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Prices and Policies:
Carbon Caps and Efficiency Programmes for Europe's Low-Carbon Future

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Abstract

Keywords: carbon allowances, consumers, climate policy, electricity bill, energy efficiency policy, funding, EU Emission Trading Scheme (EU ETS), power markets, carbon revenue recycling

With the adoption of the Climate and Energy Package in 2008, European decision-makers created an integrated suite of policies to reduce carbon emissions, increase renewable energy production, and advance energy savings. As the EU ETS moves to carbon auctioning, decision-makers must continue to link carbon prices with other policy tools to meet Europe's adopted carbon and sustainable development goals. However, carbon-pricing advocates sometimes object that other public policies will interfere with carbon markets or "undermine" the carbon price. In reply, this paper will show how energy efficiency (EE) policies can help meet ETS goals at lower cost, creating space to tighten carbon caps, and/or reduce the cost of protecting high-emitting industries and new Member States.

Main points:

Europe must decarbonise its power supply and electrify cars and buildings to meet EU GHG goals by 2050. The link between carbon markets and power markets is crucial to success in all of these areas.

Carbon pricing is an important tool to guide power markets and investments; however, carbon pricing alone will not deliver the GHG reductions needed in the power sector. Market barriers (especially to EE) and investment constraints (especially to renewable power) make it hard to reduce CO2 through carbon prices alone. In addition, even with carbon auctions, wholesale power markets can multiply the cost of carbon prices to consumers, and confer windfall gains on many generators.

In this mix there is also some good news: EE programmes can lower emissions at low cost to consumers and society, and save 7 to 9 times more carbon per consumer Euro spent, than would carbon prices alone. Thus, EE is triply valuable – it reduces bills directly, and also lowers power clearing prices and carbon prices for all consumers. Policy-makers should see EE not as a resource that weakens the ETS, but as an essential component of a combined strategy to reduce GHG emissions at the lowest social cost.

Smart “complementary policies” can directly link ETS and EE strategies, especially by using auction revenue for EE programmes, Complementary policies are also needed to support low-carbon power markets, grid expansion, and renewable power investment across Europe. If these policies have the welcome effect of lowering carbon prices, political space is created to reduce targets to 30 per cent or beyond.

INTRODUCTION

Since the earliest days of environmental markets there has been a robust debate over the roles of *pollution pricing* on the one hand, and direct regulatory and governmental *programmes* on the other hand, as tools to reduce societal pollution levels equitably and efficiently. As the European Union Emissions Trading System (ETS) moves into a new phase, governmental officials and other policymakers face important questions on how to harmonise carbon pricing policies with other policy tools to meet the EU’s ambitious greenhouse gas (GHG) reduction goals. The power sector is particularly significant in this dialogue. To begin with, it is the largest single source of industrial carbon emissions. Moreover, it is crucial to the well-being of nearly all businesses and households, and represents a largely non-bypassable source of energy for many applications.

More importantly, as the European Climate Foundation’s Roadmap 2050 reports and other studies[1] have recently demonstrated, **the nearly-complete decarbonisation of the European power grid and the simultaneous electrification of the transportation and buildings sectors is essential to meeting Europe’s carbon reduction goals between the present and 2050. For this reason, the intersection of cap-and-trade programmes and markets with power sector programmes and markets lies at the very heart of success in addressing climate change in Europe.**

In addressing the role of the ETS and complementary policies in decarbonising the European power sector, this paper advances five main points:

1. **Price is important, but not enough.** Carbon prices are important, delivering a continuing stream of market signals that will affect behaviour among many actors in major economic sectors over the course of many years. To this end the ETS is rightly a centrepiece of European public policy. However, global experience teaches that **a climate programme that attempts to reduce emissions through price alone will be more costly and less certain** than a comprehensive programme that includes proven techniques to deliver low-carbon resources, especially cost-effective efficiency resources.[2]
2. **Power markets raise additional barriers to efficient outcomes from carbon pricing.** In electricity markets, relying on carbon prices alone can lead to inefficient resource allocations and unnecessarily high power costs to consumers and the economy as a whole.

[1] European Climate Foundation, *Roadmap 2050 A Practical Guide to a Prosperous Low-Carbon Europe* (2010), http://www.roadmap2050.eu/downloads.html. *See also*, *e.g.*, C Jones and J-M Glachant, *Why and How the European Union Can Get a (Near To) Carbon-Free Energy System in 2050?* Center for Energy and Environmental Policy Research, (March 2010).

[2] We are, of course, not alone in making this point. As the well-known Stern Review on Climate Change emphasized, “carbon pricing alone will not be sufficient to reduce emissions on the scale and pace required.” (p. 347) The Stern review argues that a variety of barriers and market failures demonstrate the need for standards and regulations to support the carbon price in attaining climate mitigation goals. N Stern, *The Economics of Climate Change: The Stern Review*, (2007), Part IV, chapters 15-17, *available at* http://webarchive.nationalarchives.gov.uk/+/http://www.hm-reasury.gov.uk/stern_review_report.htm.

3. **A strong suite of complementary policies is available, and is needed.** Both at the EU and Member State levels, clean energy policies are key both to emission reductions and to cost containment for meeting the EU's 2050 goals. In particular, **energy efficiency is the cornerstone resource** and the key to cost containment.
4. **Carbon cap-and-trade programmes and complementary policies can have positive, mutually-supportive effects.** Market-based mechanisms like the ETS, and policy-based programmes like efficiency mandates and feed-in tariffs, should be designed and implemented in concert. Complementary policies will not necessarily lower *total emissions* within capped sectors, since the reductions they deliver can be taken up elsewhere, but they can lower the *cost* of the cap-and-trade system, and by doing so, accelerate progress in lowering emissions, limit the need for exemptions, and help gain public support for tightening the cap.
5. **Carbon *revenues* can add significant value.** The manner in which carbon revenues are spent can have as great or greater effect on reaching overall GHG goals than the initial impact of carbon prices under the ETS itself. Investing carbon revenue to develop new technologies is an effective means of driving down the cost of needed low-carbon resources. More significantly, investing a sizable portion of allowance value in end-use efficiency measures can achieve the emission reduction targets established by the cap at lower costs per tonne, while reducing both power prices and energy bills for the European economy.

Cap and Market Realities: Why Carbon Prices Alone Will Not Deliver Needed GHG Reductions in the Power Sector

Economists and policy-makers often assume that a carbon tax or its equivalent, such as an auction of pollution credits,[3] will significantly reduce the electric power sector's carbon footprint if set at a realistic level. While some reductions are expected to come from operating improvements (e.g., heat-rate improvements, fuel substitution) at some power plants, most reductions will need to come from three other real-world impacts:

- Demand reductions by consumers,
- Changes in the daily and monthly dispatch orders of plants in the generation mix, and
- Longer-term changes in the investment decisions for new generating facilities, substituting low-emitting resources – renewable power, nuclear, or fossil with carbon capture and storage – for traditional fossil generation.

In each of these areas, it will be difficult to produce significant reductions at carbon prices that governments throughout Europe can realistically expect to impose. Political considerations

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[3] Power cost increases will occur whether tradable allowances are sold at auction or distributed to emitters for free. Most economists agree that once credits are made tradable through a cap and trade system, power generators will include the opportunity costs of carbon allowances in their operational decisions and price bids in the electricity wholesale market, even where the allowances have been granted for free. *See, e.g.*, Sijm, Hers, et al., *The implications of free allocation versus auctioning of EU ETS allowances for the power sector in the Netherlands*, ECN-E-08-058 (December 2008), at pp. 12, 16), *available at* http://www.ecn.nl/docs/library/report/2008/e08007.pdf;and *Cong. Budget Office, Shifting the Cost Burden of a Carbon Cap-and-Trade Program* (2003), p. 17, *available at* http://www.cbo.gov/doc.cfm?index=4401. *See also* Dallas Burtraw et al., *The Effect of Allowance Allocation on the Cost of Carbon Emission Trading* (2001), P. 15–25 (2001), *available at* http://www.cba.ufl.edu/purc/docs/presentation_2004Palmer_Effect.pdf (analysing three different approaches for distributing carbon emission allowances under an emission-trading programme in the electricity sector).

aside, **setting a carbon price at a level high enough to drive the necessary reductions creates unnecessarily high power cost increases for consumers.** This is because wholesale power markets magnify the cost of reducing 1 tonne of CO_2, when the total cost to consumers is measured on a cost-per-tonne basis.

