Decoupling between economic activity and GHG emissions in France: building a fully consistent official statistics framework

CESS
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Insee
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01 OUR PROJECT

Our purpose : facilitate the joint use of carbon emission and macroeconomic data in France

- **Partnership between**
  - INSEE, the national statistical office (NSO) → *compiles the monetary national accounts*
  - The SDES, statistical office of the ministry of the environment → *compiles the Air emission accounts (AEA) and the carbon footprint*
- **Focus on consistency between monetary and physical information**
  - To allow relevant analysis of coupling / decoupling at economy and sector level, both for national emissions and footprint

The “carbon accounts” will regroup three sets of tables

Three « hybrid » sets of tables to link the physical and monetary accounts

- Production approach
  - Air emission accounts with monetary production and value added
    - → *carbon intensity of resident production*
- Demand approach
  - Carbon footprint with monetary final demand
    - → *carbon content of final demand*
- International carbon transfers or “bridge tables”
  - Carbon embedded in imports and exports
    - → *bridge between the production and demand approaches*

Support national policy making (monitoring and evaluation)

- National low-carbon strategy (Government plan to reach GHG neutrality)
- Dashboard monitoring : Sustainable Development Goals (SDGs) / “New wealth indicators”

Provide a base to develop new environmental and economic analyses

- Support analytical work by environmental and macro-economists, in the public sector and other research institutions
- Provide connections with micro-data on carbon footprint (GHG contents of goods and services)

02 THERE IS (SIGNIFICANT) MODELLING INVOLVED !

In general, what do you need to compute a (macro) carbon footprint ?

GHG emissions by industry in all countries = “Air emission accounts” (AEA)

- In our project : 45 countries + “rest of the world” X 64 industries

A large matrix describing all global economic flows, inside countries and between countries = “multi regional input-output” tables (MRIO)

- In our project : FIGARO tables developed by the European Commission, describing 46 countries X 64 products

To combine them : the important assumption that when you buy a given product, the carbon content is proportional to its monetary value

Our new methodology : a “simplified SNAC” method based on FIGARO

The French ministry of the environment has been estimating and disseminating a carbon footprint annually since 2012

- Input/output method modeling France and 19 foreign regions – but several limitations :
  - For extra EU countries, the EU input-output structure was used
  - Assumption that a good imported from country X was *manufactured entirely under the technical conditions* of country X : no real modelling of international value chains

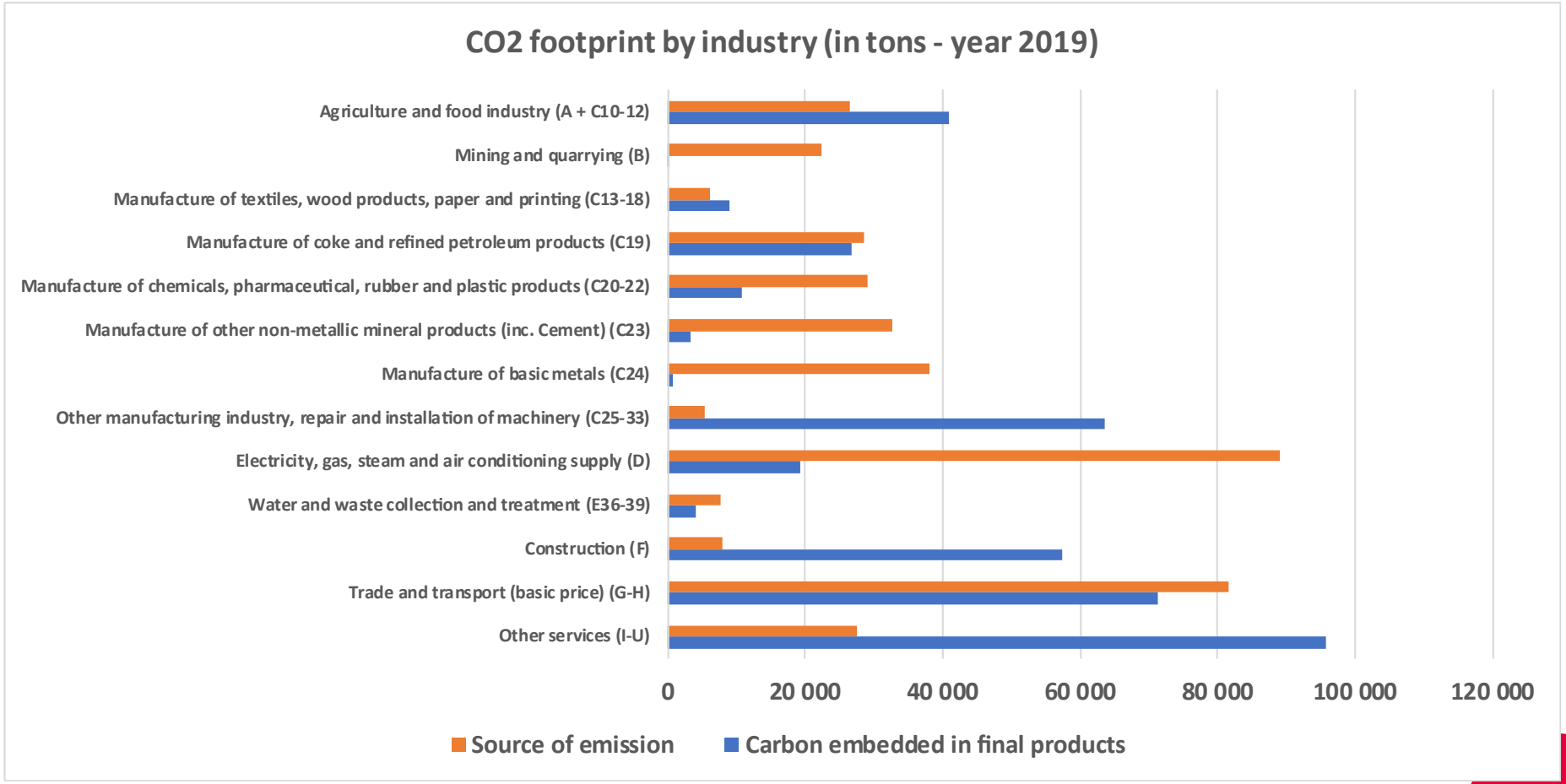
In 2024 : transitioning to the FIGARO multi regional input-output model (MRIO)

