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French carbon footprint – calculation improvement planned

1. Institutional context
2. Current calculation method
3. Upcoming work program (including the possibility of using MRIO data)

Aug. 2021

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1. Institutional context

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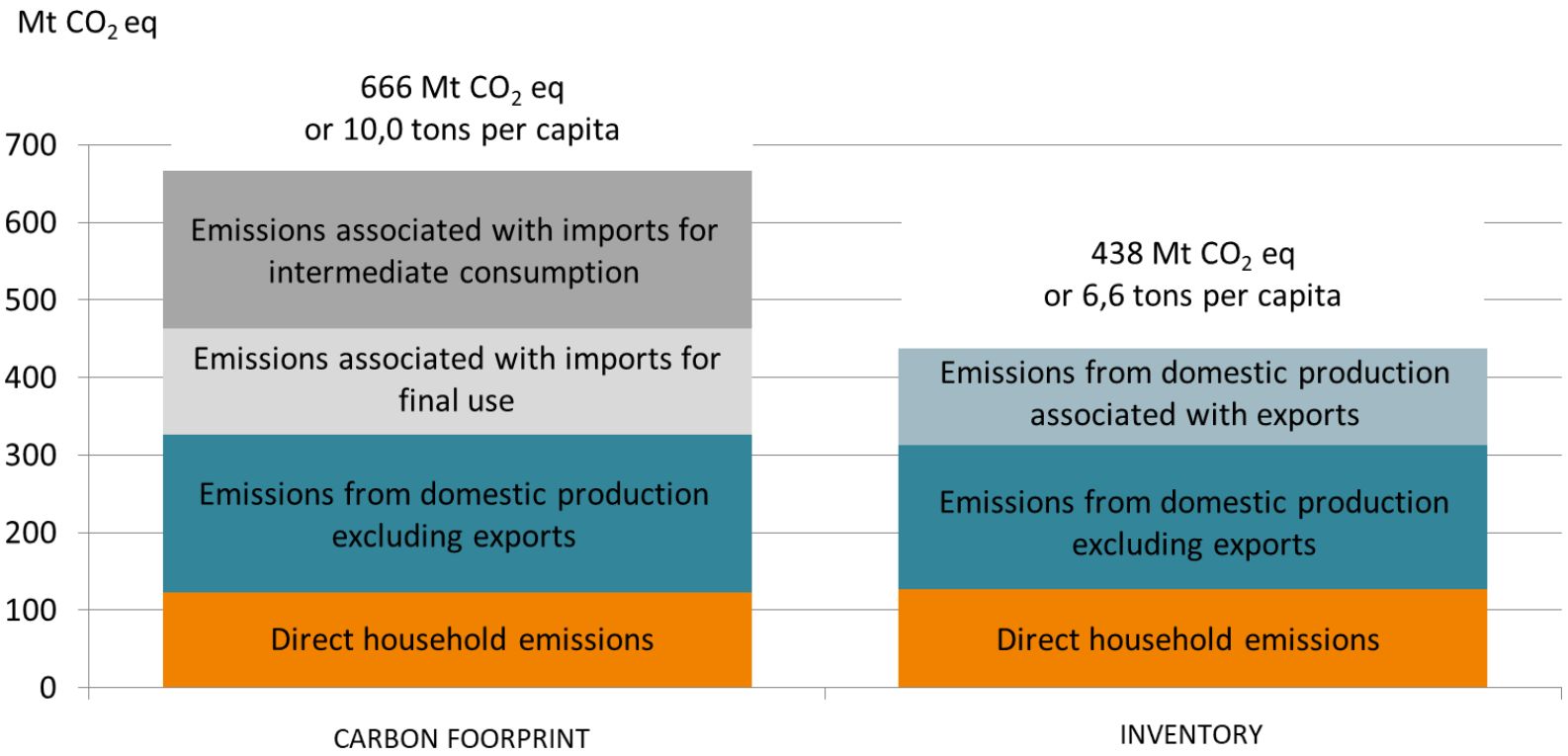
An indicator developed by France's Ministry of ecological transition for environmental information purposes

❑2009 -2010 : Methodological development of carbon footprint calculation and 1st publications

https://www.statistiques.developpement-durable.gouv.fr/

Comparison of carbon footprint and national inventory in 2016



GHGs considered: CO_2, le CH_4 et le N_2O
Geographical coverage: France + Overseas territories
Source: Citepa, Eurostat, Insee, AIE, FAO.
Calculation: SDES, 2020.

