

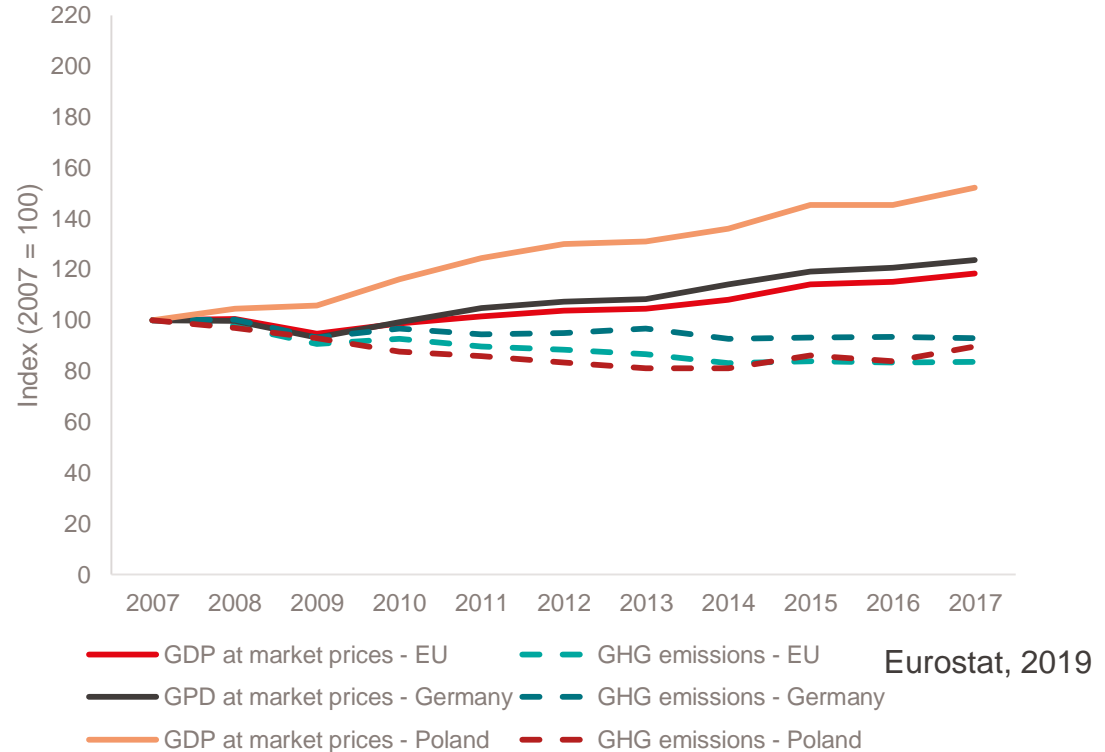
Carbon Leakages: Towards Tailored Policies to Reduce Emissions Embodied in the EU Petrochemical Sector

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Energy Policy II

Decoupling Greenhouse Gas Emissions from Economic Growth in the EU is vital

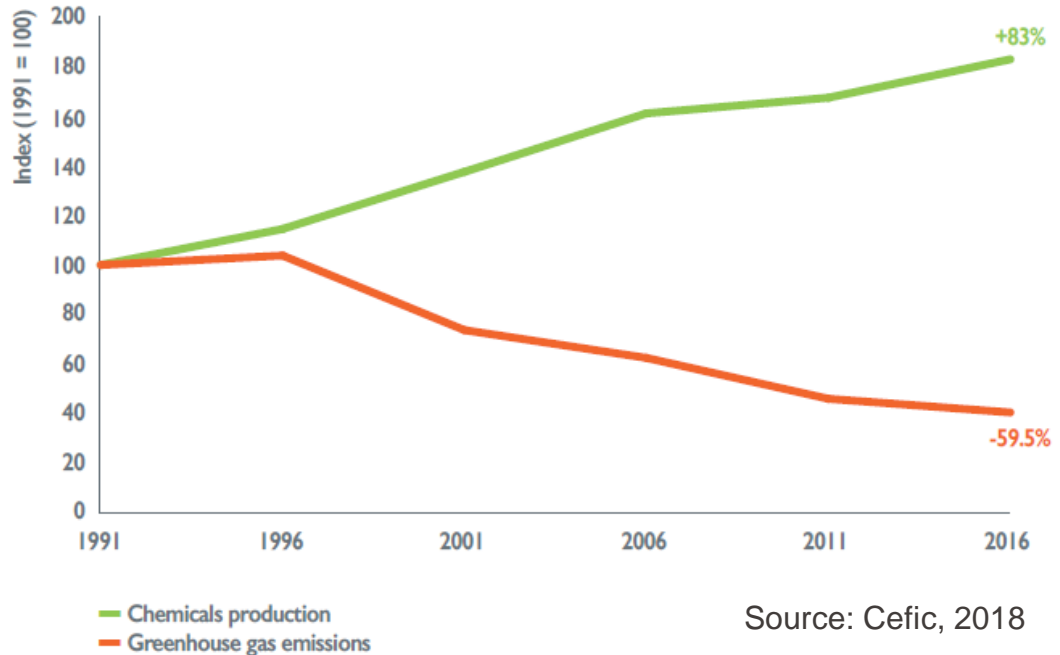
The EU and its Member States have achieved (relative) decoupling of over the last decade



