LA TRANSITION ÉNERGÉTIQUE
Useless, costly, unfair

Rémy Prud'homme

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About the author

Rémy Prud'homme studied business administration at HEC (the top French business school), and then economics at the University of Paris, where he completed his PhD, and at Harvard. He then became a professor of economics in the French university system. He taught for many years at the University of Paris XII, where he is now professor emeritus, and at MIT, as a visiting professor. He has also worked at the OECD, as deputy-director of the environment directorate, and has been a regular consultant for a number of institutions, notably the World Bank. His main interests are in public finance, transportation, and the environment. Additional information can be found on his website at www.rprudhomme.com.

1 Introduction

The energy landscape did not change much before the 19th century. Napoleon and Caesar travelled, dressed, and warmed themselves in very similar ways. Since the beginning of the 19th century, however, change has been rapid and drastic. Traditional energy sources – manpower, horsepower, wind and water – have been all but eliminated, replaced by new ones: coal, oil, electricity and nuclear. In transportation, for instance, walking, horse-riding and sailing ships were replaced by railways, cars, planes, and steamships. Such changes greatly contributed to the extraordinary improvements in living standards registered over the past two centuries in the so-called developed countries; and then, over the last fifty years, in the so-called developing countries.

These changes show that energy transitions have been a constant of our societies. They have been driven by two forces: technology and the market. It was technology, based upon science, that created the steam engine, the combustion engine, and nuclear power. And it was the market, not government intervention, which ensured the implementation of these innovations. In most countries, railways, cars and nuclear electricity became widespread by themselves, with some government regulations, but generally without significant subsidies.* None of these 'transitions' has been the outcome of a specific public policy.

This is in sharp contrast with what is presently called in France *la transition énergétique* – the energy transition. It essentially relates to the decarbonisation of the economy. The objective is to reduce annual French carbon dioxide emissions from the current level of 340 million tons to 170 Mt by 2050, and subsequently to zero. This trajectory, or transition, has not been engendered by any particular technological innovation; it is entirely politically motivated. Its sponsors justify it by the fear of the consequences that carbon dioxide could have on the global climate. This transition can only happen by means of a set of taxes, subsidies, bans, laws and more subtle methods of persuasion, which will all be costly in budgetary and economic terms. This makes the current energy transition completely different from the ones in the past.

This by itself does not necessarily condemn the policy; there are many public policies (such as education, justice, safety, environmental protection) that are highly desirable, and even necessary. But it does not justify it automatically either; there are also many public policies that are useless and undesirable. It is therefore legitimate to assess the French energy transition. A critical examination suggests that it is useless, costly, and unfair.

2 A useless policy

French (and European) energy transition policy is largely driven by the theory of anthropogenic global warming. This theory maintains that greenhouse gases, mostly carbon dioxide,† emitted by human activity, are the driver of increases in the average temperature. This theory is more political than scientific. The UN created a new international organization – the IPCC – with the purpose of developing, proving and improving the theory in order to

* The French nuclear programme was financed by bonds issued on the market, and mostly purchased abroad (in particular by US funds). The implicit government guarantee did lower bond rates, which can be seen as a form of subsidy, but a very minor one.

† Instead of speaking of 'greenhouse gases', measured in 'equivalent tons of carbon dioxide', we will refer to carbon dioxide only. The loss in terms of precision is, we believe, outweighed by the gain in terms of simplicity and clarity. We will also ignore the minor land use change element of carbon dioxide emissions, which is unaffected by climate policies.

drive political change. It does so quite effectively. This activism was honored by a Nobel prize (as members of the IPCC like to remind us), although it was a Nobel peace prize, which honours a political activity, not a science prize (a detail of which members of the IPCC do not like to be reminded).

There are reasons to entertain doubts about this anthropogenic global warming theory, but explaining why is not the purpose of this paper. On the contrary, I will take the IPCC theory as it is, as if it were empirically validated, and use it to show that the policies based on it are pointless and damaging. The official theory states that the average of world temperatures is a function of the quantity of carbon dioxide in the atmosphere. If it increases, so do temperatures. By how much? The IPCC maintains that an increase of 1,000 GT in cumulative emissions of carbon dioxide induces an increase of 0.49°C .[‡] Equipped with this information, we can estimate the impact on world temperatures of carbon dioxide emissions reductions associated with various policies. That impact is in fact rather modest, as we shall see.

Impact of potential OECD policies on temperatures

The policy scenario tested is the following: between 2017 and 2050, OECD countries (assumed to be the developed countries) reduce their carbon dioxide emissions by 50%; the rest of the world (in broad terms, the developing countries) do not increase their yearly carbon dioxide emissions. This policy will then be compared to a reference scenario, without energy transition policies, in which yearly emissions continue at their 2017 level. Both scenarios are plausible, and even optimistic.

The reference scenario is realistic. In the absence of specific policies, it is hard to see why carbon dioxide emissions would decrease in the 33 years between 2017 and 2050: over the last 33 years they have increased by 80%, in spite of 23 UN conferences that pretended to be bringing about their decline. Therefore, assuming carbon dioxide emissions stability in the three coming decades assumes great confidence in technological progress and its ability to produce energy savings (per capita or per unit of GDP).

The policy scenario tested is also rather ambitious. Over the last 33 years, carbon dioxide emissions in the OECD countries have increased by 16%. Turning this +16% into −50% implies a set of costly constraints. Achieving stability of carbon dioxide emissions in the rest of the world over the same period will also be challenging: they have increased by 290% over the last 33 years.

