

Economic and social-ecological policies towards a low-carbon economy: the case of the EU

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1. Introduction

In the past two decades, our economies and societies have gradually entered the economic age of ecology, in which economic instruments must be mobilised to reduce environmental damage resulting from economic activities, chief among them being climate change. But to overcome the many obstacles on the road to a low-carbon economy, a social perspective is also needed on these ecological issues, one that puts at the forefront social realities and, at their core, the principle of justice, not only that of economic efficiency. This perspective might be the key not only to altering behaviour, but also changing people's attitudes and thereby building a lasting social-ecological constituency to support the much needed sustainable public policies.

Within this general framework, this chapter aims first at taking stock of global and European performance in mitigating climate change, showing that much is still to be achieved to attain the sustainable path required by climate science. Then, after attempting to define the neighbouring notions of 'green jobs', 'green growth' and 'green economy', it reviews the different types of public policies that can be used to enable a low-carbon economy to emerge and flourish. The first objective of such policies should be to develop economic sectors that, while fostering employment, can limit the environmental impact of human activities. In this logic, public authorities should price carbon, encourage the financing of and innovation in the new energy and environmental technologies and invest in education and training so that 'green skills' can answer the growing demand for 'green jobs'. Beyond this perspective of 'green growth', a second direction of reform should aim at developing a functional and circular economy, the bases of the 'green economy'.

Finally, closer to the idea of 'sustainable development', linking economic, ecological and social imperatives, a third approach (not exclusive of the first two) consists in redefining the very notion of development, giving a higher priority to its human dimension (environmental sustainability, equality, health, education) over the economic one (growth of GDP per capita). With regard to this broad goal of human development, public authorities should engineer and put in use alternative development indicators focused on individual and social welfare, design true social-ecological policies that articulate environmental and social issues, and pay particular attention to the growing issue of environmental justice and environmental inequalities.

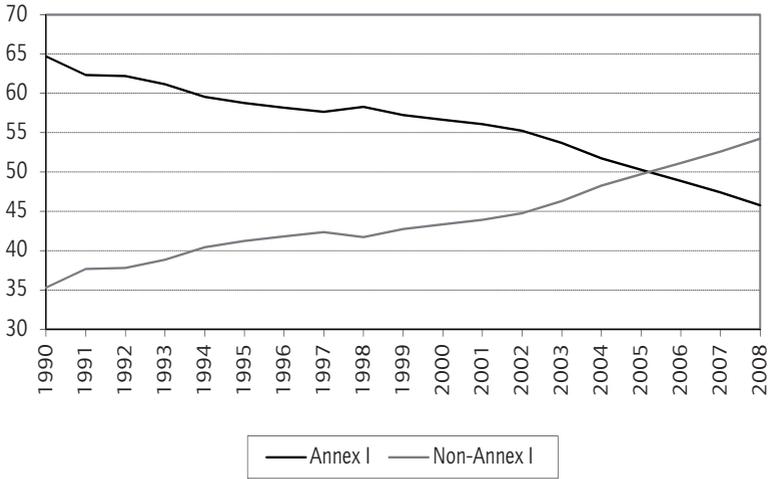
2. Global and European greenhouse gas emissions: where we are

International climate negotiations, the only means of enabling effective collective action at the global level, have made little progress since the Bali conference in December 2007 and the design of the 'roadmap'. The agreement reached in Cancun (11 December 2010) does represent real progress, but remains too vague, even if it helped to repair the UN multilateral framework that was seriously damaged in Copenhagen (December 2009). The international community is still looking for a binding agreement that could take over from the Kyoto Protocol, signed in 1997, entered into force in 2005 and whose first commitment period expires in 2012. At the heart of the current stalemate in discussions lies the question of fair distribution of the climate burden among nations.

Climate arithmetic is indeed revealing: in 2004, the poorest 37 per cent of the world's population accounted for only 7 per cent of CO₂ emissions, while the richest countries produced 45 per cent of emissions, despite being home to only 15 per cent of the world's population (the factor of inequality was thus more than 15). Indeed, as the IPCC indicates, Africa accounts for less than 4 per cent of greenhouse gas emissions in the world, but as early as 2020 could see between 70 million and 400 million people exposed to water shortages caused by climate change.

