakage

Outlook on 2030, 2050 and “lessons learned”

Empirical Evidence: Abatement, Innovation

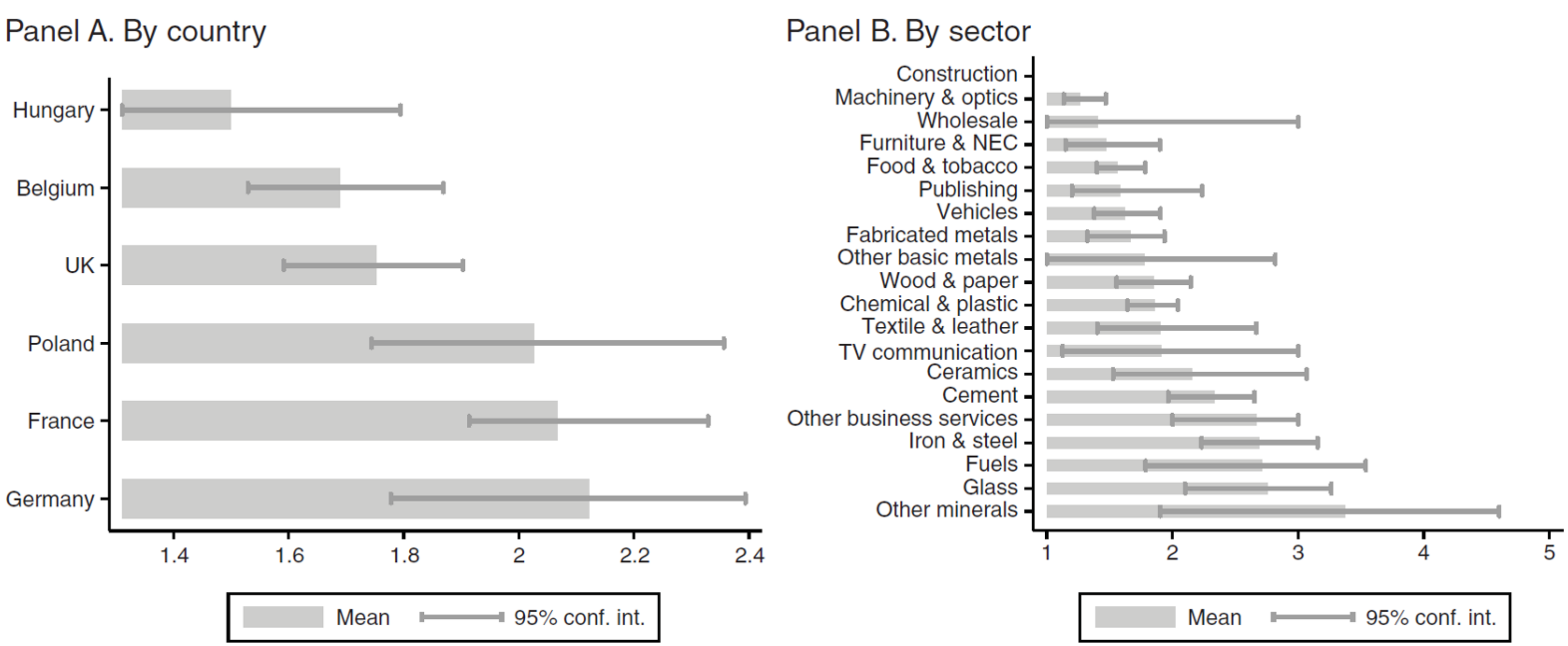
- General consensus that the EU ETS has driven GHG abatement at least in Phase I and beginning of Phase II
  - Phase I, estimates based on aggregate emissions: about 3% (Ellerman/Buchner 2008; Ellerman et al. 2010; Anderson/Di Maria 2011)
  - Phase II, studies based on firm data: 10-28% reduction of German and French EU ETS firms in early Phase II wrt non-regulated firms (Petrick/Wagner 2014; Wagner et al. 2013)
  - 1% increase in low-carbon patenting (Calel and Dechezleprêtre, 2016)
  - Effects related to stringency in early Phase II (EUA price ~15€)

- In late Phase II and early Phase III (emissions<cap), other reasons for reductions: (i) effect of economic crisis (Bel et al. 2015) and (ii) renewables and energy efficiency (Alberola et al. 2014)

- Environmental effectiveness of EU ETS is a given; emission target has in fact been overachieved.

Empirical Evidence: Surveys

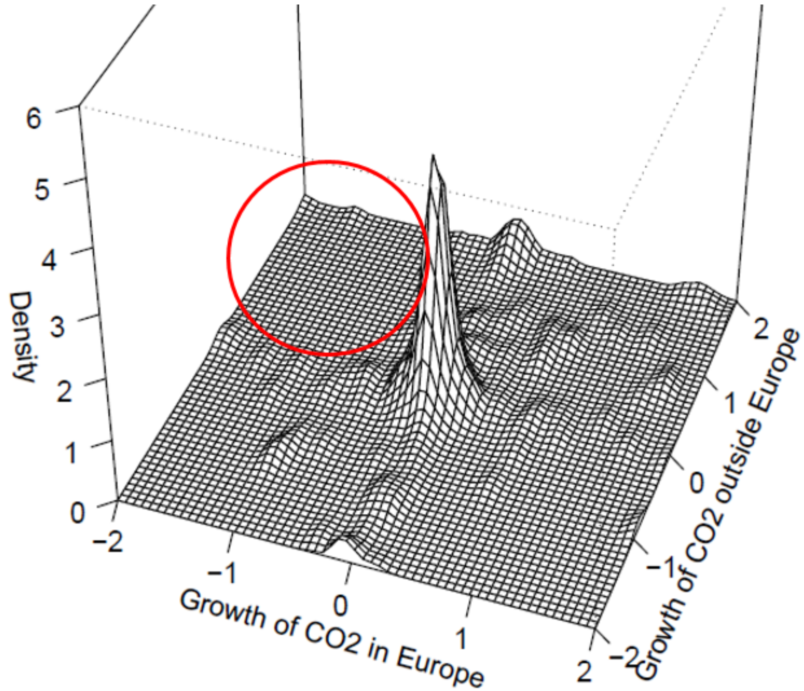
1. Martin et al. (2015): Interviews of 761 company managers
   - average relocation risk for the near future clearly below a 10% reduction in production/jobs



[Scale: 1 = no impacts; 3 = >10% outsourced; 5 = plant closure]

Empirical Evidence: Emissions

2. Dechezleprêtre et al. (2015): Data on emissions of multinational enterprises within the Carbon Disclosure Project
   - ➢ no evidence for emission leakage from Europe towards the rest of the world (within a company structure)



Empirical Evidence: Foreign Direct Investments (FDI)