Table 1 shows the impact of the policy scenario on world temperatures. In the absence of energy transition policies, the average of world temperatures in 2050 would increase – according to the IPCC theory – by 0.53°C. A strong policy, constraining OECD countries to reduce their carbon dioxide emissions by half, would bring this temperature increase down to 0.48°C. The difference between these two scenarios, which is a measure of the impact of the strong energy transition policy considered, is 0.05°C, or 5/100ths of a degree. The impact is not non-existent, but it is small, and in practice negligible.

We also estimated the impact of our two policy scenarios upon the stock of carbon dioxide in 2050. Then, using the transient climate response, estimated to be 1.5°C per doubling of carbon dioxide,[§] we derived a second estimate of the impact of a strong energy transition policy. This was just 0.03°C, even smaller than the impact estimated above.

[‡] IPCC 2018, Figure 2.3, p. 105.

[§] The IPCC gives a range of 1.0–2.5°C.

Table 1: Impact of energy transition policy on 2050 temperatures.

	2017	2050 without policy	2050 with policy
Annual CO_2 emissions	(Gt)	(Gt)	(Gt)
OECD countries	12	12	6
Rest of the world	21	21	21
Total world	33	33	27
Cumulative emissions 2018–50 (Gt)	—	1089	990
Temperature variation/2017 (°C)	—	+0.53	+0.48
Impact of policy (with − without) (°C)	—	—	−0.05

Sources BP (2018) Statistical Review for 2017 emissions; IPCC (2018, p. 105) for the transient climate response to emissions. The policies examined are: (i) the situation resulting from the continuation of present yearly emissions over the 2017–2050 period ('without policy', or 'without'), and (ii) a linear diminution of 50% of OECD CO_2 emissions and the stagnation of rest of the world emissions over the 2017–50 period ('with policy', or 'with'). The resulting temperature variations are calculated with a transient climate response to emissions (TCRE) of 0.49°C per 1,000 $GtCO_2$. Gt = Giga tons = billions of tons.

In short, developed countries are not able to reduce their carbon dioxide emissions to the extent necessary to stop global warming (if you believe the IPCC), and developing countries are not willing to do so. The conclusion is that OECD energy transition policies are useless.

Impact of French policies on temperatures

What is true for all OECD countries – that energy transition policies are of no use – is even truer for France alone, for at least two reasons.

The first is that France does not amount to much, and less and less so, in the world of man-made carbon dioxide emissions. It currently emits 0.3 Gt per year, or just 1% of the global total, which is itself just 1% of the total stock of carbon dioxide in the atmosphere, which is supposed to be the driver of global warming. If France were to stop carbon dioxide emissions overnight (by some sort of miracle), the growth of the level in the atmosphere would be reduced by 1/10,000, and the impact upon global warming would be entirely insignificant.

The argument often put forward to justify the energy transition in France (and in many other developed countries) is that small streams make great rivers, and that we must set a good example to other countries. The answer is that we have already set an excellent example, but one that is not widely followed: France happens to be one of the countries with the lowest ratios of carbon dioxide emissions to GDP, as suggested by Table 2.

The French electricity mix, which is 85% nuclear and hydro, explains this very low carbon intensity. Of the five main sources of power, two emit carbon dioxide: coal (a lot), and gas (half as much); and three do not: hydro, nuclear and intermittent renewables (wind and solar). Astonishingly, a recent survey shows that 78% of the French believe that nuclear electricity is a major contributor to global warming. This belief owes nothing to their personal experience or real knowledge on the subject; it owes everything to what they have seen or

heard in textbooks, newspapers, broadcasts, or TV. This is a measure of the remarkable level of disinformation on energy issues that predominates in France.

Table 2: Carbon dioxide content of GDP and electricity.

	GDP (CO_2/GDP) 2017	Electricity (CO_2/output) 2013
France	124	68
Germany	208	520
United Kingdom	151	455
Italy	178	384
USA	262	491
Canada	339	158
Russia	965	643
China	761	696
European Union	204	388
World	414	539

Sources: World Bank for GDPs; BP Statistics for global CO_2; IEA (quoted by the French ministry for ecology) for electricity-related CO_2. Notes: The ratio for GDP is expressed in tons of CO_2 per million US$ of GDP; the ratio for electricity in tons of CO_2 per million MWh.

Attempting an energy transition is therefore particularly pointless in France. The country has already done a lot – more than most – towards decarbonisation. Rather than claiming that everything should change, French governments would be better to advertise French successes in this area, in the hope that others might emulate them.

To conclude on the uselessness of a radical energy transition in France, consider the case of coal-fired power plants in France and China. There are still four of these in operation in France (with a capacity of 3 GW, accounting for 1.8% of electricity output). The French government is determined to close them in the next four or five years, and attaches great importance to this aim; President Macron himself presents it as a major contribution to the energy transition. In the same period, China – usually presented by French environmentalists as a model to follow – will open about 560 thermal power plants with a capacity of 259 GW. We therefore have a small step forwards and a great leap backwards: −4 in France, −560 in China.