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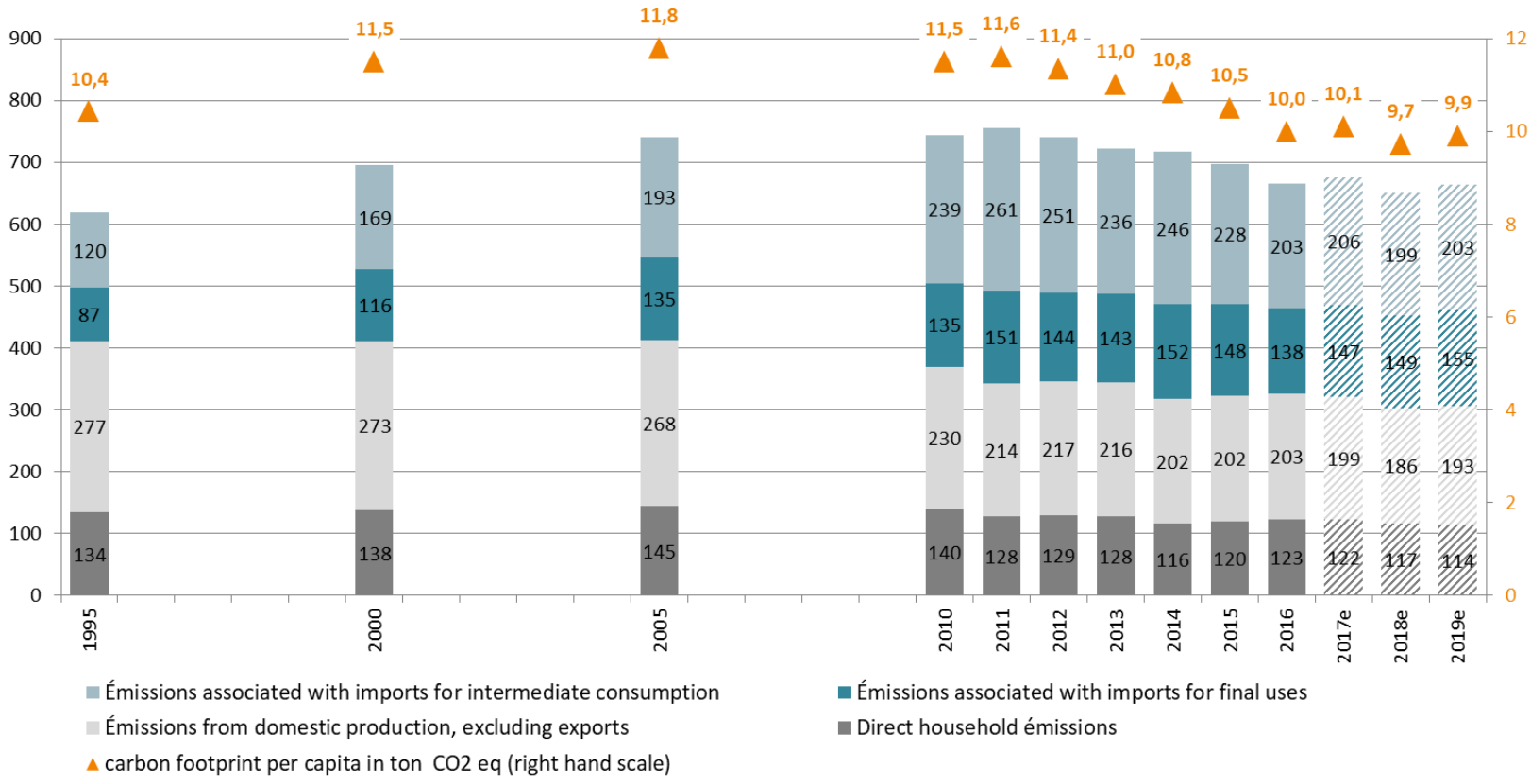
Estimated evolution of the carbon footprint 1995 - 2019