The Petrochemical Industry achieved necessary decoupling

- A successful decoupling has been achieved by reducing GHG emissions, even though production has grown substantially
- This however neglects the trade dynamics of the petrochemical industry

Development of EU chemicals production and greenhouse gas emissions



Source: Cefic, 2018

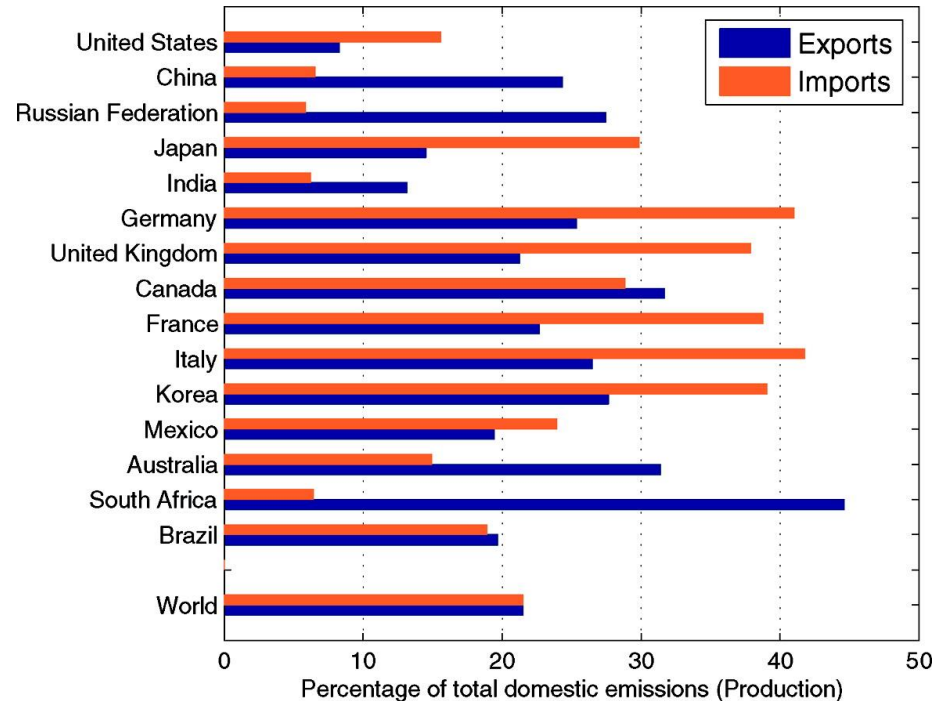
Production- vs. Consumption-based Accounting

Production-based Accounting	Consumption-based Accounting
Producer carbon responsibility	Consumer carbon responsibility
Method adopted by UNFCCC	Alternative method that puts the burden of emitting GHG on consumers
Accounts for GHG emitted within a country's territory when goods, services or energy are produced	Accounts for GHG emitted within a country's territory when goods, services and energy are consumed
Does not consider where goods are finally consumed (i.e. imports)	Does not consider where goods are produced (i.e. exports)
Unable to account for potential carbon leakage, both weak and strong	

EPFL Focusing on Territorial Emissions favours highly Industrialised Countries

- Big differences between the developed and developing economies with respect to their emission trade balance
- The GHG emission trade deficit illustrates the potential distortion of the carbon responsibility of developed countries

