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Do European Climate and Energy Policies Threaten to Postpone the Energy Transition?

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European climate and energy policies are under stress. The Emissions Trading System (ETS) of the EU suffers from a severe over-allocation of emission permits, leading to a very low CO_2 price. In almost all European countries, wholesale electricity prices are declining and are already too low to trigger investments in new generation and network assets. Such investments are essential to prepare for the coming transition towards a more sustainable global energy system.[41] Estimates of conventional generation reserve margins between now and 2020 suggest low electricity prices and a problematic investment climate for the next years. As the energy transition is a gigantic investment project, the current disincentives to invest are likely to significantly delay the pace of decarbonisation efforts in Europe.

Meanwhile, the production of coal and its use for electricity generation is increasing in Europe. In 2011, the consumption of coal in the EU increased by 3.6%, while demand fell by 1.1% in all other countries of the OECD (Rühl and Giljum, 2012). In the UK, the share of coal in electricity generation increased from 30% in 2011 to 42.8% in 2012, leading to an increase in coal consumption of 32.5% in 2012 (Department of Energy and Climate Change, 2013). Similar evolutions in Germany and Spain conflict with decarbonisation scenarios for Europe.

In the period between 2000 and 2010, greenhouse gas emissions dropped by 5.7% in the US, but by only 4.4% in the EU-27 (EC-JRC, 2012). As the very complex European climate and energy policy architecture is outperformed by a country without explicit climate policy targets – but with a higher economic growth rate – how sustainable is the perception that the EU holds the leadership in international climate policy?

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[41] Fossil fuels have a role to play in all transition scenarios up to 2050.

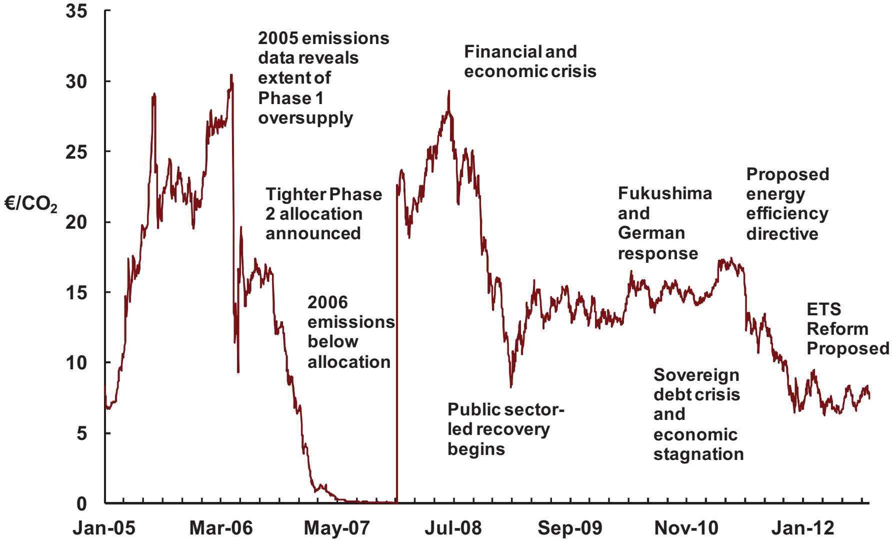
The goal of this chapter is to explain and assess some of the problematic interactions in European climate and energy policies. Is the complex European approach contributing to the problem it was designed to cure? Do we risk delaying the European component of the energy transition? How problematic might such a delay be? Based on a transition perspective, I conclude by discussing some options to improve the effectiveness of policy frameworks in the next decade.

OVERALLOCATION IN THE EMISSIONS TRADING SYSTEM AND '20/20/20'

Too soft a cornerstone

IHS CERA (2011) estimates that the overallocation of emission permits under the ETS is equivalent to 1.4 billion tonnes of CO_2 in the period between 2013 and 2020. The steep economic downturn since 2008, combined with the current double-dip outlook, is partly responsible for this overallocation. Although Phase III of the ETS (2013–20) introduced auctioning for the energy sector, CO_2 prices under the ETS fell further in the first half of 2013 (to €5). Figure 3.1 shows the evolution of the CO_2 price under the ETS between 2005 and 2012.

Figure 3.1 *The ETS CO_2 price between 2005 and 2012*



Source: Roques (2012).

The contrast with projections of the ETS price made in 2007 is large. As a consequence, the ETS sectors – responsible for close to 45% of total European CO_2 emissions (EC-JRC 2012) – currently do not have a market incentive to invest in ambitious carbon-mitigation measures. Without a significant carbon penalty, the relative fossil fuel prices of today ensure that old CO_2-intensive coal-powered electricity plants in Europe can easily compete with gas-powered plants that are much more carbon efficient but face a higher fuel cost per MWh of electricity produced. As the EU unfailingly presents the ETS as "the cornerstone of its drive to reduce emissions of man-made greenhouse gases" (EC-JRC, 2012), the current situation is far from optimal.

Interactions among climate policy goals and the ETS

Climate and energy policy options determine technological choices for the production of energy services as well as for the mitigation of greenhouse gas emissions. An economy-wide carbon tax will result in other technological choices than binding targets for renewable energy sources (RES). The European '20/20/20' approach of 2007 sets an overall emissions reduction target of 20% (the first '20' of 20/20/20) but also imposes very direct technological choices by 2020 (European Commission, 2007). Economic agents are required to invest in RES and in energy efficiency projects, irrespective of the availability of low-cost sources and technologies. By its nature, the 20% reduction target suggests that economic agents are free to decide how to meet the mitigation target. But emissions trading or carbon pricing is limited to those emissions not yet reduced by RES and efficiency policies.