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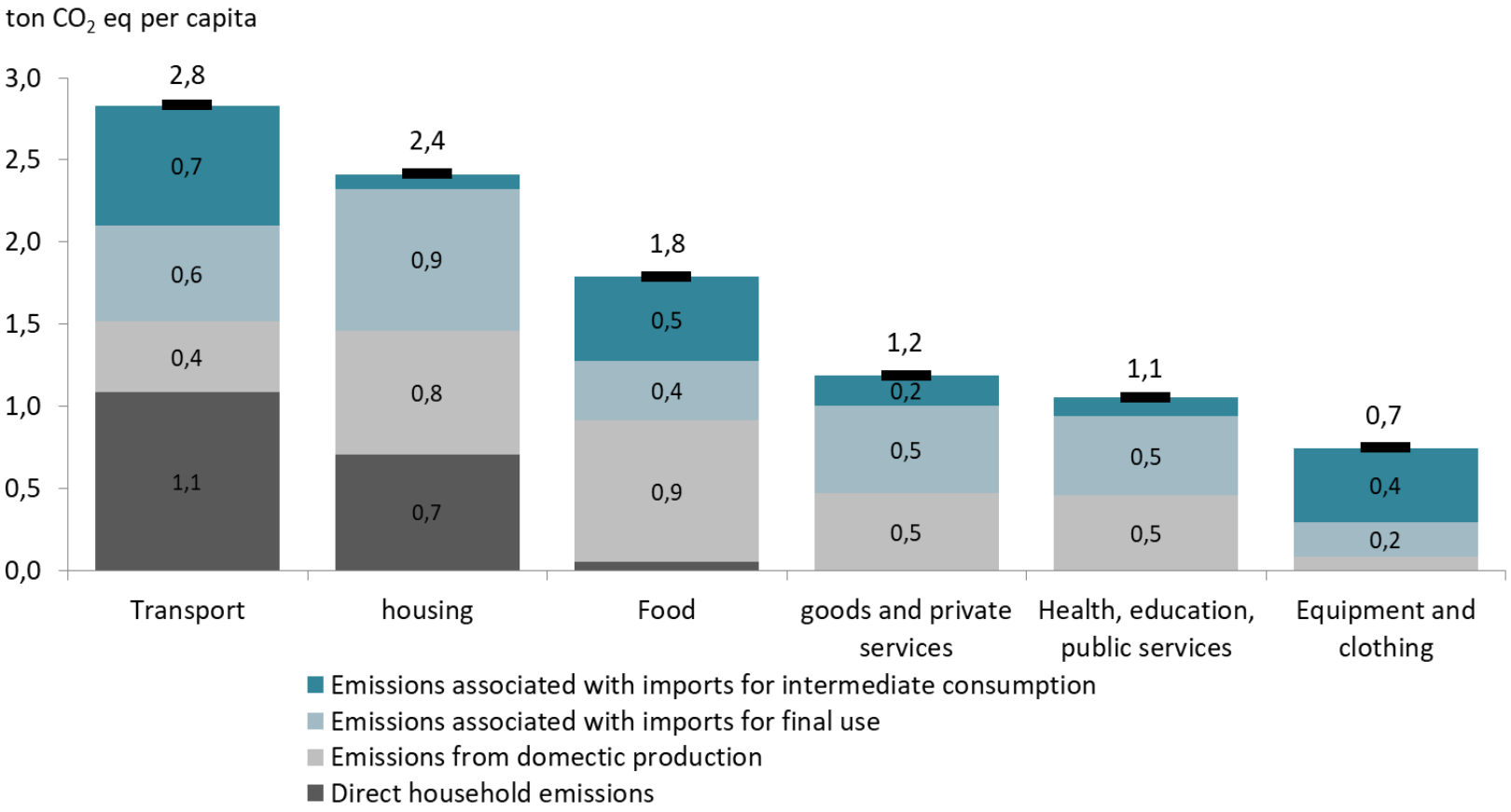
Breakdown of carbon footprint by type of consumption in 2016.



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Now a popular indicator for monitoring public policies

❑2015 : loi « Eva SAS » : **a law** aimed at taking into account the new wealth indicators in the definition of public policies -> since 2015 annual production of the carbon footprint indicator in France in order to meet a **legal requirement**.