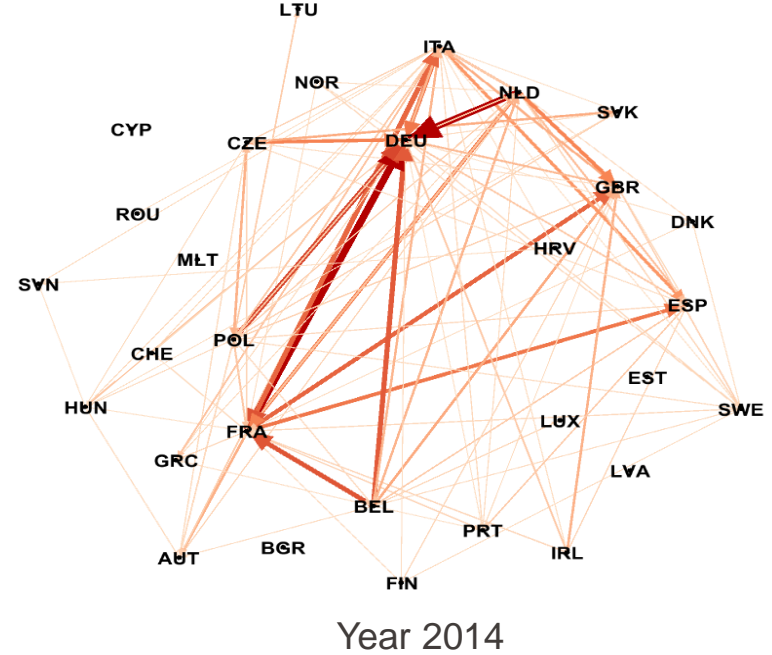
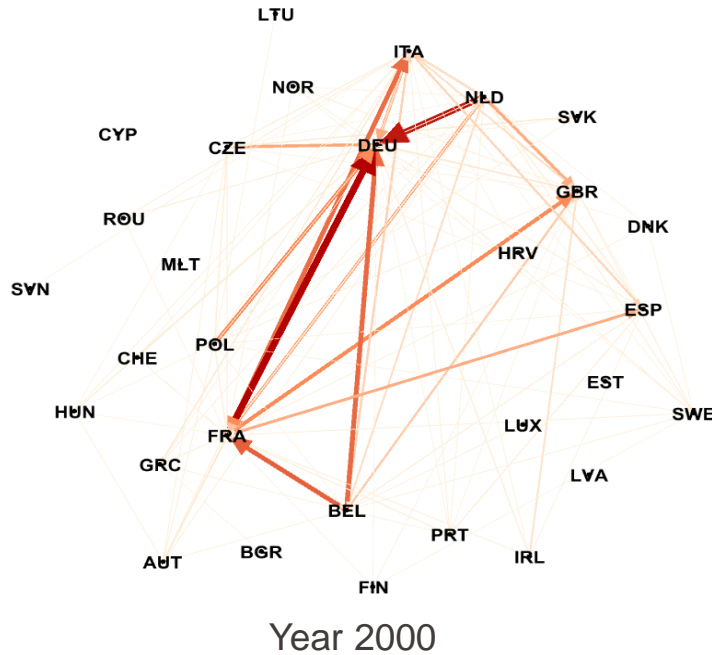
Emissions embodied in industry and exports compared to total production-based emissions



Peters and Hertwich, 2007

Embodied Emissions in the Petrochemical Industry

- Virtual carbon flows between petrochemical sectors among EU member states (Gt of GHG) are becoming increasingly more



Research Objectives

As a result of only focusing on territorial emissions, the analysis of whether decoupling is achieved for European petrochemical industries may not be an accurate representation

- **We aim to analyse the state of decoupling in EU petrochemical industries, based on a range of different measures of carbon responsibility**

Neglecting embodied emissions further raises questions about the responsibility of different countries with regards to their contribution to the European emission inventory

- **We illustrate how the allocation of GHG emissions impacts the “true” carbon responsibility of different countries and their respective petrochemical sector and enable a more equitable representation of the contribution to emission reduction targets**

National and industrial energy and climate policies are mainly as a result of territorial emission inventories only and similarly focus on the reduction thereof

- **We therefore propose taking account of the varying emission burdens of countries and the petrochemical industry in policy-making, by showing the impact of the different carbon responsibility measures**

I

Full producer carbon responsibility (i.e. territorial emissions from production + exports)

II

Full consumer carbon responsibility (i.e. territorial emissions from production + imports – exports)

III

Shared carbon responsibility

A mix between full producer and carbon responsibility, e.g. an average



Other scenarios planned with alternative weights

- E.g. Attribution of relative responsibility based on the individual contributions of each actor in the supply chain to value added