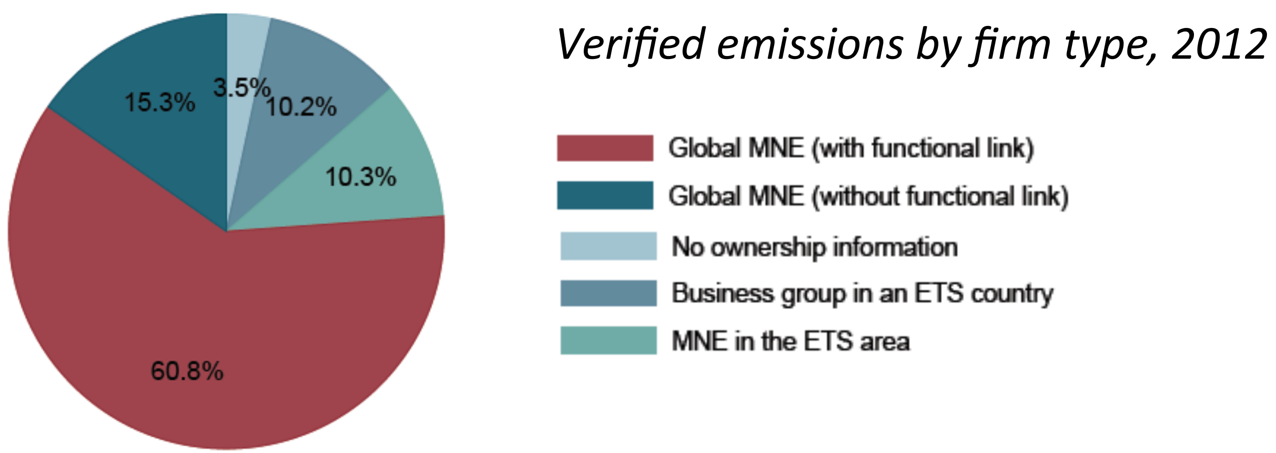
3. Koch/Basse Mama (2017): FDI from 547 German EU ETS regulated companies based on administrative data from Deutsche Bundesbank
   - On average -0.02% change compared to non-ETS companies

   - Curious: Investment leakage only for footlose companies in „clean“ industries
     - machine building, electronics and automobiles
     - increased FDI significantly by 52%
     - represent 3% of German EU ETS emissions

Empirical Evidence: Asset structure

4. aus dem Moore / Großkurth / Themann (2017): fixed assets and firm structure data from 1.677 European manufacturing firms based on administrative data from Bureau van Dijk

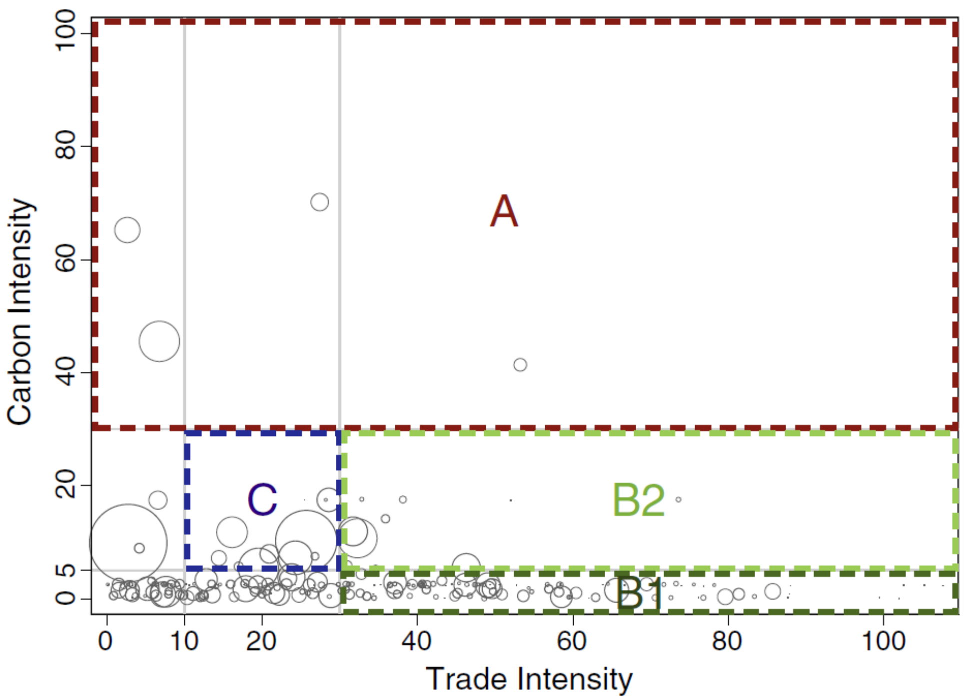
- 11.1 – 14.8 % increase in EU assets compared to non-ETS companies
- Less committment by „lightweight" multinational enterprises (MNEs)
  - increased asset base by only 1.3%
  - represent less than 4% of overall EU ETS emissions in 2002-2012



Empirical Evidence: Compensation

5. ~90% manufacturing emissions (2012) exempted from auctioning (aus dem Moore / Großkurth / Themann 2017)

   Martin et al. (2015) identify three groups:



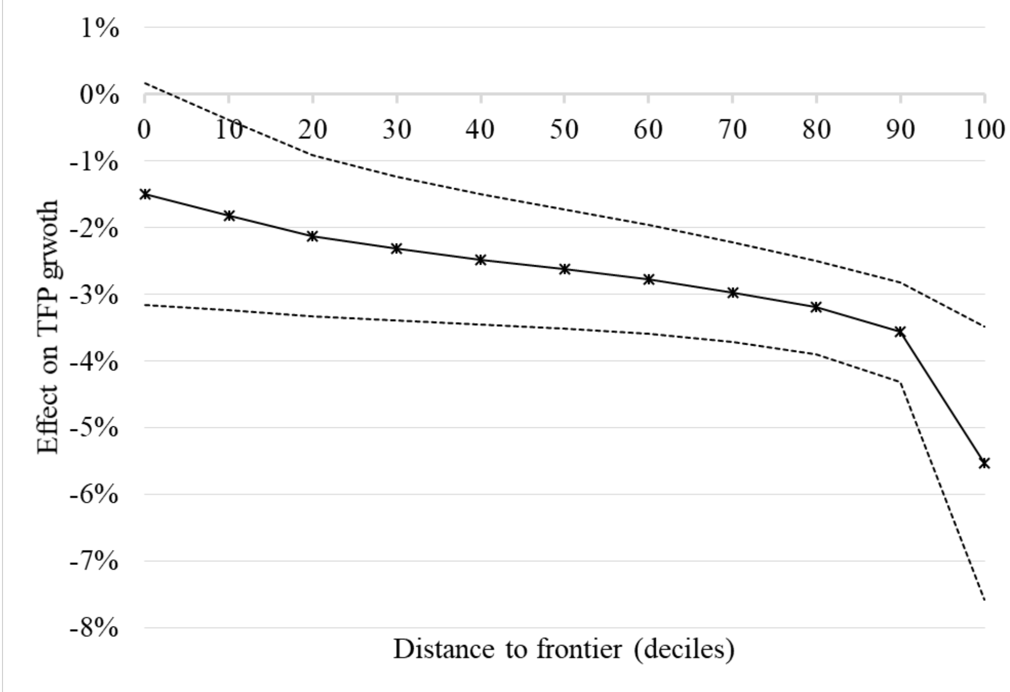
Carbon and trade intensities of four-digit industries

Size of circles proportional to # firms in a given industry

➢ Main issue: relocation risk related with CO2-intensity, but not trade intensity

Empirical Evidence: Total factor productivity (TFP)

6. Themann/Koch (2018): growth in TFP from 3.911 EU ETS regulated companies based on administrative sources compiled by provider Bureau van Dijk
   - % change compared to non-ETS companies (preliminary results)
   - Impact depends on the distance to the technology frontier



Estimated overall effect, with 95% confidence intervals

Lessons learned (I)

In phases I+ II the EU ETS (so far)