3 A costly policy

This useless policy is nevertheless very costly. To properly estimate this cost, it would be necessary:

- to start with the overall objectives (e.g. reduce carbon dioxide by half in 2050)
- to deduce the implied sectorial goals (e.g. specified levels of carbon dioxide emissions reductions in the transport sector)
- to identify the measures required to reach these goals (e.g. specific increases in fuel tax rates)

- to estimate the direct and indirect consequences of the implementations of these measures (e.g. reduction of mobility by a specified percentage)
- to evaluate the costs of these consequences for the economy and for the Treasury.

This is a massive task that governments, at least in France, have not even attempted to undertake; the cost of the energy transition is apparently not their main concern. Here, we will briefly try to describe, and when possible put numbers on, what is happening in, or is being envisaged for, France.[‖]

The starting point of this exercise is the distribution of carbon dioxide emissions by sector in 2017, and the objectives for 2050, as presented in Table 3.

Table 3: French carbon dioxide emissions by sector, 2017–2050.

	2017 Mt	2017 %	2050 Mt
Energy	47	14	?
Transportation	124	39	?
Residential and services	78	24	?
Manufacturing industry	70	21	?
Other	11	3	?
Total	330	100	165

Source: CITEPA. Note: 'Other' is mostly agriculture.

Four sectors stand out:

- transportation (mostly road transportation)
- energy (mostly electricity)
- the residential and services sector (mostly heating and hot water)
- industry.

The French case is atypical. In most countries, the distribution is rather different, with electricity accounting for a much larger share (about 40% on average).

As the question marks in Table 3 show, the French energy transition objectives for 2050 are only specified for the total: a 50% cut. We do not know the goals envisaged for the various sectors. All are heavily taxed, regulated, and subsidised. The ministry in charge is proud to be operating at least 36 environmental taxes,[¶] raising €50 billion per year.[**] We shall focus on the two sectors that seem to be the main targets of policies undertaken in the name of the energy transition: electricity and transportation.

Electricity

The emphasis put on electricity by energy transition policies in France is paradoxical. As mentioned above, electricity is the area in which France is doing particularly well in terms

[‖] By way of comparison, the reader might keep in mind that the budget of the Justice ministry (which includes jails) amounts to 7 billion euros.

[¶] Ministère de l'Environnement 2017, p. 109 seq.

[**] Ministère de la Transition Ecologique, 2018.

of carbon dioxide emissions. Nevertheless, a clear objective of French transition policy is to reduce nuclear power in order to replace it with wind and solar. The ministry responsible states this very clearly: 'Wind electricity will constitute a *pillar* [our emphasis] of the French electricity system'. As in most other European countries, the demand for electricity in France has not increased over the past fifteen years, and there are no reasons why it would significantly increase in the next thirty years. In this context, more renewables means less nuclear electricity. This evolution is undertaken in the name of the energy transition. Here, we no longer face a paradox but a lie. To shut down functioning nuclear plants that do not emit carbon dioxide, so that they can be replaced by wind turbines that do not emit carbon dioxide either, will not reduce French carbon dioxide emissions at all.

As a matter of fact, it might even increase them, for two reasons. The most important one, which is well known, is that wind and solar power are intermittent and random. They function only when the wind blows (about 25% of the time) and/or when the sun shines (12% of the time), and – this is the important point – not necessarily when electricity is needed. Presently, we do not know how to store electricity in large quantities at reasonable cost. To ensure a demand-responsive supply at every hour of the year, in order to avoid blackouts, one must keep, or build, coal or gas power plants to provide dispatchable electricity for when there is no generation from wind or solar power. Coal- and gas-fired power stations emit carbon dioxide. The other reason is that each windmill needs 1500 tons of cement for its foundations and cement production produces large amounts of carbon dioxide.[††] There may be good reasons to prefer wind power to nuclear power (although we do not quite see them), but carbon dioxide emissions are not one of them.

The energy transition policy therefore has a cost, which is both direct and indirect.[‡‡]

Direct cost

The direct production cost of electricity from renewables (what is paid by producers) has traditionally been higher than that of conventional generation. Consequently, developers have asked for and received subsidies. No subsidies means no wind or solar energy, in France as elsewhere. When Spain stopped granting such subsidies, investments in renewables stopped immediately. These subsidies have taken the form of compulsory purchases, at (high) government-mandated prices. EdF, the main utility, which is state-owned, must buy all the renewable electricity produced, whether it needs it or not, for a period of about 15 years (the assumed length of life of the intermittent electricity investment). For a producer, this is a dream: a guaranteed market, at a generous price. A special fund then reimburses EdF for the difference between the price it paid and the 'normal' cost of electricity.

This difference is a measure of the direct additional cost of renewable electricity. The figure is official, because the energy regulator[†] calculates and publishes it every year, in order to determine the amount of the reimbursement. The cost is currently about €5 billion, and increases regularly. The regulator has calculated that, even with very conservative assumptions, the cumulative cost will be €57 billion over the period 2014–25.

[††] The construction of a nuclear power plant also requires cement: 18 times less than the building of wind mills, per kWh produced.

[‡‡] Prud'homme 2017.

[†] Commission de Régulation de l'Énergie (CRE).

Who foots the bill? The answer is electricity consumers, by means of a tax on electricity consumption, called the CSPE.[‡] The rate of this tax increases every year. It can be found on everybody's electricity invoices, albeit in very small print. In addition, the Treasury imposes a 20% value-added tax upon the CSPE (although many people think that the value-added dimension of the CSPE is less than obvious). The cost to consumers of the direct additional cost is therefore not €5 billion, but €6 billion.