This picture is of course complicated by the rise of emerging countries: driven by China, developing countries in 2008 represented 55 per cent of global emissions against 45 per cent for developed countries. The economic downturn has exacerbated the gap: between 2008 and 2009,

Figure 1 CO₂ emissions from fossil fuels and cement in MtC/yr (TgC/yr), Annex I and Non-Annex I countries, 1990–2008 (%)



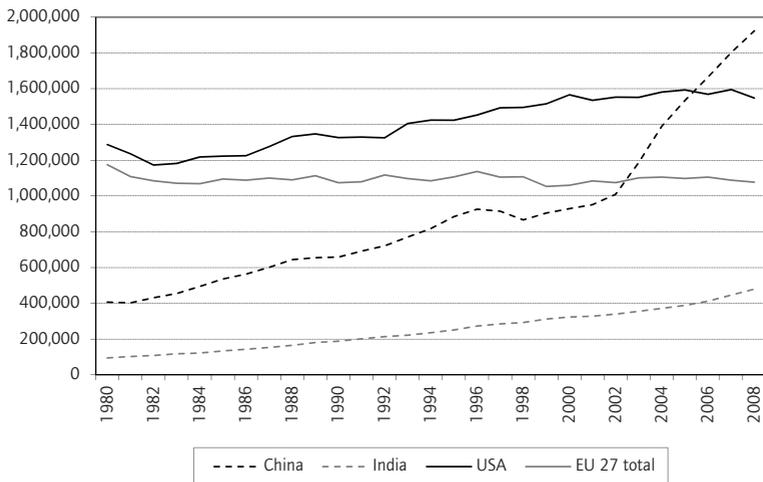
Note: The UN Convention on climate change divides countries into two groups according to differing commitments: *Annex I* Parties include the industrialised countries that were members of the OECD (Organisation for Economic Cooperation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States and several Central and Eastern European States. *Non-Annex I* Parties are mainly developing countries.

Source: Global Carbon Project.

emissions fell sharply in developed countries affected by the crisis (down by 7 per cent for example in the United States), but increased sharply in emerging nations which have been relatively unscathed, at least in Asia, by the great recession (the distribution is now 57 per cent for developing countries against 43 per cent for developed countries). Figure 1 gives some idea of the rapidity of this global climate shift since the mid-2000s, driven by China’s economic expansion. Figure 2 makes it possible to compare emissions dynamics since 1980.

In quantitative terms, Raupach et al. (2007) have shown that developed countries account for 77 per cent of cumulated emissions since the mid-eighteenth century, but only 59 per cent of total emissions in 2004 and for 27 per cent of emissions growth between 2003 and 2004. Historical data available from 1850 to 2006 confirm this trend: developed countries have emitted far more greenhouse gas emissions than developing

Figure 2 CO₂ emissions from fossil fuels and cement in MtC/yr (TgC/yr), USA, EU27, China and India, 1980–2008 (%)



Source: Global Carbon Project.

countries but the latter are rapidly catching up, even if their level of emission per capita is still far from parity.

This dynamic only gives new urgency to updating the Kyoto Protocol by assigning non-Annex I countries quantitative targets. But this will be possible only if the first phase of Kyoto is respected: that is, if Annex I countries meet their commitments. However, this is far from being realised. The UNFCCC notes that over the period 1990–2008, total aggregate GHG emissions excluding emissions/removals from land use, land-use change and forestry (LULUCF) for all Annex I Parties decreased by 6.1 per cent, and total GHG emissions/removals including LULUCF decreased by 10.4 per cent. The Kyoto target was thus surpassed even before the great recession. But the breakdown of Annex I countries offers a troubling picture: for Annex I Parties with economies in transition (Annex I EIT Parties, that is, Russia and the former Soviet bloc), GHG emissions excluding and including LULUCF decreased by 36.8 per cent and 48.5 per cent, respectively. But for Annex I non-EIT Parties (that is, developed countries, such as the United States and Japan), GHG emissions excluding LULUCF have actually increased by 7.9 per cent and

GHG emissions including LULUCF have increased by 8.3 per cent. In other words, developed countries, which are now demanding quantitative commitments from developing and emerging economies, are not being serious about their own Kyoto commitments. This is not true of all Annex I countries, however: the EU15, collectively engaged in Kyoto by a 'bubble' agreement, has indeed reduced its emissions since 1990, but even this performance may be a source of concern.

In spring 2009, the EU legally adopted its 'climate-energy package', which includes the ambitious objective of reducing greenhouse gas (GHG) emissions by 20 per cent by 2020 compared to 1990. More recently (March 2011), the European Commission has proposed aiming for an even higher 25 per cent target, even while international negotiations are stalled, arguing reasonably that the global recession makes cuts less economically painful. By pursuing such explicit quantitative and quite ambitious objectives independently of what is to come out of the next rounds of climate negotiations (especially that of Durban in December 2011), the Commission has chosen to ignore the failure of the Copenhagen conference of December 2009. It obviously wants the EU to continue leading the fight against climate change in the hope that its example will exert pressure on the United States and win over China. This strategy is certainly clever, but the EU should pay attention to the efficiency of its own economic instruments aimed at mitigating climate change.