Figure 1 below summarizes how carbon prices and public policies intersect and complement each other in the deployment of low-carbon resources. The base figure is a fairly typical cost-of-abatement curve prepared by McKinsey for the EU-27. On the left-hand side of the curve we see the large potential for low-cost or negative-cost GHG reductions; these are actions that are already economic without a carbon price, but which are still not being captured, chiefly due to the market barriers that have always stood in the way of cost-effective efficiency improvements. The right side of the curve shows the abatement potential of higher-priced actions, including investments in nuclear power, renewable power, and fossil generation with CCS. These investments are not occurring for a variety of price, risk, and non-price barriers to deployment, and analysts understand that carbon prices would have to be reliably high over a long period of years in order to overcome these price and non-price challenges. The centre of the curve represents those abatement options where a moderate carbon price might well stimulate investments and yield reductions. However, this region represents only a portion of the GHG reductions needed to meet Europe's climate goals. While positive carbon prices and markets will support reductions in all three regions, carbon prices alone would deliver only a portion of the reductions needed.

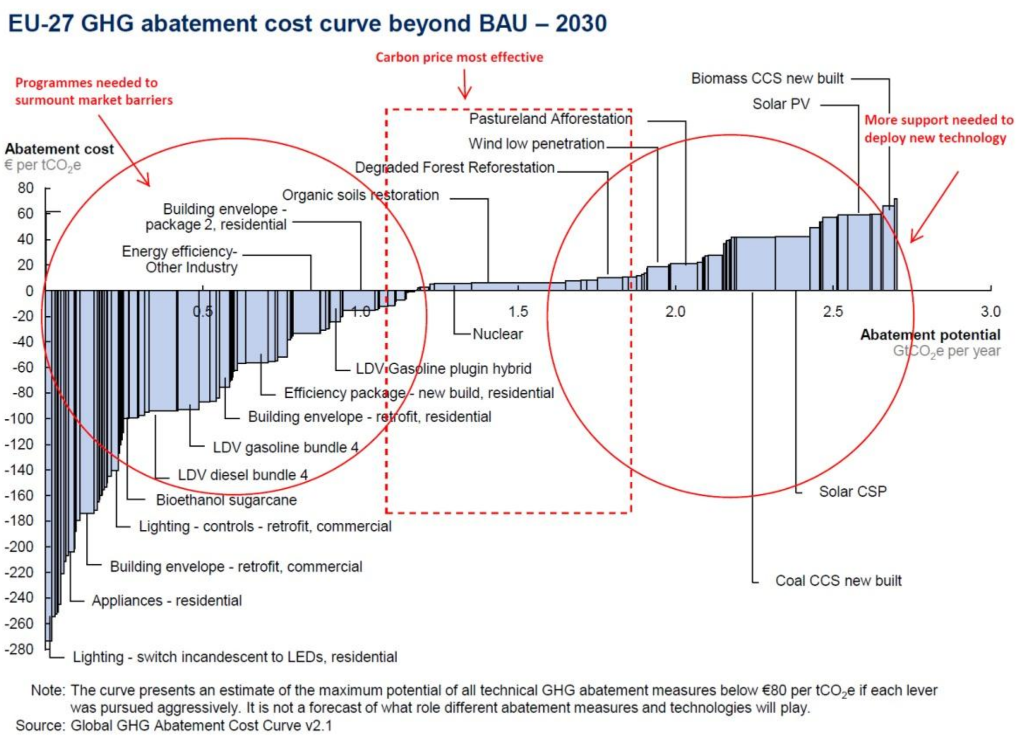

Figure 1: *Carbon prices can be effective, especially in the mid-range of the cost schedule, but market barriers and investment challenges limit the abatement potential of carbon price alone.*

There is growing recognition of the essential relationship between carbon pricing and other public policies in creating a European low-carbon economy. As the Öko Institute's Felix Matthes recently observed: "[A]gainst the background of the empirical findings that have been made available up to now and especially against the background of the (necessary) ambitiousness of future climate policy, effective climate protection can only be achieved through the interplay of different instruments. A balanced mix of an emission trading system, or other measures of carbon pricing, and other instruments is urgently needed. It is not expected that severe efficiency losses will result from the implementation of additional strategies and instruments to complement emissions trading."[4]

The following sections discuss the reasons that complementary policies are needed, and set out options to integrate the ETS with policies that help to meet climate goals in the most timely and cost-effective manner possible.

Carbon Prices and Market Responses: What Are the Effects on Consumer Demand, Power Market Dispatch, and Clean Energy Investments?

Carbon Prices Alone Will Not Deliver an Adequate Consumer Conservation Response

Cap-and-trade architecture is based on carbon pricing to raise the cost of electricity, and relies on those price increases to reduce consumption. Influenced by standard economic theory on internalized external costs, cap-and-trade theory often views increased power prices as desirable, and any resulting demand reductions as merely a consequence of the programme. Unfortunately, it is difficult through price signals alone to inspire a conservation response among consumers that will deliver an adequate level of investment in end-use efficiency. A more effective approach would be to view emission reductions that can be acquired through cost-effective efficiency programmes as an integral component of the cap-and-trade scheme.

There are three related reasons for this conclusion. To begin with, market barriers prevent the wide-scale adoption of cost-effective efficiency improvements. Furthermore, demand for electricity is relatively inelastic, which means that higher prices alone will lead to only a very small decrease in end-user demand for electricity. Lastly, rising incomes are correlated with increased consumption and can override the effects of higher prices on consumption.

There are numerous, well-documented market barriers to cost-effective efficiency investments.[5]

Those market barriers are not removed by carbon prices being applied to power generators. They will continue to block needed improvements, despite any rate increases that could reasonably be expected to flow from a politically-acceptable carbon cap-and-trade programme.

Whether due to market barriers or not[6], there is solid evidence extending over several decades that demand for electricity in our modern economy is relatively inelastic with respect to price and positively correlated with increases in income. Demand does respond somewhat to price, but the long-term reduction due to price increases is relatively small.[7] It would take a 10 percent

[4] F Matthes, *Greenhouse gas emissions trading and complementary policies. Developing a smart mix for ambitious climate policies*, (June 2010), [hereinafter *Matthes 2010*], *available at* http://www.oeko.de/oekodoc/1068/2010-114-en.pdf.

[5] There is extensive literature detailing these market barriers, including access to information, high first-cost problems, consumers' high discount rates, unpriced externalities, the landlord-tenant problem, and others. *See, e.g.*, Am. Council for an Energy-Efficient Economy, *Quantifying the Effects of Market Failures in the End-Use of Energy* iii-vi (2007), *available at* http://www.aceee.org/energy/IEAmarketbarriers.pdf (detailing the various types of market barriers to end-use energy efficiency).

[6] Price elasticity of demand is also influenced by the degree to which consumers can find reasonable substitutes in the market for goods and services that are considered necessities to their health and well-being. For many applications, electricity has no close substitute.

[7] Analysts estimate the short-term price-elasticity of demand as no more than -0.1 to -0.2. *See, e.g.*, Sijm, Hers, et al, *The impact of the EU ETS on electricity prices*, Final report to DG Environment of the European

increase in prices almost every year just to offset growth in power demand, and much greater price increases would be needed to reduce absolute demand and drive down emissions from the existing generation fleet. .