Indirect cost

The direct cost, which is clear and quantified, is only one part of the cost of renewables. Saying that it is the visible part of the cost iceberg would be an exaggeration, but the metaphor would capture part of the reality. This is because wind and solar power impose other, indirect, costs upon society. A brief list is as follows:

- Wind turbines, taller than all gothic cathedrals, destroy centuries-old landscapes. They lower the market value of nearby buildings. The loss of value caused by existing wind turbines to real estate has been valued at €20 billion (in total, not per year).
- Wind turbines kill birds, particularly protected migratory species, and above all bats, at a difficult-to-estimate but significant environmental cost.
- The spatial distribution of wind or solar 'farms' (the word conveys a bucolic image that has little to do with the industrial reality it pretends to describe) leads to a significant increase in the size of electricity transport networks. There used to be about 200 electricity production plants in France; there are now nearly 10,000. The additional transport cost amounts to about €1 billion per year.
- Their intermittent generation requires costly safety nets in the form of standby thermal power plants, or of equally costly 'interruptible contracts' (giving the distributor the right to stop supplying power to some big consumers). Storage, if it can ever be made to work at scale, will also be costly.
- The worst is probably the so-called 'eviction effect'. Renewable electricity has priority access to the grid system. Whenever wind or solar power production increase, traditional power plants must reduce their output. They must therefore amortise their fixed costs over a lower output, thereby increasing their unit costs of production, a form of waste which is necessarily reflected in higher system costs.

These (and other) indirect costs are not very well known and quantified, but available information suggests that their importance might be comparable to that of the direct cost. And consumers must again bear the cost, in the form of higher electricity prices.

How have these direct and indirect unit costs changed as the share of renewables in the electric mix has increased? Direct costs tend to decline, mostly because the cost and/or price of imported components (wind turbines, solar panels) diminishes. But indirect costs increase.

Increased prices

Direct and indirect costs are obviously reflected in higher prices paid by consumers. In Europe, this price is a function of the renewables penetration rates in the electricity mix, as shown in Figure 1.

‡ Contribution au service public de l'électricité.

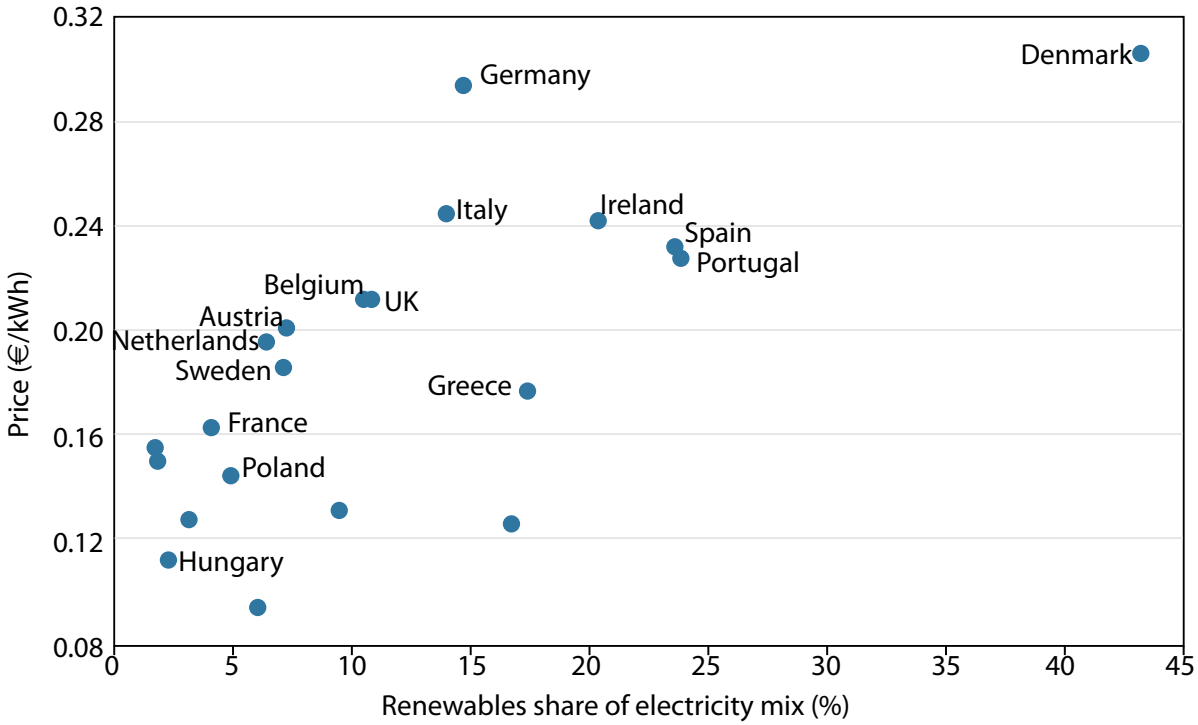


Figure 1: Electricity prices as a function of the share of renewables in the electricity mix, 2015.
Renewables here defined as wind and solar.

When the share of intermittent renewables (wind plus solar) is low, prices are low. When this share is high, so are prices. German households pay twice as much for their electricity as French households.[§] The developments planned for the French 'energy transition' imply a doubling of electricity prices.