Let's start with a closer look at the EU's performance. Overall, the EU has been doing much better than the rest of the developed world under Kyoto and is now, 'thanks' to the global recession,¹ more than halfway towards its 2020 goal (the latest data exhibit a 11.3 per cent reduction for the EU27 and a 6.9 per cent reduction for the EU15 compared to 1990). However, precisely because the base year chosen in the Protocol for the different greenhouse gases is generally 1990, a significant fraction of the overall EU performance was achieved by new members from Central and Eastern Europe (CEE) in the early 1990s when their economies collapsed. Even in the EU15, German reunification and British energy shift away from coal played a crucial part in the initial strong performance. Both effects are now phasing out: emissions from new member states are increasing and the pace of emissions reduction in the EU15 has been

1. Spain alone, where emissions fell by almost 8 per cent between 2007 and 2008, accounts for one-third of the overall achievement of the EU27 between 2007 and 2008.

Table 1 GHG reduction in percentage terms

	1990–2008	1990–2000	2000–2007	2000–2008
EU 27	-11.3	-9.1	-0.4	-2.2
EU 15	-6.5	-3.1	-1.6	-3.4
Germany	-22.2	-16.8	-5.5	-5.4
UK	-18.6	-12.8	-4.2	-5.7
Poland	-12.7	-13.9	2.1	1.2
Czech Republic	-27.5	-24.4	0.0	-3.1

Source: EEA data service.

divided by roughly a factor of three since 2000 (Table 1). In this context, the targets adopted in the climate-energy package really are ambitious.

The fall induced by the global crisis and the European recession is likely to be reflected in 2009 data as well. But when one considers 2000–2007 trends, which are ‘normal’, it seems likely that this good news will prove ephemeral and be fully compensated by an acceleration of emissions as soon as the EU economy recovers, which is not yet the case even while other economies, especially in Asia, are currently contributing to the highest level of GHG emissions in history.

Indeed, a closer look at the sectoral composition of GHG emissions and trends reveals the structural weaknesses of the current EU carbon strategy. Submitted to the emissions trading system (ETS), heavy industry has reduced GHG emissions, but only moderately and, with the obvious accidental exceptions of 2008 and 2009, ever more slowly. In the negotiations over the ‘climate-energy package’, heavy industries and the countries in which they still represent a large fraction of economic activity and of GHG emissions have actually been resisting the tightening of existing policies and the introduction of new ones, except when it comes to those that can be understood as mitigating ‘carbon leakages’. Other sectors, such as agriculture, have been improving their performance, due to specific regulations. But the most worrying trend can be observed in ground transportation, especially light vehicles, whose GHG emissions have been growing at an accelerated pace over recent decades, despite emissions standards that are relatively stricter than in the rest of the world (Table 2).

Table 2 Changes in emissions, 1990–2008 (%)

	EU27	EU15
Road transportation	+25.9	+20.7
Transport	+23.6	+19.9
Energy Industries	-9.3	-1.3
Residential	-11.3	-6.3
Commercial/institutional	-13.0	-6.5
Industrial processes	-15.4	-16.6
Agriculture	-20.2	-12.2
Manufacturing and construction	-25.0	-16.8
Solvent and other product use	-25.7	-27.7
Waste	-33.0	-40.5

Source: EEA data service.

The question is thus clear: Is the EU climate strategy a mere replay of the doomed Lisbon Strategy that failed due to the lack of willingness on the part of EU decision-makers to endow the Union with adequate instruments to engage in efficient economic collective action? By themselves, targets do not constitute an efficient policy. EU policymakers thus have to think hard about their carbon policies and within the general framework of the 'green economy'.

3. A transition to where? 'Green growth', 'green jobs' and the 'green economy'

Different definitions, more or less extensible of 'green growth', 'green jobs' and the 'green economy', coexist today. According to the OECD, 'green growth' is:

a way to pursue economic growth and development, while preventing environmental degradation, biodiversity loss and unsustainable natural resource use. It builds on existing sustainable development initiatives in many countries and aims at identifying cleaner sources of growth, including seizing the opportunities to develop new green industries, jobs and technologies, while also managing the structural changes associated with the transition to a greener economy.

