The Value of Greenhouse Gas Emission Reduction in the EU

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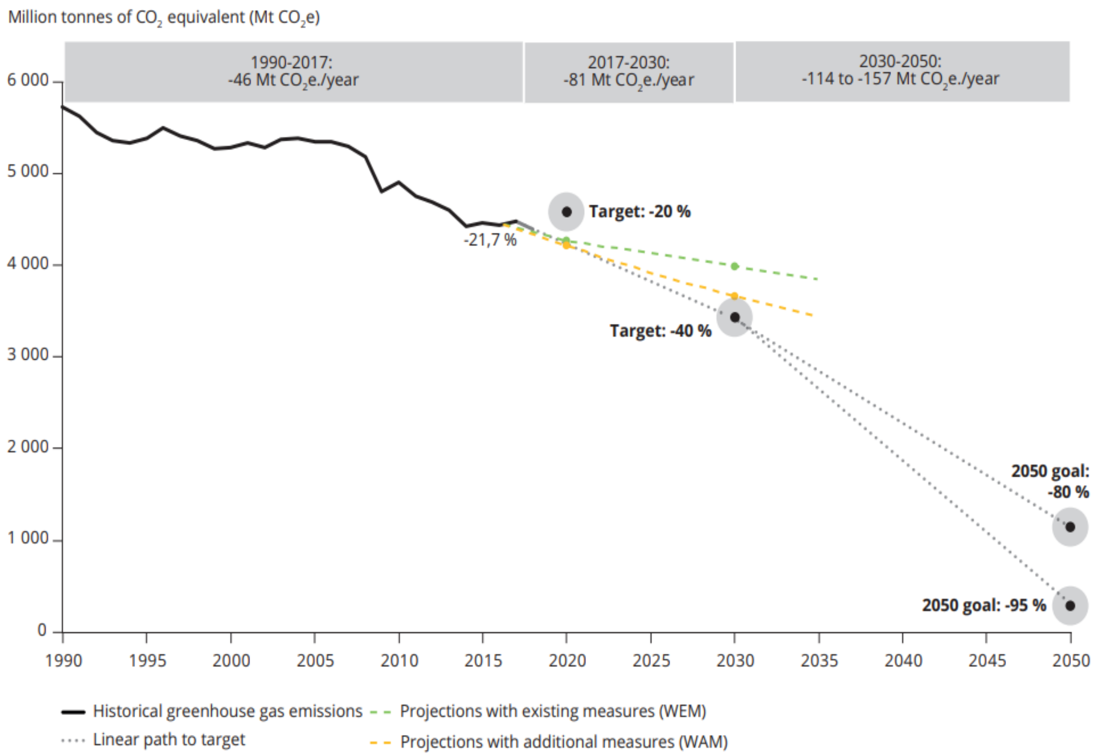
Climate policy and emission reduction in the EU

- EU aims to be a global leader in climate protection
  - GHG emissions were reduced by 24% between 1990 and 2019
  - Continuous sharpening of set targets and strategies
- Emissions have to be reduced faster to meet future reduction targets
- Most measures are money and time consuming, e.g. expansion of renewables, innovations etc.



To what extent can eliminating inefficiencies in the use of currently available technologies contribute to achieving the intended climate targets?

Current state of research

- Two main strands in current literature on climate economics
  - Estimation of reduction potentials on high aggregated level (e.g. Stern, 2007; Hanaoka and Kainuma, 2012; Bosetti et al., 2009)
  - Estimation of potential emission reductions for specific sectors (e.g. Golub et al, 2008; Krautzberger and Wetzel, 2012; Yan and Crookes, 2009)
- Usually, heterogeneous industry structures of different countries are neglected so that the potential emission reductions are likely to be biased

Aim and Contribution: Estimation of the EU‘s overall reduction potential by

(1) differentiating between various member states and

(2) accounting for multiple industry sectors

to identify an optimal and cost effective distribution of reduction targets between countries and sectors

Methodological approach I

- Benchmarking approach to compare the **production performance** of several decision making units (e.g. countries) while accounting for **multiple inputs and outputs** (**= relative inefficiency**)