Important decisions on the future allocation of CO_2 emission permits up to 2020 under Phase III of the ETS were also taken in 2007. The time horizon of the 20/20/20 package and of Phase III of the ETS is often presented as offering a long-term perspective to investors. However, the lifetime of energy system assets is typically in the range of 25 to 50 years. From this perspective, targets through 2020 mainly affect short-term investment decisions.

Twenty per cent or 30 per cent?

The EU initially wanted to commit to a 30% reduction target by 2020 upon the condition that other leading economies, such as the US, would commit to similar efforts. This easy switch of emission reduction targets reveals that the 20% target is a soft one because of the ongoing deindustrialisation of Europe. With less energy-intensive activities in Europe and more imports of manufactured goods from outside the EU, it is rather easy to lower the domestic production of CO_2 emissions (Helm, 2012). From a strategic perspective, Europe risks losing credibility by choosing domestic reduction targets as a bargaining chip.

Why supplemental policies?

The 20/20/20 package contains two additional policies to support carbon pricing as the core policy instrument to trigger a least-cost market response to the challenge of climate change. Because of multiple market barriers and failures (imperfections), carbon pricing alone will not fully unlock the existing potential for energy efficiency. Without technology-support policies, no radically new low-carbon technologies will hit the market in the coming decades. The availability of cost-effective energy-efficiency opportunities offers the potential to meet a given emission-reduction goal at a low carbon price. Without the emission reduction from energy efficiency investments, other sectors – such as industries exposed to international competition – need to take additional and more expensive mitigation measures (IEA, 2011).

Unfortunately, the use of supplementary policies adds additional uncertainty to the ETS market. The companies participating in the ETS base their strategic behaviour on price expectations. If supplementary policies such as RES and efficiency targets over- or under-deliver on their expected level of emissions reductions, the needed abatement within the ETS and, hence, the ETS price will be affected. These additional fluctuations in the CO_2 price can delay investment decisions.

Recent policy experiences show, furthermore, that the cost of supplementary policies can be higher than expected. Deployment targets for RES threaten to bring (too) expensive technologies into the market because of the historical under-investment in energy research, development, and demonstration (RD&D). Premature support for immature technologies should be avoided (Kramer and Haigh, 2009). It is not a coincidence that EU countries with very generous support schemes for photovoltaics today face a real explosion of retail electricity costs (see CEER, 2013). This could have been avoided by scaling up past public RD&D efforts in order to set more ambitious deployment targets at a lower cost to society. As the high cost of deploying RES is partly channelled to ETS companies through higher electricity network costs, this supplementary measure risks undermining the competitiveness of energy-intensive ETS companies on international markets.

Finally, measures to accelerate the potential for energy efficiency often are not justified from a market failure perspective. Many energy efficiency opportunities are neglected because of high discount rates, differences in preferences, or limited access to capital. These are not market failures – everyone would like to have more capital – and hence do not justify the use of expensive fiscal subsidies that primarily benefit those economic agents with higher and middle incomes. These fiscal subsidies do not have a direct impact on the electricity price but they do have an opportunity cost (for example, by crowding out resources available for public R&D). Policy interventions should focus on traditional market failures such as principal-agent relationships, split incentives (landlord-tenant), and adverse selection. Such market failures can partly be addressed with smart regulation at a lower cost.

Policy interactions and impact on the ETS price

Because of the economic crisis, electricity demand in many European countries was lower in 2012 than in 2007. Overcapacity in conventional generation increased during that period, and wholesale electricity prices in northwestern Europe fell from €75 in 2007 to less than €50 in 2012. More than five years after the start of the crisis, Europe is entering a new – or perhaps just another – crisis in the steel industry, with job losses and plant closures. Energy demand can be further reduced, leading to an even greater over-allocation of permits in the ETS.

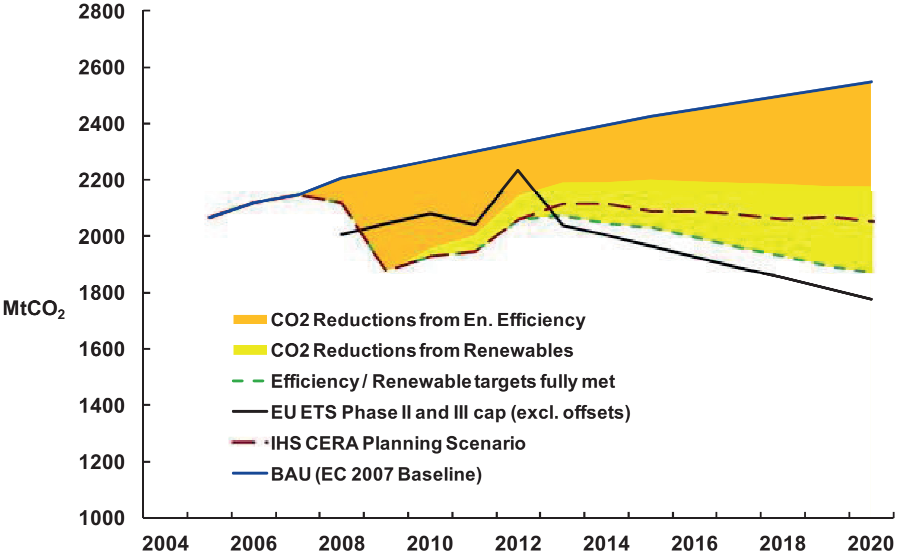
But the efficiency of the ETS is also affected by the 20% RES target and the 20% energy efficiency target.