- Use of EORA dataset, an open source global multi-regional input-output table, which links 26 activities ($i, j = 1, 2, \dots, 26$) in 189 countries plus RoW ($C = 1, 2, \dots, 190$) and provides complete time series from 1990 to 2015
- Assessment of the impact of different carbon responsibility measures, depending on emission factors e_i , final demand y_{ij} and technical coefficients matrix A_{ij}

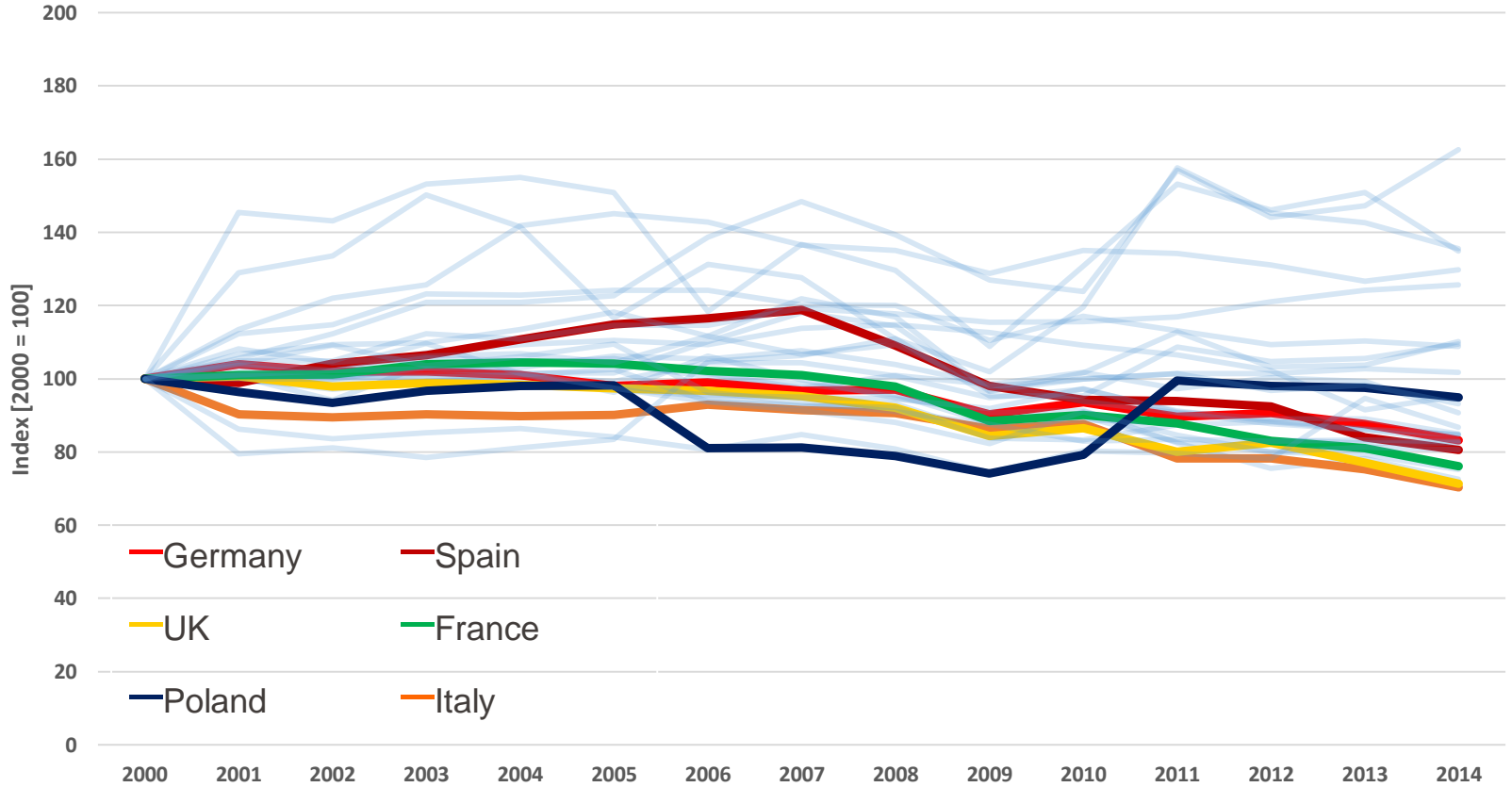
$$\begin{pmatrix} p_{11} & \cdots & p_{1C} \\ \vdots & \ddots & \vdots \\ p_{C1} & \cdots & p_{CC} \end{pmatrix} = \begin{pmatrix} E_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & E_C \end{pmatrix} \begin{pmatrix} I - A_{11} & \cdots & -A_{1C} \\ \vdots & \ddots & \vdots \\ -A_{C1} & \cdots & I - A_{CC} \end{pmatrix}^{-1} \begin{pmatrix} y_{11} & \cdots & y_{1C} \\ \vdots & \ddots & \vdots \\ y_{C1} & \cdots & y_{CC} \end{pmatrix}$$

$$\text{Producer responsibility}_i = \sum_j p_{ij}$$

$$\text{Consumer responsibility}_i = p_{ii} + \sum_j (p_{ij} - p_{ii}) - \sum_i (p_{ij} - p_{jj})$$

