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A Proposal for the Climate: Taxing Carbon not People

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The need to fight global warming appears to be consensual in France. According to a recent survey, 85% of French people are concerned about global warming (IFOP, October 2018). The urgency of a global approach that would tackle all CO_2 emissions is reiterated by the IPCC. Yet, as demonstrated by the yellow vest protest movement that was ignited by the increase of the carbon tax, environmental policies remain widely debated. Environmental taxation has been perceived as an additional tax mainly motivated by budgetary considerations rather than by environmental concerns. It has also been seen as unfair, particularly to the least well-off households and those with too few alternatives, for example, on their choice of transport means. But without a carbon tax, our CO_2 emission reduction targets will not be achieved by 2030. The challenge is therefore to propose major changes in order to build an effective and fair system of environmental taxation. Efficiency requires that the price signal be safeguarded and justice requires that the cost sharing of environmental measures be fair.

The starting point of this *Note* is a detailed analysis of the simulated impact of environmental taxes on household purchasing power based on three key criteria: income, location and equipment (transport or heating). The objective we fix for a reform is to reduce as much as possible the number of households in the first five income deciles who would lose from it. This is after full redistribution of the tax through transfers to households and ad hoc subsidies promoting equipment changes. We show that by returning the full amount of the tax revenue in the form of transfers to households based on their income (in favour of the first five income deciles) and on their location (in favour of rural municipalities and small urban areas), this objective can be achieved. Many low-income households even experience an increase. We also recommend to reforming the "*chèque énergie*" (energy voucher) for poor households, so as to eliminate the mandatory allocation of the existing voucher to energy expenditure.

We also propose to broaden the environmental tax base by including sectors presently exempted with corresponding measures to maintain their competitiveness. Keeping the same ambition to reduce emissions, this makes it possible to reduce the growth of the household carbon tax rate in the coming years. Finally, we propose mechanisms to smooth the impact of oil prices peaks.

Environmental policy requires a mix of instruments that are complementary: carbon tax and redistribution to households on the one hand, but also regulations, conversion subsidies and public support for innovation and green investment on the other hand. The latter must be subject to *ex ante* economic evaluation or small-scale experiments to compare their cost with the number of tons of carbon avoided.

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The rapid pace of climate change, which is caused by greenhouse gas emissions from human activities, is a fact. This is why we must strengthen action to reduce these emissions in order to leave a sustainable planet for our children. For economists, environmental taxation is the best instrument because it allows any emission reduction objective to be achieved at the lowest cost and leaves private agents, households and companies, the choice of implementation and the amount of emission reduction. Even in case of imperfect information from public authorities on the cost of reducing emissions from households or companies, they will always have an incentive to achieve these reductions when the cost is lower than the tax. Consequently, the tax, by setting a price on CO_2, helps to guide both the choice of equipment and its use. Unlike a subsidy, it avoids the more intensive use of more efficient equipment,[1] which generally reduces the impact on emissions of subsidies to purchase new equipment. Finally, the tax stimulates green investments and innovation by providing a business model for green projects.

In the United States, a country reluctant to accept new taxes, this analysis has led many economists and economic leaders from all sides to recently join forces to recommend the introduction of a significant and steadily increasing carbon tax, the revenue from which would be fully redistributed to households.[2] In France, the same arguments in favour of carbon pricing led to the introduction of the climate-energy contribution (CCE) in 2014.

However, this strategy faced a movement of protest in France challenging the carbon tax, the causes of which are multiple. The planned increase in the tax took place against a backdrop of long stagnation in the purchasing power of middle-class households, a very rapid rise in oil prices in the first half of 2018 compared to their low level since the end of 2014, and growing mistrust of the tax system, accused in particular of ignoring territorial inequalities. Insufficiently explained, or even hidden, to mask the efforts required by the energy transition, whatever the used instruments, it also placed a disproportionate burden on some households. But the problem of rejecting the carbon tax is neither only French nor short term.

One of the first reasons for this rejection is the public's suspicion of the purpose of the tax, which is still perceived as meeting the needs of the budget. In addition, its incentive effect is misunderstood or denied. It should be noted in this respect that the tax has only taken off in countries where trust in institutions is high, and where a long period of preliminary work has been done to explain this approach and enshrine it in a social contract (Switzerland, Scandinavian countries, British Columbia). In Sweden, for example, the green tax reform launched after the 1988 elections was only adopted in 1990. The two-year gap was used to define the modalities, including the principle that its revenues should be fully redistributed in the form of tax relief. The question of the acceptability of the carbon tax is therefore the main challenge that public authorities must address,[3] with the question of its equity as a stumbling block.

Impacts on purchasing power and equity of a carbon tax

Gross distributive effects of the carbon tax

When examining the impacts on purchasing power of the carbon tax, it is necessary to distinguish between the overall impact, considering all economic agents as a whole, and the impact on the different categories of households. The overall impact corresponds to the cost of emission reduction efforts that are needed to achieve a given objective. These costs are known as "abatement costs". In this respect, a tax that makes carbon emissions costly for economic agents is similar to a "carbon price signal" It provides an incentive to mobilize abatement efforts by focusing on the least costly. The impact of the policy implemented on the different types of household results from the way in which the abatement efforts are distributed among the population. This in turn raises the question of the transfers associated with the tax, i.e. how its revenue is used.

To address this issue, we first quantify the gross distributive impacts of the carbon tax, before behavior changes and before transfers associated to the the revenue of the tax. We

The authors would like to thank Claudine Desrieux, Scientific Advisor of the CAE, who followed this work, and Samuel Delpeuch. They also thank Thomas Douenne for the simulation work carried out in the context of this *Note*.

[1] Paradoxically, more efficient equipment can lead to higher consumption because the energy savings expected from its use can be reduced by changes in behaviour: this is the "rebound effect". An example would be a household heating only a few rooms in a house with very energy-intensive equipment, while all rooms would be heated if the equipment became more efficient. Energy savings are therefore not achieved at a constant level of consumption. A study of a program to replace air conditioners and refrigerators in Mexico shows that the replacement rate of refrigerators reduces electricity consumption by about 8%, or a quarter of *ex ante* predictions, with air conditioning replacement actually increasing electricity consumption. See Davis L., A. Fuchs and P. Gertler (2014): "Cash for Coolers: Evaluating a Large-Scale Appliance Replacement Program in Mexico", *American Economic Journal: Economic Policy*, vol. 6, no 4, pp. 207-238.