The obligation to invest in RES serves to reduce emissions, especially from gas-powered plants in markets with stagnating demand. As a consequence, CO_2 emissions in the electricity sector – a major sector in the ETS – are in principle lower than in scenarios without high RES obligations. Because the electricity sector has to execute a technological mandate, the 20% RES mandate affects the remaining demand for emission permits. Simultaneously, all economic sectors – including the ETS sectors – are required to improve their energy efficiency performance between now and 2020. Higher energy efficiency levels lead to lower consumption of fossil energy and lower CO_2 emissions.

IHS CERA (2011) and Roques (2012) estimated the impact of both targets on CO_2 emissions – 20% RES and 20% energy efficiency – to conclude that their potential impact on emissions from ETS companies is large enough that the cap of the ETS Phase III can be met without any further mitigation effort. Figure 3.2 shows that subtracting the CO_2 reductions from both 20% targets by 2020 leads to emissions very close to the ETS Phase III cap. From this perspective, the 20/20/20 package seems to be a deliberate effort by policymakers to make the ETS redundant. After 2013, projected emissions exceed the ETS cap in Figure 3.2. However, the 2007 projection of baseline emissions for the period 2007–20 in the figure dates from the pre-crisis era. Since 2008, emissions of ETS companies followed a bumpy road. In 2009 alone, there was a reduction of 200 million tonnes of CO_2 (Roques, 2012). So while the economic crisis has had a profound impact on over-allocation in the ETS, even without the crisis the cap would be a soft one. With the crisis, the cap has no relevance whatsoever. Even with a 30% reduction target for the EU, this would likely be so – an embarrassment for the '*backbone of European climate policy*'.

The assessment by IHS CERA (2011) shows that energy efficiency measures, in particular, can lead to very strong emission reductions, even in a few years. This may be an overly optimistic presentation of the emission-reduction potential of energy efficiency measures in the short run. Nevertheless, the conclusions of this quantitative assessment are largely confirmed in other assessments. The IEA (2012) also argues that the strong growth of renewable energy, driven by policies outside the trading system, undermines the efficiency of he ETS. The IEA therefore concludes that ”policy considerations aimed at enhancing coherence between renewable policies and the ETS would be justified” (IEA, 2012, p. 569).

Figure 3.2 *Interaction between ETS and the 20% RES and efficiency targets*



Source: Roques (2012) and IHS CERA (2011).

Although 20/20/20 is a soft package in terms of reduction ambitions, its design is not responsive to external factors such as the ongoing economic crisis or the rise of unconventional energy sources. The ETS faces the same rigidity – the cap cannot be adjusted to a new economic reality. The rigidity is problematic because of the use of short-term targets in 20/20/20 and in the ETS. With a longer time horizon – for example, 2030 or 2035 – unforeseen events would have a less dramatic impact on the relevance of policy goals because markets would have a better chance to adjust before the end of the longer commitment period. The alternatives of flexible reduction targets and flexible caps in the ETS by 2020 – for example, a cap inversely indexed to EU GDP – would severely complicate the ability to plan long-term energy technology investments. The alternative of a general carbon tax not connected to a specific short-term emission reduction target would avoid the current situation of economic incentives too low to trigger investments, but at the cost of creating another challenge: paying the carbon tax at times of severe economic crisis.

ELECTRICITY GENERATION OVERCAPACITY

European electricity markets today face a significant generation overcapacity despite phase-out scenarios for old nuclear and coal capacity. In major economies, the reserve margin for conventional generation, or the available or remaining generation capacity at times of peak load, is in the range of 10% to 25%. E.ON AG (2011) projects a reserve margin of 15% between 2013 and 2020 for Germany, France, and the Benelux countries. For the Nordic region, the reserve margin is close to 25% in the same period. Spain, too, faces an overcapacity of close to 20% in the period 2013–20. Only in the UK does the reserve margin fall back to zero around 2016.

Because of additional investments in renewable energy technologies between now and 2020, the reserve margin will remain rather high in coming years. For onshore wind, generation capacity in Europe is expected to triple between 2008 and 2020 while offshore wind capacity will increase more than tenfold (E.ON AG, 2011). The prospect of sustained overcapacity puts pressure on electricity prices. In fact, electricity prices below €40 per MWh are no longer exceptional on forward markets (European Commission 2012a). The contrast with pre-crisis prices is large.

The downward price evolution is enforced because of the very low marginal generation cost of intermittent renewable technologies. As the supply of generation technologies on wholesale markets is based on marginal costs, subsidised RES technologies push conventional generation technologies with the highest marginal generation costs out of the wholesale market under optimal weather conditions. This combination of structural overcapacity and the low prices on electricity wholesale markets excludes investment possibilities in generation technologies that do not benefit from subsidy regimes.

The low prices on electricity wholesale markets are of little relevance for photovoltaic (PV) and wind projects, as they benefit from subsidy schemes (FITs) that cover their full cost. From a societal perspective, the high cost of PV and offshore wind – not to be confused with their very low marginal generation cost (Table 3.1) – increases the cost of short-term climate policy targets.