Moreover, price responsiveness is dampened by the income-elasticity of demand, which is positively correlated with consumption: as incomes increase, consumption of electricity goes up, and the conservation impact of any price increase is diminished. The historical figure for a 10 percent increase in power prices in the UK residential sector, for example, is -2.3 percent, but the income-elasticity is such that a 10 percent increase in income results in an increase in demand of 3.4 percent—thus, household income is at least as important as power prices in determining the demand for electricity, and rising incomes will blunt any conservation effect created by carbon prices in the power sector.[8]

Carbon Prices Delivered to Generators Must be Quite High to Significantly Alter Emissions Through Changes in Generator Dispatch

Dispatch conditions

The second problem with cap-and-trade designs that rely on carbon prices to alter power sector emissions results from the make-up of the generation fleet, and the manner in which individual generators are dispatched. It takes a high carbon price to materially alter the dispatch order, and therefore reduce emissions resulting from generation in the usual course of business. While this fact can be demonstrated through complex power models, the reasons are logical and straightforward:

- On a daily and hourly basis, power plants are dispatched largely in the order of their marginal operating costs. In competitive wholesale markets, they are dispatched in the order of their bid prices, which are logically based on those marginal costs.
- Because they do not burn fossil fuels, power plants with the lowest GHG emissions—such as hydro stations and wind farms—tend to have low marginal costs. Therefore, they are dispatched whenever they are available. Nuclear units are also dispatched whenever they are available. *Thus, the existence of high carbon prices does little to cause these low-emitting units to run more often.*
- Carbon prices will force modest improvements in the performance of fossil plants. Some relatively efficient plants will displace less efficient plants in the dispatch order. However, these impacts will be small in GHG terms. To greatly improve the emissions profile of the existing EU power fleet, it would be necessary for a large number of lower-emitting gas units to displace a large number of higher-emitting oil and coal units in the dispatch. This can occur as a result of major shifts in the price of natural gas, but it has proven difficult to achieve through prices in carbon allowances alone.

Commission   ECN-E-08-007 (2008), p. 104, [hereinafter *Sijm 2008*] *available at* http://www.ecn.nl/docs/library/report/2008/e08007.pdf. The long-term price-elasticity for electricity is higher but also small, closer to -0.25 to -0.32. This is quite similar to the experience in the United States; US DOE models employ a long run elasticity of -0.31 for residential electric use and -0.25 for commercial electric use. Steven H. Wade, *Price Responsiveness in the NEMS Buildings Sector Model* (Sept. 9, 1999), *available at* http://www.eia.doe.gov/oiaf/issues/building_sector.html. To put these rates in perspective, electricity demand seems even less responsive to price increases than demand for an addictive product such as tobacco, which has a price-elasticity rate of -0.34 to -0.37. *See, e.g.*, Financial Times, June 18, 2010 at p.14, (reporting a study by UBS). .

[8] J Dimitropoulas, L Hunt and G Judge, *Estimating Underlying Energy Demand Trends Using UK Annual Data*, *available at* http:///userweb.port.ac.uk/~judgeg/AEL_04.pdf.

- Carbon taxes and allowance auction prices affect all fossil units to some degree. Therefore, when carbon prices drive up the cost of coal-fired generation, they drive up the cost of gas-fired generation as well. In general, a carbon price of 20 Euros per tonne will drive up the marginal cost of coal-fired power by about 20 Euros per MWh, and gas-fired generation by about half that amount, or 10 Euros per MWh. This reduces coal's cost advantage over gas by about 10 Euros per MWh, which in most circumstances is not enough to broadly alter the order of dispatch.[9]

The Effect of Fuel Prices on Dispatch

The crossover point – the carbon price at which gas generation would cost less than coal generation due to carbon prices – will vary according to the price of gas compared to the price of coal per MWh of generation. Since coal prices are fairly stable, the ability of carbon charges to alter the dispatch of power plants depends largely on the market price of gas for generation. When gas prices are relatively high, it will take a larger carbon price to induce fuel-switching in generation; when gas prices are low, a lower carbon price might have an impact. Even when gas prices are relatively low, however, the impact of carbon prices on total emissions will be softened, for at least four reasons:

1. Concerns over Europe's security of supply;
2. The current installed capacity of efficient combined-cycle gas turbines (CCGTs) is insufficient to displace production from Europe's existing coal fleet even if it were all called upon;
3. Raising the demand for gas will raise the price of gas, elevating the crossover point at which carbon prices can be expected to alter the short-run dispatch order;
4. In the long-run, natural gas cannot be a major part of the generation mix if Europe moves towards a nearly fully decarbonised power sector by mid-century.

For these reasons, it would take a relatively high carbon price to displace a significant fraction of total emissions from fossil generation in today's power systems. And as discussed below, even a high carbon price would be unlikely to drive the transformative technological development necessary to decarbonise the power sector by 2050.

Pricing and Timing: Carbon Prices Are Not High Enough to Spur Technological Development and Low-Carbon Generation Soon Enough

If we are to meet Europe's ambitious carbon reduction goals and timeline, the switch from high carbon to low carbon generation needs to happen as quickly as reliability and security of supply considerations will allow. This involves both the rapid uptake of existing renewables technologies – particularly offshore wind, solar thermal, and photo-voltaic generation – but also the commercialisation of emerging low carbon generation options such as fossil CCS, ocean wave power, etc.

Sound economic logic holds that a "sufficiently high" CO2 price has the potential both to change the merit order of dispatch, and the long-term marginal cost of generation enough to shift investors' choices about what types of generation to build. Nevertheless, it is widely understood that carbon prices are at present insufficient, and complementary policies are essential if we are to accelerate development and deployment of low-carbon generation.

A number of support schemes are already in place across Europe to meet the 2020 target for renewable energy sources and to support longer-term technology development and

[9] One very thorough study for the European Commission found that a carbon price of 40 Euros per tonne would reduce emissions across Europe by only 13 percent, and only about one-half of the reduction would come from changes in the dispatch order. See, Sijm 2008, *supra* note 7, at Table 5.11.

deployment. The Strategic Energy Technology Plan (SET Plan) aims to support the research and innovation that will drive emerging technologies forward. Renewables obligations, feed-in-tariffs, and public financial support for carbon capture and storage (CCS) represent the major vehicles for commercialising these supply technologies. These schemes have demonstrated the benefits of creating investment security and market opportunities for low-carbon generation.

These additional support mechanisms are needed for a variety of reasons. At the outset, new technologies face numerous cost barriers not present with mature technologies. As a result, they need public support for research and development and to launch new production techniques, eventually driving costs down. Even after new technologies are proven, a relatively high carbon price is necessary to alter investment decisions, which are driven by the total costs of new facilities, not just the marginal costs of operating existing units. Investors in those facilities also need to be confident that high carbon cost differentials will remain in effect over long project lifetimes. Investor confidence is undercut by volatility in fuel prices, carbon prices, and technological and political risks. Thus, it is difficult for carbon prices alone to deliver adequate market signals to call forth the high level of investments in new technology that would transform the power generation fleet. The difficulties in relying on a carbon price alone can be summarized as follows:

- A sustained, long-term price differential is needed to drive investment in low-carbon generation. Several competing realities make it difficult to set and sustain a high carbon price signal, including fluctuating fuel prices for the competing fossil generation (especially natural gas) and political uncertainty about the stability of carbon policies as prices and price impacts rise over time.
- Immature technologies face initial cost barriers of several types, and need public support for research and development and to launch new production techniques, eventually driving costs down. Investors rationally discount future carbon prices when making investment decisions. Even if carbon prices are expected to be high in the future, this is insufficient in many cases to spur investment in low-carbon generation today. Applying a typical investors' discount rate of 15 percent (which many companies use for investment decisions), if developers believe that carbon costs will be 100 Euros in 2030, that rate equates to a carbon price of less than 10 Euros per tonne today, far too low to drive new investments in low-carbon generation.
- Would-be investors in new generation, especially renewable generation, also require access to transmission, including new network investments, in order to bring their power to market. Grid expansion is a precondition to low-carbon outcomes, but transmission assets are not brought forward by carbon pricing alone.

These market and policy risks combine to favour existing and traditional resources of electricity generation, and to weaken the reliability of depending on a carbon price alone to lead the transition to a near-zero carbon electricity sector.

Carbon Prices and Power Markets: Why Policies Are Needed to Manage Consumer Costs and Deliver Efficient Outcomes

The sections above highlight the difficulty of reducing emissions in the power sector through carbon prices alone. A frequent reply to these observations is that if expected carbon prices prove inadequate to drive efficiency, change dispatch, and spur investment in low-emitting resources, then public policy should simply focus on making carbon prices higher. As we consider that option, it is also important to consider the impact of this choice on business and residential consumers. Power cost increases must be weighed carefully, particularly where the rise in cost is not proportional to the benefits achieved in terms of tonnes reduced per Euro spent.

The central lesson from competitive wholesale power markets is this:

Applying high carbon prices to marginal generation units can greatly raise the cost of the carbon programme to consumers, particularly if the cost to consumers is measured on the cost-per-tonne of avoided GHG emissions.