However, for the French Ministry of the Environment,² for example, ‘green growth’ is a much broader concept, namely:

[an] economy for the long term, using fewer energy resources and non-renewable raw materials and emitting much less greenhouse gases; which focuses on environmental technologies (all technologies whose use is less harmful to the environment than the use of standard techniques meeting the same needs), practices responsible production and consumption, thinks in terms of production lifecycles where transport is rational, cities sustainable, territories globally designed and managed according to a mode of sustainable development that protects and restores the ecosystem with regard to water, soil and biodiversity; which puts men and women at the center of the business and social project; that promotes the participation of everyone in decision-making and is enriched by diversity; that respects cultures and heritages; [and] which assesses the effects of decisions on future generations.

Along these lines, the Ministry defines ‘jobs from green growth’ as a ‘concept [that] goes far beyond that of “green jobs” to include almost all the jobs in our economy’.

More operationally, the joint Report by the UNEP and the ILO in 2008 defines green jobs as jobs that reduce the impact of economic sectors and business on the environment, bringing it down to sustainable levels. ‘Green jobs’ are

work in agricultural, manufacturing, research and development (R&D), administrative and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high efficiency strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution.

The 2011 follow-up report on the green economy goes on to define the sectors in which those jobs can be created and the policies needed to that end.

2. ‘Introduction à la croissance verte’, www.developpement-durable.gouv.fr/Introduction-a-la-croissance-verte,13882.html

This is also the sense preferred by Eurostat (2009) in its report on environmental goods and services, defined as a heterogeneous compact of production technologies, goods and services that prevent or reduce pollution and minimise the use natural resources. Environmental activities are grouped into two broad categories: environmental protection and natural resource management. Green jobs, which are not explicitly defined by Eurostat, would in that case be jobs that fall under one or the other sector. 'Green growth' would also be defined as the growth of these environmental activities, also called 'green industries' or 'eco-industries'.

The perceived vagueness of the concepts of 'green growth' and 'green jobs' does not derive from their evanescent nature, but their dynamic aspect: their perimeter can be defined according to what they seem to be, what they really are and what they should be.

The scope of 'green jobs', for instance, must take into account the induced effects of these sectors on the rest of the economy. GHK et al. (2007) have perhaps generously estimated that total employment in eco-industries in the EU27 reached 4.6 million in 2000, divided into 2.4 million direct jobs, 1.3 million indirect jobs and 0.9 million induced jobs (depending on the resources invested in direct and indirect jobs). If we extend the Eurostat definition of eco-industries to include activities that depend on environmental resources (such as agriculture, forestry or eco-tourism), the total exceeds 10 per cent of employment in the EU27 and even 17 per cent if the indirect and induced jobs are added. Under this broad accounting, one job in six in Europe would be more or less 'green'.

But we can and indeed must push the argument further. Is the 'green economy' limited to 'green growth' and 'green jobs'? Or does it designate a more fundamental change in our mode of development? According to the broad UNEP definition, a green economy results in 'improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities'; more precisely a

green economy is an economy in which the vital links between economy, society and environment are considered and in which the transformation of production processes and patterns of consumption and production, while helping to reduce the amount of waste produced per unit of pollution and use of resources, materials, energy, revitalize and diversify the economy,

creating new opportunities for decent work, promoting sustainable trade, reducing poverty, improving equity and income distribution.

ESCAP (United Nations Economic and Social Commission for Asia and the Pacific) likewise defines green growth as a notion 'that emphasizes environmentally sustainable economic progress to foster low-carbon, socially inclusive development'.

At this stage, we can therefore highlight three requirements of a 'green economy'. The first is the development in the short term of economic sectors that, while they create employment, also limit the impact of human activities on the environment (climate, ecosystems, biodiversity). Growing the green economy in this first sense means developing eco-industries and protect the natural resources upon which millions of jobs depend. This involves both developing new areas of production of goods and environmental services (for example, renewable energy), but also 'greening' existing sectors in the name of environmental requirements. The second, more ambitious, dimension of the green economy is precisely to change economic structures in the medium term by fostering a circular and functional economy. The third is to redefine for the longer term the very concept of development with greater emphasis on its human dimension (environmental sustainability, equality, health, education) than on its economic dimension (growth of GDP per capita).

Public authorities will thus be required to price carbon, promote the financing of innovation and eco-oriented research and invest in training for the purpose of developing careers in ecology, but also to govern in accordance with new indicators of development and implement a 'social-ecological' paradigm that articulates the social and environmental dimensions.

The first requirement of a low-carbon economy in the EU is to restore efficiency to economic instruments of climate change mitigation.