In other words, the current support schemes for energy from RES shelter a large sector from market dynamics, while the expansion of subsidised RES exerts a significant impact on wholesale prices and on investment opportunities in conventional generation. It remains unclear how long this type of market distortion can be sustained in a market that should be liberalised and fully integrated at the European level. The differences among the national RES support schemes already distort investment decisions in renewables.

Table 3.1 compares the marginal generation cost – for simplicity restricted here to fuel costs – to the total generation cost for the main generation technologies. The levelised cost of electricity (LCOE) is used to calculate the full generation cost. The LCOE values in Table 3.1 are based on a 10% discount rate but exclude a carbon or a CO_2 cost per technology. For wind and solar technologies, optimistic load factors from northwestern Europe have been selected: 25% for onshore wind, 35% for offshore wind, and 12% for PV. For conventional generation, the high load factors typical of the pre-crisis period have been selected – for example, 70% for gas-powered plants – although the current generation overcapacity and the expansion of RES do lead to much lower load factors that preclude investment.

Table 3.1 *Marginal versus total electricity generation costs for NW Europe in 2012*

	Fuel cost (€/MWh)	Total cost (LCOE, exclusive of CO_2 cost), €/MWh
PV (photovoltaics)	0	198
Wind onshore	0	107
Wind offshore	0	142
Nuclear	8	98
Coal	30	67
Gas	50	76
Biomass	75	122

Source: Albrecht *et al.* (2012).

An assessment of the LCOE is based on a stand-alone perspective for the technologies considered. This implies that the necessary costs of backup, balancing, and system flexibility are not included in the LCOE of intermittent generation technologies.

Table 3.1 confirms that in Europe, gas-powered electricity is not competitive once (wholesale) electricity prices are close to €50/MWh. As a consequence, coal-powered generation with a much lower marginal cost – €30/MWh in northwestern Europe – remains in the market and replaces gas capacity. This merit-order effect explains why electricity companies close down gas-powered plants but burn more coal. The most efficient coal-powered electricity plants can emit 740 g CO_2/kWh, whereas state-of-the-art gas-powered plants emit less than 400 g CO_2/kWh (IEA, 2012). In northwestern Europe, many old coal-powered plants are still in use today, so we can assume that emissions are close to 1,000 g CO_2/kWh. With a high CO_2 price in the ETS, efficient gas-powered plants would be much more competitive. But the electricity prices of today exclude all investment projects – including coal-powered generation – that do not benefit from production subsidies such as FIT.

The closings of gas-powered plants in northwestern Europe are not attributable solely to low wholesale electricity and CO_2 prices. In the first months of 2013, European gas prices were three times as high as gas prices in the US. This price gap is partly due to Europe's historical preference for gas contracts with oil-indexed prices. Meanwhile, the US economy benefits from low gas prices because of the ongoing shale gas revolution. Coal-powered plants are being closed in the country; new electricity plants are efficient gas-powered plants. As a consequence, CO_2 emissions in the US are decreasing, and the surplus of coal on the US market is shipped to Europe and Japan.

Investing in new gas-powered plants is consistent with decarbonisation scenarios because flexible gas plants offer the capacity needed to balance intermittent or weather-based generation. Hence, investments in flexible new gas-powered plants avoid the risk of a carbon lock in. Because the attractiveness of gas-powered electricity depends on gas prices, Europe not only needs to reconsider its climate policy goals but also the current organisation of its gas markets.

The energy transition as an investment challenge

The energy transition is a global project, and all economic regions should contribute to it. When economic agents do not face CO_2 mitigation incentives and the investment climate excludes the construction of flexible new gas-powered plants and intelligent energy networks, investments in crucial components of the transition to a low-carbon economy risk being delayed by several years. Can we afford the current levels of inactivity and uncertainty? What policy options can be considered to break the current stalemate?

A transparent assessment of the investment needs of the energy transition can be found in *Energy Technology Perspectives 2012* of the *International Energy Agency* (IEA). We focus now on the global investment needs in the electricity sector to support the energy transition (Table 3.2).

Table 3.2 *Global investment needs in the electricity sector, 2010–50 (US$ trillion)*

	2010–20	2020–30	2030–50	Total
Expansion of the electricity system without the transition investments	5.9	6.5	15.9	28.3
Expansion of the electricity system with transition investments	6.5	8.7	20.7	35.9
Additional transition investments in the electricity sector	600	2.2	4.8	7.6

Source: Based on IEA (2012).

According to IEA (2012), close to $28 trillion will have to be invested in the global electricity system by 2050 to replace old assets and expand the electricity system in response to global economic and population expansion. Most of these investments will occur in emerging markets and be triggered by market forces.

If the expansion of the electricity system also has to support the goals of the global energy transition, additional decarbonisation investments will be needed. To support the energy transition, total investment will have to amount to $36 trillion in the period 2010–50.

The additional investment cost of the energy transition is close to 30% of the projected investment needs to modernise and expand the electricity system. Of the total investment needs in the electricity sector of $36 trillion by 2050, $25.4 trillion is allocated to generation technologies, while $10.5 trillion needs to be invested in transmission and distribution. Table 3.2 shows that the bulk of the transition investments should take place in the period 2030–50. In optimisation models such as those used for IEA (2012), a carbon value is introduced to trigger the deployment of available technologies and to invest in the development of new and much more efficient technologies. To minimise the cost of the energy transition, the models assume massive investments in energy R&D in the first model periods, thereby lowering future deployment costs while also avoiding premature investments.