❑Since 2015, the carbon footprint has been taken into account in the monitoring of national policies**:**
❑Sustainable Development Goals indicators; 1st edition of the **National Low Carbon Strategy** (SNBC)

❑The law of November 9, 2019 on Energy and Climate
❑foresees for **indicative limits for France's carbon footprint**, to be set in the **SNBC**, and to be respected
❑(deadline for determining the limits: 01/01/2023)

❑Even if these footprint-related objectives are only indicative, it is now recognized that there is a **trend towards greater use of the footprint as an indicator for monitoring and evaluating public policies**.

2. Current calculation method

The most recent edition of the methodological document is currently available in French only

Manuel Baude, Jean-Louis Pasquier (2020), *Méthodologie de calcul de l'empreinte carbone de la demande finale intérieure française*. Commissariat Général du Développement durable – Service des données et études statistiques – Document de travail, Décembre 2020.
https://www.statistiques.developpement-durable.gouv.fr/lempreinte-carbone-des-francais-reste-stable?rubrique=27&dossier=1286

One of the 1st paper published in english contains a summary of the methodology, data sources have changed but the approach is the same

Fabrice Lenglart, Christophe Lesieur, Jean-Louis *Pasquier (2010), CO_2 emissions from the economic circuit in France. L'économie française - Comptes et dossiers - Insee Références - Édition 2010, Insee Références*
https://www.insee.fr/en/statistiques/1372484?sommaire=1372493

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Calculating France's carbon footprint

- Methodological concept : allocating GHG emissions to the **domestic final demand**
- (goods and services consumed by a the population of a country
- regardless of the geographical origin of these emissions)

- Three components:
  - Households' direct emissions (transport, housing)
  - Emissions from domestic production (excluding exports)
  - Emissions embodied in imports

- **No** international conventions **or standards** for its calculation.

- Environmentally extended input-output calculation

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Calculation overview : « detailed estimates » up to N-4 (1/3)

- **CO_2, CH_4 and N_2O:** three of the seven greenhouse gases are taken into account in the calculation of the footprint, representing around **95% of total of GHG emissions** in terms of GWP_{100}.

- Household Emissions: Air Emissions Accounts Data (MTE/Citepa)

- **Domestic production** emissions:
  Input Output calculation using France's
  - symmetrical input-output tables (Insee/Eurostat)
  - air emissions accounts (MTE/Citepa),
  - both broken down into **A64 industries**

$$\mathbf{E^d} = \langle \mathbf{e_j^d} \rangle . \left[\mathbf{I} - \mathbf{A^d} \right]^{-1} . \langle \mathbf{DF^d} \rangle$$

$\mathbf{E^d}$	are the GHG from the domestic production attributed to the domestic final demand
e_j^d	are the GHG intensities of the production by industries
$\left[I - A^d\right]^{-1}$	is Leontief inverse matrix, where A^d is the matrix of the domestic technical coefficients
$\mathbf{DF^d}$	is the final demand

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Calculation overview : « detailed estimates » up to N-4 (2/3)

❑Emissions from **imports from the EU**:

❑

❑Same input-output calculation using { the **EU** symmetrical IOT (Eurostat)
❑ **EU** air emissions accounts (Eurostat)
❑ both broken down into **A64 industries**

❑distinguishing imports for **final use** from imports associated with **intermediate consumption**

GHG embodied in imports for intermediate consumption

GHG embodied in imports for final use

$$E^{m.ue} = \langle e_j^{ue} \rangle . [I - A^{ue}]^{-1} . [A^m] . [I - A^d]^{-1} . \langle DF^d \rangle + \langle e_j^{ue} \rangle . [I - A^{ue}]^{-1} . \langle DF^m \rangle$$

GHG content of EU products	Imports embodied ine the domestic production	Domestic final demand (i.e. excluding exports)	Imported final demand

❑**simplifying assumption:** all goods and services imported from the EU were produced in the EU

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Calculation overview : « detailed estimates » up to N-4 (3/3)

❑Emissions from **non-EU imports**:

Split into 9 foreign zones (fz)