Why does this occur? One of the key features of competitive wholesale power markets is their use of the "single price auction" in which, for any relevant trading period, the price paid to the highest-cost unit dispatched is also paid to all lower-bidding resources in the bid stack. This means that an increase in running costs for the fossil unit setting the clearing price will also be paid to the nuclear, wind, and hydro units lower in the bid stack. From the consumer's point of view, carbon prices make fossil-based electricity more expensive – but low-emitting generation will be more expensive too. In such markets, the inframarginal rent paid to power generators can be very extensive.[10]

How Significant is this problem? Power market rents, consumer costs, and a suboptimal resource mix.

The problem of windfall gains to generators from carbon pricing in power markets has received a great deal of attention, and has led to reforms and auctions in both the EU ETS and the US Regional Greenhouse Gas Initiative (RGGI), a cap-and-trade system for the electric power sector in 10 Northeastern US states. These are very important improvements, but they do not eliminate windfall gains, nor the potential of high-cost carbon reductions to consumers in power markets. In the absence of targeted investments in low-carbon generation and programmatic investments in energy efficiency, increased payments to generators alone would yield a suboptimal resource mix for Europe as a whole, and a slower, less efficient transition to a low-carbon economy.

One very thorough study, by the Energy Research Centre of the Netherlands (ECN) examined price impacts of the ETS in power markets under numerous scenarios, including conditions labelled Perfect Competition and Oligopolistic Competition, and with varying assumptions about carbon prices and consumer price-elasticity of demand.[11] That study found, generally, that allowance costs are passed through in wholesale power markets, that marginal generators will recover their carbon costs, and that low-emitting generators will earn rents as a result.

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[10] *See, e.g.*, *GHG Rules May Mean Nuclear Windfall Profits In Wholesale Market*, Energy Washington Week, (February 11, 2009).

[11] Sijm 2008, *supra* note 7. Another useful analysis was performed by the PJM Interconnection, the US power pool covering the Mid-Atlantic region and much of the Midwest. PJM operates the largest competitive wholesale market in the world. The PJM study estimates the increased wholesale energy market prices, and cost to consumers, that would result from various cap and trade proposals in the year 2013. At a presumed carbon price of $20/(short) ton (15 Euros) the PJM study finds that PJM customers could pay $12 billion (9 billion Euros) in higher energy prices in 2013 in order to reduce emissions by 14 million tons. This translates to a cost of over $850 (640 Euros) per ton of carbon dioxide reduction, or more than 40 times the per-ton market price of the carbon allowances. *Potential Effects of Proposed Climate Change Policies on PJM's Energy Market*, PJM, (January 23, 2009), p. 25.

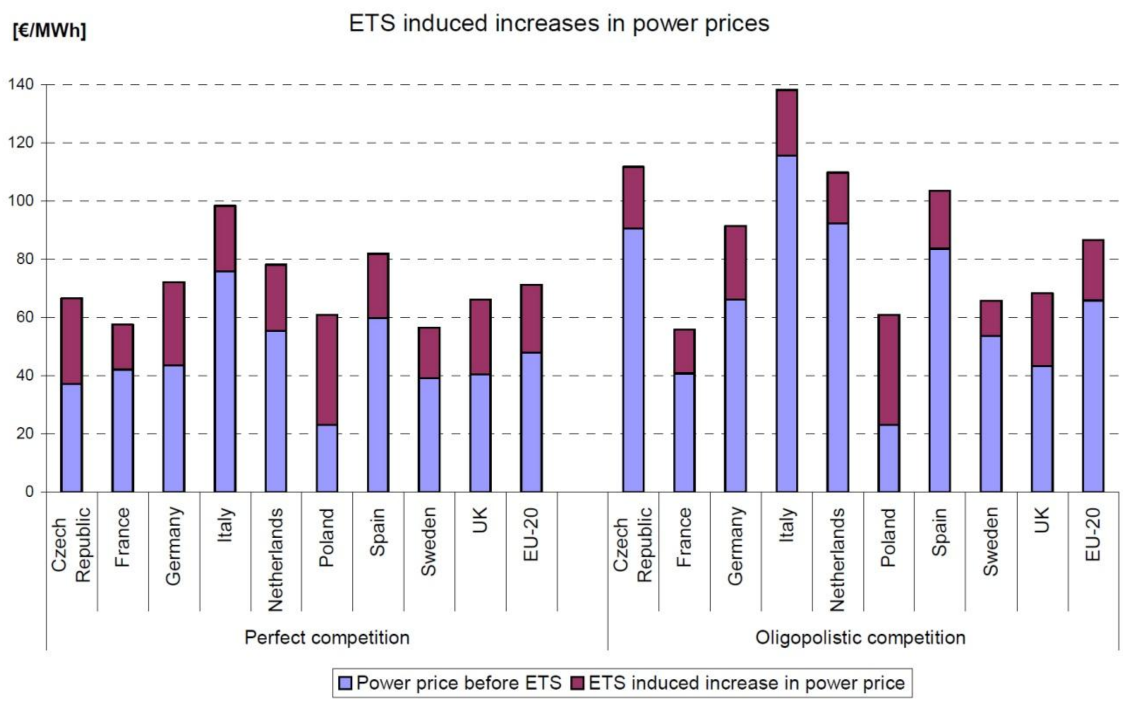

Figure 2: *ETS-induced increases in power prices in EU countries under two COMPETES model scenarios*

Note: Both scenarios are based on a carbon price of 40 €/tCO2 and a price elasticity of power demand of 0.2.[12]

This study did not report directly on the cost to consumers per tonne avoided by operation of the carbon price, but by comparing the results that are reported, we are able to construct a fair picture of the consumer costs of adding carbon prices to power prices in competitive wholesale markets. (See Table 1 on next page.)

[12] Sijm 2008, *supra* note 7 at 109.

Table 1. Calculating the consumer cost per tonne of abatement in competitive power markets, based on results of power system model runs reported in ECN study [13]

Scenario	**Carbon price** **20 Euros**	**Carbon price** **40 Euros**
Event/Result	*No demand response*	Price-elasticity -.2
(a) Power price increase*	€ 10.9 /MWh	€ 23.2 /MWh
(b) Total sales*	3016 TWh	2881 TWh
(c) Total Cost increase**	€ 33 Billion	€ 66.8 Billion
(d) Emission reduction*	133 Mt (all due to redispatch)	363 Mt (165 Mt from dispatch, 198 Mt from demand response)
(e) Consumer cost **per tonne reduced*** **	**€ 248 per tonne**	**€ 184 per tonne**

*Data in rows a, b, and d taken from ECN study, specifically: Table 5.2 (row a); Table 5.7 (row b); and Tables 5.11 and 5.12 (row d).[14]

** Power price increase times total sales (a × b).

***Total cost increase divided by emission reduction (c ÷ d).

In general, across 20 nations of the EU, the ECN study finds that a carbon price of 20 Euros per tonne would lead to an average price increase in power markets of 10.9 Euros per MWh, for a total increase in power costs of 33 billion Euros annually. The carbon price changes the merit order of dispatch enough to reduce emissions by 133 Mt, yielding a cost to power consumers of 248 Euros per tonne avoided.

If carbon prices were to rise to 40 Euros per tonne, the average price increase in wholesale power markets would rise to 23.2 Euros per MWh. However, if consumer price-response were as high as -.2, the emission reductions would also improve, rising to 363 Mt, and the cost per tonne avoided would drop somewhat, to 184 Euros per tonne. Thus, even with favourable assumptions on consumer behaviour, the cost to consumers per tonne of abatement remains more than 4 times the market price of the carbon allowances themselves.

Economists will correctly observe that a significant portion of the consumer cost noted here is in the form of transfer payments to generators, not a net cost to society. This is true, but the practical consequences are also important, and will tend to undercut societally efficient carbon reductions. Transfer payments to existing generators do little to reduce emissions, while diverting limited societal resources away from the investments needed to overcome barriers to low-cost efficiency and to advance low-carbon generation technologies. The carbon price will

[13] Author calculation based on results of EU-20 model runs reported. This study does not report the consumer cost per tonne of reduction, but does include the information needed to calculate this cost, as set out above.