4. Overcoming the limits of mitigation policies in the EU

The basic principle of environmental policy is to restore the 'ecological truth' of prices of goods that depend directly or indirectly on the use of natural resources: in the case of climate change, the price system should

reflect the ‘social cost’ of carbon.³ This requirement refers to two dimensions of public action: the relevance of the chosen ecological objective (the ‘social price’ of carbon, determined by the public authority, should reflect the ‘social cost’ of carbon itself, determined by various estimation methods) and the effectiveness of the instruments used to achieve it (regulation, emission permits or environmental taxes).

Even when various economic instruments have indeed been implemented in the EU, they are still far from the ecological efficiency promised by economic theory.

The main reason for the European ‘climate fatigue’ detailed above is simple: the incentives to reduce greenhouse gas emissions are too low, due to the narrow coverage and insufficient rigor of the EU emissions trading system and also the importance given in the climate arsenal to emissions standards, while tax instruments are not sufficiently mobilised.

First, the functioning of the ETS is unsatisfactory. Since its inception in 2005, it has not managed to determine a price per ton of CO₂ that is both adequate and sufficiently stable, which poses two problems. The first is the weakness of the signal given to companies that should be encouraged to develop ‘technological efficiency’ (the technologically most advanced companies are supposed to be rewarded in the ETS with an attractive price for permits they are likely to sell to their less advanced competitors). The second problem is the lack of a stable price for carbon in the long term, which has an adverse effect on the profitability of low-carbon intensive technologies and the incentive to adopt them. Many of these technologies – renewable energy (wind, solar, marine and biomass energy in particular), thermal retrofitting of buildings and so on – are already available, but for the most part require relatively high cost fossil fuels, and therefore a relatively high price of CO₂. In other words, a carbon market such as the emissions trading system is as important for the price of carbon that it determines as for the quantity it regulates (the total amount of emissions assigned each year to all participating companies).

The creation of the European carbon market in 2005 has reduced greenhouse gas emissions, especially compared to what has been observed in the other OECD countries. But because of its limited coverage – about

3. This section draws on Laurent and Le Cacheux (2009) and Laurent and Le Cacheux (2011).

11,000 industrial facilities, which represents just over 40 per cent of total emissions in the EU – and overly generous allocations of permits in the initial phases, resulting in excessive volatility and too low price on average, the ETS has not been able to issue a strong enough price signal for the sectors it covers. The two phases of its operation have been affected by a collapse in prices: in 2005–2007, the too generous allocation of emission allowances led to a first ‘carbon crash’; in the second phase, from January 2008 – and despite the Commission’s efforts to reduce the volume of allowances distributed – a second price collapse occurred, this time because of the difference between emissions and allocations generated by the recession of 2008–2009: the decrease in activity resulted in a sharp decrease in emissions, while permit allocations remained unchanged. Since the start of the recession in the European Union – around summer 2008 – the price has fluctuated between 13 and 15 euros, well below the 30 to 50 euros recommended by existing studies.⁴

The other major component of EU climate policy is emissions standards for light vehicles. This has already produced significant results: new vehicle emissions today are, on average, much lower than in the United States, for example, and, if more stringent standards adopted in 2008 apply, they will probably decline further by 2015 and 2020. The EU has become, with Japan, the world leader in automotive climate standards and the attractiveness of the single market, with its nearly 500 million consumers, has a positive ecological influence on producers around the world wishing to sell their products on the European market.

However, this tool has proved to be clearly insufficient in the absence of a strong price signal, as illustrated by the poor performance of the road transport sector: vehicle manufacturers eventually complied with stricter emissions standards and produce vehicles that consume less fuel per kilometre, but consumers facing lower cost tend to drive longer distances (a textbook case of the ‘Jevons Paradox’ or ‘rebound effect’), so that total emissions are thereby boosted. According to the European Environment Agency, the intensity of fossil fuel combustion of road vehicles in the EU fell by over 40 per cent from 1990 to 2005 and their carbon intensity fell by about 2 per cent. However, the number of miles driven exploded, growing by over 100 per cent over this period, while the total number of private cars increased by nearly 10 per cent. Freight transport has seen a

4. See, for instance, Quinet (2004), Defra (2007) and Impact (2007).

comparable evolution with growth of over 80 per cent in mileage and of 40 per cent in the share of trucks in total vehicles, while carbon intensity (2 per cent) and combustion intensity have decreased (by nearly 2 per cent and 30 per cent, respectively). Overall, as we have seen, emissions from the transport sector (95 per cent from road transport emissions) have grown strongly since 1990.