The expected increase in investments in the electricity system is geographically concentrated in Asia. Between 2010 and 2020, close to 30% of all investments will take place in China. With a total investment of $1.8 trillion by 2020 – including energy transition investments – China will invest more than Europe and the US together. Energy technology companies know this. Because of its economic expansion, investments in Asia will be largely market-driven, which is definitely not the case in Europe. Total investment needs in Europe – including energy transition needs – are estimated by the IEA (2012) to amount to $950 billion between 2010 and 2020. In case the transition investments in Europe cannot take place because of the problematic investment climate of today, the amount needed in the period 2020–30 will increase by a similar amount.

As long as energy R&D projects remain financed – even in times of crisis marked by budget cuts – at a level sufficient to deliver efficient low-carbon technologies over the coming decades, the energy transition as a whole will not be endangered because of a decade of bad investment climate. Unfortunately, it remains uncertain whether energy R&D efforts are indeed high enough to prepare for an ambitious energy transition. The share of energy R&D expenditures in the total R&D budgets of OECD countries has been decreasing – from 12% in 1980 to less than 4% today (IEA, 2012). In an earlier publication, the IEA (2010) compared current annual energy R&D spending levels to the estimated annual R&D investments needed to realise ambitious energy transition targets. That publication concluded that the annual estimated R&D spending gap ranged from $40 to $90 billion. To benchmark this R&D spending gap, consider that current public energy R&D spending is less than $13 billion.

As a final note, all discussions about low-carbon electricity systems should include the other components of the global energy system that also need to be transformed – among them, manufacturing processes and the electrification of transportation.

TECHNOLOGICAL CHOICES IN UNCERTAIN TIMES

Investing in energy assets is a risky business today. Investment decisions hinge on market expectations; poor market outlooks will delay investment programmes. Investors may wonder how energy markets will respond to a decade of low economic growth. We now know that the high economic growth rates of recent decades were artificially boosted and reflected unsustainable overconsumption based on the excessive and unsustainable debt positions of governments, private companies, and households (Rajan, 2010). Unfortunately, the unavoidable deleveraging (or reduction of outstanding excess debt) will take place at a time when the increasing cost of an ageing population will make it more difficult for governments to balance budgets. The weak economic outlook will continue to have a direct impact on prices and energy demand expectations, and hence on investment decisions.

The energy transition is premised on the development of new technologies that are then selected by investors. To minimise the cost to society of the transition, no single technological trajectory should be favoured; instead, the selection of technologies should be based on competitive mechanisms. Today's climate and energy policy framework strongly influences the way technologies are selected. In Europe, the selection process is very complex because of the coexistence of technology-neutral and technology-imposing instruments. The ETS as the backbone of European climate policy is a technology-neutral policy instrument designed to ensure the selection of least-cost mitigation options by market forces. By contrast, the 20/20/20 package, with its RES and efficiency obligations, directly imposes specific technological choices. Other environmental policies, such as the Large Combustion Plant Directive (LCP Directive 2001/80/EC) to limit emissions pollutants other than CO_2 (mainly SO_2, NO_X, dust particles, and ozone precursors), also affect the use of old power plants and hence can lead to significant CO_2 emission reductions. The LCP Directive can even accelerate the phase-out of old (coal) power plants. At the national level, nuclear phase-out scenarios in Germany and Belgium directly affect technological choices.

Technology-neutral and technology-imposing measures

As many policy goals and processes can affect technological choices, Table 3.3 distinguishes between European policy processes, goals, and instruments that are technology-neutral and those that can be considered as imposing technological choices on economic agents. The simultaneous use of technology-neutral and technology-imposing processes, as found in Europe today, can be counterproductive. In Europe, a blurred combination of multiple views on how to select technologies is the heart of the problem. Eskeland *et al.* (2012) and Böhringer *et al.* (2009) provide estimates of the additional cost to society of some of Europe's multiple targets and approaches.

Table 3.3 *Technology-neutral versus technology-imposing processes, goals and instruments in European climate and energy policy*

Technology-neutral processes, goals, instruments	Liberalisation of energy markets, ETS, 20% reduction target of 20/20/20
Technology-imposing processes, goals, instruments	20% RES target of 20/20/20, 20% efficiency gains target of 20/20/20, phase-out scenarios, LCP Directive

Because the short-term technology-imposing instruments (such as the 20% RES goal) are not backed up by historical energy R&D support schemes, the mandatory investments in renewable generation are very expensive, while the opportunity of selecting less expensive mitigation options is foregone.

From a philosophical perspective, the imposition of very specific technological targets is typical of the economic planning tradition, whereas the use of technology-neutral processes or instruments expresses belief in the power of market forces. However, as there is no monolithic attitude with respect to economic planning versus market forces within the EU, it is not surprising that European climate and energy policies combine both approaches. In principle, there is nothing wrong with this combination (IEA, 2011). What matters is that public R&D spending trajectories must be planned to avoid important market failures. Short-term penetration rates for young technologies should not be planned when it is more appropriate to invest first in better technologies.