[2] See the tribune signed by twenty-seven Nobel Prize winners, four former Presidents of the US Federal Reserve (FED), fifteen former leaders of the Council of Economic Advisers, two former Secretaries of the Department of Treasury and thousands of economists: "Economists' Statement on Carbon Dividends", *The Wall Street Journal*, 17 January 2019.

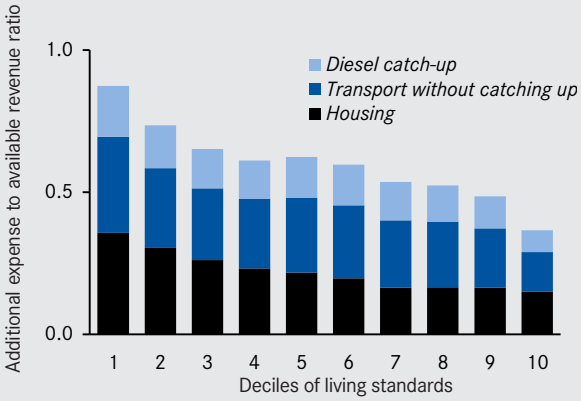
[3] Klenert D., L. Mattauch, E. Combet, O. Edenhofer, C. Hepburn, R. Rafaty and N. Stern (2018): "Making Carbon Pricing Work for Citizens", *Nature Climate Change*, vol. 8, no 8.

are carrying out this exercise in the case of the French carbon tax, the *contribution climat-énergie* (CCE, climate-energy contribution).[4] The CCE is an excise duty applied to the CO_2 content of energy.[5] It was introduced in 2014 at the initial rate of €7 per ton of CO_2 and applies to the price of goods before VAT. It is part of the existing domestic consumption taxes on energy products: TICPE and TICGN.[6] With a share of around 60% in households and 40% in businesses, the CCE generated revenue of €6.4 billion in 2017. In 2017, the government announced an increase in the tax rate in order to reach 86.2 euros/tCO_2 in 2022. For 2018, the level of the CCE has thus increased from 39 to 44.6 euros/tCO_2, the level currently in force. This increase to 55 euros and the continuation of the catch-up of diesel-gasoline were stopped by the government in November 2018 following the "yellow vests" movement.

Let us now examine the distributive impacts of the reform consisting of an increase in the CCE from its current level (44.6 euros/tCO_2) to the level expected to be reached in 2022 (86.2 euros/tCO_2), accompanied by the catching-up of the diesel tax by 7.8 cents per liter. This corresponds to the sum of the increases initially planned for January 2019, 2020 and 2021. This reform is first considered without any revenue redistribution mechanism, in order to establish a solid basis for proposing a more equitable system.

The impacts of the reform on social equity are evaluated for each standard of living decile.[7] Figure 1 illustrates the burden of the reform in household disposable income (the supplement of tax to income level of households), broken down into three parts: additional expenditure on housing due to the CCE, transport due to the CCE and transport due to diesel-fuel catch-up. The poorer the households, the higher their burden: nearly 1% of disposable income for the first decile compared to 0.3% for the top decile. Thus, the reform is regressive *ex ante*. The effect caused by housing is more regressive than that caused by transport. The share in the cost ratio of diesel-gasoline catching up is far from negligible, as this catching up also has a regressive effect. This regressivity, which reflects the structure of emissions and the weight of energy expenditure in the respective household budgets, requires accompanying mechanisms to ensure the equity of the reform and its political acceptability. This is what has been lacking in the establishment of the CCE.

1. Effort rate of households associated with the reform before revenue use, in %



Source: Authors' calculations.

Simulations carried out with two different methodologies and data[8] show that the unequal impacts of the taxation is not only due to the level of income (vertical heterogeneity).Within each income decile, the heterogeneity (called horizontal) of the taxon purchasing power is significant. Among the households belonging to the first decile, 10% of households lose more than 220 euros in purchasing power per year and per consumption unit with the implementation of the reform, while about 10% of households are not affected at all. Horizontal heterogeneity increases with income, so that in the 10th decile, 10% of households lose more than 480 euros in purchasing power per year and per consumption unit, while 10% of households lose less than 25 euros. This intra-decile heterogeneity is due in particular to the location of households and the type of equipment they own: oil or gas heating *vs.* electric heating, diesel engine *vs.* petrol. For example, for a given income, the relative loss of rural households compared to households in the Paris agglomeration is significant, around 130 euros on average per consumption unit. But a more in-depth analysis shows that horizontal heterogeneity is better explained by the equipment than by the geographical location alone. Once the differences in equipment are taken into account, the differences in losses between rural and urban households vanish: with equal income and equipment, a rural household loses 20 euros more than a Parisian one, per consumption unit. On the other hand, for the same

[4] Which we will call in an equivalent way "carbon component".

[5] As an order of magnitude, 10 euros/tCO_2 represents just under 3 cents/liter of fuel.

[6] TICPE is the domestic consumption tax on energy products and TICGN the domestic consumption tax on natural gas.

[7] According to the INSEE definition, the standard of living is equal to the household's disposable income divided by the number of consumption units (cu). On average, a French household has 1.59 cu. As a reminder, the consumption unit is a weighting system that assigns a coefficient to each member of the household and allows the situation of households of different sizes or compositions to be compared. With this weighting, the number of people is reduced to a number of consumption units.