Transportation

In France, the transport sector is by far the most important sector in terms of carbon dioxide emissions. These emissions are overwhelmingly caused by road transport of both people and goods. For many years, governments have attempted to reduce the importance of road transport, as a means to reduce its emissions. Policies to that effect have been many, costly, and inefficient.

Numerous attempts

Anti-car measures have been manifold. Let us briefly mention eight instruments utilised:

- replacing trucks by trains
- replacing cars by trains for long distance rides
- facilitating car-sharing
- favouring public transport in cities

[§] The difference is not as large for industrial prices: Germany allocates additional costs disproportionately on households, in order not to overcharge industry.

- lowering speeds on roads
- promoting bicycle use in cities
- replacing diesel oil by gasoline[‖]
- replacing fuel cars by electric cars.

Costly attempts

To reach these goals, governments have spared no effort. They have heavily taxed vehicles, and heavily subsidised alternatives. Specific taxes on road transport –taxes that do not apply to other goods and services – amount to €45 billion in 2017. This is nearly as much as corporate income tax (€57 billion), and amounts to 60% of the personal income tax take (€77 billion). This is three times as much as the amount public administrations, including local government, spend on road investment and operation. The most important of these taxes is the TICPE, a fuel tax, which raised €36 billion in 2017.[*] Road fuel is, after tobacco, the most taxed good in France.

The government intended to increase the burden on road users further this year, by increasing an existing carbon tax. However, their plans infuriated many members of the public, and led to the Yellow Vests protest movement. The government has therefore postponed the increase, although perhaps only temporarily. If a massive reduction of carbon dioxide emissions were necessary (a hypothesis we reject), a carbon tax is not absurd, in principle. If carbon dioxide is a 'bad', to tax it in general, in all its forms, is desirable. This will exert pressure on consumers, and therefore carbon dioxide producers, to reduce their usage and the associated emissions, in hundreds of different ways that we need not know and even imagine. The higher the tax, the lower will be carbon dioxide emissions. A good carbon tax could thus replace all anti-carbon policies, and ensure by itself the desired energy transition.

It is the implementation of this elegant principle that raises difficulties. Let us mention two problems, amongst many. Because the carbon dioxide 'illness' is global, the remedy must be applied globally too; its implementation in just one country would only displace activities – and carbon dioxide emissions – out of that country. Unfortunately, a single world carbon tax is but a dream; it is socially and politically unthinkable.

Second, a carbon tax is hegemonic in nature, and its implementation assumes the elimination of all existing taxes and regulations on carbon-dioxide-generating goods. In reality, the carbon tax in France (and in many other countries) was introduced as an addition, not as a substitute. This is well illustrated by the debate on the French carbon tax. One argument put forward was that France could afford a €45 per tonne carbon tax because Sweden has a €120 one, and is surviving well despite it. This argument ignores – either deliberately, or through ignorance – the fact that the TIPCE, which has been in place for many decades, functions exactly like a carbon tax. As a matter of fact, fuel taxes are slightly higher in France than in Sweden.

Non-automobile transport modes, by contrast, are heavily subsidised in France (as much, and probably even more, than in many other countries). SNCF, the railway monopoly, tries to hide this, with the help of the media. In reality, the difference between its expenditures

‖ Since most cars were diesel-fueled, and cheaper to use, inducing people to shift from diesel to petrol (by higher taxes) meant increasing the cost of automobile usage.

* This amount does not include the VAT that is charged on fuel, like any other good, but it includes the VAT collected on the fuel tax, which is an extension of the fuel tax itself.

and its commercial income amounts to about €14 billion per year, something that has been known by all specialists in the field for years, and was recently recognized in an official report.[†] This difference – a deficit in plain English – is compensated by all sorts of subsidies and by yearly increases in debt (which is itself eliminated from time to time by an ad hoc subsidy). The rail reforms introduced in 2018 will not change this situation.

Urban public transport is even worse. Their deficit (investment and operating expenditures minus commercial income) amounts to about €9 billion. It is covered by a tax allocated to local government for that purpose, called the *Versement Transpor*t (Transport Contribution), which is a tax levied on the wages paid by businesses. The total subsidy to public transport is therefore about €23 billion. This level has been approximately constant in recent decades.

Other forms of subsidy to reduce carbon dioxide transport emissions are relatively modest. The exception is the development of electric vehicles. The subsidy is presently €6,000 per vehicle purchased. If the number of vehicles reached one million per year, a level targeted by the government in the name of the energy transition (although a very unlikely prospect), the taxpayer's bill would increase to €6 billion per year.

Inefficient attempts

For the most part, all these costly efforts to reduce transport-related carbon dioxide emissions have not achieved much. Cars and trucks continue to transport most people and goods in France. This is not because of pro-road policies, but in spite of anti-road policies.

The continuing importance of road transport is obvious for freight. Notwithstanding a dozen 'freight plans' aiming at doubling, or even tripling, the share of rail, and costing billions of euros, the share of subsidised rail has stagnated or diminished, whereas that of overtaxed trucks has increased. In ton–kilometres, rail freight represents now about 10% of total freight. In terms of user expenditures, a figure that is much more meaningful economically, it represents less than 2% of the total.

For daily transportation, including journeys to work, cars represent 89% of passenger–kilometres. This is not true for Paris and the Paris region, where an excellent network of subways, local trains, and high-capacity rail lines reduces the share significantly. But Paris, contrary to what the elites living there think, is not France. In transport matters, Paris and France are two distinct countries.