Two extreme abstract views on the selection of technologies and the evolution of the energy system can be teased out of Table 3.3. When the free-market approach dominates, energy markets must be fully liberalised and a European carbon tax or cap-and-trade system applies to all economic sectors. From an investment perspective, a carbon tax is more predictable than the fluctuating CO_2 price in the ETS. An escalating carbon tax provides the strongest incentive to invest in new mitigation technologies. As market forces will select technologies and trigger investment decisions, national policymakers are mainly observers or gatekeepers. Domestic preferences for technological mixes become irrelevant as the European landscape will adjust to the European policy targets.

Even in this free-market approach, policymakers have to invest in public R&D to ensure that more efficient energy and mitigation technologies can hit the markets in the next decades. Otherwise, the carbon incentives will bring only mature technologies into the market. Radical innovation projects such as the energy transition are impossible to realise without multiple policies working together in a synergistic package. That package includes supply-push measures – mainly public R&D expenditures followed by demonstration projects – and demand-pull measures such as the creation of niche markets, public procurement or fiscal incentives (Norberg-Bohm, 2002). Once technologies evolve into concepts 'close to the market' the balance will shift toward demand-pull measures. An effective and efficient package of policies measures should be based on a consistent view of how to select and diffuse technologies.

National phase-out scenarios and short-term obligations to invest in renewable energy and energy efficiency technologies are not consistent with this market-oriented view on the organisation of energy markets. But because the energy landscape of today reflects historical choices and preferences, the pure free-market approach alone is not a realistic option for the selection of energy technologies.

The other extreme is a completely planned energy system. This option, too, requires the allocation of sufficient resources to energy R&D projects, in this case by planning departments. Under this scenario, planners define short-term and long-term policy targets and regulate the optimal mix of energy and mitigation technologies. Economic agents lobby for adequate support mechanisms, and investments are made in a low-risk environment. As energy decisions are still made at the national level, liberalisation can only disturb the implementation of planning decisions.

The ideal scheme of policy measures should be based on the dynamic interactions between supply-push and demand-pull measures. As it often takes decades to develop radically new but efficient technologies, the obsession with short-term targets in international climate negotiations and in the 20/20/20 approach of the EU is problematic. For policymakers, however, the selection of short-term targets is tempting because many new and promising technologies are already available. Why not push massive deployment of the new technologies to realise a quick switch to low-carbon energy?

Kramer and Haigh (2009) challenge this view on the grounds that the mere availability of a new technology should be distinguished from the economic significance (in their terms, the "materiality") of this new technology. When reaching 1% of the global energy mix is taken as a benchmark, history teaches that it can take 30 years before a new technology achieves some market importance. PVs supply just 0.01% of world energy today and enjoy exponential growth rates. As it takes a few hundred billion dollars to bring new technologies to materiality and many years to build the human and industrial capacity to realise this, the relevance of short-term national targets on the evolution of new technologies is limited. Furthermore, exponential growth rates for new technologies will always be replaced by linear growth rates. Because energy technologies have a long lifetime – between 25 and 50 years – replacement rates have to be low to avoid large capital losses. Technological targets become especially expensive when technologies that are too young or too inefficient are selected too early, or when it becomes necessary to replace existing capital too early.

Liberalisation or 'small is beautiful'?

Climate and energy policy goals through 2020 were established around 2007, when the liberalisation of European energy markets was in full swing. In principle, the liberalisation process should be complete by 2014. However, several member states are already experiencing a significant delay in implementing the liberalisation directives. Abolishing price regulation, particularly, appears to be very difficult in some countries.

Liberalisation can have a strong impact on energy market decisions in the period during which energy and mitigation technology choices should align with the climate policy goals. From an investment perspective, it is challenging to predict the possible interactions between liberalisation as an ongoing process and progress with the climate policy goals.

The liberalisation of energy markets purports to replace historical national energy monopolies with a larger, more efficient, transparent, and interconnected system in which economic agents compete and invest at the European level.

To ensure high levels of competition and economic efficiency, domestic market barriers need to be abolished. And to trigger investments and production decisions in the open European energy market, market forces need to be empowered. Ultimately, market forces will select technologies based on their market merits at the European scale.

The final configuration of liberalised energy markets has never been explicitly specified, but capital-intensive industries are typically evolving into oligopolies dominated by a few transnational companies. Indeed, a likely consequence of the EU's wish to foster energy companies with the capacity to pursue strategic goals at the European level may be that European energy markets will be dominated by a small number of large companies by 2030, or even earlier. The European Commission (2012b) has identified as a recent achievement that by 2012 "at least 14 European electricity and/or gas companies are now active in more than one Member State." We can assume that these 14 international companies are not small. This potentially oligopolistic market outcome may conflict with popular visions of decentralised generation in local energy clusters of small companies. In several member states, governments have taken certain measures to limit the power and market share of the incumbent utilities. In Germany, there is a gathering trend away from the mega-integrated utilities, back to the *Stadtwerke*. The German government even wants to fund 15% of new-plant capital expenditures of small utilities with a market share of less than 5% (HSBC, 2011). Schumacher's 'small is beautiful' principle (1974) is again a very popular concept for national energy policy makers, while Europe is preparing the energy landscape for the rise of a limited number of powerful transnational corporations.