[8] Based on the TAXIPP model of the *Institut des politiques publiques* (IPP, Institute of Public Policy) and the Prometheus model of the Office of the Commissioner General for Sustainable Development. See Douenne T. (2019): "Les effets de la fiscalité écologique sur le pouvoir d'achat des ménages : simulation de plusieurs scénarios de redistribution", *Focus du CAE,* no 30-2019, March and Conseil économique pour le développement durable (CEDD) (2019): "Quels instruments pour la stratégie climatique ? Premières leçons de la crise", *Synthèse CEDD*, no 37, French Ministry of Ecological and Solidarity Transition, forthcoming.

income and type of location, a household running on diesel loses 230 euros more per consumption unit over one year than a household without a car, while a household heating on domestic fuel loses 157 euros more than an household heating on electricity.[9]

Based on these initial analyses, the redistribution of carbon tax revenues seems necessary to better share the efforts of households serving climate objectives, but its implementation raises a series of difficulties. It is relatively easy to redistribute revenues according to income, but much more difficult to take into account the dimensions of horizontal heterogeneity in order to properly identify losers without creating overly complex arrangements, significant windfall effects or a weakening of the price signal. The previous exercise suggested calibrating the redistribution of revenues according to equipment. But it would be both complex regarding the information to be collected and environmentally counterproductive: the loss of transfers when an equipment is changed would indeed constitute a strong disincentive to make this change. Keeping transfers when equipment is changed would solve the incentive problem but would create a new form of injustice: why should a household that already made an effort for the environment before the introduction of a tax, by choosing less polluting equipment, receive less transfers than its *alter ego* who cared less about the environment and has just brought about the change? Another –still imperfect– option, would be to subsidize equipment changes. This makes it possible to target some losers of the reform (those with polluting equipment) and does not decrease the incentive. But this mechanism also has several disadvantages: it can create significant windfall effects, it can be regressive if it is poorly calibrated and, above all, it does not compensate all the losers. A last possibility is to base the redistribution of revenues on geographical location, since the previous year showed us that it is correlated to equipment, although not perfectly.

Our conviction is that to restore an increasing carbon tax trajectory, this tax must be fair and therefore coupled with a redistribution of the revenue. The political economy constraint we impose on ourselves in the following exercise is that the combination of carbon tax and revenue redistribution should reduce to a minimum the number of losing households in the first five deciles. We explore different scenarios by taking into account two crucial dimensions: household income and location.

Application to the project frozen in fall 2018

Five scenarios for the tax redistribution are under study:

- a neutral flat-rate transfer per consumption unit (for all households);
- Terra Nova's[10] proposal to transfer 500 euros to households in the first income decile, then 400 euros in the second, 300 euros in the third, etc. until the fifth;
- an increased energy voucher (three times the amounts allocated in 2019) benefiting the 5.6 million currently eligible households;
- a redistribution of 30% of revenues through lump-sum transfers, and 70% through transfers proportional to income per consumption unit;
- a redistribution with transfers based both on income and geographical criteria.

By simulating these scenarios, we try to identify which one would minimize losses for households in the first five deciles.

Scenario 1. A neutral flat-rate redistribution per consumption unit makes it possible to eliminate the regressiveness of the reform because the poorest households consume less carbon than richer households. Households in the 1st decile earn on average 60 euros as a result of the reform; it is more or less neutral for households in the middle of the distribution (deciles 5, 6 and 7); finally, households in the 10th decile lose on average 80 euros. But there is still a significant horizontal heterogeneity: among the first deciles, 10% of households receive more than 150 euros of transfer per consumption unit, while 10% lose more than 80 euros per consumption unit.

Scenario 2. Terra Nova's proposal does not exhaust all revenues (remaining €2.3 billion). Its structure obviously makes it more progressive than the pure flat-rate redistribution of scenario 1. On average, households in the 1st decile earn 250 euros as a result of the reform. The effect is neutral for households in the 4th decile, while losses appear for the 5th decile. Households in the 6th decile lose 150 euros per year on average. 10% of households in the 1st decile earn more than 380 euros per consumption unit but more than 25% of the households loose in the 3rd decile (Figure 2a).

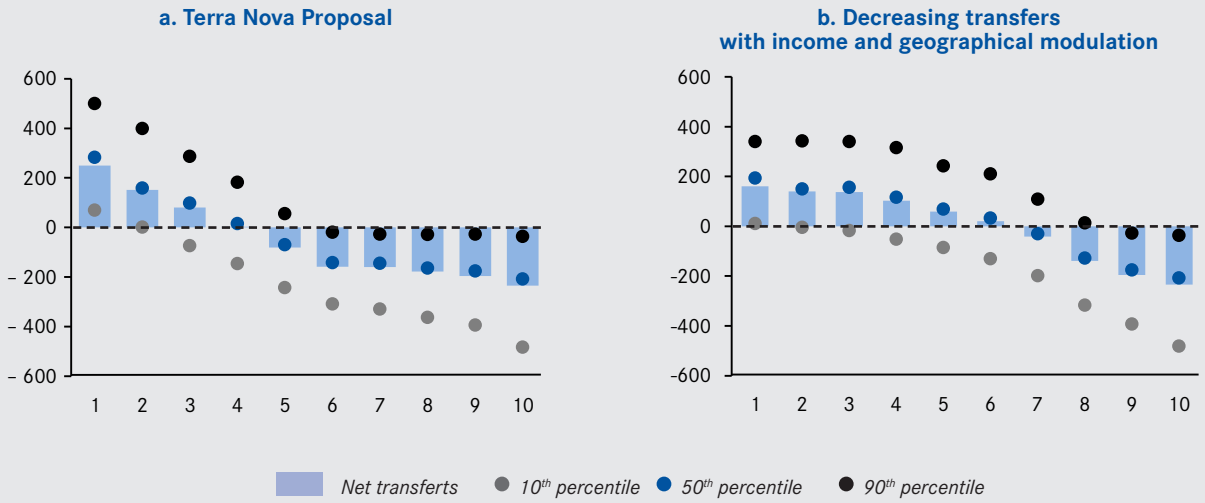
Scenario 3. An increased energy voucher fails to target mobility problems and there are still many losers, especially among the first deciles.[11] This is mainly due to the current restrictive eligibility conditions for the energy voucher.

[9] See Douenne (2019) *op. cit.*

[10] Guillou A. and Q. Perrier (2019): *Climat et fiscalité* : trois *scénarios pour sortir de l'impasse*, Terra Nova and I4CE, February.

[11] See Douenne (2019) *op. cit*.

2. Distribution of net transfers, by standard of living decile, in euros



Source: Authors' calculations.

Scenario 4. A redistribution of 30% of income in flat-rate transfers, and 70% in transfers proportional to income per consumption unit (semi-proportional redistribution) leads to a zero average impact according to income (there is therefore neither progressivity nor regressivity), except for the 10th decile which earns on average 60 euros per year, this being mainly due to the gains provided to the very high incomes by a transfer proportional to income. The heterogeneity within each decile remains important.