For passenger transport across most of the country, motor vehicles (cars, motorbikes and buses) account for 87% of traffic as measured in passenger–kilometres. Bicycles account for 0.5%. To inflate this number, cycle enthusiasts measure bicycles' share in terms of trips, as if a 1-km bicycle trip could be compared to a 50-km car ride. They also limit themselves to urban trips, which are almost the only trips that can be undertaken with a bicycle.

Transport in France is therefore predominantly road transport. Some might deplore this fact, but all should recognize it. The success of road transport is explained by its higher performance for most – though not all – trips in terms of speed, cost, comfort, and versatility. The hyper-taxation of the automobile, and the hyper-subsidisation of alternative modes, changes nothing. This is why the carbon dioxide emissions of the transport sector are not declining much. They have fallen somewhat in recent decades, but not because road transportation diminished, to the benefit of other modes. On the contrary, road use in-

[†] Spinetta 2018.

creased slightly. Instead, carbon dioxide emissions per vehicle–kilometre declined, thanks to progress in vehicle technology.

Putting the brake on road transport therefore means putting the brake on transport at large. The share of road transport is so large, and substitution possibilities so few, that additional taxes and constraints on it necessarily produce higher transport costs in general, and reduce mobility. Lower mobility reduces the effective size of labour markets, and hence their efficiency. It means workers cannot access the jobs they want, and enterprises cannot access the workers they need, leading to lower productivity and higher unemployment. In the country as a whole, lower mobility reduces trade between regions, and the gains that come with it. The positive role of transport infrastructure in the attractiveness and prosperity of a country or zone is well established. Improving transport infrastructure while at the same time increasing transport costs is no improvement at all.

In passing, let us mention the much-too-frequent use of the argument: 'it will decrease carbon dioxide emissions' to justify any transport project or decision. One cannot seriously defend the (indefensible) €30-billion Lyon-to-Turin high-speed rail link by saying that this project will save a few million tons of carbon dioxide. Such a statement is a pretext, not an argument.

Even more shocking is the statement to be found on the official site of the French Road Safety Agency: 'Driving at 80 km/h instead of 90 km/h, means 30% lower CO_2 emissions'. This is publicity for lowering the maximum authorized speed from 90 km/h to 80 km/h on secondary roads; a controversial measure. It will reduce average speeds by 2–5 km/h, fuel consumption by 1 or 2% (according to official French formulas), and carbon dioxide by a similar percentage. Transforming 1 or 2% into 30% is a huge piece of disinformation.

4 An unfair policy

The so-called 'energy transition' policies are not only useless and costly, they are also regressive. They weigh more heavily on the poor than on the rich, relative to income, and occasionally even in absolute terms – on poor households, on poor regions, and on poor countries.

Interpersonal regressivity

Electricity, road transport, and housing are the sectors which contribute most to carbon dioxide emissions. Carbon dioxide reduction policies will mostly target these sectors, and increase their costs. Unfortunately, in these three sectors, consumption increases more slowly than income. For each, the share of expenditure is larger in poor households than in rich ones. To tax these expenditures, or to otherwise increase their cost, will therefore hit poor households more than rich ones. One number sums up this reality: the income elasticity[‡] of demand for these goods. Calculations based on the household expenditure survey[§] produce income elasticities of 0.5 for electricity and 0.8 for fuel. Such numbers overestimate income elasticities, because they are calculated relative to household expenditures, not household incomes.

[‡] The income elasticity of demand for a given good tells us by how much demand increases when income increases by 10%. If demand increases by 10%, income elasticity is 1; if demand increases by 5%, income elasticity is 0.5; if demand increases by 20%, income elasticity is 2.

[§] For 2011, the most recent available.

It has been known for a long time that environmental taxes hit the poor more than the rich. Governments are well aware of this. Therefore, to limit the resulting social damage, they introduce subsidy schemes targeted at poor households, for instance energy vouchers, or subsidies for the purchase of newer, more efficient automobiles. On the one hand, governments increase the price of power or of fuel; on the other hand, they subsidise poor households for the consumption of these goods. But such schemes, which are always administratively costly and complicated, often fail to eliminate the basically regressive dimension of the price increases caused by the energy transition.

There are even cases of regressive subsidies. Consider the example of electric vehicles, the purchase of which is heavily subsidised, as noted above. Even with this aid, prices remain far beyond the means of a poor household. In practice, this subsidy therefore mostly benefits rich households, usually for the purchase of a second (or third) car.

Such issues have led to more and more energy poverty. A growing number of households no longer have enough income to heat their homes or to travel to work. The phenomenon has been analysed by INSEE, the French National Statistics Agency,[‖] under the term 'energy vulnerability'. This is defined as when a household spends more than 8% of its income on home heating and/or more than 4.5% on transport. Twenty-two percent of households are in a situation of energy vulnerability for housing or mobility or both. This vulnerability is particularly prevalent for older citizens, and those under the age of 30. The study simulated the impact of large increases in energy prices, of magnitudes in line with energy transition policies. A 40% increase in heating costs would increase the number of those experiencing heating vulnerability from 15% to 27% of households; nearly a doubling. A 30% increase in car fuel prices would increase mobility vulnerability from 10% to 17%.

Energy poverty is not specific to France. It is also a reality in the United Kingdom and in Germany. Energy transition policies are not the only cause of it, but they do play an important role.