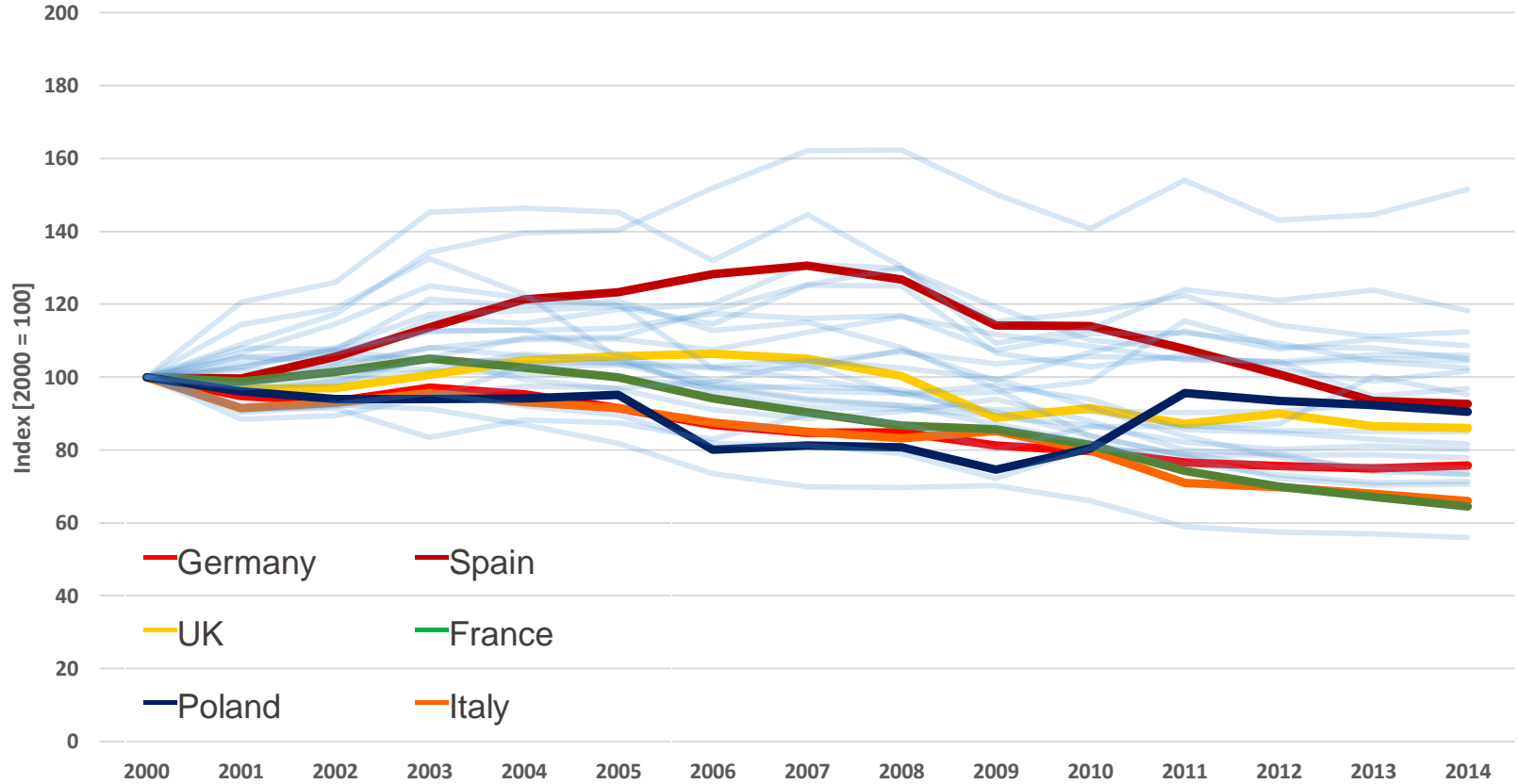
$$\text{Shared responsibility}_i = \overline{\left(\sum_j p_{ij}, p_{ii} + \sum_j (p_{ij} - p_{ii}) - \sum_i (p_{ij} - p_{jj}) \right)}$$

