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Decarbonising Industry in France

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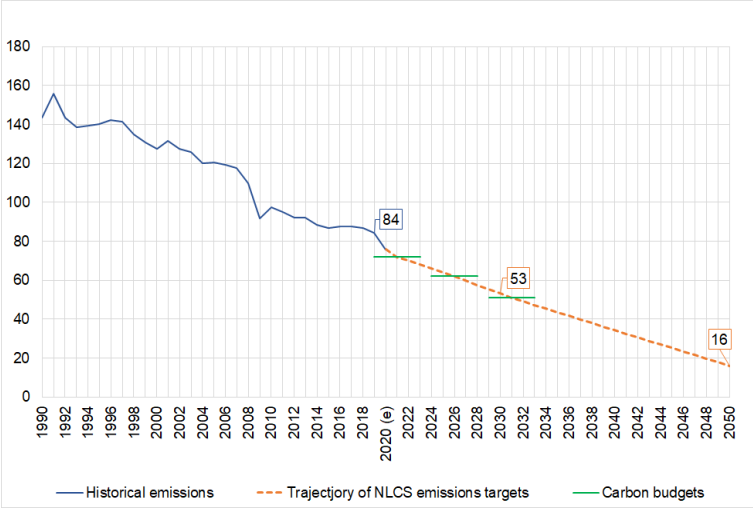
- France's National Low-Carbon Strategy (NLCS), adopted in March 2020, set target caps for industrial greenhouse gas (GHG) emissions of 53 $MtCO_{2eq}$ in 2030 and 16 $MtCO_{2eq}$ in 2050, compared to 84 $MtCO_{2eq}$ in 2019. A number of tools, including carbon pricing and public support for decarbonisation, are being used to meet these targets.
- Since 1990, industry has been the sector of the economy making most progress towards decarbonisation. But continuing to decarbonise at the same pace as between 2013 and 2019 would not be enough to achieve the current NLCS targets – which are to be made even more ambitious to meet the revised GHG reduction target set at European level. In 2019, industry was responsible for nearly one-fifth of France's GHG emissions, led by the chemicals, non-metallic minerals and metallurgy sectors.
- Since 2000, the reduction in France's industrial GHG emissions has been exclusively due to technical advances embedded in investments aiming at reducing pollution and enhancing manufacturing processes (improving their "carbon efficiency"). At the same time, industrial value-added has continued to trend upward.
- Econometric analysis of firm-level data between 2013 and 2018 shows that the likelihood of a firm investing in decarbonisation increases with its size, its productivity, its consumption of carbon-based energy (gas, petroleum products, coal) and whether it is included in the European Union Emissions Trading System (EU ETS). After these factors are accounted for, the firms investing most in decarbonisation are not those in the highest-emitting sectors (chemicals, non-metallic minerals and metallurgy), which, in addition to being big energy consumers, use the fuels and industrial processes that release the most GHG emissions.

Industrial emissions, historical and targets up to 2050 (in $MtCO_{2eq}$)



Source: NLCS (for 2030 and 2050 emissions targets and for carbon budgets - defined by emissions caps, expressed as an annual average for each five-year period) and Citepa data from April 2021 (for historical emissions).
Scope: Mainland and overseas France belonging to the EU.
(e) = preliminary emissions estimate.

1. Economic policy tools and targets for decarbonising industry

Adopted as part of the 2015 Energy Transition and Green Growth Act and revised in 2018-2019, France's National Low-Carbon Strategy (NLCS) sets out a trajectory for reducing GHG emissions and making France carbon neutral by 2050, as required by the 2019 Energy and Climate Act. Under the supervision of the Ministry for the Ecological Transition, the NLCS is based on a system of "carbon budgets" made up of sector-specific emissions caps that align with climate targets set at European level. The targets set for the industrial sector are particularly ambitious, with a GHG emissions cap of 53 $MtCO_{2eq}$ in 2030 and 16 $MtCO_{2eq}$ in 2050, compared to 84 $MtCO_{2eq}$ in 2019.[1] That will mean reducing GHG emissions by 37% for 2030 and 81% for 2050 in relation to 2019 levels (see chart on cover page).

France's strategy is aligned with the European target that was in effect when it adopted the NLCS in March 2020, which was a 40% reduction in GHG emissions by 2030 (compared to 1990 levels). However, the European target has since been raised to 55%, which means France will need to revise its own GHG reduction targets, particularly those for industry. The next version of its NLCS is set to be published by mid-2024.