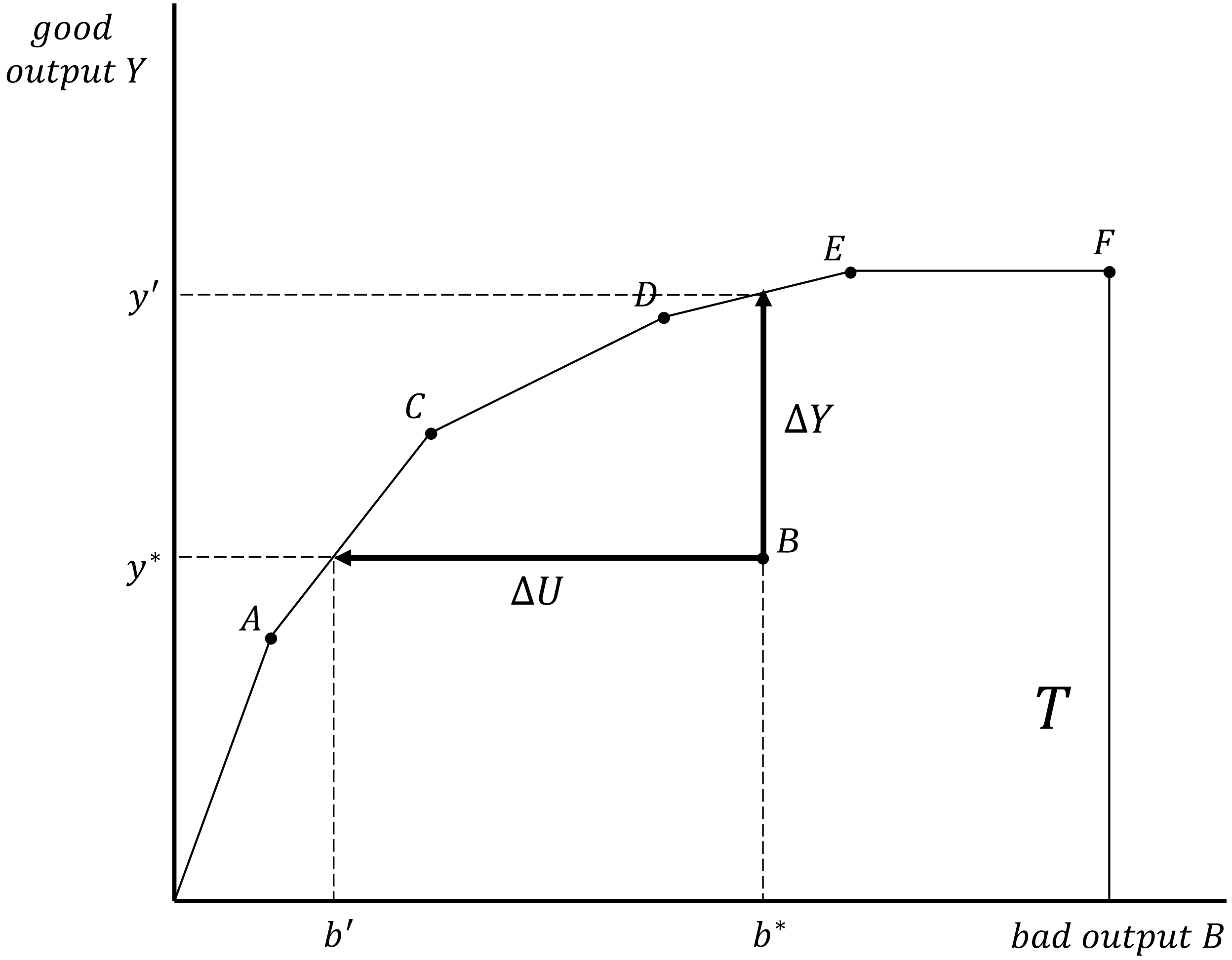
- Determination of the **technology set *T***, i.e. all possible input-output-combinations, and the **best practice (frontier) function**, i.e. upper bound of the technology set

- Non-parametric **Data Envelopment Analysis (DEA)** to estimate frontier function

- Further development of the **environmental DEA** allows to differentiate between the simultaneous production of **good (desirable) outputs** and **bad (undesirable) outputs** such as emissions

- Bootstrapping procedure to correct biased results

Methodological approach II



Removing inefficiency by

(1) **Reducing the bad output** and keeping the good output constant

(2) **Increasing the good output** and keeping the bad output constant

Data

- Development of a data basis that links historical production and emission data on the sectoral level

- Use of two data bases
  - EU KLEMS Growth and Productivity Accounts (2019)
  - Eurostat Air Emission Accounts (2021)

- Variables
  - Inputs: Labour *L* (total hours worked in thousands) and capital *C* (real fixed capital stock in Million Euros, converted with PPPs)
  - Good output: Gross value added *Y* (in Million Euros, converted with PPPs)
  - Bad output: Total GHG emissions *B* (in 1000t CO2 equivalents)