- To retain a complete consistency with French national accounts : we use a so called « simplified single national accounts consistent » method (simplified SNAC)
  - The carbon content per euro of imported goods and services comes from FIGARO, but is applied to the official French national accounts monetary aggregates

Content of the “demand approach” tables :

- **GHG content of the French final demand with two complementary breakdowns**
  - GHG content of final goods and services
  - GHG emissions at the source (initial production in all countries)
- **Estimation of the carbon footprint up to year N-1**
  - Some forecasting needed for the GHG content per euro of imported products in N-2 and N-1 !
- **Level of detail available**
  - GHG content of final goods and services : up to 64 products
  - GHG emission at the source : ~ 12 industries X 10 regions

Two complementary breakdowns of the carbon footprint : source of emission and carbon embedded in final products



Data-sources / precision

- Emissions : uncertainty around GHG emissions in many countries ! (especially for CH4)
- Insufficiently detailed economic data
  - IOT and MRIOT are difficult to build and some source information is very scarce or missing (trade and transport margins, detailed uses of imports …)
  - No detail in FIGARO for agriculture and extractive activities → introduce a possible bias in the estimation & limits the analytical potential

Methodology / concepts

- Using standard IOT definitions, fixed capital amortization is not propagated in the value chain
- Carbon emissions related to land-use change (LULUCF) is not integrated into the current “Air emission accounts” and carbon footprints

Further research planned in France

Possible improvements in the coming years

- Building on FIGARO tables, but increasing the level of details for agriculture and extractive activities
- Complementing the “carbon accounts” with similar “energy flows accounts” (energy domestic use and footprint)
- Building around the “footprint of production” for specific activities, like tourism

In parallel : a major goal is to provide a robust breakdown of the carbon footprint by household categories (age, revenue, occupation, location…)

- Requires reliable surveys on households behavior, possibly complemented by administrative sources

03 WHAT'S NEW IN OUR PROJECT ?

Carbon fooprints based on MRIOs have been around for a while ...

… but few countries compile and publish it as official statistics

- Netherlands and UK : full SNAC based on EXIOBASE
- Denmark, Finland, Norway, Sweden : simplified SNAC based on EXIOBASE
- Switzerland : EXIOBASE ?...
- European Union : based on FIGARO

[list based on our best knowledge !]

No harmonized methodology or data source for these national estimates !

Some refinements around the core footprint calculation

- **Footprint estimation up to year N-1**
  - Some forecasting needed for the GHG content per euro of imported products
- **Full estimates of trade and transport margins in France and abroad**
  - To correctly reconcile the imports values in French national accounts (CIF valuation) with FIGARO (basic prices)
- **Estimates of "gross" carbon content of imports and exports**
  - To reconcile the footprint narrative with trade statistics (GHG balance by type of goods and partner countries), and to be able to build a full carbon equivalent of the classical GDP equation :