Results: 100 % Producer Carbon Responsibility



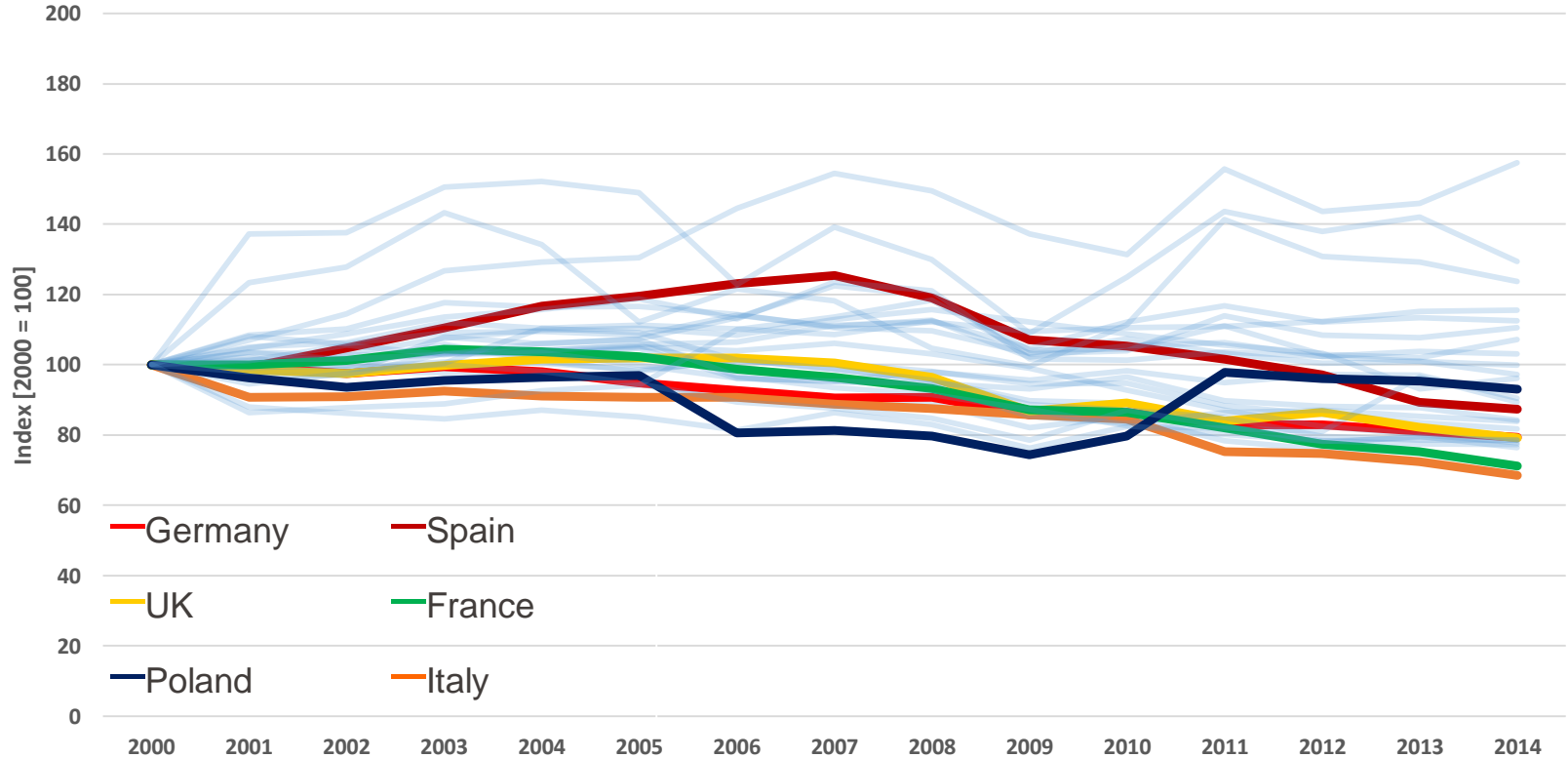
Results: 100 % Consumer Carbon Responsibility