1. helped to reduce GHG emissions
2. had some impact on investment
3. induced little investment into patented (!) low-carbon innovations

In terms of competitiveness

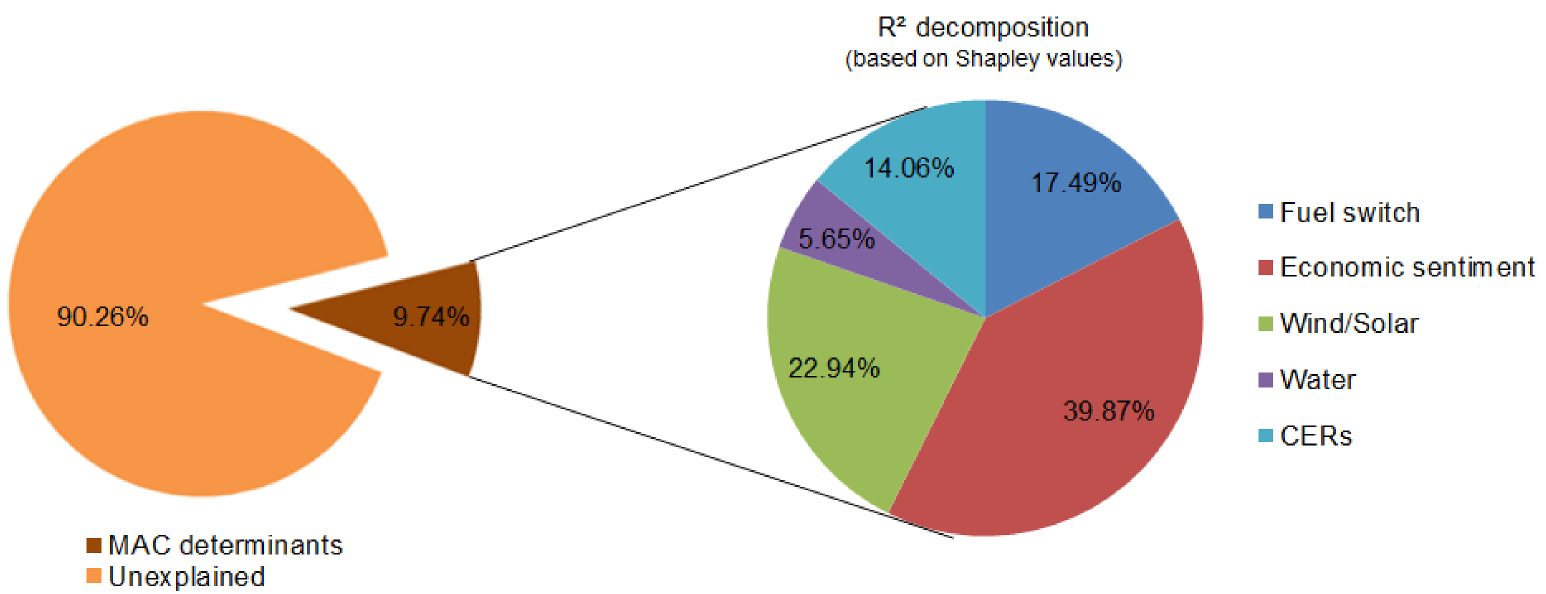
1. has not induced carbon leakage (relocation costs, cost pass-through, compensation, lack of stringency)
2. has let to some productivity decreases for regulated (!) firms
3. has provided extensive, not cost-effective protection from carbon leakage

But major uncertainties

- Effect of higher EUA-prices in the future?
- Effect of increased auctioning?

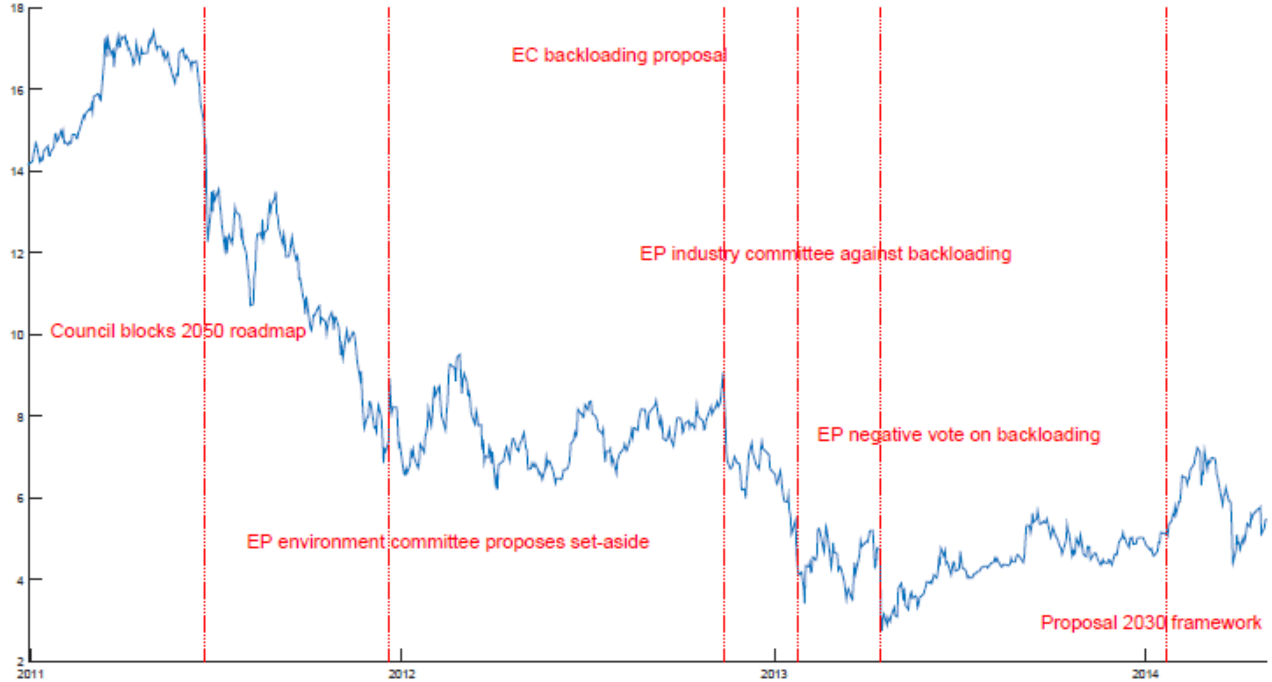
Empirical evidence: Prices are driven by expectations (I)

7. Koch et al. (2014): Demand-side fundamentals related to abatement matter (Alberola et al. 2008, Mansanet-Bataller et al. 2007, Hintermann 2010), but explain less than 10% of EUA price dynamics



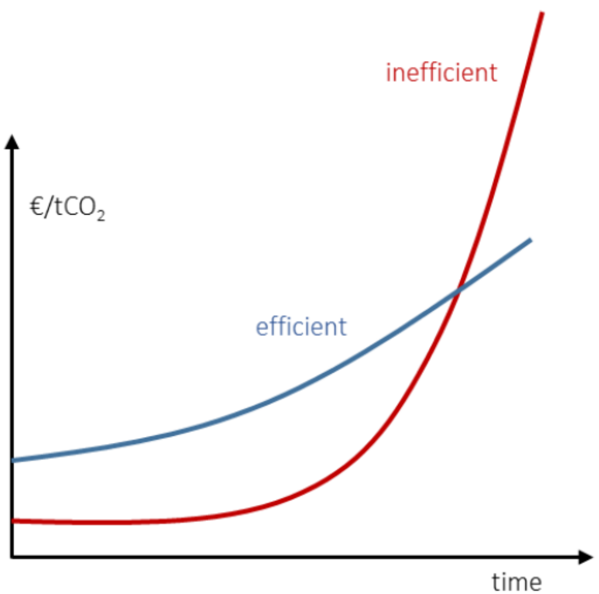
Empirical evidence: Prices are driven by expectations (II)