The opportunity of emerging markets for energy companies

Once energy companies operate with a European perspective, it is a small step to approach energy markets from a global perspective. Because the growth prospects for the European economy are meagre when compared with the emerging economies, the major European energy companies may well shift their focus. In the emerging markets, close to 1.8 billion people will enter the global consuming class over the next 15 years. Because of this expansion, McKinsey (2012) projects that global consumption will nearly double to $64 trillion before 2030. Developing countries will continue to drive global growth in demand for manufactured goods as well in demand for energy system investments. The needed expansion of the Chinese electricity system alone over the next decade offers a market opportunity of $1.8 trillion (IEA, 2012). Why invest in a stationary European market with uncertain returns when emerging markets offer a guaranteed profit?

WHAT'S NEXT?

The current climate and energy policy framework is not optimal. Several options can be considered to improve its overall effectiveness. We can distinguish between short-term and long-term options. Their relevance depends on a more consistent view of how to change the energy system. In the short run, it is unlikely that Europe's policy framework will change radically – for example, by phasing out the ETS after 2020 or suddenly eliminating the 20% RES or the 20% efficiency target from the 20/20/20 package. Radical changes in policy development are possible only in the long run.

Between now and 2020

The European Commission has launched a debate over so-called backloading options to increase the ETS price in the next years. Backloading refers to temporarily removing from the market a huge volume of permits – for example, a billion ETS permits in the period between 2013 and 2015 – and re-injecting them into the market later on. With backloading, there is no destruction or buyback of permits. As such, it can alter the average CO_2 price in a given year but will not lead to a structural change in the CO_2 price. Hence, backloading will hardly affect decisions on mitigation investments by ETS companies in ETS Phase III. Moreover, ETS companies object to backloading strategies because they further complicate investment decisions without offering a real solution.

The ETS price could easily be regulated by installing a price floor that would vary over time. It could be limited to auctioned permits or set for all transactions in the ETS. Given the low CO_2 prices of today, the floor would set the market price. The ETS would then be transformed into a carbon taxation scheme. This is not a desirable transformation of the cornerstone of European climate policy and the ETS was thus the wrong choice. Although public authorities count on ETS revenues to finance energy R&D projects and a price floor could secure sufficient resources to finance the needed research efforts, ETS companies would object to a shifting floor as an unpredictable and discriminatory market intervention. (Discriminatory because the floor would be especially beneficial for companies with excess permits that they could now sell at higher prices.) It would be difficult to introduce a price floor without discriminatory consequences. Because the low CO_2 price in the ETS reflects some structural economic trends – partly embedded in the design of European policies – why tamper with a market mechanism intended to reveal information? If a price floor were to be installed, a European floor should be preferred over different floors in different member states.

A much more attractive option relates to the cap for ETS Phase IV. Around 2015, Europe should present a clear post-2020 climate policy perspective to all ETS and non-ETS economic agents. The cap for ETS Phase IV should be consistent with the overall CO_2 reduction target by 2030 or by 2035. When the energy transition is taken as the reference perspective, it would make sense to set a long-term reduction target with ETS caps up to 2035, or even later. In that case, the next ETS phase would run from 2021 until 2035. But if saving the ETS as the cornerstone of climate policy is the main priority, a 2028 or 2030 cap for the next phase will have more impact on the ETS market in the period 2015–20. Because of banking (i.e., transferring non-used permits from one Phase to another) between Phase III and Phase IV, a very challenging ETS cap by 2028 or 2030 would increase demand for permits before 2020 and push prices up. To avoid the risk that complementary targets (articulated in a possible 30/30/30 follow-up to the 20/20/20 package) would again reduce the demand for ETS permits and hence the relevance of the ETS as a cost-minimising policy instrument, it is essential that no RES target and no energy efficiency target should be set after 2020. Europe should support the future deployment of energy from renewable sources and efficiency technologies by allocating a significant share of ETS revenues to R&D projects dedicated to future generations of renewable and efficiency technologies. In the absence of binding targets for RES after 2020, member states would be able to phase out subsidy regimes, thus lowering the cost of the energy transition. The removal of an important sheltered sector with an impact on the investment climate for conventional generation technologies would facilitate the completion of the internal market.

Some ETS companies argue that the low CO_2 price in the ETS should not be seen as a problem because European industry still faces a recession. A higher CO_2 price would increase the operational costs of energy-intensive companies that are already struggling with the crisis. Some ETS companies state that those not pleased by the current functioning of the ETS are free to buy CO_2 permits to increase the price; given the estimated overallocation of 1.4 billion permits, buying permits to eliminate the overallocation would cost close to $7 billion. This clearly is not a realistic option. But if some governments decide to buy 300 million CO_2 permits in 2014 as an exceptional intervention to restore market fundamentals and announce their intention to buy additional volumes in Phase III when deemed appropriate, market expectations could adjust to a lower level of overallocation, leading to higher prices. Although ETS companies with excess permits would support this type of intervention, European institutions and national authorities should not participate directly in the market because they designed the ETS and will later decide on its future caps. Regulators, too, should stick to their role and not act like the market participants they regulate. Another aspect relates to insider trading. When public authorities today buy permits at a low price and later introduce a very ambitious cap for 2030, they can sell their permits at much higher prices. Such an abuse of market power to create profits would not be acceptable to private market parties.

Long-term options

The ETS can be saved. At the same time, phasing out technology-imposing measures would increase the consistency of European climate and energy policy. A phase-out of RES targets would also be consistent with the goal of integrating energy markets. The continuation of the ETS in its next phases – possibly through 2050 – does not eliminate the risk that external factors, such as a new recession between 2020 and 2025, might again depress CO_2 permit prices, bring on a temporary excess in generation capacity, and cloud the investment climate.