Inter-regional regressivity

Inter-regional regressivity – the fact that poorer regions are hit harder than others by energy transition policies – is a less well-known problem, but is no less important. The situation for France is illustrated in Table 4. This is striking. As electricity and fuel prices are identical over

Table 4: Household expenditure on electricity and fuel by region, 2011.

	Electricity		Car fuels	
	€/yr	Index	€/yr	Index
Greater Paris	527	100	841	100
Large cities	630	120	1083	129
Medium-sized cities	555	105	1196	142
Small cities	698	132	1462	174
Rural areas	850	160	1769	210

Source : INSEE, Survey of household expenditure 2011. Note: The numbers in euros are somewhat out of date, but the hierarchy remains significant; this is why index numbers are more meaningful than the euro values.

‖ Cochez *et al.*, 2015.

the territory, differences in expenditure reflect differences in consumption. They are significant. A rural household consumes 60% more electricity than one in Paris, and spends 110% more on transport fuel. Relative to income (which is obviously higher in Paris and other large cities), differences in expenditure would be even more marked. Increases in power and fuel prices caused by energy transition policies are therefore much more painful for rural areas and small cities: about twice as much in absolute terms, and three times as much relative to income. These differences markedly deepen the already serious regional divide in France. Looking at Table 4, one gets a better understanding of the geography of the Yellow Vests movement.

A number of other energy transition policies have similar effects. The location of wind farms, for instance, is heavily concentrated in the poorest regions or areas. No wind farms have been built in the fashionable Ile de Ré or Lubéron, and nearly none in the wealthy Ile-de-France. The damage they cause, such as the loss of property value, are therefore concentrated in poorer areas. The same can be said of the loss of time caused by the change in maximum speed limits on secondary roads. Parisians are entirely unconcerned: their daily trips are undertaken at 50 km/h; and their week-end or vacation trips are undertaken on highways at 130 km/h. By contrast, inhabitants of Creuse (in Central France) only drive on the secondary roads affected by this policy measure.

International regressivity

The worst unfairness probably relates to the distribution of the energy transition costs between rich and poor countries. In absolute terms, in US dollars, the cost of a given reduction in carbon dioxide emissions (for instance by the substitution of wind farms for a coal-fired power plant) is the same in India and in Germany. Let us assume it is US$200. One must understand that $200 means more – much more – in India than in Germany. It corresponds to 200 hours of work in India, and to 2½ hours in Germany. Poor countries simply cannot afford our energy transition.

Rich countries have tried to persuade the developing world that the opposite is the case, using two equally weak arguments. The first is that reducing their carbon dioxide emissions is in their own interest, in that it will save them the costs of excessive warming. But these are costs for tomorrow, for the end of the century; and they are the costs forecast by questionable climate simulations. Today, such costs do not exist. Contrary to what is repeated again and again in rich countries, we have so far seen little or no negative impact of global warming on the economy: the number and the intensity of hurricanes has not increased, nor has rainfall or drought, nor is there any sign of accelerating sea level rises. Illnesses have not become more prevalent (infant mortality and life expectancy is improving everywhere), nor have famines, which have completely disappeared from countries at peace. Agricultural output, far from declining, is increasing nearly everywhere, and faster than population – in part because the amount of atmospheric carbon dioxide, which is the natural food of plants, has increased.

The second argument is that rich countries promised poor countries that they would give them hundreds of billions of dollars per year if they agreed to play our game. That was in Copenhagen, in 2009, at the fifteenth UN 'Conference of the Parties' (COP). The amount was considerable, and it was a tempting offer, but a virtual one. Nine conferences later, no progress has been made. There is absolutely no agreement as to who exactly will pay what, to whom, according to what criteria, and with what controls.

These arguments, unsurprisingly, have failed to convince poor countries, and in particular China and India. Their priority is economic and social development, not an energy transition. They have always said so clearly (and honestly), in particular at the Paris COP in 2015, and have consistently refused to make any concrete commitment to reduce their carbon dioxide emissions. Whenever there is a contradiction between the twin objectives of development and decarbonisation, they choose economic development.

Rich countries have made a different choice, not only for themselves, but also for others. In striking a balance between an energy transition and the economic development of poor countries, rich countries have chosen the energy transition. This choice, which has been perceived as 'climate imperialism', has been particularly clear in the area of electricity. Poor countries, particularly in Africa, but also in India or Pakistan, want coal-fired power plants, which produce the electricity they desperately need at a lower cost. Rich countries, their aid agencies, and the development banks they control (including the World Bank), have decided not to finance any coal-fired power plants, even through reimbursable loans. In addition, environmental NGOs have successfully pressured private banks in rich countries to adopt the same policy. In practice, the consequences of this shameful refusal have been limited. China has stepped in. It finances (at interest rates higher than World Bank rates, and with fewer environmental constraints) the coal-fired power plants poor countries consider necessary for their economic development. This refusal, however, will leave socio-political scars.

5 Conclusion

The author is not a foe of the environment, nor systematically opposed to public intervention; quite the contrary. We have been, for many decades,[¶] very much aware of the damage that man's activities can cause to nature and to our environment: pollution of all kinds, excessive consumption of natural resources, threats to biodiversity, destruction of our natural and cultural heritage, and so on. We know that the fight against this damage, potentially great and at times irreversible, must be constant, and that it necessarily implies appropriate government intervention.