GHG intensities of industries are **adjusted** according to the relative difference between the intensity of the EU and that of the area concerned (Sources: IEA and FAO)

- CO_2 intensity of electricity production
- CH_4 or N_2O intensity of agriculture
- GHG intensity of GDP for other industries

$$E^{m.ue} = \langle e_j^{fz} \rangle . [I - A^{ue}]^{-1} . [A^m] . [I - A^d]^{-1} . \langle DF^d \rangle + \langle e_j^{fz} \rangle . [I - A^{ue}]^{-1} . \langle DF^m \rangle$$

GHG content of Foreing zones' products	Imports embodied in the domestic production	Domestic final demand (i.e. excluding exports)	Imported final demand

- the **EU technical coefficients matrix** is used for all imports' zones

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Calculation overview : « preliminary estimates »

Given the unavailability of some data for recent years, a methodology for producing preliminary estimates was developed. The calculation is based on the last available detailed calculation (year N-4).

❑Direct household emissions
Data from GHG emissions accounts available

❑Emissions from domestic production
Input-output calculation based on the latest detailed calculation (N-4)
Adjustment: domestic final demand ()
domestic GHG intensity of the industries ()

The structure of the intermediate consumption remain unchanged ()

❑Emissions associated with imports
Input-output calculation based on the latest detailed calculation (N-4)
Adjustment: domestic final demand ()
imported final demand ()
foreign GHG intensity of the industries (and)
The structure of the intermediate consumption remain unchanged (and)

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3. Upcoming work program
(including the possibility of using MRIO data)

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Upcoming work program

❑Reminder: At this stage there is no regulatory objective linked to the calculation of the footprint. This being said**, by 2023 the footprint will be used to define targets** for indicative GHG emissions limits.

❑A **working group** has been set up on the **carbon footprint methodology**, which should be completed in the fall of 2021 in order to make the current **methodology more robust**.

- Short term first priority: improve the estimation of the imported carbon footprint.
- Medium term priority: improve the "provisional" calculation (working with fresher data).
- Long term priority: investigate whether, and how to use MRIO database and, if any, which one?

❑Helping tool: use of Avionic (see last slide for more details):

- *The model is based on French symmetric input-output tables and propose three types of modeling*
- The source code and detailed documentation of the model are available on github.

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Focus on the improvement of imported carbon footprint

❑Possible ways to improve the calculation of the imported carbon footprint: **brainstorming stage**

a) by reproducing the current model to which new inputs are integrated: fall of 2021 in order to make the current **methodology more robust**.

- by subdividing EU IOT with other IOT relevant for the different foreign zones
  - *enables the use of tables of technical coefficients specific to each geographical area*
  - *but does not make it possible to find the geographical locations of the value chains*

- by mobilizing data from a MRIO databse (MRIO in structure? geographical groupings? GHG intensities?)

b) by using a MRIO model only for the imported carbon footprint

- make it possible to find the geographical locations of the value chains.

❑Conclusion: **a better understanding of the international databases** is needed to enable their use in the calculation of the French carbon footprint

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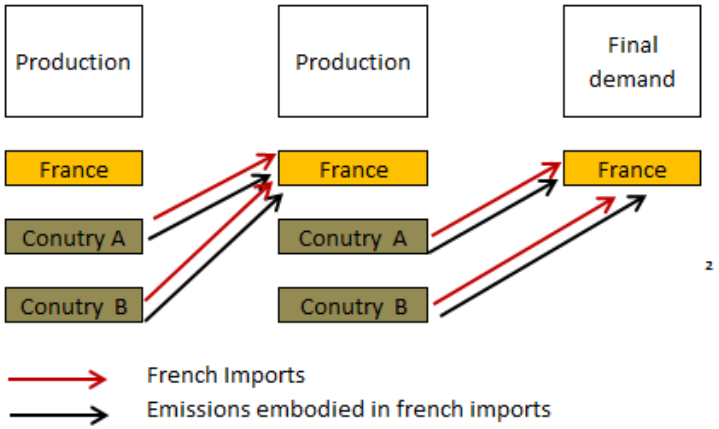
Current french method vs multi-regional input-output model

Import estimates
in the current French methodology



Import estimates
with a MRIO model