

Summary

Once the balance between emissions generated by imports and those generated by exports is taken into account, *France's final demand carbon footprint* is around 9 tonnes of CO₂ per person per year, i.e. 33 per cent more than the quantity of CO₂ emitted in France. In the 1990–2007 period, technological progress in France led to a reduction in the level of unit emissions of CO₂ from production and consumption. Overall, however, this reduction was offset by increased levels of production and consumption. The emissions from manufacturing industry as a whole nonetheless dropped by 10 per cent in the period. The total amount of CO₂ emitted in France in 2007 was almost identical to that emitted in 1990. Seventy per cent of emissions result from activities of production (companies and public administration). Thirty per cent are generated directly by households (cars and heating). Two-thirds of the CO₂ emissions from France's production arise from satisfaction of domestic demand; the other one-third is associated with exported production.

Combating climate change is now a priority issue in international discussions, with the aim of coordinating public policy on the global scale. In preparation for the post-2012 period of the Kyoto Protocol, the European Union member states have opted for an ambitious approach by adopting the legislative *climate-energy package*¹, of which the three main aims are now referred to as the 20-20-20 targets: 20 to 30 per cent reduction in greenhouse gas (GHG) emissions by 2020 in relation to 1990 levels; 20 per cent of energy consumed to be from renewable sources by 2020; and a 20 per cent improvement in energy efficiency² by 2020 in comparison with currently projected levels.

Monitoring of progress towards these objectives is based on the GHG emission inventory system put in place by the United Nations Framework Convention on Climate Change (UNFCCC). However, this system of accounting does not systematically link emissions with the activities and economic actors generating them, and fails to fully capture the international nature of economic activities. The study presented in this document, relating solely to carbon dioxide (CO₂) emissions, is based, essentially, on integrated economic and environmental accounts of the *National Accounting Matrix including Environmental Accounts* (NAMEA) type, which combine input-output tables (IOT) from national accounts with (physical) environmental accounts broken down in terms of economic activities (Ifen, 2006).

The study covers, in order of presentation:

- 1) the CO₂ emissions generated in France, broken down by economic activity, and changes in those emissions in France between 1990 and 2007;
- 2) allocation of emissions to final demand;
- 3) factors influencing changes in emissions;
- 4) estimates of CO₂ emissions associated with imports in France.

On the basis of the accounting methods specific to the NAMEA methodology, a certain number of results, already stated elsewhere, are confirmed (reduction in CO₂ emissions from industry, and rise in those generated by the services sector, including transport), but are examined at a finer level of detail. These accounts also show the emissions generated directly by households (cars and heating systems): one-third of the national total (including use of biomass as fuel).

Attribution of emissions from domestic production to final demand, by combining emissions accounts with IOT, makes it possible to distin-

guish between two types of aspect: direct (fuel use) and indirect (intermediate consumption of products of which manufacture generates some CO₂ emissions). This approach reveals the underlying role of activities such as services and construction in the total of domestic production emissions, in spite of their relatively modest direct contribution. It also reveals that around one-third of CO₂ emissions from France's domestic production is generated to satisfy external demand (exports).

Analysis of the factors influencing changes in CO₂ emissions shows, at all levels (households and branches of the economy regardless of area of activity), gains made during the past two decades as a result of technological progress. However, given the increases in production and consumption, the amount of CO₂ emitted in France has, overall, remained stable.

Lastly, the initial estimate of CO₂ associated with imports gives an emissions balance for national final demand (including imports and excluding exports) considerably higher than that currently reported to the UNFCCC, which only includes the quantity of CO₂ emitted on national territory.

Breakdown of CO₂ emissions in France by economic activity, and variations between 1990 and 2007

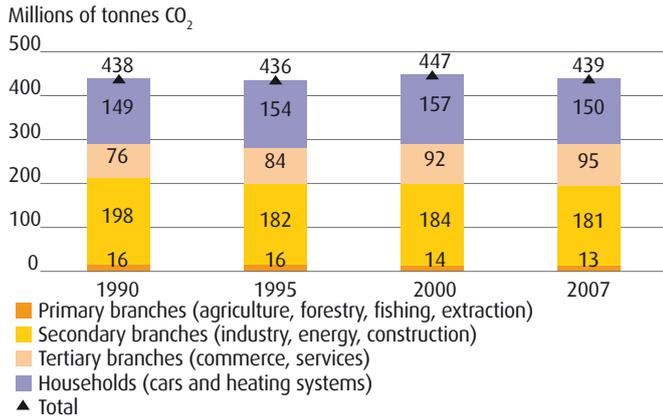
Around two-thirds of the total of CO₂ emissions (including from biomass used for energy) arise from activities of production and one-third arise directly from households (household space and water heating systems, cooking and private car use). This breakdown remained stable over the 1990–2007 period.