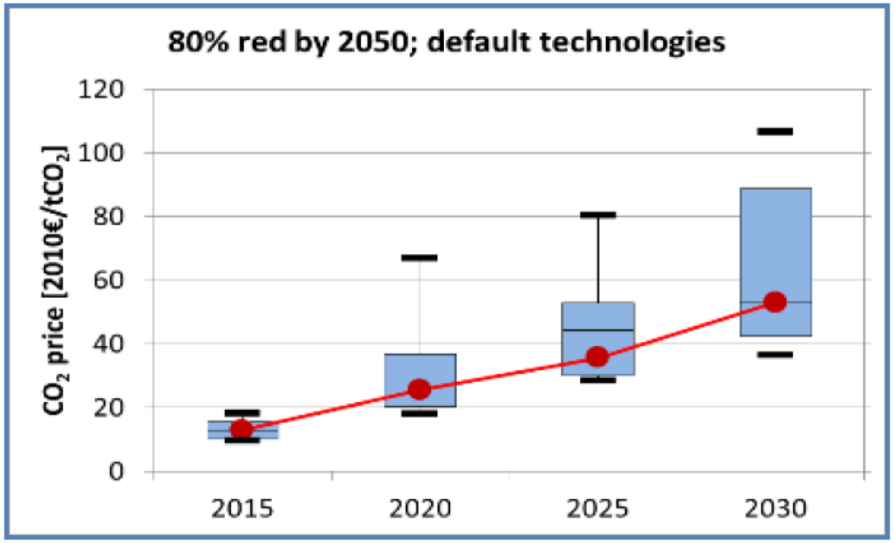
8. Koch et al. (2015): Event-induced price falls reflect a downward adjustment of expectations about the cap stringency
   - ➢ Mere speculation about the cap can influence market outcomes



The path to 2030

9. Edenhofer et al. (2017): EUA price observed on the market and expected by companies may remain below its economical benchmark level for several years to come
   - lock-in of high-carbon capital stocks that remain profitable (steady EUA demand)
   - cap declining by 2.2% per year
   - prices and political costs of sticking to the cap schedule will rise steeply





The path to 2050

Costs projections for a universal carbon price

Carbon price needs to stimulate demand for low-carbon technologies in all sectors (power, heat and mobility).

- Only 45% of emissions covered by EU ETS
- Very different price signals across sectors (ineffective sectoral policies)

10. German Academies of Science (2017): -85% reduction scenarios for Germany in 2050 using an universal carbon price across all sectors
    - 2030 critical juncture: risk of lock-in effects (technical lifetimes, investment cycles)
    - Electricity demand can double (1000 TWh in 2050)
    - 5-7 times higher wind and solar capacity than today (500-600 GW)
    - Investments into energy efficiency, grids, backup capacities (100 GW), s. gases, fuels
    - Systemic costs around 1-2 % of GDP in 2017 (125 bio. € yearly, 1.500 bio.€ total)

Policy options and shared learning

- Carbon price (EU ETS) needs to be cross-sectoral, consistent, effective
  - Carbon price floor starting at 30€ in 2020 (Canada Proposal: ~32 € / 50 CAD)
  - Establish credible price path to 2050 as soon as possible
  - Commitment to the (short-run) costs and long-term benefits
  - Compensation only if necessary
- Support policies
  - Technology development and adaption (productivity and innovation)
  - Revamp system of energy taxes, levies, subsidies to reduce distortions and costs
  - Regulatory policies in case of market failure (infrastructure, adoption…)
- Also: measure causal effects wrt benefits: "green" value added, employment…

For more information

acatech/Leopoldina/Akademienunion (German Academies of Science), 2017: Coupling of Energy Sectors – Options for the next phase of the German Energy Transition (Series on science based policy advice), 2017. ISBN: 978-3-8047-3672-6.

aus dem Moore, N., Großkurth, P., Themann, M. (2017) : Multinational corporations and the EU Emissions Trading System: Asset erosion and creeping deindustrialization? Ruhr Economic Papers, No. 719.

Calel, R. and Dechezleprêtre, A., 2016. Environmental policy and directed technological change: Evidence from the european carbon market. Review of Economics and Statistics, 98(1): 173–191.

Edenhofer, O., C. Flachsland, C. Wolff, L. K. Schmid, A. Leipprand, N. Koch, U. Kornek, M. Pahle. 2017: Decarbonization and EU ETS Reform: Introducing a price floor to drive low-carbon investments. MCC Policy Paper, 24.11.2017.

Koch, N., Basse Mama, H. (2016): European climate policy and industrial relocation: Evidence from German multinational firms, SSRN Working Paper, 2868283.

Koch, N., Grosjean, G., Fuss, S., Edenhofer, O., 2015: Politics matters: Regulatory events as catalysts for price formation under cap-and-trade, Journal of Environmental Economics and Management, 78, 121-139.

Koch, N., Fuss, S., Grosjean, G., Edenhofer, O., 2014: Causes of the EU ETS price drop: Recession, CDM, renewable policies or a bit of everything? New evidence, Energy Policy , 73, 676-685.

Martin, R., Muûls, M., Preux, Laure B. de, Wagner, U. J., 2014. Industry compensation under relocation risk: A firm-level analysis of the eu emissions trading scheme. American Economic Review, 104(8):2482–2508.

Martin, R., Muûls, M., de Preux, Laure B., Wagner, U. J., 2015. On the empirical content of carbon leakage criteria in the EU Emissions Trading Scheme. Ecological Economics, 105:78–88.

Martin, R., Muûls, M., Wagner, U. J., 2016. The impact of the European Union Emissions Trading Scheme on regulated firms: What is the evidence after ten years? Review of Environmental Economics and Policy, 10(1): 129–148

Themann, M., Koch, N (2018): Catching up and falling behind: Cross-country evidence on the impact of the EU ETS on productivity growth, mimeo.

Thank you!