Scope of analysis

We compare the production and emission performance of 16 EU countries

- Austria (AUT)
- Belgium (BEL)
- Czech (CZE)
- Germany (DEU)
- Denmark (DNK)
- Spain (ESP)
- Finland (FIN)
- France (FRA)
- UK (GBR)
- Greece (GRC)
- Ireland (IRL)
- Italy (ITA)
- Netherlands (NLD)
- Poland (POL)
- Slovakia (SVK)
- Sweden (SWE)

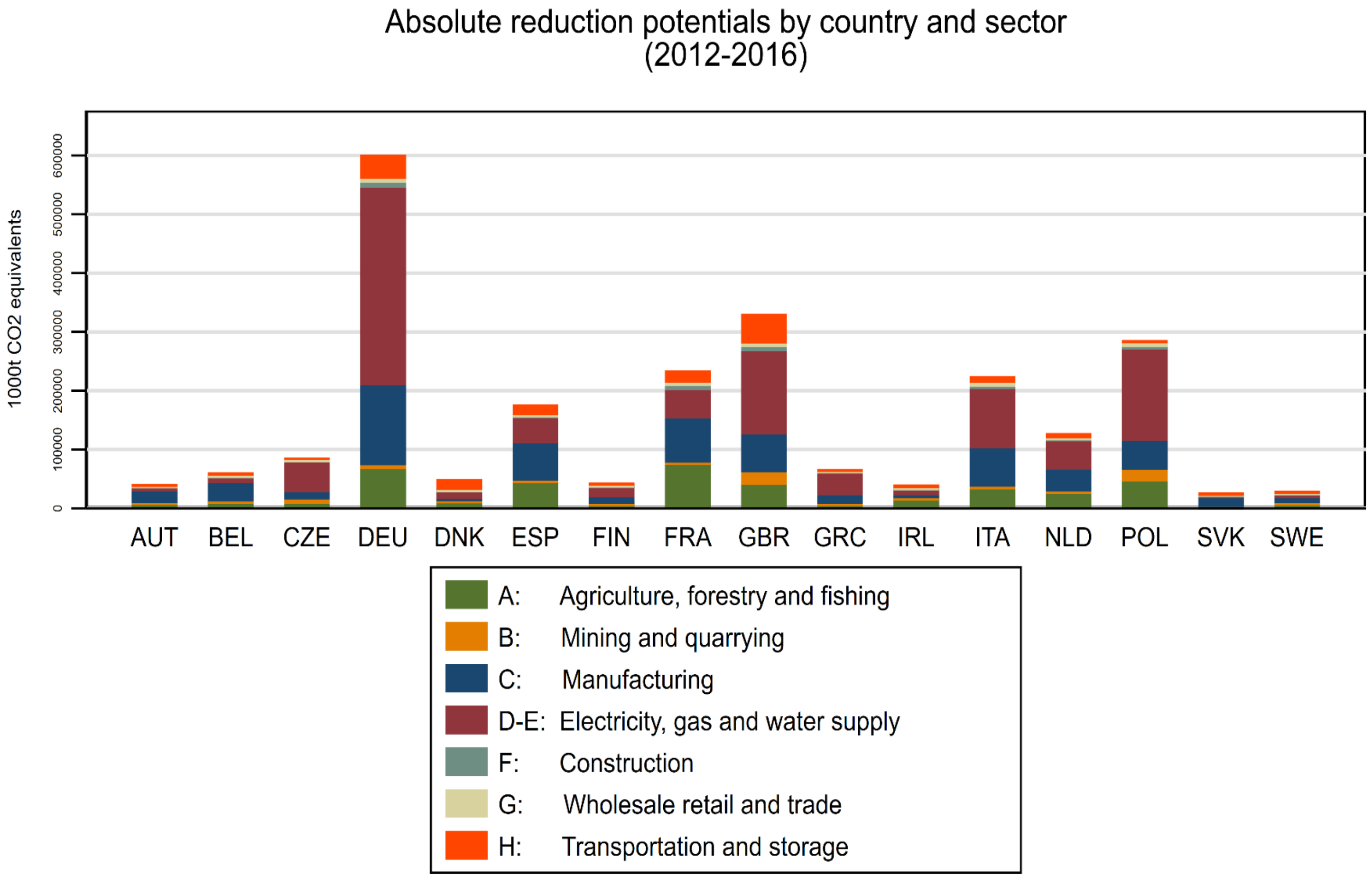
for 7 industrial sectors (classified according to NACE rev. 2)

A: Agriculture, forestry and fishing
B: Mining and quarrying
C: Manufacturing
D-E: Electricity, gas and water supply
F: Construction
G: Wholesale retail and trade
H: Transportation and storage