In 2007, residential emissions from households with their own heating systems (including hot water and cooking) accounted for 56 per cent of direct household CO₂ emissions: 38 per cent for fossil fuels and 18 per cent for biomass (mainly firewood). The total amount of CO₂ generated directly by households in 2007 is very close (+1%) to that for 1990 (the increase is 4.4 per cent excluding biomass used for energy). Residential emissions reduced by more than 5 per cent, whereas those from private vehicles increased by nearly 10 per cent.

¹ The climate energy package comprises four legislative texts: directives 2009/28/EC, 2009/29/EC and 2009/30/EC and Decision 406/2009/EC adopted by the European Council on 11–12 December 2008, approved by the European Parliament on 17 December 2009 and published in the Official Journal of the European Union on 5 June 2009 (no. L. 140).

² Energy efficiency here is seen from the macro-economic point of view and is expressed by calculating the energy intensity of the national economy (total energy consumed within national territory/gross domestic product).

Breakdown of CO₂ emissions in France 1990–2007



Where branches of production are concerned, primary activities (principally agriculture as CO₂ from forestry, fishing and extractive industries are marginal in France) generate 3 per cent of the country's CO₂ emissions. Secondary activities (manufacturing industries, energy production and construction) generate a little over 40 per cent (15 per cent for energy production), and tertiary activities (commerce and services) around 22 per cent, of which 9 per cent arise from transport services³.

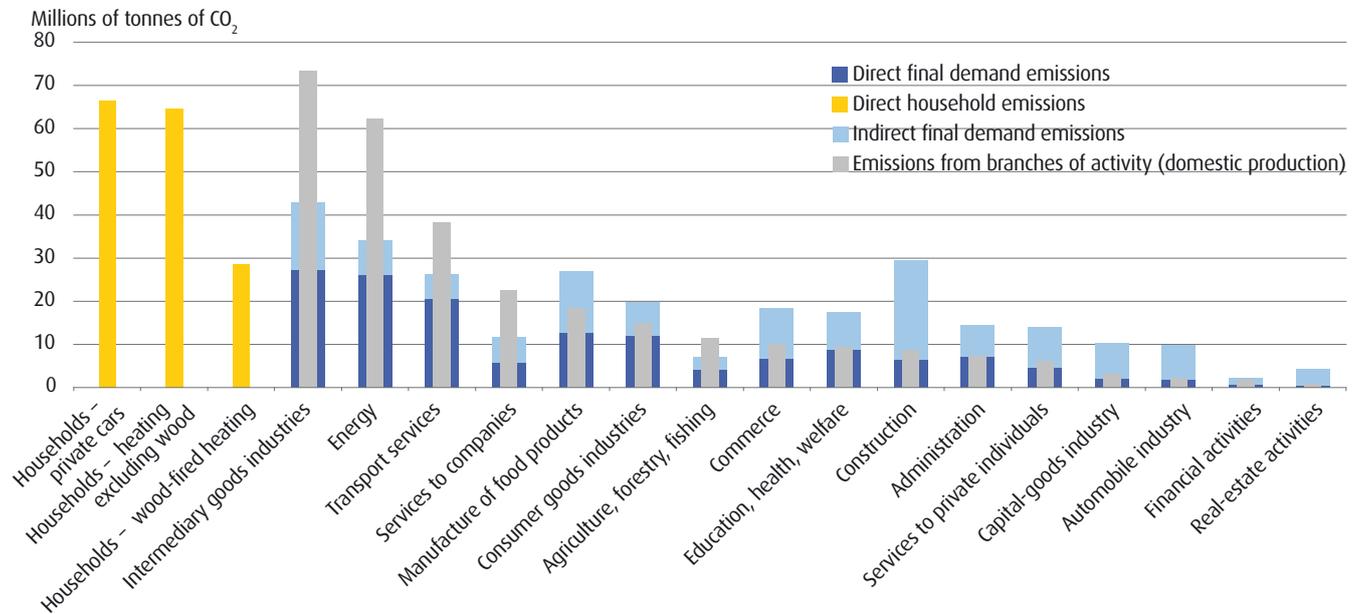
The total quantity of CO₂ emitted by production in the different branches in France in 2007 (289 Mt) was almost identical (- 0,4 %) to that for 1990. Emissions from industry reduced, overall, by 10 per cent while those from services increased by around 25 per cent; the increase was 35 per cent for transport services.