Michael Themann
RWI – Berlin Office

Research Group *Sustainability & Governance*
Michael.Themann@rwi-essen.de

rwi
Leibniz Institute for Economic Research

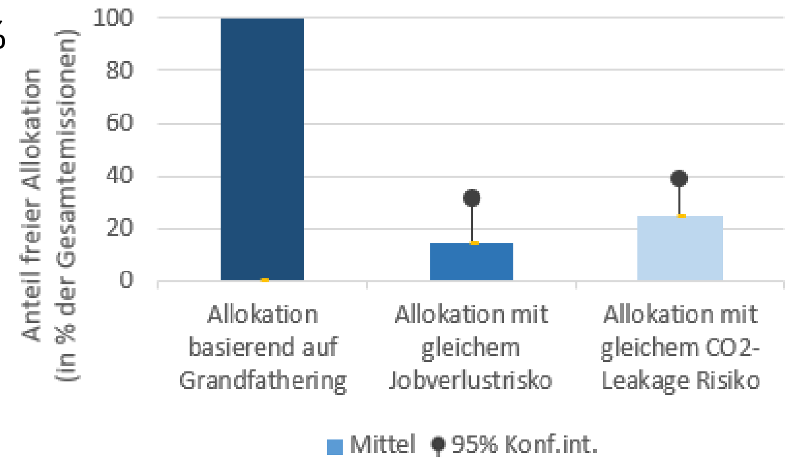
| research with impact

Reform example: improve permit allocation

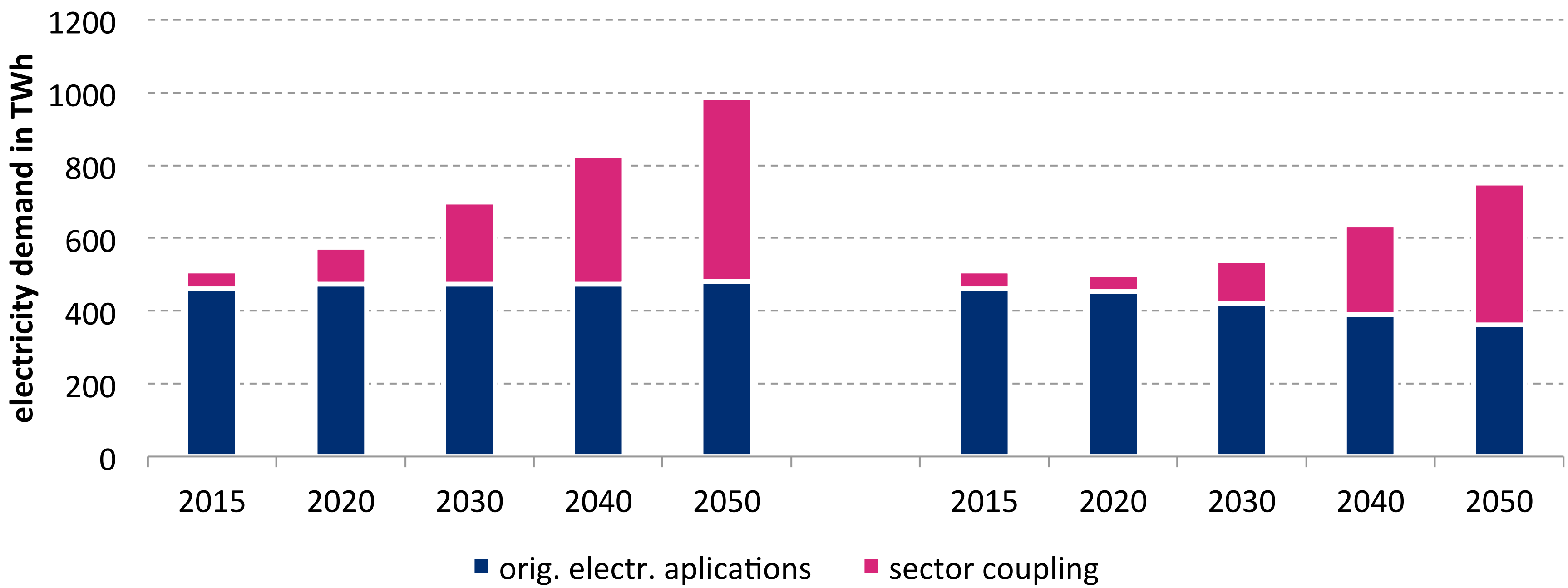
Based on Martin et al. (2014a, 2014b)

- Improvement 1: modify trade intensity threshold
  - Exemptions only for A+B2: 100.3 Mio. less free EUAs p.a.
  - Revenue: 500 Mio. € (EUA price = 5€) – 3 Bio. € (EUA price = 30€) p.a.

- Improvement 2: Refining the definition of trade intensity
  - Trade intensity with less developed countries: 14.4 Mio. less free EUAs p.a.
  - Revenue: 71 – 430 Mio. p.a.
  - Share of free allocation optimal < 40%

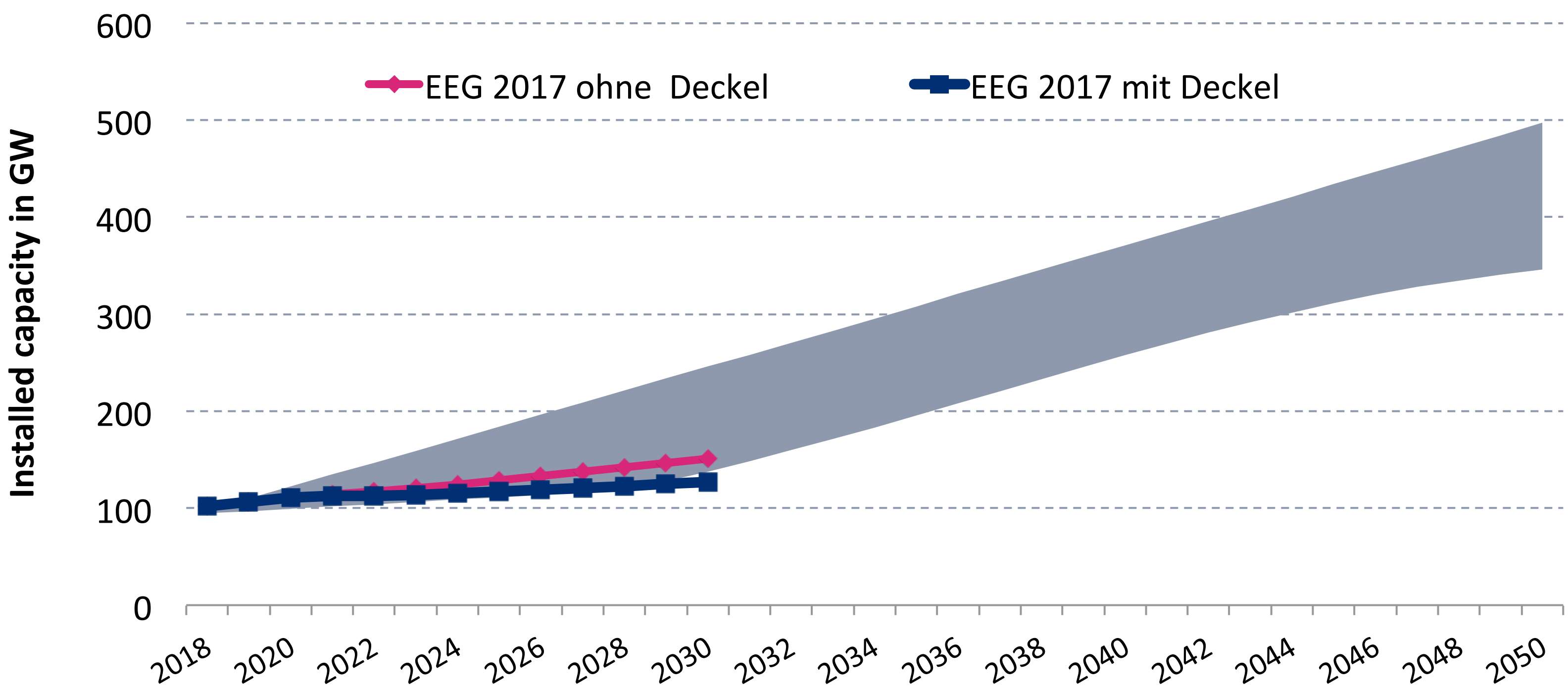


Projected Development of Electricity Demand (-85% CO_2)