Since 2005, the industrial decarbonisation strategy has been largely based on the European Union Emissions Trading System (EU ETS), which puts a cap on GHG emissions for high-emitting sectors in the EU,[2] including the manufacturing industry.[3] Within the cap, emitters are given or buy emission allowances at auctions, which they can then trade.[4] In order to meet the new European GHG reduction target for 2030 (55% vs 40% as initially planned), in July 2021 the European Commission proposed raising the GHG reduction targets for sectors included in the EU ETS,[5] requiring the manufacturing industry to pick up the pace of its decarbonisation efforts between now and 2030.[6]

In addition to the incentives generated by the EU ETS and environmental regulations, a number of financial support mechanisms have been introduced for industry. At European level, for example, new or increased funding has been allocated to research and innovation into low-carbon production processes under the new Multiannual Financial Framework for 2021-2027, such as the Horizon Europe programme and the Innovation Fund.[7] At domestic level, part of the increased funding for research and innovation under France's recovery plan will go toward decarbonising industry (support for the development of a French low-carbon hydrogen industry,[8] funding for the energy transition under the fourth Invest for the Future programme, etc.). France's recovery plan has also earmarked €1.2bn for new low-carbon production methods in industrial firms.[9] This financial support is designed to encourage: (i) decarbonisation investments by improving energy efficiency, through the electrification of processes and the use of fossil fuel alternatives, and (ii) the production of low-carbon heating with biomass or refuse-derived fuels.

(1) Source: Citepa, April 2021.
(2) 75% of France's industrial emissions are subject to the EU ETS (roughly 1,200 industrial sites). Source: Citepa.
(3) The EU ETS also applies to power plants and the airline industry for flights within the EU.
(4) Allowances can be traded either on exchanges or by direct trade (over the counter or via an intermediary).
(5) Since 2018, the emissions reduction target for sectors in the EU ETS has been 43% by 2030 compared to 2005 levels. That trajectory was aligned with the overall EU emissions reduction target of 40% by 2030 compared to 1990 levels. With the overall EU target now 55%, the Commission has proposed raising the target for sectors in the EU ETS to 61% by 2030 compared to 2005 levels and adding international maritime transport to the list of sectors.
(6) To limit potential carbon leakage in connection with this new target, the Commission has proposed implementing a carbon border adjustment mechanism, which is backed by France. See L'Heudé W., Chailloux M. and Jardi X. (2021), "A Carbon Border Adjustment Mechanism for the European Union", *Trésor-Economics* no. 280.
(7) Funded by the proceeds of EU ETS emissions allowance sales.
(8) Support for hydrogen production through electrolysis and for new industrial applications, e.g. in steelmaking or chemical production.
(9) This is in addition to other support schemes in place prior to the recovery plan, even if they only minimally benefitted the industrial sector (white certificates, financial aid from the Heat Fund managed by France's Environment and Energy Management Agency (ADEME)).

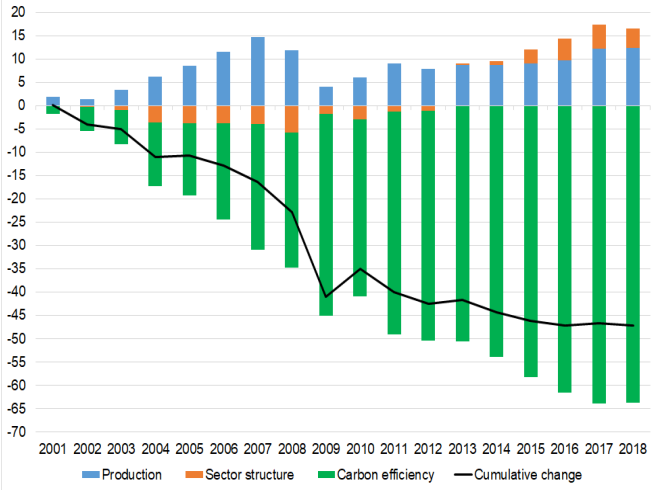
2. The slackening pace of decarbonisation

In 2019, GHG emissions from industry[10] accounted for 84 $MtCO_{2eq}$ or nearly 20% of France's emissions (second only to the transportation sector, which accounts for 30% of the total). The heaviest emitters are the chemicals, building materials and metallurgy sectors.[11]

Since 1990, industry has been the sector of the economy to make the most progress towards decarbonisation (a decrease of 44% compared to 12% for the rest of the economy). But keeping up the current pace would not be enough to reach the NLCS targets by 2030. GHG emissions declined by 1.4% per year between 2013 and 2019; this would need to grow to 4.1% per year between now and 2030 just to reach the current NLCS target - which is set to be revised upwards.

For the past two decades, the decrease in France's industrial GHG emissions has been exclusively due to technical advances as part of investments made to neutralise pollution and enhance manufacturing processes (improving their "carbon efficiency"). At the same time, industrial value-added has continued to grow, and changes in sectoral structure have caused an increase in emissions in recent years, with specialisation in relatively higher-emitting segments such as the chemicals sector (see Chart 1).