Allocation of CO₂ emissions from France's domestic production to final demand

The goods and services produced by companies and administrative activities are destined for direct final use in France (consumption by households and by administrative services, plus investment), for use abroad (exports), or for use by companies as intermediate consumption. Each of these types of consumption is embodied in a good or service destined, ultimately, for a final use, which it therefore indirectly contributes to satisfying.

A difference is observed between the distribution of CO₂ emissions from branches of activity and that for emissions associated with final demand for the corresponding products. The highest emitting branches produce intermediate goods that are consumed by other branches and used for production (e.g. cement, metals, electricity when used in industry). Conversely, some branches where production is a relatively low emitter are consumers of intermediary goods with high CO₂ content. This is the case for construction, using cement, or automobiles using metals. Some branches, such as chemistry and the food industry, generate high direct and indirect emissions.

CO₂ from domestic production vs domestic final demand, 2006



Reading the chart: companies in the construction sector emitted 8.6 Mt of CO₂ in 2006. In that same year, final demand in construction induced emissions of 29.5 Mt of CO₂ in France (imports excluded), of which 23 Mt arose indirectly via the CO₂ associated with manufacture for intermediate consumption in construction. (Some of the products of the construction branch are used as intermediary consumption by companies from other branches.)

³ This figure does not include the balance between the CO₂ emitted by French people abroad and the CO₂ emitted by foreigners in France engaged in international transport activities, as recommended by the residence principle which applies to Namea type accounts. Work has been undertaken by the S0eS with a view to applying this principle to the forthcoming version of accounts. For France, international air transport would be the main source of difference with the perimeter of national territory.

Source: S0eS, based Citepa (emissions accounts) and Insee (IOT) calculations.

On this basis, allocating emissions to final demand indicates that consumption by France's households is responsible for 60 per cent of CO₂ emissions in France as a result of their consumption: slightly more than a third directly related to the use of their cars and heating equipment and slightly more than a quarter, via the production of companies, in order to satisfy their demand for goods and services. Public administration and non-profit organisations serving households (associations, foundations), on the one hand, and investment spending, on the other hand, account respectively for 8 and 9 per cent of these emissions. The remaining 22 to 23 per cent are linked to satisfying final demand abroad, via exports.

Factors for variations in France's CO₂ emissions between 1990 and 2007

CO₂ emissions result primarily from energy consumption⁴. However, the relationship between this consumption and the level of emissions, as well as the changes in energy consumption itself, depend essentially on technical and economic factors of which the respective importance warrants investigation. This is the purpose of the decomposition analysis of change in environmental pressures.

Improved technology of household equipment is offset by intensification of use

In addition to the general trend towards lower residential emissions and greater emissions from use of private cars, some similarities are observed in the role played by the different factors for changes in household CO₂ emission patterns. Whereas technical factors (CO₂ content of energy consumed and, above all, energy intensity⁵) have brought about a lowering of emissions, economic factors (the surface area occupied per person in the case of residential emissions and the distance travelled per person for the private car) and demographic factors have, conversely, driven emission levels upward.