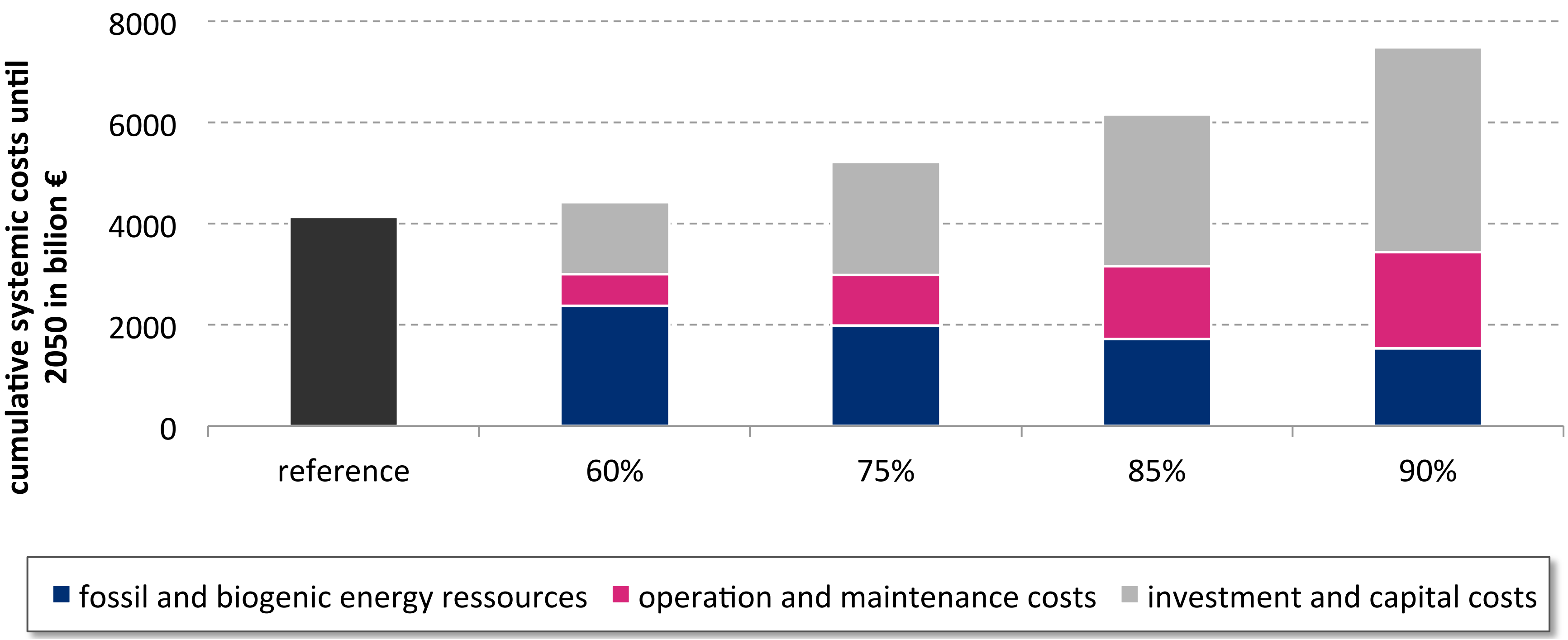
German Academies of Science (2017)

Projected Installation of Wind and Solar Power



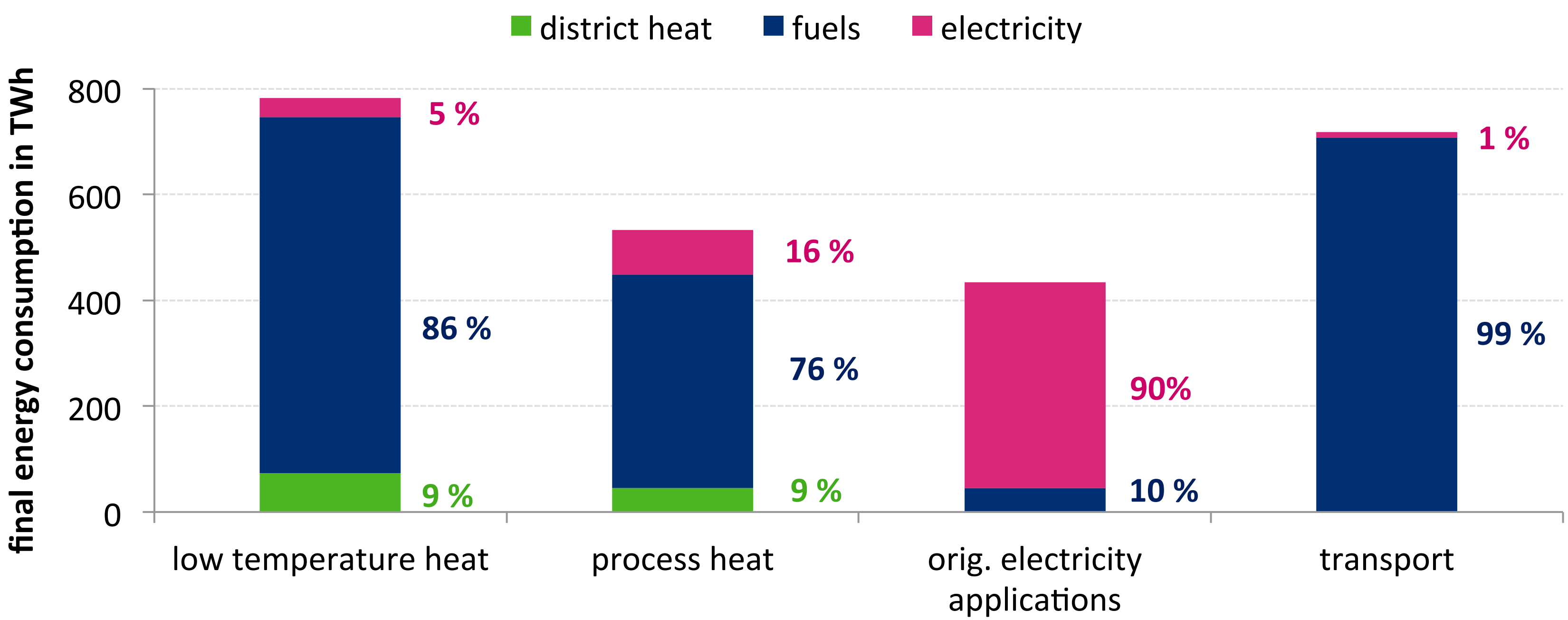
German Academies of Science (2017)