Coverage of 85% of EU's total GHG emissions

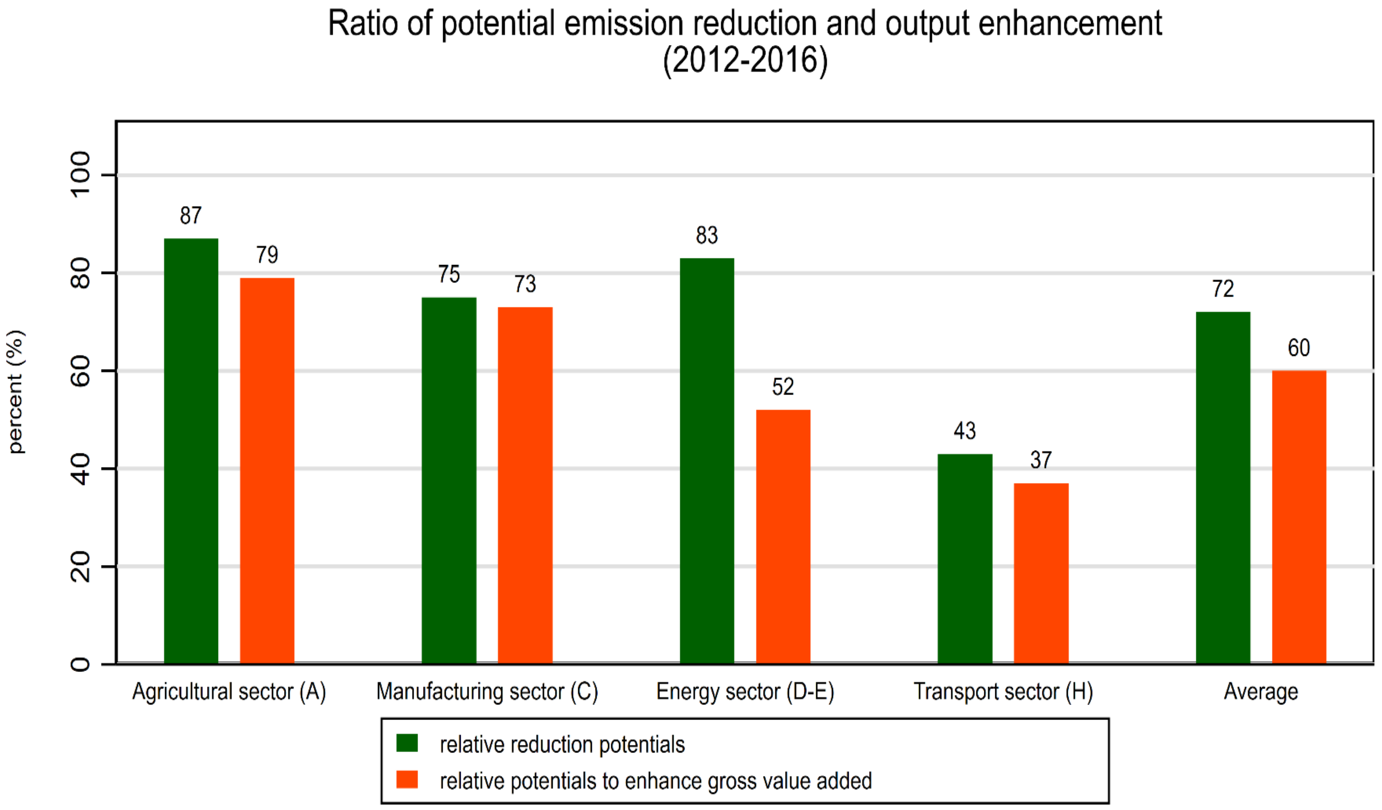
from 2012 to 2016 (median value).