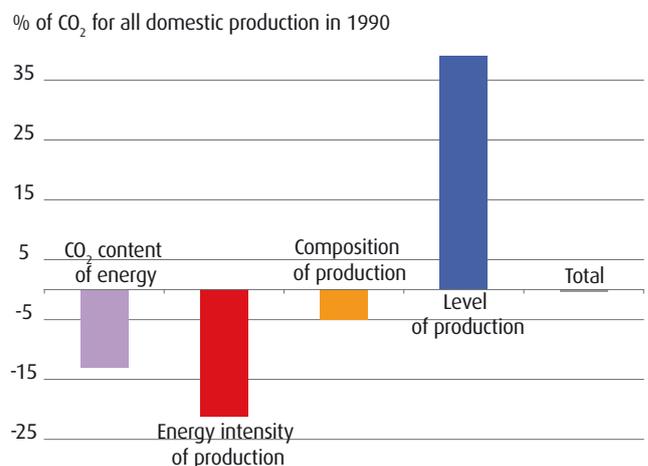
In both cases (car and household heating), there is a rebound effect, where improved environmental efficiency in the use of a resource or equipment is wholly or partially offset by increased usage of the resource or equipment. Here the reduction in average consumption per kilometre travelled or per square metre heated reduces the price of each of these, thereby allowing greater comfort or mobility at equivalent cost (in the case of residential emissions, this development has been influenced by the reduction in the average number of people per household).

Level of CO₂ emissions from production maintained in spite of relatively marked technological progress

All other things being equal, the results of technological progress (reduced energy intensity of production and reduced CO₂ content of energy used⁶) would have entailed a reduction of 33 per cent in CO₂ emissions for all branches of activity. However, given the scale of the counter-effect of the growth in production⁷, the amount of CO₂ emitted in the different branches of activity in France in 2007 was more or less the same as in 1990.

This opposition between technological advance and greater volumes of production is observed, where CO₂ emissions are concerned, in most branches of activity. The effects of improved technology have outweighed those of increased production, notably for industry, whereas the converse is true for service activities.

Factors for change in CO₂ emissions from the different branches of activity between 1990 and 2007



Source: SOeS, calculations based on Citepa (emissions), CVS consultants (energy), Insee (production, chained-linked prices, baseline 2000).

Final demand, an important driver

Between 2000 and 2006, the increase in final demand would, other things being equal, have entailed an increase of more than 10 per cent in CO₂ emissions from domestic production, offsetting the effects of technological progress in the same period. This increase stems, primarily, from the increasing average standard of living (final demand per person) and very little from demographics (increase in size of the population)⁸.

⁴ Around 95 per cent of France's CO₂ emissions (excluding land use, change of use and forests) arise from energy consumption. However, for non-metallic mineral industries a significant part of CO₂ emissions is from decarbonation (formation of CO₂ from carbon contained in non-energy raw materials – e.g. limestone – under the effect of heat). This proportion is more than 60 per cent for cement and lime and around 20 per cent for glass and tiles/bricks. Citepa (2009b), pp. 38-39.

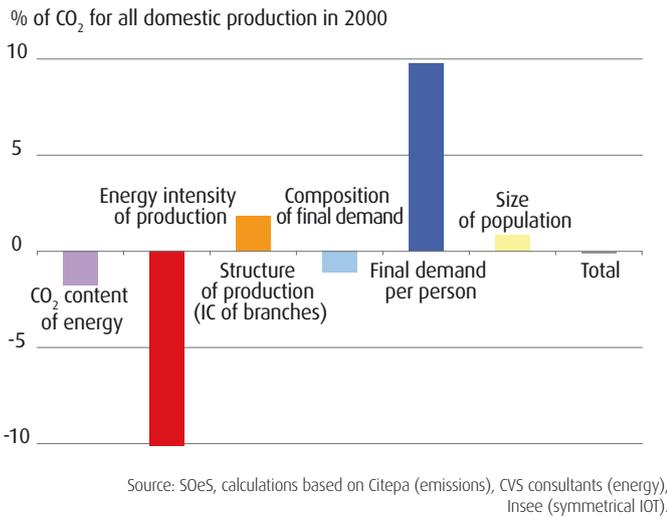
⁵ Ratio of energy consumed to the service provided by the consumption (distance travelled, area heated).

⁶ Energy intensity: ratio of energy consumed (expressed in physical terms) by a branch of activity or whole of the national economy to production (expressed in monetary terms) of the branch in question or the national economy. CO₂ content of energy: ratio of CO₂ emissions from a branch of activity to energy consumed by the branch.