Scenario 5. The previous results show that the most favorable scenario for the poorest households is the one proposed by Terra Nova. However, it does not exhaust all revenues and does not sufficiently compensate households in the middle of the distribution. We are now studying a final scenario that attempts to address these issues. This scenario uses the principle of redistributive transfers, the amount of transfers being chosen in order to ensure progressiveness while avoiding excessive losses for households in the middle of the distribution (310 euros for the first three deciles, 300 for the 4th, 255 for the 5th, 240 for the 6th, 150 for the 7th and 60 for the 8th).Transfers are both decreasing in income and based on geographical criteria.[12] Although imperfect, the geographical tag makes it possible, in principle, to take partly into account the possibilities of substitution available to individuals: urban areas are, for example, more equipped with public transport than rural areas which are more constrained in their choices. This scenario (compared to the others) is the one that minimizes losses for the first five deciles (Figure 2b), but mainly because it gradually redistributes the entire revenue.

Concretely, transfers linked to carbon tax revenues would be a new simplified *chèque énergie*, whose eligibility conditions would be determined as described in scenario 5. In addition, there would be no mandatory allocation of the *chèque* anymore, like it is now as a voucher to energy expenditure.

Four main lessons must be learned from these simulations:

- Building an equitable reform requires a comprehensive approach, first dealing with the regressiveness of the gross reform. It is therefore different from redesigning existing systems (energy vouchers, vehicle conversion subsidies, tax credits);
- it is possible, through an appropriate redistribution mechanism, to ensure that more than 90% of households in the first 5 or 6 deciles benefit from the implementation of the reform;
- it is very difficult, however, to erase horizontal heterogeneity. A differentiation of transfers by geographical criteria is a first approach to correct this horizontal heterogeneity. However, it is very imperfect, so that more detailed criteria accounting for local and public transport constraints would be desirable, but more complex to set up:[13]
- conversion aids are therefore necessary. However, they must be means-tested (see below).

[12] A scenario of decreasing transfers with incomes using all tax revenues without geographical criteria would also limit losers in the intermediate deciles but would be slightly less effective in eliminating horizontal disparities, see Douenne (2019) *op. cit*.

[13] The most interesting possible criterion in this perspective would be accessibility to urban public transport networks. For example, by favouring areas not covered by the "transport payment".

Recommendation 1. Redistribute all new carbon tax revenues with decreasing transfers based on income and geographical criteria. In addition, set up mechanisms to help the change of the most polluting equipment, targeted on the most vulnerable households.

How to build an efficient and fair carbon pricing system?

A mix of a "carbon tax-recycling the revenue and recovery accompanying measures" as proposed here may not be sufficient to allay all fears and answer the questions raised by the tax.

Some of these fears are unfounded, such as the doubt of the ability of the price-signal to influence behaviour, or the belief that most emissions are incompressible. On the contrary, fuel demand decreases when price increases, as shown by empirical studies establishing significant price elasticities of the order of – 0.5. They also appear to be poorly differentiated by household group, the highest being even observed among modest non-Parisian households. The lowest price elasticity is found among Parisian households in the top decile, while it is highest for the first decile of medium-sized cities.[14] Similarly, significant price elasticities could be identified by analysing the behaviour of comparable companies, whether they were subject to the European Union ETS or not, despite the generally insufficient price level that has prevailed there since its introduction.[15]

Other issues are legitimate and should be addressed with the greatest attention. Would using tax revenues to seek a double dividend[16] make it more acceptable? Should the tax base be broadened by removing exemptions? How can we ensure that French households are not forced to make a disproportionate effort, not only compared to companies but also compared to households from other countries?

Sharing the decarbonation effort

Considering that the instruments put in place should absolutely be fair and perceived as such, we do not support the the strategy of the double dividend. A first reason is that this option was more or less explicitly chosen by the French government since the establishment of the CCE in 2014, and that it clearly did not convince (probably because of a lack of explanation). The second reason is that the possible gain to be expected from this option, in relation to the return of revenues, seems to us to be a second order benefit. In addition, equity and social justice issues would remain, and could even be exacerbated, unless a tax to be lowered is found that is paid more by the losers of the carbon tax. Finally, we do not think it is appropriate to wait for a thorough review of our taxation system to strengthen our climate policy.

In contrast, we believe that broadening the tax base is advisable. In order to take into account equity concerns in the implementation of a green tax, our preferred option is to reactivate carbon pricing with a clear upward trend in the tax, but on a larger base to ensure that households are not the only ones making efforts. Indeed, what would be the point of taxing an ever-increasing narrow base of emissions when a significant proportion, with significant CO_2 emissions, would not be mobilized? It seems preferable to include all fossil products leaving refineries in the scope of the tax before "colouring" fuels according to their end use. This should go together with mechanisms (similar to the ones detailed above for households) that would redistribute revenue (in the form of refunds of revenue in proportion to activity) to the newly concerned sectors in order not to penalize their competitiveness.

Currently, TICPE exemptions mainly concern the transport sector, with two main measures: the TICPE exemption for fuels used in commercial aviation (€3.6 billion in 2019), and its partial reimbursement to road hauliers (€1.5 billion in 2019). Excluding transport, the main measure is the reduced rate for farmers (€0.9 billion in 2019).[17] The point here is not to remove all TICPE exemptions since some TICPE exemptions are justified by the fact that neither agriculture nor the building industry use road infrastructure (contrary to road freight transport). We instead propose to shift the generating event of the carbon component, to target the pollution that will be induced whatever the reasons.

Since about 15% of energy use emissions (excluding the sector covered by the European allowance market) are exempt, this effective widening of the tax base could allow a slightly lower growth rate of the tax than initially planned, while maintaining the same overall emission reductions.

[14] See Douenne (2019) *op. cit*.

[15] Dechezlepêtre A. and R. Calel (2016): "Environmental Policy and Directed Technological Change: Evidence from the European Carbon Market", *Review of Economics and Statistics*, vol. 98, no 1, pp. 173-191.