It thus appears that standards are effective only insofar as they are combined with an adequate price signal. Since road transport is not covered by the ETS and is not planned to be, the signal must come from energy taxation. However, the trend over the past decade is a cause for concern: the share of energy taxation in GDP and total tax revenues has been declining since the mid-1990s, and especially since 2000, clear evidence that climate tax policies lack ambition at national level. Energy taxation with regard to GDP increased from 1.8 per cent in 1980 to 2.1 per cent in 1993 but fell to back 1.8 per cent in 2007 (Table 3).

Obviously, the ‘green shift’ taken by the Nordic tax systems in the early 1990s did not spread to the EU. On average, in Europe environmental taxation (75 per cent of energy taxation) has never exceeded 3 per cent of GDP and 7 per cent of tax revenues over the past 25 years.

A subordinate problem related to tax policy concerns income elasticity with respect to energy consumption. Available studies indicate that this elasticity is moderate in the short term, but strong enough in the long term (see OECD 2007). To increase this elasticity – and thus to increase the potential effectiveness of climate-mitigating energy taxation – public

Table 3 Energy taxation (percentage of GDP)

	1995	2000	2005	2006	2007	1995–2007
Eurozone averages						
weighted	2.1	2.0	1.9	1.8	1.7	–0.4
arithmetic	2.0	1.8	1.9	1.8	1.7	–0.2
EU-25 averages						
weighted	2.1	2.1	1.9	1.9	1.8	–0.4
arithmetic	1.9	1.9	2.0	1.9	1.8	–0.1

Source: Eurostat.

authorities must offer economic alternatives and therefore invest heavily in public transport networks, which is clearly a case in point for a coordinated European programme.

How can these potentially powerful but empirically flawed climate mitigation instruments be reformed effectively? In the short term, the least ambitious strategy, but probably the most realistic one, seems to be to strengthen existing instruments, including ensuring that economic activities that are not currently exposed to a price signal in Europe become so exposed. This implies, at minimum, eliminating public subsidies for fossil fuels in many sectors in most EU countries. In addition, to avoid excessive price volatility and repetition of episodes in which the market price of carbon is not high enough to encourage investors to take decisions leading to the adoption of low-carbon production techniques, the ETS should be 'taxified' (that is to say, its characteristics should be as close as possible to a tax) by introducing a floor price for carbon or even a fluctuation corridor.⁵ This could be achieved by creating an intervention mechanism, possibly funded by the proceeds from auctioning permits, on the carbon market, which would remove the oversupply of allowances when prices fall below the floor and increase supply when prices rise above the ceiling (the intervention currently being considered by the European Commission to limit the amount of transferable permits from the second to the third period of the ETS is very close to such a mechanism).

To expose the non-ETS sectors to a higher and more uniform carbon price, there are two relatively simple options available to policymakers. The first would be to devise an upstream inclusion mechanism requiring fossil fuel suppliers to purchase a quantity of emission allowances reflecting the carbon content of their sales that, if the ETS is itself reformed adequately, could lead to the emergence of a unified environmentally efficient price for carbon across the EU single market.

The second option corresponds to the recent Commission proposal to promote tax harmonisation by revising the 2003 energy directive: in addition to setting the minimum excise duties on fossil fuels, as the current version does, the Commission proposes to establish minimum excise duties on carbon emissions from various fuel categories, with reference to a price of around 20 euros per tonne of carbon.

5. See also Tirole (2009).

Both solutions could lead to a more effective European climate policy. Finally, the international dimension of European carbon pricing should be briefly mentioned. If an ambitious agreement is not found in Durban in December 2011, the EU should probably resort to a 'carbon tariff' or 'carbon border adjustment'. Here also, different options are available. In any event, the current EU policy of exempting certain sectors from carbon tax or free distribution of allowances is not a real solution to the problem of 'carbon leakage': it may delay the decisions of companies to relocate production, but it will not change economic calculation based on relative production costs. Such a policy thus results in a 'triple penalty': European public finances are deprived of revenue from the possible sale of emission allowances; the EU economy loses production facilities and jobs, not only in the most carbon-intensive sectors but also in many others against which imports from third countries will become artificially more competitive; and no mitigation effects occur as far as global carbon emissions are concerned.

This reform agenda for EU climate change mitigation instruments is far reaching, but represents only a fraction of the policies needed towards a 'greener' European economy.

5. Beyond pricing: finance, skills and structural transformation

It is indeed necessary to complement carbon pricing to ensure an efficient and effective transition towards a 'green economy'. We will briefly discuss three options here: instituting a 'green bank'; increasing government support for environmental R&D; and developing skills to meet the demand for green jobs.