16th IAEE European Conference Ljubljana - 25-28 August, 2019

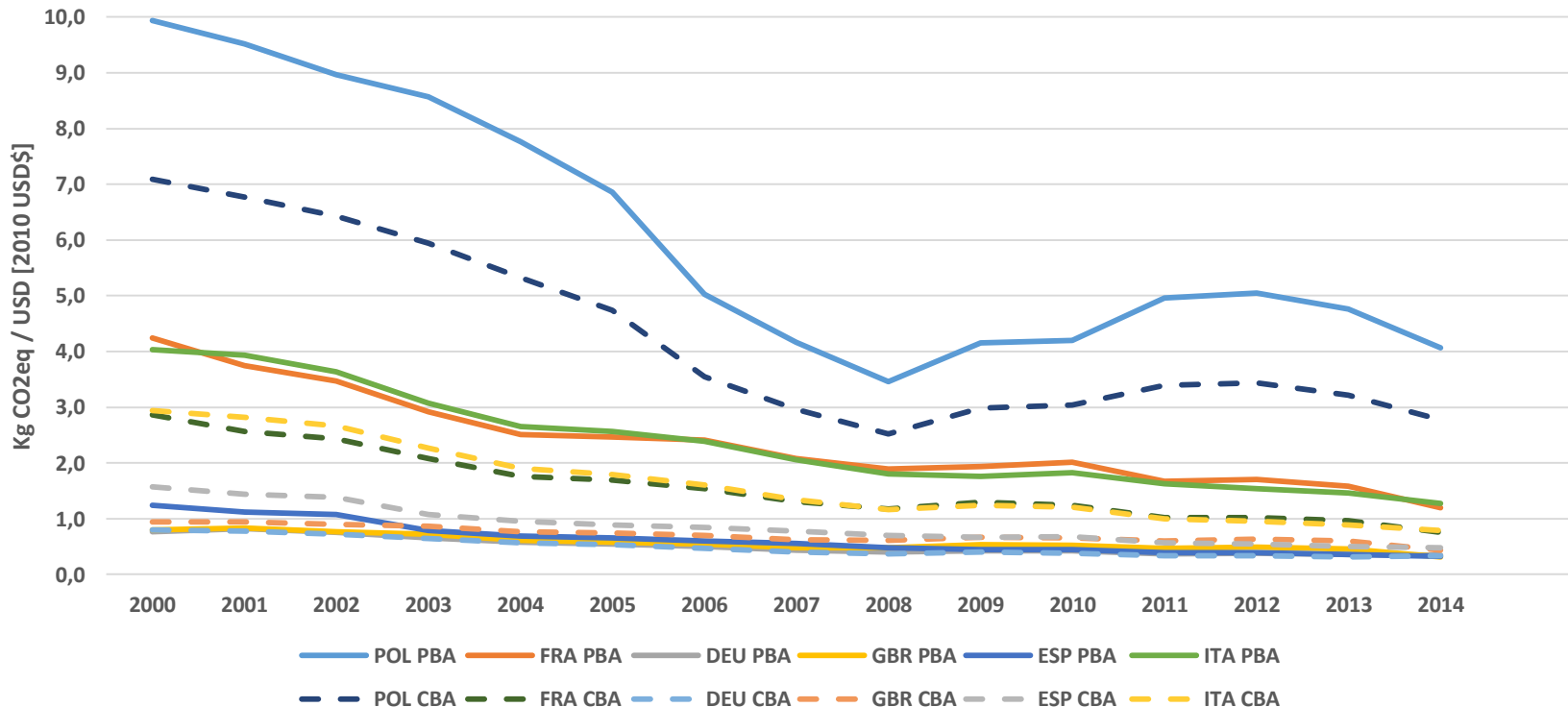


Results: Shared Responsibility - 50% Producer Responsibility and 50 % Consumer Responsibility