[16] In the case where incentive tax revenues are used to reduce another tax, it is theoretically possible to obtain, in addition to a reduction in emissions (the first dividend), a positive effect on economic activity (the second dividend), if the changeover reduces distortions in the tax system as a whole, see Goulder L.H. (1995): "Environmental Taxation and the 'Double Dividend': A Reader's Guide", *International Tax and Public Finance*, vol. 2, pp. 157-183.

[17] Note that until 2018 the reduced rate for non-road diesel was for farmers and the building industry (€2 billion in 2018); the 2019 FDP had removed the tax niche for construction, but this removal was abandoned in the face of the yellow vest crisis.

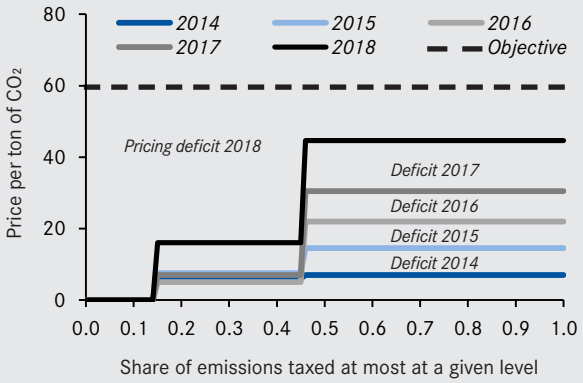
A key monitoring indicator is the "carbon pricing gap indicator" proposed by the OECD, which measures how far the pricing of all emissions is from a uniform carbon reference price for all emissions. This indicator captures, for example, how the increase in the CCE has brought us closer to countries with the most ambitious carbon pricing policies, while pointing out the exemptions that remain.[18] Figure 3 measures the carbon pricing gap[19] compared to an objective of 60 euros/ tCO_2, the OECD benchmark, which is a reasonable level if the trajectory is regularly raised to be in line with a price level of 100 euros/t in 2030.[20]

There is thus a gradual reduction in this carbon pricing gap thanks to the increase in the carbon component and, at the end of the period, to the reform of the functioning of the European carbon market. However, in absolute terms, the price of the European quota remains low and the effective price per ton of carbon remains lower than the target set by the CCE. If the exempt sectors were to be effectively integrated into the carbon tax, the larger base would ease the upward trajectory of the price per ton of CO2. By 2022, the target price would thus be 20% lower for the same average effective carbon price.

Recommendation 2. Continue to increase the climate-energy contribution and explain its issues and mechanisms to the public. Broaden the base by uniformly applying the tax at the refinery exit level, with no exemption nor refund mechanism. Use the new revenues to support the affected sectors in order to preserve their competitiveness.

Shifting the point of application of the tax in order to broaden its base is required so the households would not to be the only ones supporting the burden. A complementary measure would be the introduction of a European carbon floor price to reduce the distortion between the price of allowances on the EU-ETS market and the price of diffuse emissions.[21] It would also allow to remove conflicting injunctions on the electricity sector, that could in the short term call power plants in order of merit, and in the medium term choose new equipment.[22] Environmental diplomacy must work to implement this floor price.

3. Carbon pricing gap in France compared to the target of 60 euros per ton of CO_2



Reading: For each year, the pricing deficit compared to the target of 60 euros/ton of CO_2 corresponds to the area between the curve and the target (dotted line). It is 52% in 2018 and 69% in 2017.

Source: Authors' calculations based on OECD.

With regard to the legitimacy of the effort required on French households and businesses in an uncooperative world, it may be recalled that the objectives set for 2030 reflect the European desire to be a driving force in the construction of climate cooperation and its pivotal role in what has already been undertaken, without setting an excessive example. The (global) carbon budget compatible with the 2°C target being much stricter than fossil resources accessible in the subsoil, the implementation of an increasing carbon price, in addition to market prices, is necessary. Thus, environmental diplomacy must propose a convincing plan to strengthen the ambition of international efforts, particularly those of major emitting countries, to strengthen the legitimacy of national policies.[23]

Recommendation 3. At European level, align the EU-ETS market price of allowances with the levels targeted for domestic emissions, complementing the existing scheme with a floor price.

[18] See OECD (2018): *Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading*, OECD Publishing, Paris.

[19] Energy-related carbon emissions represented 322 $MtCO_{2eq}$ in 2016, representing 70% of France's GHG emissions, of which 54% are subject to the carbon component, 31% to the European allowance market and 15% are subject to exemptions.

[20] 100 euros/t in 2030 is the target of the Energy Transition for Green Growth Act (LTECV), but insufficient to meet emission reduction targets, see Quinet A. (Pres.) (2019): *La valeur de l'action pour le climat. Une valeur tutélaire du carbone pour* évaluer *les investissements et les politiques publiques*, France Stratégie Report, La Documentation française, February.

[21] Diffuse emissions are non-point emissions from dispersed sources such as road transport, domestic heating, agriculture, small and medium-sized industry and services.

[22] Conseil économique pour le développement durable (CEDD) (2018): "Après la réforme du marché carbone européen. La question du prix-plancher reposée, notamment au-delà de 2023", *Synthèse CEDD*, no 37, French Ministry of Ecological and Solidarity Transition.

[23] Bureau D., L. Fontagné and K. Schubert (2017): "Trade and Climate: Towards Reconciliation", *Note du CAE*, no 37, January.

Beyond the new mechanisms to support the increase in the carbon price, it is necessary to build their legitimacy, by better informing the public about the effectiveness of climate policies and by gradually establishing a legal framework so as to give credibility to the respect of the announced redistribution rule.[24] To do this, it is important that this rule precedes the definition of the price path. Under these circumstances, the agenda for restarting the process would be, in parallel with the establishment of this new legal framework, the definition, after broad consultation, of the basic rule for the use of the revenue.[25]

To make credible the environmental commitment of its tax and its only objective to provide incentive, Switzerland uses a mechanism whereby scheduled increases are automatically applied if emission targets are not met. On the other hand, increases are postponed if they are exceeded. In this way, the incentive nature of the tax is claimed and credibility is lent to it since the State will not have any additional revenue when its objectives are achieved. Beyond that, each citizen understands that, if everyone's efforts are strengthened to achieve the desired objective, taxes will be reduced. One of the tasks of the new *Haut Conseil du climat* (High Climate Council) could be to give an opinion on the increases in CO_2 taxes (for the following year) according to the observed CO_2 emissions (for example, over the last two years by smoothing weather-related hazards).