The sectors of the green economy have certain economic characteristics – uncertainty, innovation, competition and so on – that require ad hoc financing structures. This should be the purpose of a 'green bank', possibly operating at the European level (within the EIB) and responsible for ensuring an adequate flow of credit to small and medium-sized businesses that will form the industrial fabric of the green economy transition.

Public R&D targeted towards new energy and environmental technologies is at present inadequate. The OECD environment ministers stated:

We will consider expanding incentives for green investment, in particular in areas where pricing carbon is unlikely to be enough to foster such private sector responses. Such areas may include smart, safe and sustainable low-carbon infrastructure and R&D technologies that can contribute to building a sustainable low-carbon society.⁶

However, the budget share devoted to those goals in the past three decades has remained far too low, as shown in Table 4. Only Canada stands out, having almost quadrupled its efforts in this field, raising it to almost 5 per cent of GDP in 2005.

Finally, it is imperative to develop new skills that will enable labour markets to provide the manpower required to develop these new sectors. Three challenges emerge in this area, according to the European Commission (2007): transferring jobs from fossil fuel sectors to the developing sectors of energy efficiency; moving jobs from fossil fuel sectors to renewable energy sectors; and moving jobs from road transport to public transport and rail. In this process, some skills will become obsolete, new skills must be developed and existing skills can be maintained provided they are 'greened'. In total, the transition to a green economy involves gains and job losses to be smoothed by a policy of appropriate training. This could take the form of a skill pooling at the European level through the creation of a 'European institute for green jobs'.

But as already mentioned, existing economic structures should be more fundamentally altered to meet the demands of a 'green economy'. The greening of the economy presupposes three requirements: it must be 'decarbonised' by reducing the use of carbon contained in fossil fuels in the production process; it should be 'de-energised' by increasing energy savings and energy efficiency (two processes that hold the key to close to 50 per cent of the total reduction in greenhouse gas emissions required by 2050, according to the International Energy Agency); and it should be 'de-naturalised' by increasing resource productivity and minimising extraction and waste. In this ecological transition, a 'circular economy' (which limits the use of non-recyclable resources and energy) and a 'functional economy' (which transforms goods into services to limit production) must be strongly developed.

6. OECD, 'Declaration on green growth', June 2009.

Table 4 Public R&D budgets for control and care of the environment, selected countries, 1981–2005 (% of total R&D budget appropriations)

	1985	1995	2000	2003	2004	2005
Canada	1.9	3.7	4.5	4.8	4.4	4.4
Mexico	–	0.6	1.2	–	–	–
United States	0.5	0.8	0.6	0.5	0.5	0.4
Japan	–	0.6	0.8	0.9	0.9	0.8
Korea	–	–	3.8	4.4	4.6	4.5
Australia	1.9	1.2	2.0	2.2	2.4	4.2
Austria	0.9	2.5	1.5	1.7	1.6	1.9
Belgium	2.5	1.7	3.3	2.1	1.6	2.3
Czech Rep	–	–	–	4.1	4.1	2.9
Denmark	1.5	4.4	2.7	1.9	1.9	1.7
Finland	1.5	2.5	2.3	2.0	1.9	1.8
France	0.5	1.9	1.7	3.1	3.0	2.7
Germany	3.1	3.6	3.3	3.3	3.5	3.4
Greece	3.4	3.6	5.0	3.9	4.3	4.0
Iceland	0.1	3.4	0.6	0.4	0.4	0.4
Ireland	0.8	1.4	1.4	2.1	0.7	0.9
Italy	1.0	2.4	2.3	–	–	2.7
Netherlands	3.2	3.7	3.6	2.8	1.9	1.2
Norway	2.7	2.8	2.8	2.4	2.2	2.1
Portugal	–	4.4	4.4	3.3	3.7	3.5
Slovak Rep.	–	2.0	1.3	1.6	2.7	1.0
Spain	0.4	2.6	4.0	1.9	2.8	3.0
Sweden	1.5	2.3	1.4	1.5	1.8	2.2
Switzerland	–	–	0.2	–	0.1	–
United Kingdom	1.3	2.3	2.3	1.8	1.8	1.8

Note: Data refer to government budget appropriations or outlays for research and development (R&D) for the control and care of the environment. They cover research into the control of pollution, aimed at the identification and analysis of the sources of pollution and their causes, and all pollutants, including their dispersal in the environment and the effects on humanity, species (fauna, flora, microorganisms) and biosphere. Development of monitoring facilities for the measurement of all kinds of pollution is included. The same applies to the elimination and prevention of all forms of pollution in all types of environment.