Results I - Reduction potentials



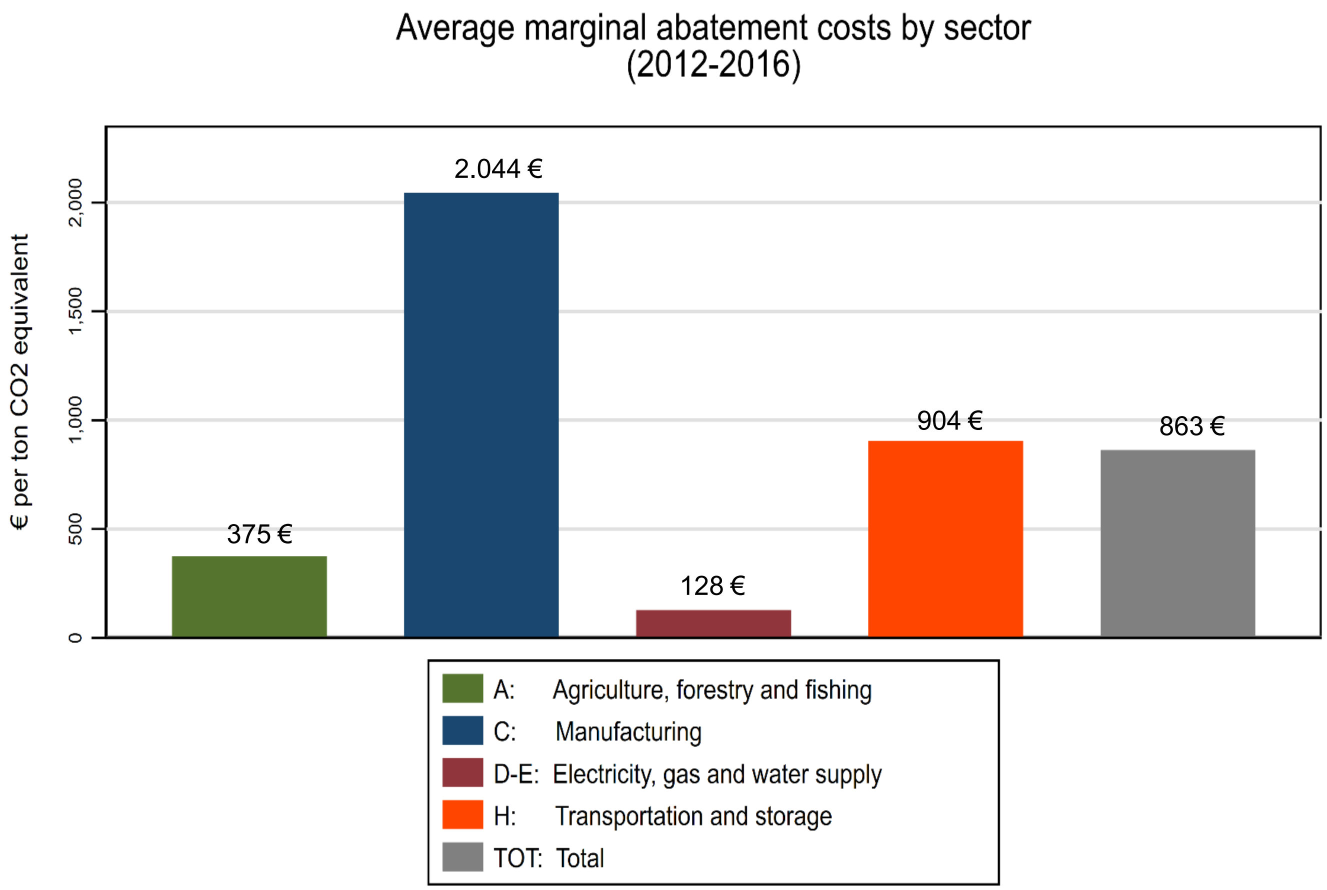
- Overall reduction potential of 2,6 mega tons CO2 equivalents (≈ 77% of total GHG emissions)
- Reduction potential is mainly driven by emission intensive sectors A, C, D-E and H (≈ 93% of total reduction potential)
  → **consideration of abatement costs**
- Sectors B, F and G only account for 7% of the overall reduction potential

Results II - Abatement costs as ‘foregone output enhancement’



- Positive ratio of potential emission reductions to potential output enhancement for all sectors
- On average, a 72% reduction in emissions would cost a foregone output enhancement of 60%
- Ratio is most favourable for the energy sector

Results III – Marginal abatement costs



- Average marginal abatement costs of approx. 860 € per ton CO2 equivalent
- Marginal abatement costs vary by sector and country
  - Highest abatement costs in the manufacturing sector
  - Lowest abatement costs in the energy sector
- Estimated marginal abatement costs differ significantly from actual CO2 prices

Conclusion

- Huge reduction potentials related to inefficiencies in the use of currently available technologies
- Highest reductions are possible in most emission intensive sectors (manufacturing and energy sector)
- Potential enhancements of gross value added are also high
- Average marginal abatement costs of 860 € per ton CO2 equivalent
  - Much higher than current CO2 prices
  - Emission reduction is on average most cost effective in the energy sector
  - Average marginal abatement costs are highest for the manufacturing sector
- Removing inefficiency can contribute to achieve intended climate targets