⁷ The breakdown of each effect 'other things being equal' used here does not allow appreciation of the degree to which growth in production has or has not encouraged technological development.

⁸ In addition to the French population, the population concerned includes that of countries of destination for French exports.

Product-related factors for changes in CO₂ emissions (domestic production) between 2000 and 2006⁹



For all services and commerce, the cumulative effect of economic factors outweighs that of technological development over the period. Conversely, for industrial products taken as a whole, the effects of technological development are greater than those of economic factors.

Total quantity of CO₂ from France's final demand

In the context of a globalised economy it appears necessary to extend the current national monitoring of CO₂ emissions (and of GHG more generally) to monitoring of emissions associated with consumption by the populations concerned, in the interests of both effectiveness and equity of public policies to combat climate change. This supposes estimation of emissions associated with goods and services that are imported and exported¹⁰.

Initial estimates for the year 2005¹¹ show all of France's imports to be directly and indirectly responsible for more than 340 Mt of CO₂. Part of these emissions, around 110 Mt, associated with the production of French exports (re-exported imports), cannot be allocated to French demand. All French exports, for their part, are the sources of 205 Mt of CO₂, of which 95 Mt are emitted within national territory and 110 Mt emitted in other countries (re-exported imports). The resulting balance of CO₂ emissions from France's foreign trade is 135 Mt, to be added to the 410 Mt emitted on national territory (excluding CO₂ from biomass used for energy), giving a total of 545 Mt of CO₂. This results in an

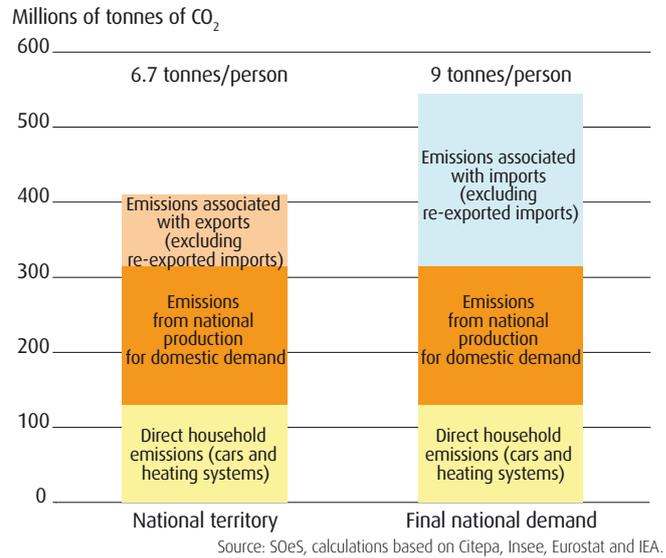
⁹ Breakdown based on a first version of symmetrical by volume IOT chain prices, baseline 2000). The calculations cover the 2000–2006 period because of availability of the necessary national accounting data.

¹⁰ The resulting indicator was presented under the title Empreinte carbone de la demande finale nationale (carbon footprint of national final demand) at the national conference on sustainable development indicators, organised jointly by the Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer, the Conseil économique, social et environnemental and the Conseil national de l'information statistique. <http://www.developpement-durable.gouv.fr/Indicateurs-du-developpement,14064.html>.

¹¹ These estimates use complete data (emissions and input-output tables) from five European Union member states (Belgium, Germany, Italy, Spain and the UK), countries of origin, in 2005, of almost half of France's imports in terms of value as well as CO₂ intensities of production per branch of activity in the countries, considered as representative for the other regions of the world (for more detail see chapter 'Total quantity of CO₂ from France's final demand').

increase from 6.7 tonnes of CO₂ per person per year on the basis of emissions in France to around 9 tonnes of CO₂ per person for the perimeter of France's consumption: an increase of some 33 per cent.

Domestic CO₂ emissions vs carbon footprint of French demand, year 2005



As most of France's trading partners were other European countries in 2005, around 70 per cent of the CO₂ emission attributed to goods and services imported by France were generated in other European countries. Around 15 per cent were generated in Asia (including Middle-East), 7 per cent in North America, 6 per cent in Africa, 2 per cent in South America and less than 1 per cent in Oceania. The breakdown of countries for GHG emissions associated with France's exports is broadly similar.