Projected Costs of the Energy Transition in Germany



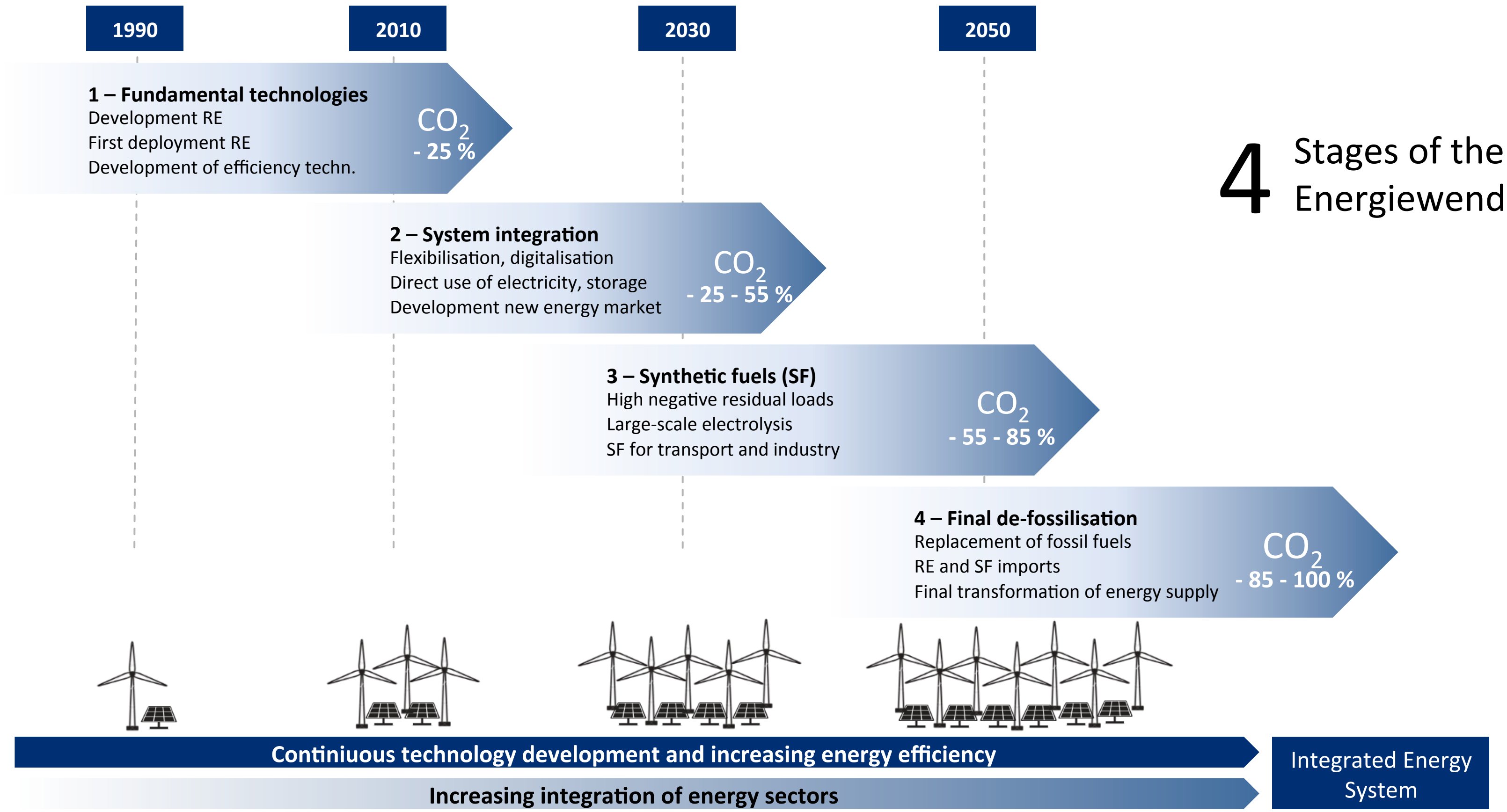
German Academies of Science (2017)

Final Energy Consumption in Germany by Energy Carrier (2016)



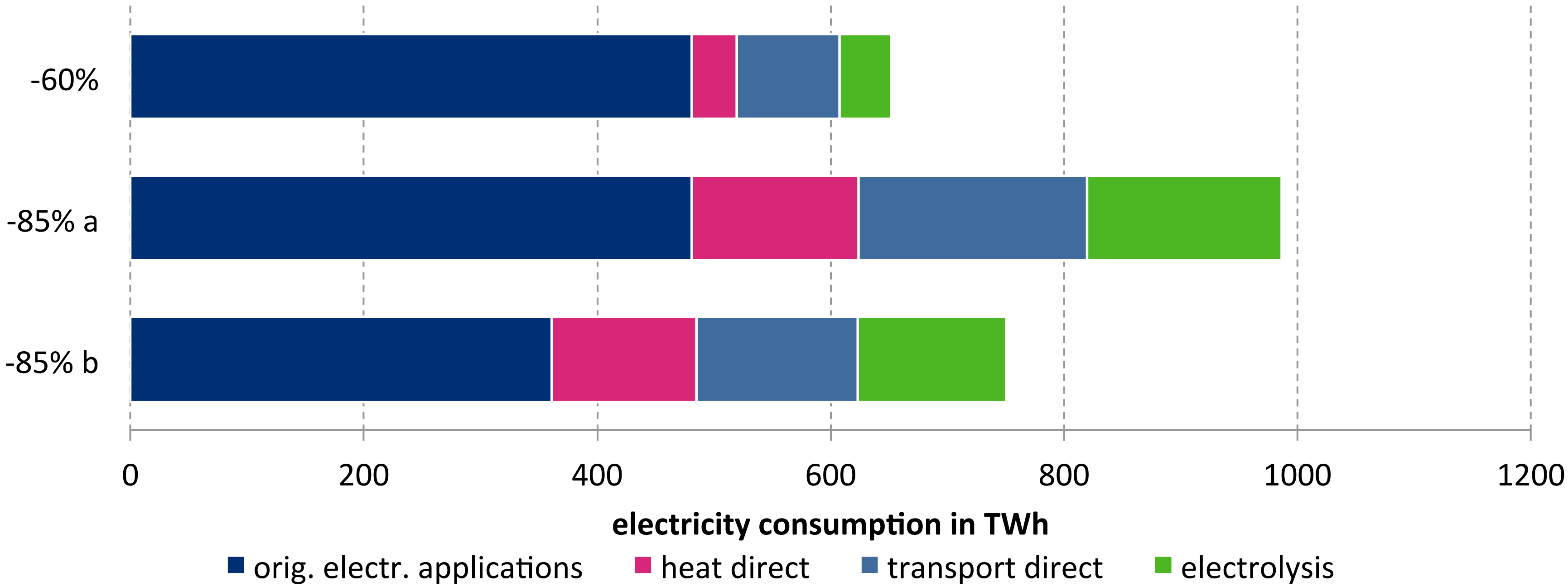
Federal Ministry for Economic Affairs and Energy (2017)