> **Recommendation 4.** Establish the rules governing the use of the revenue before the price trajectory, accompanied by broad communication to the public to make it a shared project. Introduce a mechanism to freeze the trend if emission reduction targets are exceeded.

Adjust to oil price volatility

The yellow vest crisis began with a surge in fuel prices due to their market component, not taxes.[26] This points to a recurring problem: the lack of mechanisms to manage fuel price volatility on the purchasing power of some highly exposed households, leading to the same crises each time fuel prices soar. It led to the reignition of an idea that had already been experimented (without success) between 2000 and 2002: the floating carbon tax. The justification for this system is that oil demand does not depend solely on the carbon tax, but on the total price paid by the consumer, the sum of the world oil price and the tax. Under these circumstances, aiming for a total price trajectory that makes it possible to achieve the environmental objective by adjusting the tax to fluctuations in the price of oil may seem attractive. But such a strategy is not optimal because it is not cooperative at the international level. If it were adopted by all consumer countries, it would encourage producer countries to raise prices. At national level, it would probably give distributors an incentive to increase their margins. Finally, the experience of 2000-2002 shows that it is very easy politically to lower the tax when the producer price rises, but very difficult to carry out the symmetrical operation when the price falls.[27] This asymmetry is well documented by the post-mid-2014 sequence: the carbon tax did not compensate for the drop in oil prices at all, and its increase was problematic as soon as the price rose, even though the final price remained close to the 2012 level.

To address the issue of pre-tax price volatility, mechanisms should be considered to reduce prices peaks in order to limit the difficulties of households that are indeed increasingly constrained by pre-committed expenditure and therefore vulnerable vis-à-vis unforeseen situations. In this respect, 2018 has combined the two problems: first, a substantial increase in the carbon component and the price of diesel fuel and second, a rapid rise in the price of oil. The implementation of the revenue restitution mechanisms discussed above is in itself a response to the first problem. Such an approach is, indeed, in line with the general idea that it is through the use of carbon tax revenues that the redistributive problems of the carbon tax must be addressed, not by weakening its rate, and that redistribution must be appropriately targeted. To respond to the second problem, two complementary insurance mechanisms for households can be considered.

The first would legally authorize the government to adjust, by order, the TICPE rate collected during the year. For example, it would allow the increase in TICPE (carbon component and diesel/gasoline convergence) as stated in the law to be reduced by half for a maximum of three months. This

[24] Such an institutional framework is necessary to ensure the credibility of the use of the revenue to correct regression, according to rules established upstream. It is justified by the incentive object, a signal-price without a performance objective, and with the possibility of issuing (thus falling under Article 3 of the Environmental Charter and not Article 13 of the Declaration of the Rights of Man and of the Citizen) as a counterpart. For the justification for setting the rule for the use of revenue in advance, see Bureau D. and B. Peyrol (2018): *Comment construire la fiscalité environnementale pour le quinquennat et après 2022 ?,* Comité pour l'économie verte (Committee for the Green Economy) and, theoretically, Cramton P., A. Ockenfels and S. Soft (2015): "Symposium on International Climate Negotiations", *Economics of Energy and Environmental Policy*, vol. 4, no 2.

[25] This revenue could be voted on in the public finance programming law; then the price trajectory, after consultations, in particular with the *Haut Conseil du climat* (High Climate Council), in the finance law.

[26] As a reminder, between September 2017 and September 2018, only 21% of the increases in the price of SP95 were due to taxes, 29% for diesel fuel.

[27] In order to avoid slackening efforts when oil prices are low, it is important that statistical information on major emissions (which can be estimated on the basis of fuel sales) is provided according to the same quarterly schedules as for short-term economic information.

modulation would be possible in the event of an increase in the price per barrel (in euros and excluding distribution costs) of more than 10% compared to the average of the previous four quarters. After three months, the legal rate would be restored. This mechanism could be activated at any time of the year, for example, after public notice from the *Haut Conseil du climat* (High Climate Council). The corresponding mechanism must operate symmetrically, in the event of an unexpected sudden drop, which would thus make it possible to advance half of the expected increase in TICPE for the following year. This modulation would not aim to erase all variations in the price of oil but to smooth them out.

The second would be an optional subsidized mechanism to insure the most vulnerable households, due to their income and geographical location without access to public transport, against peaks of oil price. It could take the following form. In exchange for the payment of a premium partially paid by the State for vulnerable households, the "insurer" pays the price above a threshold of "current price + x %" for a certain number of months (for a fixed quota); the State also acts as a regulator to ensure the emergence of a supply of this type of product for households.

Recommendation 5. To protect households from extreme oil price fluctuations, temporarily adjust the path of increase of the TICPE or propose a specific coverage mechanism for the most vulnerable households.

A scenario for the evolution of climate policy

Reducing diffuse emissions from construction and transport

Existing environmental policy uses many instruments other than carbon taxes: technical standards, including for vehicles and buildings, subsidies for clean technologies and renewable energy, energy efficiency programs... However, these instruments are less effective than carbon pricing. Indeed, standard setting freezes technological choices while competition should be stimulated to be "greener". Subsidies also allow socially unproductive structures to be maintained when new sectors emerge. They are also subject to a very strong tension between two objectives. On the one hand, targeting to avoid deadweight effects and contain public expenditure. And on the other hand, avoiding distortions resulting from too narrow targeting that breaks the neutrality between equivalent technologies, which often generates undue rents for some agents. The cost per ton of carbon avoided by these policies can therefore be very high.

French greenhouse gas emissions have decreased from 550 $MtCO_2eq$ in 1990 to 470 today. Most of the reduction was achieved between 2005 and 2014, the most recent period being even marked by a reversal of the trend, in a context of low oil prices. This 80 $MtCO_2eq$ reduction, although insufficient to meet the targets set in 2003,[28] was achieved without any carbon pricing other than the pre-existing fuel pricing. This suggests that substantial emission reductions are possible at moderate costs once the process is started, with the switch from coal to electricity production and the reform of the most polluting industrial processes. Then, this dynamic can continue by switching from different uses to electricity, whose production must be totally carbon-free.