Chart 1: Contributions to the cumulative reduction in industrial GHG emissions since 2000 (in $MtCO_{2eq}$)



Source: DG Trésor calculations using INSEE and Citepa data. The data and methodology that were used are detailed in R. Faquet (2021), "Which industrial firms make decarbonization investments?", DG Trésor Working Paper no. 2021/3.
How to read this chart: The 47 $MtCO_{2eq}$ reduction in industrial GHG emissions between 2000 and 2018 breaks down as follows: –64 $MtCO_{2eq}$ attributable to less carbon intense production practices, +12 $MtCO_{2eq}$ attributable to an increase in industrial value-added, and +4 $MtCO_{2eq}$ attributable to a sectoral shift towards higher-emitting sectors.

3. Determinants of industrial decarbonisation investment

The "Antipol" survey[12] conducted by France's national institute of statistics and economic studies (INSEE) provides an estimate of decarbonisation investments, which are particularly difficult to measure. In 2019, investments made by industrial firms to reduce GHG emissions amounted to an estimated €311m out of a total €1.3bn in industrial anti-pollution investment.[13] This includes equipment dedicated to reducing emissions (filters, carbon capture) and the use of more environmentally friendly production equipment – the monetary value of which is determined based on the cost differential compared to standard (but less environmentally effective) equipment available on the market.

Econometric analysis of firm-level data was used to predict the probability of a firm making a decarbonisation investment and the intensity of such investments. From this, we were able to identify the characteristics of the firms contributing to industrial decarbonisation.[14]

Firm-level data on industrial decarbonisation investments from the Antipol survey was matched with three other sets of firm-level data from between 2013

(10) "Industry" is used here with the same meaning used for GHG inventory purposes, which includes manufacturing and construction but excludes energy generation. Emissions include all GHG emissions (CO_2, CH_4, N_2O, etc.), measured in "CO_2 equivalent", which is the relative global warming potential of a given gas over 100 years as compared to CO_2.
(11) Source: Citepa, April 2021. Data from 2020 was not used as it is not yet final and, because of the pandemic, would not be representative of industrial emissions.
(12) In this annual study, INSEE surveys approximately 11,000 industrial establishments with more than 20 employees, including all firms with more than 250 employees, about what they spend on reducing the pollution they generate.
(13) Other main areas of anti-pollution expenditure include air pollution (€328m), wastewater (€212m), soil (€163) and habitats, landscapes and biodiversity (€145m).
(14) See R. Faquet (2021), "Which Industrial Firms Make Decarbonization Investments?", *DG Trésor Working Paper* no. 2021/3.

and 2018: (i) tax return data from the FARE database (INSEE-DGFiP), which provides basic structural information about French firms, such as balance sheets and income statements; (ii) data on industrial energy consumption and expenditure from the INSEE's EACEI database; and (iii) the list of French industrial firms subject to the EU ETS. The final sample is an unbalanced panel of 4,395 firms.

A number of results emerge from the analysis, which should be interpreted with caution due to weaknesses in the data.[15]

Firstly, it appears that 12% of firms adopt decarbonisation technologies on average in a given year. The distribution of these investments is highly skewed: the amount invested by the top 10% of investment-making firms is 10 times as high as the median amount.

Secondly, the likelihood of a firm making a decarbonisation investment increases with the size of the firm, its productivity, the intensity of its carbon-based energy consumption and whether it is included in the EU ETS. This likelihood decreases with the age of the firm, suggesting that there is a path dependency effect.[16] Among decarbonising industrial firms, the rate of investment in emissions-reducing technology is determined by the intensity of the firm's carbon-based energy consumption.

Thirdly, after accounting for the above factors, we observed that the firms that invest the most in decarbonisation do not belong to the highest-emitting sectors (chemicals, metallurgy, non-metallic minerals), which, in addition to being big energy consumers, use the fuels and industrial processes that release the most GHG emissions. This paper does not answer the question of whether this is due to higher abatement costs in these sectors, a lack of available technology or other reasons.

(15) Sample size and representativeness; measurement of decarbonisation investments; public subsidies not factored in.
(16) The longer a firm uses carbon-intense technology, the more likely it is to become increasingly costly for it to initiate decarbonisation investments. This phenomenon of path dependency is documented in the automotive sector in: Aghion P., Dechezleprêtre A., Hemous D., Martin R., Van Reenen J. (2016), "Carbon Taxes, Path Dependency, and Directed Technical Change: Evidence from the Auto Industry", Journal of Political Economy, 124, 1 51.

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