4 Stages of the Energiewende



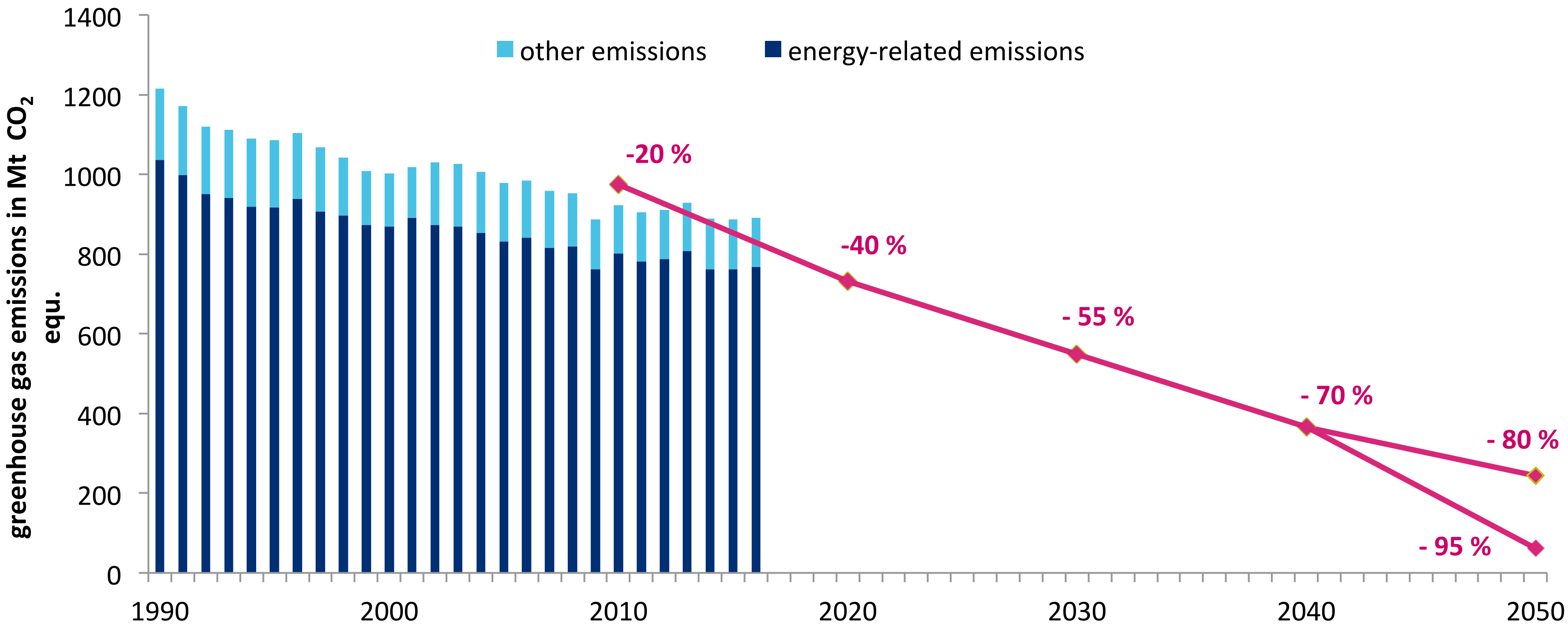
German Academies of Science (2017)

Projected Use of Electricity (-85% CO_2)



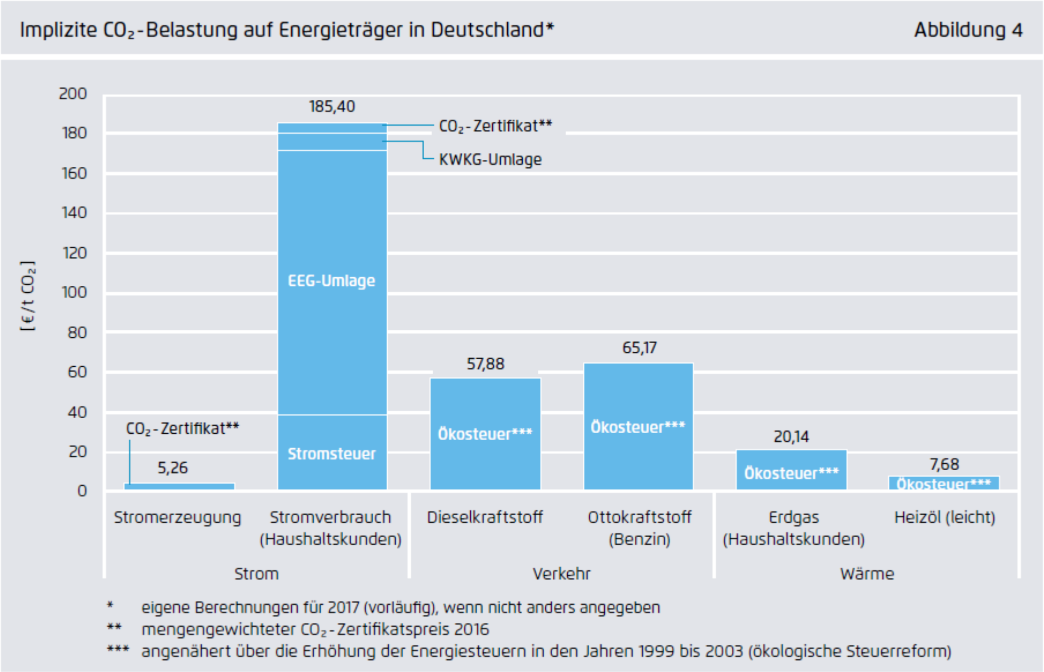
German Academies of Science (2017)

Main goal of the 'Energiewende': reduce emissions



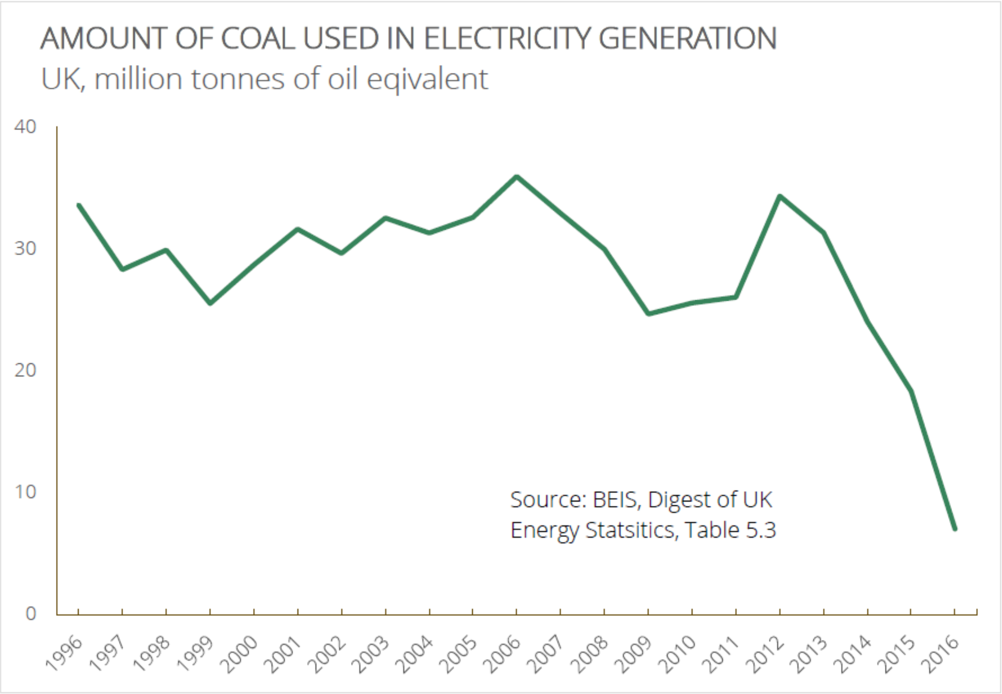
German Academies of Science (2017)

Implicit German CO2 prices for power, transport and heat



Agora Energiewende (2017)

Carbon Price floor in UK



BEIS (2017)

Projected Costs of the Energy Transition in Germany

The energy transition causes **additional systemic costs**.

In Germany, the additional costs per year will be around **1 – 2 % of the GDP** (although these calculations are always subject to significant uncertainties, they can help to estimate the order of magnitude)

The **systemic costs considered here include**: investments for all infrastructures (*e.g.* power plants, grids, cars, energy storage), financing costs, expenses for energy resources, operation and maintenance costs, costs for renovation of buildings.

Not included are: economic effects like local value added, employment effects, export opportunities. However, technology expertise and export is paramount for Germany.

German Academies of Science (2017)