    GDP + imports = domestic final use + exports

To go beyond the basic results of footprint by CPA products

- **Consistency with purchaser prices**
  - Final consumption and carbon footprint of trade and transport is bundled with the related final goods, rather than being shown separately
- **A split by main "consumption categories"**
  - Housing / food / transportation / equipment / public services / market services → possible because we break down the footprint of total GFCF by institutional sectors and industries
- **New tables on the "footprint of production"**
  - To provide a decomposition of the "direct" and "upstream" footprint of french production → connection with company level carbon accounting

Dissemination 5th November 2024

- **Detailed data tables on Insee and SDES websites – combining emission and economic data**
  - Detailed time-series from 2010 to 2023
  - More aggregated results from 1990 to 2009
- **Two papers**
  - Statistics : main results of resident emissions and carbon footprint up to 2023 (4 pages)
  - Analytical / conceptual : “augmenting” national accounts to show the economic impact of climate change
- **And more to come in early 2025**
  - Methodological working paper
  - Analytical paper : time-series decomposition of the “decoupling” between GHG and economic activity , from a production and consumption perspective

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Annex : Why the simplified SNAC and not a direct FIGARO estimate ?

Many advantages to the simplified SNAC in our view

- Consistency of the footprint results with French national accounts final use vectors at a fine level of detail (typically 128 products = A64 X domestic / imported)
- Very practical framework to make N-2 and N-1 estimates of the total footprint
  - The forecasting part is limited to the carbon content per euro of imported goods and services
  - All the rest (= nationally compiled IOT and national AEA) can be used as is, and covers a large part of the volatility of the carbon footprint
- Final use vectors can be more detailed than in FIGARO. For example : GFCF of general government / firms / households

Simplified SNAC procedure : start from the MRIO expression of the carbon footprint and substitute all the elements which are available in the official French national accounts (in red)

$$F_{mrio} = \underbrace{e\left(I-A\right)^{-1}FU}_{\text{full carbon footprint of French domestic final use}}$$

$$F_{mrio} = \underbrace{e_{FR}\left(I-A_{FR}^{FR}\right)^{-1}FU_{FR}}_{\text{'domestic' component}} + \underbrace{e\left(I-A\right)^{-1}A_{M}^{FR}\left(I-A_{FR}^{FR}\right)^{-1}FU_{FR}}_{\text{imports for intermediate use}} + \underbrace{e\left(I-A\right)^{-1}FU_{M}}_{\text{final use of imported products}}$$

$$F_{snac} = \underbrace{e_{FR}\left(I-A_{FR}^{FR}\right)^{-1}FU_{FR}}_{\text{'domestic' component}} + \underbrace{e\left(I-A\right)^{-1}A_{M}^{FR}\left(I-A_{FR}^{FR}\right)^{-1}FU_{FR}}_{\text{imports for intermediate use}} + \underbrace{e\left(I-A\right)^{-1}FU_{M}}_{\text{final use of imported products}}$$

To be noted : all the elements in red should be valued in « basic prices » whereas in the national IOT, imports are valued CIF ! → need to remove all trade and transport margins (TTM) on *imported goods* and add them to *trade and transport services*

Annex : Full treatment of trade and transport margins (1)

Example : a car is produced in China and imported to France

- **Basic price out of the factory = € 10.000**
  - **+ € 800 of TTM from factory to port**
- **FOB price in the Chinese port = € 10.800**
  - **+ € 1.200 of International transit from China to France**
- **CIF price in the French port = € 12.000**

The final use for the car in the French national IOT will therefore be 12.000 euros

- **The SNAC formula, if applied to this demand vector, will associate these €12.000 with the « per euro carbon content » of a Chinese made car – from the general carbon content vector $e(I-A)^{-1}$**
- **In reality, the carbon footprint should correspond to €10.000 of Chinese made car, €1.200 of international transport services and €800 of a mix of trade and transport services in China → the total result may be different !**

How to solve this ?

- Need to estimate CIF-FOB margins by **imported good type** and **{service type X nationality of the transporter}**, whereas in the central framework only the former is available
  - Data sources : FIGARO internal estimates ; OECD ITIC database; French customs experimental database on CIF-FOB margins
- Need to estimate TTM in foreign countries by **imported good type** and **{service type X nationality of the transporter}**
  - Data sources : FIGARO internal estimates
- NB : the “**nationality of the transporter**” is rarely available, and when it is, is very fragile

The footprint calculation naturally generates the following bridge table

		Final user: France	Final user: RoW
Origin of the emissions	**France**	A	B
	RoW	C	-

Air emission accounts (A+B)
Carbon footprint (A+C)

A	French emissions, induced by French final demand
B	French emissions, induced by foreign final demand
C	Foreign emissions, induced by French final demand

However, B and C cannot be interpreted as the carbon content of French exports and imports ! ...

… indeed, French imports incorporate a significant carbon content which will not serve *French* final use, but *foreign* final use through exports → this carbon “pass-through” is neutral on the national footprint