[14] Sijm 2008, *supra* note 7.

play an important role in reducing emissions. However, there is a limit to the incremental benefit achieved by raising the carbon price to overcome barriers to investment in energy efficiency and low-carbon technologies.

The good news: By comparing results at different assumed levels of price-elasticity, the ECN analysis also reveals that a *higher rate of demand reduction by consumers* has several positive effects:

- Lowering the ETS's impact on power prices,
- Increasing the emissions avoided at a given carbon price, and
- Lowering the total cost to consumers in the power market.

This means that public policies that break down the consumer market barriers to investing in end-use efficiency can support the ETS by delivering low-cost emission reductions directly to the economy, and by lowering the power cost increases otherwise incurred by all consumers due to the effects of the ETS on wholesale power markets.

Consequences for Public Policy

It is important to note here that high price impacts are not inevitable. They are in fact avoidable through sound programme design, employing three design elements.

- ***First, the climate programme will need to rely substantially on programmes and policies, not just carbon prices*****,** to deliver low-carbon resources to the power mix. Policies such as efficiency standards and programmes, feed-in tariffs, renewable electricity standards, and low-carbon R&D programmes will add low-carbon resources to the power system without requiring across-the-board increases in power clearing prices to pull them into the mix.
- ***Second, allowances should be auctioned to emitters*****,** and allowance value should be recycled for the benefit of consumers.
- ***And third, the majority of auction proceeds should be invested to accelerate the transition*** to a low-emitting power sector, and to fund low-cost energy efficiency, which will provide greater benefits to consumers over time than short-term cash payments or bill reductions.

Complementary Policies Provide the Foundation for Successful Cap-and-Trade

Introduction

Cap-and-trade is intended to address two major objectives: to contain overall GHG emissions to globally acceptable levels and to do so at the lowest overall societal cost. But carbon pricing is not the only tool to reduce emissions, and – as noted in the sections above – price may not be the most effective tool to address sectors characterized by market barriers, high private discount rates, network externalities, and other impediments to societally rational decision-making. Under these circumstances, policy-based programmes such as efficiency mandates and feed-in tariffs can be key to achieving the emission reduction and cost containment objectives of cap-and-trade.[15] Such programmes not only serve to ensure that emission reductions are actually realised at the pace and scale required to meet the binding emissions cap, but can also achieve these reductions at lower total cost to consumers and the economy as a whole.[16]

[15] This conclusion is also found in the recent report by Felix Matthes at the Öko Institute. Matthes 2010, *supra* note 4 at 3-5.

[16] As discussed in the first section of this paper, relying on a carbon price to reduce emissions in competitive power markets requires raising wholesale clearing prices, which makes residential and

Moreover, complementary policies can help further broader societal objectives.[17] It is, therefore, vital to build on the current suite of complementary policies in place in the EU and its Member States, strengthening, improving, and adding to the portfolio of policy-based programmes to meet Europe's climate objectives in the most efficient way possible.

Most savings come from programmes and policies, not carbon prices alone

At the European level, there is broad acceptance of the value of many complementary policies. What may be less well understood is the degree to which GHG reduction plans rely on these complementary programmes, and the essential role they play in the success of cap-and-trade programmes. Even in a setting with a mature carbon pricing programme, most GHG reductions will occur only where parallel public programmes and policies are implemented.

The European Commission's recent "Roadmap for moving to a competitive low carbon economy in 2050" demonstrates the need for a combination of policies and programmes to deliver an 80% reduction in GHG emissions in Europe by 2050.[18] The Roadmap emphasises the need for a stable, long-term price signal under the ETS, as well as the importance of a range of other policies to drive low-carbon development. It emphasises the importance of meeting Europe's targets for carbon, renewables, and energy efficiency set forth in the Climate and Energy Package, as well as the danger of locking in carbon intensive investments if these targets are not met. It further calls for public investments in R&D, demonstration and early deployment of low-carbon technologies, and deployment of low-carbon transmission and smart-grid technologies.

In addition to widespread support in Europe for low-carbon policies generally, there is growing recognition of the foundational role that energy efficiency can play in meeting the EU's ambitious climate objectives. For example, according to the European Commission's Energy Efficiency Plan 2011, "energy efficiency is at the heart of the EU's Europe 2020 Strategy for smart, sustainable and inclusive growth and of the transition to a resource efficient economy. Energy efficiency is one of the most cost effective ways to enhance security of energy supply, and to reduce emissions of greenhouse gases and other pollutants. In many ways, energy efficiency can be seen as Europe's biggest energy resource. This is why the Union has set itself a target for 2020 of saving 20% of its primary energy consumption compared to projections, and why this objective was identified in the Commission's Communication on Energy 2020 as a key step towards achieving our long-term energy and climate goals."[19]

Detailed analysis performed for another large cap-and-trade program, the one adopted in California, provides another clear view of the importance of complementary policies in meeting climate goals. If California were a nation, it would be the eighth largest economy in the world, so its climate policies are globally significant. In 2006, California passed into law AB 32, which calls for California to reduce greenhouse gas emissions to 1990 levels by 2020 (which is 30 percent below business-as-usual emission levels projected for 2020). The law directed the California Air Resources Board (CARB), the state's regulatory agency for air quality, to prepare a scoping plan to identify how best to reach the 2020 target. The resulting AB 32 Scoping Plan, developed by CARB in consultation with the California Energy Commission and Public Utilities Commission, recognizes the need for policies and programmes that complement and strengthen cap-and-trade to achieve these aggressive reductions, in both capped (i.e., covered by cap-and-

business consumers pay substantial inframarginal gains to all generators in the merit order – in contrast to complementary policies.

[17] For further discussion, see *EU Emissions Trading in a Crowded National Climate Policy Space – Some findings from the INTERACT project* by Jos Sijm, Energy Research Centre of the Netherlands (ECN); and Steve Sorrell, Science and Technology Policy Research (SPRU), University of Sussex, p. 2, Summary.

[18] *A Roadmap for moving to a competitive low carbon economy in 2050*, COM(2011)112 final.

[19] Energy Efficiency Plan 2011, COM(2011)109 final, p. 2.

trade) and uncapped sectors.[20] These policies include: (1) expanding and strengthening existing energy efficiency programmes, and building and appliance standards; (2) achieving a statewide renewables energy mix of 33 percent of power supply; (3) implementing a carbon emissions standard and low carbon fuel standard for automobiles, and (4) creating targeted fees, including a public goods charge on water use**.**

While termed "complementary policies," these initiatives are turning out to be the principal means of GHG reductions in California, **accounting for more than 75 percent of the emission reductions that California expects to achieve in the capped sectors**—i.e., for transportation fuels, energy sector, industrial sources and natural gas use.[21] The role of these policies within the electricity sector alone is even more striking. By 2020, increases in energy efficiency and renewables – employing standards, regulatory reforms and expanded programme incentives -- are expected to greatly reduce greenhouse gas emissions for the power sector. In fact, **complementary policies in the electricity sector will account for more than 100 percent of the sector's proportional emission reductions by 2020**, and will be providing net reductions that will be of value in other sectors of the economy.[22]

Experience in the EU and the US together provides three useful lessons for EU policy-making:

- First, low-carbon policies can play a powerful role both in reducing GHG emissions and in reducing the cost of emission reductions;
- Second, since many low-carbon programmes and policies (e.g., building codes, utility efficiency programmes) are delivered by EU Member States, local governments, and utility administrators, climate legislation and regulation will need to support complementary efforts by Member States and sub-national governments, as well as low-carbon policies in the operation of power markets and regulations to successfully deliver deep GHG reductions; and
- Of course, complementary GHG policies must be designed and administered to work well with the ETS system, and to deliver savings efficiently. As with any governmental policy, if well-designed, renewables standards, power market rules, and efficiency programmes can lower the societal cost of reducing emissions; while if badly-designed or implemented, they can interfere with carbon markets, add investor risk, and raise the total cost of compliance.

In the following sections we discuss in greater detail some of the specific complementary policies that will support the ultimate success of the ETS.[23]

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[20] The sectors covered by cap-and-trade under the Scoping Plan are energy sector, transportation fuels, industrial sources and natural gas use.

[21] California Air Resource Board, *Climate Change Scoping Plan,* (December 2008), p.21, *available at* http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm. (77percent of the reductions in capped sectors are attributable to these foundation policies.)