Source: OECD.

This indispensable ‘decoupling’ of economic growth and absolute pollution or waste is possible in the EU, as evidenced by Denmark, which has reduced its CO₂ emissions by almost 10 per cent, while increasing its per capita income by a factor of eight from 1971 to 2007, or by the European Union, which significantly reduced its air pollution and emissions of sulphur dioxide while increasing its per capita income by a factor of 1.75 from 1995 to 2008 and reduced its greenhouse gas emissions while growing its economy by close to 40 per cent since 1990.

6. Towards a social-ecological paradigm

Beyond this second dimension of the green economy, European public authorities should engage societies on a true social-ecological development path, articulated around two instruments: a redefinition of human development indicators and new priority given to making social and environmental issues compatible.

Attitudes of Europeans to public policies aimed at fostering a low-carbon transition are far from hostile: quite the contrary.⁷ But how, besides altering behaviour, can attitude-change on environmental issues be accelerated (according to the distinction made by Andrew Dobson 2003)?

The first way consists of changing in the eyes of citizens, not merely the price of goods, but their value by developing alternative development indicators that give environmental challenges their rightful place, starting with climate change.

The Stiglitz–Sen–Fitoussi Report (2009) points in two directions. The first is to modify the existing accounting framework to better account for environmental externalities, including the human and economic cost attached to climate change (the World Bank is working in this direction). But a number of phenomena which nonetheless determine human well-being are simply not measured by our statistical system. A second research direction is thus to try to develop acceptable measures of the long-term consequences of these phenomena: existing indicators of environmental sustainability must be improved: the ‘ecological foot-

7. ‘Europeans’ attitudes towards climate change’, Special Eurobarometer, European Commission, November 2009.

print' of the WWF, the ANS (Adjusted Net Saving) of the World Bank and Yale's ESI (Environmental Sustainability Index). As shown in earlier work presented in late 2009 by the INSEE report, this redefinition is beginning to bear fruit in France (and is starting in Germany), but should extend across European countries, as the issue of harmonisation between Member States emerges naturally (the European Commission and Eurostat have started working on this in the context of the 'Beyond GDP' initiative).

The other avenue to change European minds is to make explicit the fairness of climate policies. The 'new political ecology' approach (Fitoussi and Laurent 2008) is aimed at making explicit the link between ecology and inequality or between social issues and ecological imperatives, which is enshrined in the heart of sustainable development. It proposes to reserve first place to the principle of justice in environmental issues and to approach them in a 'social-ecological' perspective (Laurent 2011).

The case of carbon taxes – essential tools for reducing transport emissions and more generally the diffuse emissions sectors of the European economy, as we have seen – illustrates this problem. Carbon taxes, like all energy taxes, have a socially regressive effect (due to the fact that the poorest households spend proportionately more for their energy than wealthier households) that may affect their political acceptability.

In France, the ADEME (Environment and Energy Management Agency) has calculated that the share of energy expenditure of the 20 per cent poorest households is 2.5 times higher than that of the 20 per cent most well-off households. However, existing studies confirm that ecological taxes in general, and carbon taxes in particular, are particularly effective in countries where they have been implemented: they do help to reduce nuisance and pollution (OECD 2007).

Serret and Johnstone (2006), who have studied the distributional effects of environmental policies, confirm that they are generally perceived as socially regressive, for two related reasons: the poorest households bear a disproportionate financial cost, while the richest households receive disproportionate benefits.

That is why European governments, especially Nordic ones, which are involved in the 'green shift' of their tax systems, have taken concrete

steps to reduce or offset the regressive effects of carbon taxes, allowing in some cases the emergence of a ‘double dividend’, social and environmental. Provided they reason in a social-ecological framework, it is possible for policymakers to design fair and effective social-ecological policies.

More broadly, EU governments should acknowledge the link between social justice and ecology, one that has a simple empirical and theoretical meaning: social inequalities are among the most important causes of contemporary environmental problems, while contemporary environmental problems disproportionately affect the poorest in society (Laurent 2011).

The study of the relations between democracy and sustainability, poverty and environmental degradation and rising income inequality and the weakening of environmental policies must thus be deepened. The issue of ‘environmental inequalities’ – inequalities in exposure and access to environmental amenities, the impact of different social groups on the environment, the unequal distributional impact of environmental policies and inequities of environmental policymaking – must also receive more attention from European authorities.

In sum, the economic age of ecology will be sustainable only if it is accompanied by the advent of the fourth age of ecology, the social age.

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