We have had the pleasure to see, over recent decades, that this fight has generally been a success. At least in the developed countries, pollution levels are now much below what they were forty years ago, and *a fortiori* what they were in the 19th century.[**] The disappearance of natural resources like iron ore, copper, or oil, widely presented in the 1970s as imminent and catastrophic, simply did not happen. The dramatic damage that environmental degradation was predicted to cause to health and longevity did not materialise. For sure, not everything is perfect in and for the environment, and much remains to be done. However, the combination of scientific progress, political intervention, and market forces did yield abundant fruit, and completely invalidated most of the catastrophic forecasts proclaimed by environmental activists.

Yet, over the last two decades, the fear of global warming has replaced the fear of environmental degradation. The fight against carbon dioxide pushed aside the fight against pollution. This uphill combat against carbon dioxide, under the name of the energy transition, has invaded minds and institutions. Symbolically, at least in France, the Ministry of

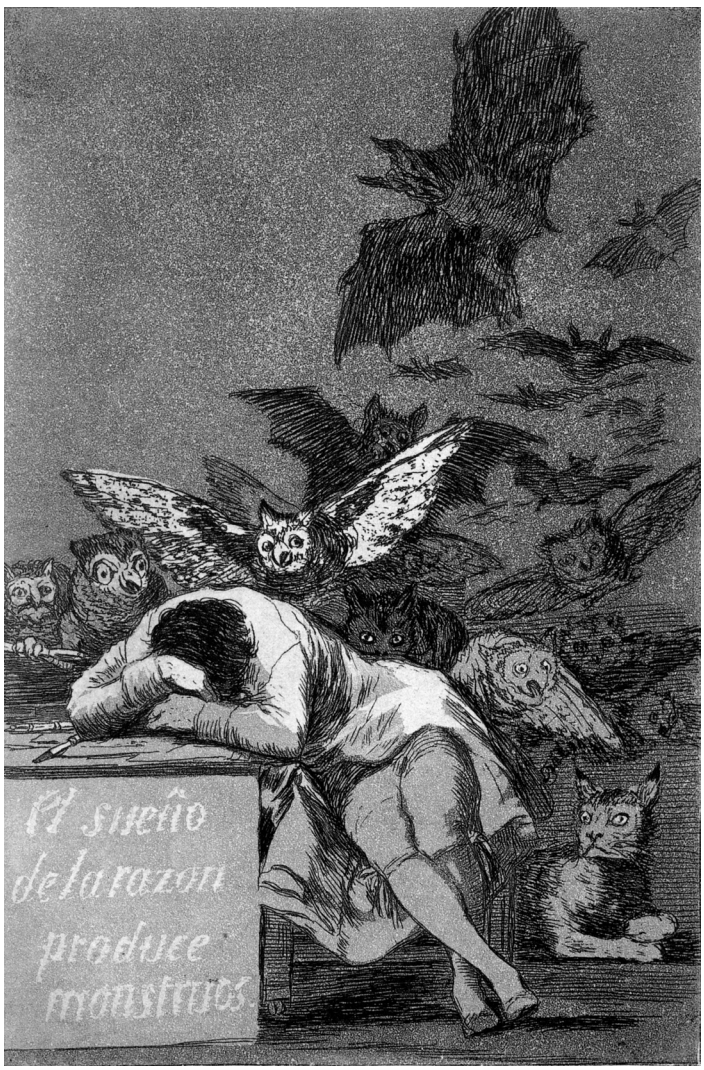
¶ Prud'homme 1980.

** Gerondeau 2018.

the Environment eliminated the word 'environment' from its title, to become the 'Ministry of Ecological Transition and Solidarity'.

Whenever there is a conflict between the defence of the environment and the promotion of 'ecological industries', the Ministry of Transition becomes an enemy of the environment. Wind turbines destroy landscapes (including landscapes classified as World Heritage by UNESCO), massacre bats by the thousands, and involve pouring millions of tons of cement in the countryside. In a surprising turn, the Ministry of Transition has sided with the wind power industry against lovers of the environment, waiving the normal need for building permits, ignoring the advice from managers of affected natural parks, and doing its best to prevent residents from bringing lawsuits.

It was this new religious-like dogma, based upon fear (of catastrophic events) and punishment (reduction of our consumption of everything), together with our care for the environment, that induced us to look more closely at the 'energy transition', with numbers and not merely with slogans. What is it exactly? What are its objectives? At what cost can they be achieved? With what economic and social consequences? This effort has led us to conclude that this 'transition' is neither ecological, nor solidary, much less economic. The transition stands beyond the realm of rationality, in a world of fantasy. As Goya puts it in one of his etchings: 'the sleep of reason produces monsters'.



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The Global Warming Policy Foundation is an all-party and non-party think tank and a registered educational charity which, while openminded on the contested science of global warming, is deeply concerned about the costs and other implications of many of the policies currently being advocated.

Our main focus is to analyse global warming policies and their economic and other implications. Our aim is to provide the most robust and reliable economic analysis and advice. Above all we seek to inform the media, politicians and the public, in a newsworthy way, on the subject in general and on the misinformation to which they are all too frequently being subjected at the present time.

The key to the success of the GWPF is the trust and credibility that we have earned in the eyes of a growing number of policy makers, journalists and the interested public. The GWPF is funded overwhelmingly by voluntary donations from a number of private individuals and charitable trusts. In order to make clear its complete independence, it does not accept gifts from either energy companies or anyone with a significant interest in an energy company.

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