[22] California Air Resources Board, *Climate Change Scoping Plan Appendices,* Volume I, Appendix F, Table 3: *California GHG Inventory by Category as Defined in the Scoping Plan*, available at http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm.

[23] Much of the material in this section is adapted from or taken directly from, European Climate Foundation, *Roadmap 2050: A Practical Guide to a Prosperous, Low-Carbon Europe – Volume II: Policy Recommendations*, (April 2010). The Policy volume is based on work provided by staff of E3G, the Energy Research Centre of the Netherlands (ECN), and the Regulatory Assistance Project, with major contributions from several colleagues, including Simon Skillings, Pieter Boot, and Meg Gottstein. I am grateful for their contributions, but interpretations, recommendations, and any errors here are the author's alone.

Will complementary policies reduce total emissions?

Focussed public policies for energy efficiency, renewable power and technology development can add certainty to power investment portfolios, and can lower the cost of delivering savings to the system. But, as applied to capped sectors, they will not directly reduce total emissions, since the cap level remains the same. Does this mean that such policies are environmentally unimportant?

Not at all. While it is true that complementary policies do not by themselves reduce emissions in sectors under the cap, they do offer several advantages to those seeking to maximize environmental protection. First, as noted in depth above, well-designed complementary policies can lower the cost of the cap and trade programme, and thus improve public and political acceptance, making it more likely that cap goals will be met on time. Equally important, when Europe is able to meet its initial GHG goals at lower cost, the opportunity to revisit and lower the cap over time arises, and the political likelihood of being able to tighten the cap will increase. This could include tightening rules for the use of global mechanisms such as CDM credits, reducing the need for internal supports to trade-affected industries, or raising the overall level of ambition. Current efforts to lower emissions by 30 percent rather than 20 percent by 2020 reflect this political situation fairly well.

Energy Efficiency is the Cornerstone of a Successful Climate Programme

Are policies to support energy efficiency compatible with the ETS? The short answer to this question is a definite “yes.” Indeed, improvements in end-use energy efficiency are so central to the success of the ETS that the ETS itself should be designed and administered to support delivery of cost-effective energy efficiency throughout the European economy.

Since it will cost far less to avoid carbon emissions through energy efficiency than by adding or substituting expensive low-emissions generation on the grid, it is entirely consistent with the overall goals of cap-and-trade to design a trading system that builds directly on efficiency as a resource. Simply stated, a carbon programme that directly mobilizes end-use efficiency will meet its reduction targets at lower cost than one that focuses only on generators. **Indeed, energy efficiency is triply valuable in helping the EU meet its carbon targets: it lowers carbon prices; it lowers power clearing prices; and it reduces bills directly**. Realising these opportunities, however, will take policy actions, including improvements in the allocation of carbon credits in the design of cap-and-trade programmes.

In March 2007, the European Council endorsed a policy to save 20 percent of primary energy consumption by 2020 against projected consumption, and this remains the central plank of European legislation relating to energy efficiency. Member States have been tasked with developing and implementing action plans aimed at achieving this objective. However, despite the widely distributed savings opportunities and other social benefits of energy efficiency, the focus and effort deployed by Member States has been patchy. A recent study by Ecofys and Fraunhofer ISI[24] concludes that the impact of energy savings policies will need to increase by a factor of nearly three times in order to reach the 20 percent energy savings target. Failure to do so would cost an estimated 78 billion Euros per year in unrealised savings to European energy consumers, net of investment costs. This study also identifies a number of reasons for this underperformance.

There are numerous, well-documented market barriers to the deployment of cost-effective end-use efficiency measures in homes and businesses alike. Existing governmental efforts to overcome these barriers have had some success, but there are still serious limitations to these government initiatives, including:

[24] Wesselink et al, *Energy Savings 2020: How to Triple the Impact of Energy Saving Policies in Europe*, Ecofys and Fraunhofer ISI (June 2010).

- Insufficient funding for energy efficiency programmes needed to stimulate investments in private buildings and businesses throughout Europe;
- The non-binding nature of the 20 percent efficiency target;
- The Energy Services Directive targets less than 1/3 of cost-effective savings potential;
- Member State implementation efforts are not consistently robust, and the state of practice in efficiency programme design and delivery lags behind best practices and leading models;
- Major delays in implementing and revising the Energy Performance Directive for Buildings;
- Long transition periods for minimum standards under the Eco-Design Directive; and
- Delays in revisions of outdated labelling schemes.

There are, of course, crucial direct benefits from a successful energy efficiency deployment strategy, including reducing direct emissions from power generation, improving power system reliability, and creating "space" in the power system to support the fuel-shift of high-emitting uses to lower-emitting electricity. There is also increasing evidence of broader economic benefits and job creation arising from industries operating in the energy efficiency supply chain, and this can form an important dimension of the rapid and sustainable return to growth and prosperity across Europe. The Green Paper on Energy Efficiency[25] estimates that energy savings measures could create 1 million new jobs in the EU by 2020 due to the labour-intensive and localised nature of the work. The bulk of these jobs would be created in local installation and manufacturing sectors and to a smaller extent in the transport, energy and service sectors.

It is essential that policy makers urgently address the need to get back on track to deliver the 20 percent target by 2020 and set in place the foundations for sustained ongoing improvements thereafter. It will not be easy to achieve this objective. It is therefore necessary to develop a broad, assertive efficiency policy strategy, which should involve the following key elements:

Treat energy efficiency as a zero-carbon power supply resource: The large-scale ramp up of cost-effective energy efficiency requires a fundamental shift in how efficiency investments and results are treated in power systems. Public policies and market rules should recognise explicitly that energy efficiency represents a low-cost and zero carbon energy system resource that benefits all customers, irrespective of the physical premises where the measures are installed.

Develop comprehensive approaches: Single-barrier approaches or higher prices alone – including the impact of carbon pricing under the EU ETS – will not bring about large-scale deployment of energy efficiency. Comprehensive approaches will be needed including packages of regulation, audits, financing, incentives and inspections.

Provide sufficient and stable public funding: While the addition of carbon prices to energy costs sends an important conservation signal to the owners of buildings and equipment, much more is needed to surmount the market barriers to efficiency. Successful removal of market barriers requires a stable and sufficient source of public funds to socialise approximately one-fourth[26] of

[25] *Green Paper on Energy Efficiency*. EC 2005, http://ec.europa.eu/energy/efficiency/do/2005_06_green_paper_book_en.pdf

[26] The '25percent-75percent' public-private investment ratio stems from experience in rolling out energy efficiency programmes over the last three decades in residences and businesses. Some applications will require a larger percentage of public funding to leverage private investments (e.g. residential retrofits with solid wall insulation) whereas others will require a lower percentage. This general rule of thumb is also borne out by the incentive levels (relative to total costs) paid out by Efficiency Vermont, an experienced efficiency deliverer in the US under a performance contract with the State. *See* http://efficiencyvermont.com/stella/filelib/2008_Efficiency_Vermont_Annual_Report.pdf.

the total investment cost in efficiency. Funding for efficiency can be derived from a number of potential sources, including:

1. Uniform, non-bypassable charges on all power transmission or sales, similar to the tariffs in place for other widespread benefits, including transmission access, reliability services, and grid operation[27];
2. Recycling revenues collected through the auctioning of carbon allowances into energy efficiency programmes; for example, Member States could direct a fixed fraction, or a threshold amount – e.g., the first 4 or 5 Euros received for each tonne auctioned – into investments in energy efficiency programmes;
3. Recovery[28] of excessive infra-marginal rents collected by some generators from the higher market clearing prices created by the EU ETS;
4. A new source of market revenues created through a tradable white certificate programme; and/or
5. A financial obligation on all retail energy suppliers that is then passed through to end-users in retail prices to the extent permitted by the market.

Create effective, trusted delivery systems: Long-term improvements in energy use will require new ways of delivering energy efficiency services to homes and businesses. Delivery systems must be able to create consumer trust in the 'messenger' and minimize market confusion from multiple energy efficiency brands and conflicting energy savings values, and establish effective quality controls for the information and retrofit installations provided to buildings.