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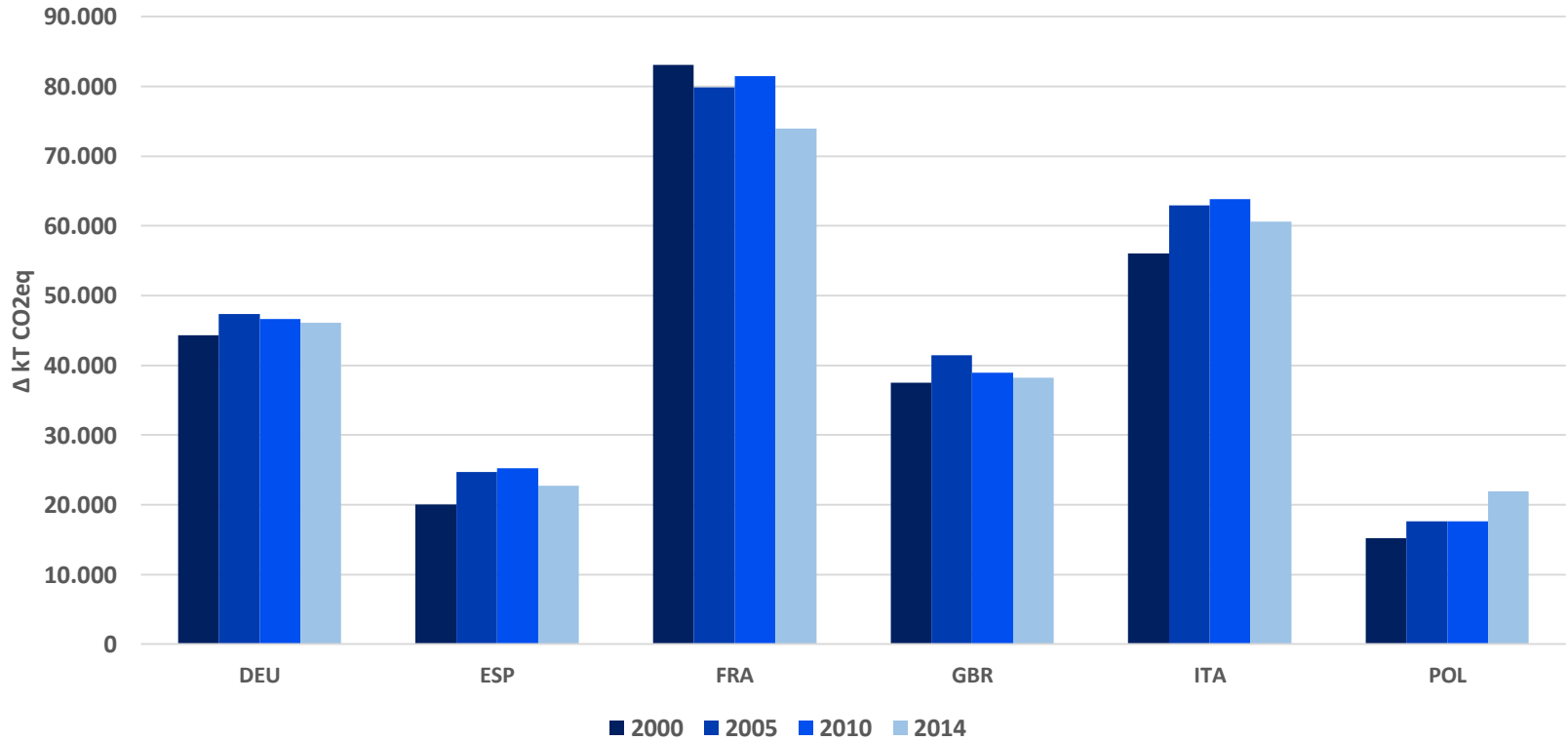


« True » picture of decoupling in the EU petrochemical industry: Producer Responsibility vs. Consumer Responsibility



Comparison – Consumer Carbon Responsibility: Worldwide vs. Intra-EU

■ 16th IAEE European Conference Ljubljana - 25-28 August, 2019



Main Lessons for Policy-Making

I

Looking at territorial emissions favors large exporting petrochemical industries in certain countries over its import-reliant counterparts

II

Little improvement in reducing emissions has been achieved over the last decade, irrespective of the carbon accounting method

III

The use of a mix of carbon responsibility measures allows policy-makers to evaluate the emission burden on national petrochemical industries more comprehensively

IV

As the emission trade with the rest of the world is becoming more and more important, policy-makers will have to consider potential carbon leakage with future energy policies

I

Great differences in producer and consumer carbon responsibility among EU petrochemical industries

II

Dynamic shifts in carbon trade balances between the EU and the rest of the world among EU countries

III

Scope for using a range of carbon responsibility methods to devise more informed policies



Future work

- Testing of more elaborate responsibility attributions (e.g. based on value added)
- Inclusion of structural effects by means of computable general equilibrium modelling

- Eurostat, 2019. Database
- Cefic, 2018. Facts and Figures of the European Chemical Industry
- Peters and Hertwich, 2007. CO2 Embodied in International Trade with Implications for Global Climate Policy

Embodied Emissions in the Petrochemical Industry: Comparison with Textile Industry

- This is much less accentuated in a less interconnected industries