It is this type of strategy, mobilizing energy savings from installations generating significant emissions in relation to total emissions (point sources), that has been implemented in the past. Emission reductions were mainly achieved in the industrial and energy sectors (Figure 4), with the specificity, however, that French electricity production was already very carbon-free in 1990: 107 grams/kWh, now reduced to 52 for an average level in the European Union of 331, Germany being 485. In addition, industry emissions have been mechanically reduced by the evolution of the French productive system, but with the counterpart of an increase in emissions linked to imports. Thus, while the emissions physically emitted on French territory were decreasing, the carbon footprint, which measures emissions induced by domestic demand, continued to grow.[29]

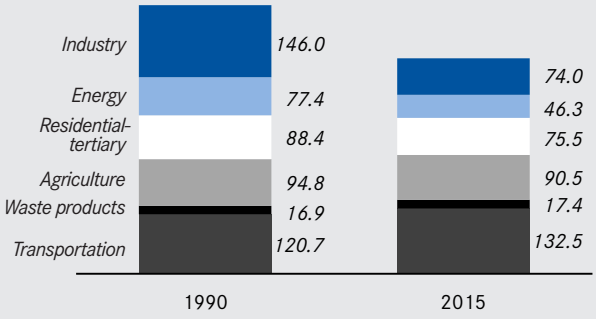
Diffuse emissions, from households or all companies, which now represent three quarters of French emissions, have remained stable since 1990, with slight decreases in the residential-tertiary sector and agriculture, being offset by increases in transport emissions and, more marginally, in the waste sector. It can only be noted that traditional instruments have not achieved the objectives that had been set for transport and building renovation.

Yet, regarding their ability to achieve the objectives, the detailed targets by sub-sector, including the number of renovations or new emission standards for vehicles and buildings seem more reassuring than carbon pricing. Can these policies be made more effective than in the past and at what cost?

[28] "Factor 4" objectives to refer to a country's objective of reducing its greenhouse gas (GHG) emissions by a factor of four between 1990 and 2050 levels.

[29] Baude M., F-X. Dussud, M. Ecoiffier, J. Duvernoy and C. Vailles (2017): *Chiffres clés du climat. France, Europe et monde*, French Ministry of Ecological and Solidarity Transition and I4CE, 2018 edition.

4. Greenhouse gas emissions by sector in $MtCO_2eq$



Source: CITEPA (2018).

First, it is important to identify more rigorously the conditions for the success of these traditional policies. The case of the "bonus-malus" policy in the car industry provides a good illustration of this. The monetary incentives introduced by this scheme have undoubtedly enabled a break in the trend in unit emissions from the vehicle fleet. But the system has favoured diesel over petrol, encouraging an increase in local pollution. And it has been shown that even by restricting the analysis on the environmental dimension, the system has not worked satisfactorily: the rebound effect and the resulting expansion of the fleet have ultimately led to an increase in carbon emissions.[30]

Which sacrifices for which emission reductions?

Simulations carried out following the Quinet Commission with economic models incorporating demand closures (so-called "sectoral macroeconomic models") show that our total emissions could be reduced to 300 $MtCO_2eq$ in 2030 if a uniform carbon price of around 165 euros/tCO_2 were applied by 2030.[31] Insofar as this price sets the upper bound of the marginal cost of the efforts to be made, the average cost per ton of carbon avoided to achieve this objective would be in the order of 93 euros/tCO_2.

The assessments carried out by the independent consulting company Carbone 4[32] indirectly provide information on the cost of the alternative strategy. The level of reduction could be achieved by a few selected measures, such as: bunch of work combining thermal insulation of the envelope and substitution of end-of-life fossil fuel heating equipment with efficient low-carbon equipment in energy-intensive housing; electrification of vehicles. The choice of these measures is the result of an optimization, which emphasizes the priority to be given to renovation over the reinforcement of the performance of new buildings, the latter being twicemore costly. Despite this, their cost would be around 200 euros per ton of CO_2 avoided in the building and between 210 and 270 for electrification of vehicles, as long as the drop in battery costs remains a promise.

We have a ratio of 1 to 2, or even much more, for the sacrifice of purchasing power to be made to ensure a certain level of decarbonation depending on whether the price signal is used or whether we rely on more traditional instruments. As mentioned in the Quinet Report, many existing decarbonation policies are in fact much more expensive than benchmarks that are considered difficult to accept when they are disclosed in full light to calibrate a carbon price signal.

What kind of instrument mix?

However, the analysis cannot be limited to asserting the superiority of eco-taxes in terms of cost-effectiveness, as political economy considerations are crucial for the implementation of climate policies. The two strategies to consider are therefore not, on the one hand, "pure" pricing and, on the other hand, regulation or subsidies for green investments. Instead, we recommend a new mix of instruments, in which carbon pricing is central.[33]

Indeed, the carbon tax stimulates green innovation and creates a business model for green investments.[34] However, supporting innovation and green investment using public funds from the general budget at the same time is justified and necessary for several reasons we discuss below. First, this policy is complementary to the taxation policy. There is no reason to link the financing of green investments to carbon tax revenues. Indeed, if a substantial share of carbon tax revenues were directed towards this financing, it would then become almost as much a return-oriented instrument as an instrument serving the sole purpose of guiding private behaviour. It might change its nature because there is no reason that the tax revenue and the financing needs of green investments should coincide. Government spending

[30] d'Haultfoeuille X., P. Givord and X. Boutin (2018): "The Environmental Effect of Green Taxation: The Case of the French Bonus/Malus", *The Economic Journal*, vol. 124, no 578.

[31] Quinet Report (2019), *op. cit.*

[32] Tazi A., J. Mossé, A. Schuller and S. Timsit (2018): "Comment décarboner en profondeur et sans tarder le bâtiment, les transports et l'industrie ?", *Carbone 4, Baromètre de la décarbonation*, November.

[33] This is in line with the reminder in the IPCC Special Report that explicit carbon pricing is one of the pillars of the decarbonation process, see Rogelj J., D. Shindell, K. Jiang, S. Fifita, P. Forster, V. Ginzburg, C. Handa, H. Kheshgi, S. Kobayashi, E. Kriegler, L. Mundaca, R. Séférian and M.V. Vilariño (2018): "Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development" Chapter 2 in *Global Warming of 1.5°C*, Intergouvernemental Panel on Climate Change (IPCC) Special Report.