Policy Action to Decarbonise Power Generation

The switch from high carbon to low carbon generation needs to happen as quickly as prudent security of supply considerations will allow. Yet as discussed above, at carbon prices that can realistically be expected to apply within the next decade, the ETS alone will be unable to accomplish the two types of actions needed to transform Europe's power generation fleet in a timely manner. Carbon prices alone will not be able to (a) force the early or scheduled retirement of high-emitting fossil units, or (b) to provide an investment environment for low-carbon resources that is early enough, high enough, and secure enough to call forth dramatic increases in new low-carbon generation. Current policies must be strengthened and expanded to drive these actions. An Emissions Performance Standard (EPS), which sets a uniform maximum emission rate for a category of generators can block the long-term "lock-in" of emissions from new investments in high-emitting generators, and could over time, drive timely retirement of existing coal-fired generation. At the same time, extending EU-wide targets for renewable energy resources can create a long-term signal that will provide clear market opportunities for new low-carbon technologies. And continued support for technical research, development, and deployment of CCS technologies can drive emissions down, particularly in heavy industry. Meanwhile, stepped-up support for energy efficiency and demand response resources can reduce the need for new supply-side investments, reducing costs as well as emissions and security concerns.

Building Power Networks and Managing Regional Power Markets to Reduce Emissions

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[27] Often called "system benefit charges" or "network charges" these charges are widely used for a variety of purposes on power systems. They are the principal means of paying for power sector efficiency programmes in the United States, now amounting to more than $4 billion annually for efficiency alone.

[28] Such taxes could equitably apply to legacy plants built with public or ratepayer support and without regard to future carbon markets (e.g., most existing nuclear facilities), but should be designed to avoid negative impacts on investments needed to deliver additional low-carbon resources in the future.

The ultimate goal of the ETS is to ensure the cost-effective reduction of GHG emissions across Europe, which as a practical matter requires the almost-complete decarbonisation of the power sector. As the extensive studies of Roadmap 2050 demonstrate, this deep level of decarbonisation cannot occur without very significant increases in renewable energy production, which in turn requires widespread *increases in network transfer capability* across the EU's power regions, together with *competitive wholesale power market mechanisms* that will enable the sale of large volumes of low-emission power across national boundaries.

While ETS-driven carbon prices will tend to support these improvements, neither of these essential elements is likely to come into being simply as a consequence of carbon pricing. Firstly, the monopolistic characteristics of the transmission grids and public nature of wholesale power markets mean that these are highly regulated areas that require regional planning, coordinated siting, and cost-allocation rules to drive large scale change. Second, planning must be coordinated across national boundaries within Europe to optimize the transition to low-carbon generation, reducing overall costs for the European energy system as a result of trading, and sharing balancing services among countries and regions. Existing institutions (ACER and ENTSO-E) should be given the additional mandate to integrate regional forecasts and to create a strategic EU-wide infrastructure plan. These institutions need to ensure that resources across Europe are utilised efficiently on an operational basis. Third, efficient planning requires a long-term strategic view of the generation and demand characteristics across Member States – one that extends well beyond a 10-year planning horizon. Fourth, an improved regulatory regime must include strategies to fund the needed infrastructure build, and to enable equitable cost-sharing across the European power systems. Lastly, an aggressive timetable for rolling out "smart grid" technology is required to capture the benefits that a modernised grid can offer. As highlighted in the Roadmap 2050 studies, smart grid, combined with an appropriate policy and market framework, has the potential to significantly improve demand response at the local distribution network level. Demand response, in turn, is key to effective functioning of a renewables-based, decarbonised power grid.

The Power of Carbon Finance: Why Carbon Revenues (Not Just Carbon Prices) Are a Key to the Success of the ETS

One of the most important breakthroughs in carbon markets analysis in the past three years has been the realisation that carbon cap-and-trade programmes such as the ETS can accomplish at least as much from *the use of carbon revenues* as they can from the *application of carbon prices* to energy choices. For this reason, a key set of "complementary policies" for the ETS are actually directly connected to the ETS itself – involving the manner in which carbon auction revenues are reinvested to support Europe's transition to a low-carbon economy.

Although carbon revenue could be invested usefully to advance almost any of the policies discussed in the sections above, including especially accelerating the deployment of CCS and other advanced technologies, the broadest and most powerful use of carbon revenues is to invest in end-use energy efficiency so as to break down market barriers to efficiency, effectively increasing the observed level of price-responsiveness among consumers to power and carbon price increases. For this reason, the discussion below focuses on the potential role to invest carbon revenues in end-use energy efficiency programmes.

The Good News: Efficiency Programmes are More Powerful than Price Increases or Supply-side Carbon Prices

The existence of market barriers and inelastic demand does not mean that efficiency resources are unavailable to the power system, just that they must be tapped through proven techniques that surmount those obstacles. More than two decades of experience with utility DSM programmes have demonstrated in practice that well-managed efficiency programmes can deliver significant savings to the power grid, and thus can lower carbon emissions at a low cost to the economy.

The most important point is that energy prices are not the principal barrier to investments in energy efficiency, nor are price increases the best tool to unlock consumer demand for greater efficiency. The power system can realise seven to nine times more savings from each Euro spent in a well-managed efficiency programme -- in MWh and resulting GHG emissions -- than it will through generalised, across-the-board price increases. The following example illustrates this reality. The example calculates the reductions in GHG emissions likely to result from two cases using the generation, rates, and sales characteristics of electricity in the UK, combined with results of the UK's second Energy Efficiency Commitment (EEC2). Although the example is based on the power mix in a particular place, the results would be similar in any jurisdiction with a high fraction of fossil generation. The example simply compares two options:

1. Adding a 3% increase in electricity prices - roughly equivalent to the cost of implementing the EEC2 in 2005; or
2. Taking the same 3% rate increase and showing what happens when that revenue is invested in energy retailer sponsored energy efficiency programmes.

Due to the low price-elasticity of demand for electricity, the rate increase itself would result in a small decrease in demand and a corresponding reduction in emissions. However, if the proceeds from a system benefit charge or carbon credit auction are invested in programmatic energy efficiency, the savings are much greater-in both MWhs and in GHG emission reductions.

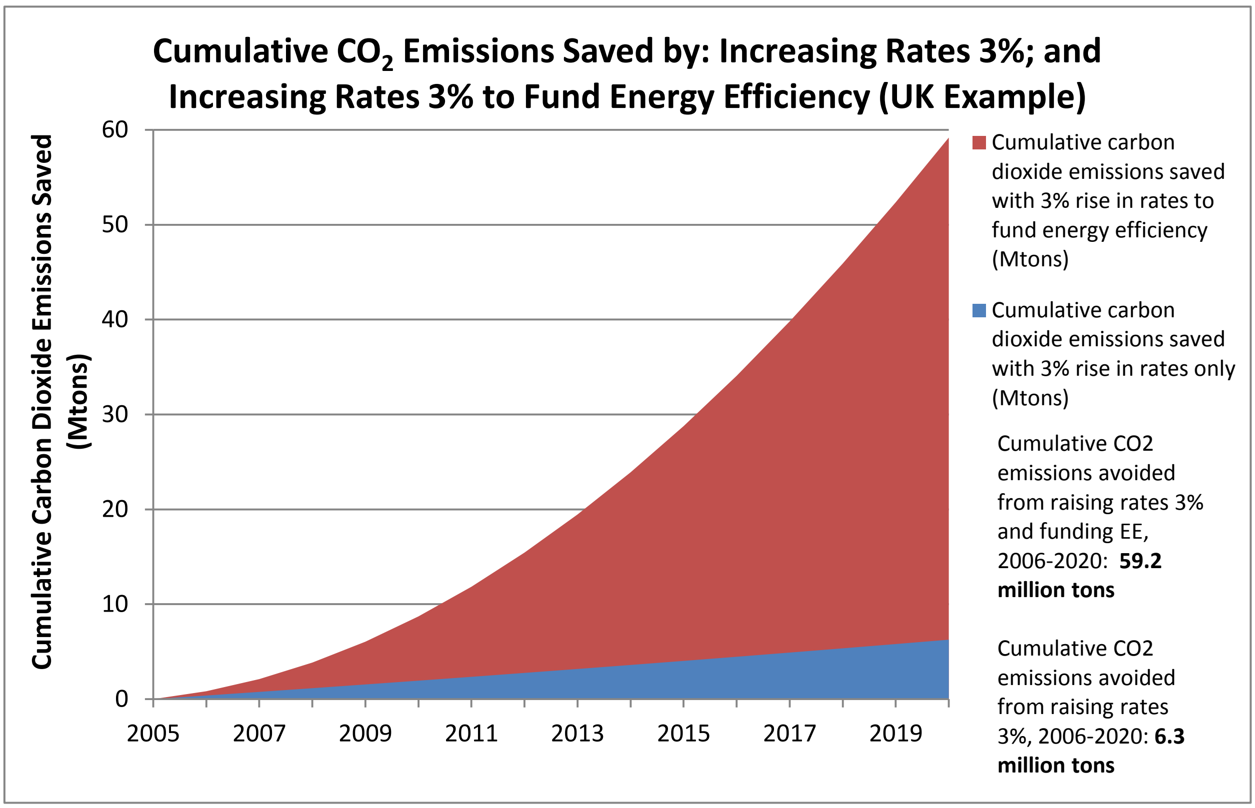

Figure 3: *Efficiency programmes save 7 to 9 times more carbon than carbon taxes or auction prices (for the same consumer cost)*