The situation today does not immediately threaten the prospects for the energy transition by 2050, because most transition investments will have to take place after 2030 to avoid expensive lock-ins of young technologies. But that could change if we face several recessions between now and 2050. Since 1975, financial crises that have a sizable impact on the real economy have become more frequent (Reinhart and Rogoff, 2009). With today's excessive debt positions, the frequency of future financial crises accompanying economic downturns may even increase. The prospect of several such periods in which investment incentives dry up because of economic slowdowns may fundamentally endanger the energy transition.

We saw from Table 3.2 that the transition of the electricity system will require a total investment of $4.8 trillion between 2030 and 2050. That is a small part of the total energy transition investment needs of $36 trillion between now and 2050, which come on top of a total investment of $120 trillion to modernise and expand the global energy system irrespective of transition targets (IEA, 2012). Financing $120 trillion will be an enormous challenge. A severe economic crisis between 2030 and 2035 could easily slow investment in expansion and transition. After such a recession, investment would resume, but is unlikely that all of the investments needed for the period 2030–40 could be executed in the second half of that period. Without very strong economic incentives – comparable to the attractiveness of investing in growing markets – energy transition investment would likely be crowded out by investment in deferred conventional expansion. As capital markets and technology companies face limitations in their ability to manage and execute projects, it is quite likely that a severe economic crisis between 2030 and 2035 would lead to a very low level of transition investments between 2030 and 2040. As long as future economic downturns do not endanger energy R&D spending levels, the constant technological improvements can provide a permanent incentive to re-launch transition efforts after the next crisis. But if a crisis leads to cuts in public and private spending on energy R&D, the energy transition may become a utopian project. For a long-term investment project such as the energy transition, stable and strong economic incentives, as well as a guaranteed investment in energy R&D, are essential.

Whatever policy design is selected, a severe economic crisis will always affect investment behaviour and can delay the pace of the energy transition. Some policy instruments will respond more strongly to economic downturns than others. Because of its design, the ETS, for example, with its rigid caps will always respond strongly to economic downturns. A carbon tax offers a stable price incentive to invest in mitigation technologies. With carbon taxation, fiscal revenues are rather easy to predict as long as the economy avoids cyclical extremes. Although a severe recession would certainly cut carbon taxation revenue, once the economy recovered that revenue would bounce back. (The

ETS price, by contrast, could remain at too low a level for much too long.) However, carbon taxes will not be popular during recessions, and rigid taxes could even deepen or extend the recession. This could be avoided by relating the carbon tax rate to GDP growth rates. During recessions and early recoveries, carbon tax rates could be cut by some specified amount. During good economic times, revenue from carbon taxes should be reserved to finance future energy R&D expenditures, thereby reducing the risk of R&D investment being cut during downturns.

The crowding out of energy transition investments by energy expansion investments may be the main long-term challenge for the energy transition. To protect transition investments, the economic attractiveness of energy transition technologies should be enhanced through a decisive increase in energy R&D efforts.

Conclusion

The energy transition is a gigantic global investment project. However, because of the current economic crisis and the design of European climate and energy policies, Europe today faces a very unfavourable investment climate for low-carbon initiatives. The EU ETS suffers from a severe overallocation of emission permits, which has depressed the CO_2 price. ETS companies have no market incentive to invest in mitigation technologies. Because of overcapacity in conventional generation, wholesale electricity prices are falling and are already too low to trigger investments in new generation and network assets. The resulting dispropensity to invest could significantly delay the pace of decarbonisation efforts in Europe.

Europe's current policy design combines technology-neutral instruments, such as the ETS, with technology-imposing targets, such as the 20% RES target for 2020. Conflicts between policy goals, meanwhile, reduce the effectiveness of the ETS. To make matters worse, European policy goals have a short time horizon and are not responsive to external factors such as an economic recession. The most likely solution (i.e., the most feasible from a pragmatic policy perspective) for the current inefficiencies is the introduction of an ambitious Phase IV cap for the ETS by 2028 or 2030. Because of banking between Phase III and Phase IV, the future cap would influence market behaviour and the CO_2 price between 2015 and 2020. After 2020, no further mandatory targets for energy from RES or for efficiency investments should be set. Targets for subsidised RES have created a large, sheltered sector that is not consistent with energy market integration and liberalisation.

Today's poor investment climate need not endanger the energy transition as a long-term project because the bulk of the needed transition investments will take place after 2030. Unfortunately, the world is sure to experience global recessions between now and 2050, and today's excessive debt will aggravate economic vulnerability in the next decades. To avoid a crowding out of investment in the energy transition by deferred investments in energy system expansion at the end of each recession, policy frameworks will have to ensure the continuous funding of energy R&D at very high levels. The more attractive energy transition technologies become, the lower the risk that investments in those technologies will be crowded out. Allocating carbon taxation revenues to energy R&D budgets offers the advantage of a relatively predictable flow of revenue. Future recessions will always have the effect of depressing the CO_2 price in the ETS, thereby putting mitigation investments on hold and lowering the revenue derived from CO_2 auctions. A carbon tax, by contrast, offers a permanent economic incentive. Because the energy transition will be delayed by stop-and-go investment dynamics, policy designs should try to maximise predictability and stability. A radical reform of the European policy framework is therefore essential. Reconsidering the 1992 proposal for a European carbon tax could offer inspiration.

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