[34] See Aghion P., R. Baron, D. Bureau, J-P. Bompard, P. Crifo, P. Criqui, N. Girouard, M. Glachant, Y. Kervinio, A. Quinet, K. Schubert, N. Triech and C. Tutenuit (2017): *Comment concilier développement* économique *et environnement* ?, Conseil économique pour le développement durable and OECD (2015): *Vers une croissance verte* ? *Suivi des progrès*, Études de l'OCDE sur la croissante verte, OECD Publishing.

in this area should be guided primarily by the shadow value of carbon:[35] if the cost per ton of carbon avoided through investment is below a threshold defined by the shadow value, then the investment is socially profitable and must be made.

What are the arguments in favour of subsidies for green equipment? First, it is rational to temporarily subsidize green research because it is easier to innovate in sectors where research and knowledge have already been accumulated.[36] Directing research and innovation towards breakthrough technologies with higher potential then requires additional support. Subsidies for green investment can also be justified by the existence of learning effects in the production of new technologies or infant industries. For example, prices of solar photovoltaic modules have fallen by about 80% since the end of 2009. This sharp drop in prices can be attributed to learning effects. However, the latter are difficult to anticipate: for example, there is no such decline in offshore wind energy. There may also be significant learning effects on the demand side in the use of new technologies. The use of a shared transport service, for example, can be made easier by the emergence of new business models and user feedback. For many new ideas, small-scale experimentation seems to be essential before triggering large-scale investments.

Secondly, a given carbon price can avoid even more emissions if green substitutes are accessible and affordable, allowing households to change their behaviour. If these green substitutes are public goods (e.g. public transport infrastructure) or if there are network externalities (density of charging stations for electric vehicles), it is justified to subsidize them. From this perspective, green public investments and carbon taxes appear to be complementary, and in the timing of climate policy it would be justified to carry out the former before implementing the latter.[37]

Moreover, if the announcements of future tax developments are not considered sufficiently credible by households, there is a risk of private under-investment in green equipment. It is also possible that households may overestimate the future benefits and costs of investment.[38]

Finally, in addition to ecological taxation, subsidies or grants for equipment changes are justified for households that are too financially constrained and do not have access to credit. To avoid deadweight effects, it is important to target assistance to the most vulnerable households (see recommendation 1) and to direct it towards effective solutions. In this respect, one should not be misled by the fact that regulations and subsidies for green investments are generally better accepted than the carbon tax. Indeed, the link between these conventional policies and the generally delayed increase in electricity or energy bills is not always clear to the general public. However, the costs are very real, not unrelated to the tax bustle, with regressive effects even if little perceived by the public.[39] Indeed, conventional policies combining regulations and subsidies often benefit to the wealthier households: they have a greater interest in changing equipment (or can do it more easily), so they benefit more from subsidies (particularly those that do not depend on their income) and the net cost of upgrading is lower for them. Individual aid must therefore decrease with income, as is the case with some vehicle conversion premium schemes or boiler replacement premium schemes. On the other hand, the energy transition tax credit, by encouraging work to be carried out to standards higher than those of the regulations, equipment by equipment, but without any minimum requirement as to overall progress made or household income conditions, would deserve a serious revision.[40]

More generally, it is important to carry out a systematic *ex ante* and *ex post* evaluation of the effectiveness of any grant and regulation, which should be independently certified in the same way as the counter-expertise requested by the Office of the Commissioner General for Investment in major projects. This requires experiments, which make it possible to compare the number of tons of carbon avoided with the cost of measurements.

Finally, to reap the full benefits of climate policy, other policies (taxation, planning, technical regulations, etc.) must not thwart its effects and, beyond that, ensure their coherence. In this respect, land policies are a key issue. The

[35] Quinet Report (2019) *op. cit*.

[36] Aghion P., A. Dechezleprêtre, D. Hémous, R. Martin and J. Van Reenen (2016): "Carbon Taxes, Path Dependency, and Directed Technical Change: Evidence from the Auto Industry", *Journal of Policital Economy*, vol. 124, no 1, February.

[37] See Meckling J., T. Sterner and G. Wagner (2017): "Policy Sequencing Toward Decarbonization", *Nature Energy*, vol. 918, no 2, November. The risks of inefficiency cannot be overlooked, see Office D. (2018): "Non-Conventional Instruments and Supervision of Environmental Policies", *Annals of Economics and Statistics*, no 132, pp. 33-51, December.

[38] De Groote O. and F. Verboven (2019): "Subsidies and Time Discounting in New Technology Adoption: Evidence from Solar Photovoltaic Systems", *American Economic Review*, forthcoming.

[39] On tax credits, see Borenstein S. and L. Davis (2015): "The Distributional Effects of US Clean Energy Tax Credit", *Energy Institute At Haas Working Paper,* no 262. On vehicle standards, see Levinson A. (2019): "Energy Efficiency Standards Are More Regressive Than Energy Taxes: Theory and Evidence", *Journal of the Association of Environmental and Resource Economists*, forthcoming.

[40] See Waysand C., D. Genet, M-P. Carraud, M. Rousseau, A. Weber and C. Helbronner (2017): *Aides à la rénovation énergétique des logements privés*, IGF-CGEDD Report, La Documentation française, April.

structural trend towards urban sprawl must be reversed to reduce emissions from the transport sector, which requires financially accessible and attractive cities.

Recommendation 6. In addition to carbon pricing, support innovation and green projects. Submit the choice of these projects, the corresponding grant programs and technical regulations to *ex ante* economic evaluation or small-scale experiments in order to compare their cost with the number of tons of carbon avoided.

The price of carbon reflects the value we place on the sustainability of the planet for our children. If it is essential to effectively guide action, it must be based on governance that removes any suspicion of its purpose and be associated with a shared narrative vision of the issues of ecological transition. If its revenue is properly redistributed, it can be effective and fair. In addition, the ecological transition requires green investments, both public and private, for which the learning curve must be stimulated. The development of green finance and the definition of research or infrastructure programs are complementary to carbon pricing.

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