Figure 3 illustrates that investing the proceeds of a carbon charge in energy efficiency in this manner will in fact increase the savings by a factor of nine over the first fifteen years.[29]

Pollution programmes that focus only on the supply side raise the price of electricity but only incidentally reduce demand. For a given cost to consumers, society can reduce much more carbon pollution through energy efficiency programmes than it can through pollution taxes or cap-and-trade programmes that focus only on the supply side.

In the context of a cap-and-trade programme like the ETS, this analysis shows that recapturing and recycling carbon revenues will lower the consumer cost of meeting the cap. But in what form should those benefits be returned to consumers? Some consumer advocates have proposed that revenues from the sale of carbon credits should be returned to consumers in the form of rate rebates. However, this will not produce the best long-term results for consumers. **The best outcome for consumers as a whole, and the best way to lower the societal cost of carbon reduction, is to invest carbon credit revenues in low-carbon resources—especially low-cost energy efficiency measures.**

There is good evidence for this conclusion. Several European Member States have experience in applying carbon revenues, either from AAU sales under the Kyoto protocol, or from national carbon levies, to investments in building retrofits and other efficiency programmes. Another relevant example, tied directly to carbon credit auctions, is found in the cap-and-trade architecture put in place under RGGI in 10 states of the US Northeast. [30] Over the first two years of the RGGI programme, 90% of allowances have been sold, and more than 50% of auction proceeds have been invested in energy efficiency programmes rather than being automatically allocated to general Treasury purposes. Indeed, half of the participating states have allocated over 80% of auction proceeds to investments in energy efficiency. This is a significant departure from previous cap-and-trade regimes, and even with low carbon prices RGGI auctions have already raised more than $400 million for investments in energy efficiency.[31] According to a recent report by RGGI, Inc., the central administrator of the programme, considering the overall consumer benefits of EE and renewable energy programmes, in the form of energy bill savings, demand-induced reductions in wholesale electricity prices, improved electric system reliability, and job creation, economic benefits are expected to outweigh the impact of the cap-and-trade programme on electricity prices.[32]

A study of the resulting investments in electricity energy efficiency programmes in the 10 RGGI states found that they reduced emissions at costs ranging from approximately negative $53 to negative $100 per (short) ton of CO2 reduction, yielding a weighted average cost of *negative*

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[29] Given the UK's consumption levels and power mix, raising rates without adding programmatic energy efficiency investments would save about 6.3 million tons of CO_2 between 2005 and 2020; raising rates along with energy efficiency investment would save 59.2 million tons over the same period. These calculations take into account avoided tons of CO2 based on electricity savings only. In fact, building retrofit programmes such as those deployed under the EEC2 result in significant heat savings, which often translate into significant emissions reductions from sectors other than electricity (district heat, gas, oil, etc.). In the UK, for example, building retrofit programmes result in avoided GHG emissions in the natural gas sector, which provides most of the heating for UK residences.

[30] For more information on the role of energy efficiency in RGGI, see R Cowart, *Carbon Caps and Efficiency Resources: How Climate Legislation Can Mobilize Efficiency and Lower the Cost of Greenhouse Gas Emission Reduction*, 33 Vermont Law Review 201-223 (2008).

[31] An additional 11 percent of auction proceeds have been applied to renewable energy programmes. RGGI, Inc., *Investment of Proceeds from RGGI CO_2 Allowances*, (February 2011), pp. 10, 12, available *at* http://www.rggi.org/rggi_benefits.

[32] *Ibid.* at 27.

$73 per ton. "For comparison, carbon reductions achieved through switching electric generation from coal to natural gas would be much more expensive. An analysis by PJM and others has found that significant CO2 reductions through fuel substitution in electric generation will only occur when carbon prices reach the neighbourhood of $50/ton CO2."[33]

Viewed through this lens, it is apparent that each of ton of reduction leveraged by way of RGGI-financed efficiency measures is both beneficial to consumers and an improvement in the societal cost-effectiveness of the carbon reduction programme.

Carbon Revenue Recycling and the ETS

While the supply of low-cost efficiency investment opportunities is not infinite, the untapped efficiency reservoir across Europe is quite large. Unfortunately, Member States as a whole are not on target to meeting even the initial 20 percent efficiency targets set out in EU policy. Additional investments in cost-effective efficiency measures would provide a large initial block of carbon reduction at the lowest cost to consumers and the economy. Governments can provide a greater long-term benefit to consumers by selling carbon credits to emitters and investing the revenues in low-cost efficiency rather than using the funds to support general governmental purposes or short-term consumer rebates. Recycling the credit revenues through efficiency services can lower the cost of carbon reduction to consumers and the economy. It can also advance other goals, including lowering power bills, creating "space" in the power system to reduce emissions through electrification of vehicles and buildings, moderating the cost of transmission and distribution upgrades, and improving power system reliability.[34] Since many end-use customers and applications are not directly subject to the ETS, many end-use energy efficiency programmes support the goals of Europe's climate policies but do not directly overlap with the ETS. Article 10.3 of Directive 2009/29/EC, concerning the use of auction revenues, states that auction revenues should be used to promote carbon mitigation and adaptation, but merely touches on energy efficiency. Wherever European institutions have the authority to promote investing carbon revenue in energy efficiency, they should do so.[35] Member States should be strongly encouraged to invest carbon auction revenues in these measures, which will lower emissions and the cost of compliance at the same time, directly advancing both of the principal aims of the ETS.

Conclusions

The European ETS is a crucial policy initiative, both within Europe and as a model for global progress. The ETS has proved extremely successful in setting a price for carbon that is now incorporated as an avoidable cost by power plant operators in generation dispatch and short term planning decisions. It also provides the basis for greater international collaboration on reducing carbon emissions through linking with other cap and trade schemes and it represents a growing source of market revenues that can be used to make investments in energy efficiency,

[33] M. Chang, et al., *Electricity Energy Efficiency Benefits of RGGI Proceeds: An Initial Analysis*, Synapse Energy Economics Inc., (October 5, 2010), p. 4.

[34] Reduced consumption will lower power market clearing prices, producing an anti-windfall effect benefiting all consumers; it will lower power bills for consumers who install efficiency measures; and it will lower demands on transmission facilities and improve reliability. For an overview of the multiple benefits of power sector end-use efficiency, see Richard Cowart, *Efficient Reliability: The Critical Role of Demand-Side Resources in Power Systems and Markets* (2001), *available at* http://www.raponline.org/Pubs/General/EffReli.pdf.

[35] For example, the derogations permitted to Poland and the Czech Republic will result in substantial sources of revenue, a portion of which could usefully be directed to investments in energy efficiency.

new low carbon technologies and the infrastructure needed to meet the 2050 carbon reduction objective.

But the ETS does not exist in a policy vacuum. Central to its success will be a number of complementary policies and programmes – elements in a much larger European programme of actions needed to deliver deep GHG emission reductions rather quickly and at acceptable cost to the European economy. European policymakers face the daunting challenge of setting a path to achieve deep reductions in GHG emissions while moderating both societal economic costs and consumer costs from the programme. A well-constructed suite of complementary policies is essential to meeting these goals.