Carbon Pricing and Complementary Mechanisms

This briefing note is drafted by Simon Skillings (E3G) with support from the group of lead authors in the 'Roadmaps to Reality' process. The note serves as the basis for the discussion at the 2nd Core Working Group seminar on 23 October 2012 on theme 2 (carbon pricing and complementary measures). The options identified in the note are non-exhaustive and put forward to be tested and further developed along with new insights and ideas with the Core Working Group at the seminar and in consultation with the expert panel throughout the 'From Roadmap to Reality' project.

Summary

The current Climate and Energy Package covers the period up to 2020 and the EU Commission is assessing what policy framework might need to be implemented to cover the period out to 2030 and beyond. At the same time, member states are also beginning to consider the mechanisms that should be established at national level and those which are best left to the EU. The European Climate Foundation 'Roadmap to Reality' process aims to support the Commission's thinking by exploring the policy framework that best supports the decarbonisation of the power sector over these timescales. This paper focuses on that part of the policy framework related to carbon pricing and those complementary policies that might be required to overcome market failures associated with financing investments, development and deployment of new technologies and inefficient consumption of electricity. It is an initial framing document that aims to set out the high level policy landscape in a way that supports a constructive and focused discussion about the policy choices.

The nature of the decarbonisation challenge is changing. Apart from the huge amount of investment required and the evolving nature of the energy market, the political differences amongst member states are becoming more apparent and a new policy framework will need to accommodate these differences. It is, therefore, unlikely that it will be appropriate, or indeed possible, to simply 'roll-over' the current policy package, and new thinking is required if a suitably ambitious set of measures is to be agreed.

A new policy package must fulfil multiple requirements and this would be challenging even within the context of a single homogenous jurisdiction, let alone where there are divergent national interests. It is, therefore, necessary to consider not only the various policy options and how they deliver against these requirements, but also how this is affected when different aspects of the policy package are defined at EU or member state level.

This paper sets out the requirements of a new policy package and assesses how various policy options compare in delivering against these requirements. In the last section, and on the basis of this analysis, we attempted to develop a series of policy package. They comprise different high-level policy choices and the extent to which they are pan-European or member state-specific. The paper will form the basis of the discussion to be held with the Core Working Group of organisations at the meeting scheduled for 23rd October. The discussion will be divided into two themes that explore the

interactions between carbon pricing and complementary policies and between EU and member state level policies. The paper highlights a number of issues for discussion:

Instruments: Carbon pricing and/or complementary policies:

- Does the EU experience with ETS tell us all we need to know about the potential of a cap and trade scheme or could it deliver more in a less constrained political environment?
- Is it generally accepted the ETS has failed to drive investment and, if so, why?
- Should complementary measures be restricted to the support of early stage technologies or are they required more generally to support investment?
- Are complementary measures to support the efficient use of energy an inevitable part of the policy framework?
- What are the key changes that are likely to arise in the market after 2020 that will affect the nature of the climate and energy policy package?
- How far should policy makers seek to provide future price certainty to encourage investment?
- Is 'least cost' the primary objective or are other requirements now more important?
- Is it accepted that the 20-20-20 package cannot simply be continued with appropriately revised numbers?
- Is it inevitable that 'policy cannibalism' will arise between complementary measures and carbon pricing or can measures be designed that are mutually reinforcing?

Competences: EU and/or member state level policies:

- What issues/opportunities might arise with EU-wide complementary measures as opposed to those deployed by individual member states?
- Can member states sustain different aspirations for the rate at which the power sector decarbonises?
- Is it possible to develop a climate package that prevents member states 'free-riding' and dragging ambition down to the 'lowest common denominator'?
- Do cap and trade schemes work best across broader geographical areas whilst tax systems are more appropriate within individual countries?
- Is it credible that significant complementary measures can be agreed across the EU or will they inevitably be restricted to individual member states?
- How important is market transparency in the design of complementary measures and is it necessarily easier to deliver this with pan-EU instruments than with those determined at member state level?
- Does member state freedom to introduce national measures enhance or undermine the stability and ambition of political agreements?

1.0 Introduction

The core objective of climate policy is to ensure that global economies decarbonise over timescales that reduce the risks of damaging effects from climate change to acceptable levels. The effects of climate change cannot be isolated within certain countries or regions. It is a global phenomenon that has, and will, require challenging levels of international co-operation. The extent to which individual country actions on climate policy are co-ordinated will depend heavily on international politics and the negotiations that establish multi-national frameworks within which specific policy measures can operate. Climate diplomacy will be an on-going challenge and any consideration of the policy framework cannot, therefore, be taken in isolation of the underlying politics.

Even within the EU, there is incomplete political consensus over the approach that should be taken with regard to a policy framework out the 2030. Different views exist between member states over the extent of the carbon ambition and whether this should be dependent on, or an input to, an international climate agreement in 2015. Some member states are already establishing aggressive carbon reduction targets for 2030 and beyond whilst others are unwilling to commence a discussion on the level of EU ambition ahead of potential international agreements in 2015.

Against this background, the EU Commission is attempting to consider the appropriate form of a climate and energy package beyond 2020 and what might be needed to succeed the current suite of policies. The focus of this paper is the European power sector. The power sector is only one element of the wider European climate policy but it is highly significant since analysis of decarbonisation pathways (see section 2.3) show that early progress in the decarbonisation of the power sector is vital if the overall decarbonisation of the economy is going to proceed within the required timescales. This paper is part of a process that aims to support the Commission's thinking through the development and discussion of some potential high level policy packages.

In order to create a firm basis for this analysis, it is necessary to make some assumptions about the politics that will underpin the policy framework. The following assumptions have been adopted:

1. The EU will agree a firm carbon reduction target for 2030 at around the level of ambition included in the EU Commission 2050 Roadmap (see section 2.3).
2. Some member states may wish to adopt a domestic carbon reduction trajectory and sectoral abatement split on the pathway to 2050 targets that are different from the European average leading to different levels of member state ambition in power sector reductions by 2030.
3. Member states will have different preferences over the energy mix that underpins the overall decarbonisation.
4. All policy packages will involve some combination of carbon pricing and policies to support investments in energy efficiency and generation technologies (see section 4.1)

The political agreements that will be required to establish a climate and energy package within the EU will be multi-dimensional and there are a range of potential packages that will involve varying degrees of policy centralisation at the European level. This paper sets out a number of scenarios that

involve differing degrees of policy centralisation. These scenarios are used to explore different policy packages and the relative merits and risks involved.

2.0 Policy Context

2.1 The policy framework

The European Union has implemented a range of policy measures to reduce greenhouse gas emissions in line with the long term ambition to achieve reductions of 80-95% by 2050 from 1990 levels. Underpinning these measures are the so-called '20-20-20 targets', established by the EU Council in March 2007. These are that the EU should achieve by 2020:

- A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels[1],
- 20% of EU energy consumption to come from renewable resources, and
- A 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency.

These targets were transposed into legislation in June 2009 through the adoption of a Climate and Energy Package. This involved four pieces of complementary legislation:

- A revision and strengthening of the Emissions Trading System (ETS), including the adoption of a single EU-wide cap on emission allowances reducing annually from 2013 to 21% below the 2005 level in 2020, progressive reduction in allocation of free allowances and the expansion of the sectors and gases covered by the system.
- An 'Effort Sharing Decision' governing emissions from sectors not covered by the EU ETS, such as transport, housing, agriculture and waste. Under the decision each member state has agreed to a binding national emissions limitation target for 2020 ranging from an emissions reduction of 20% by some member states to an increase in emissions of 20% by others. These national targets aim to cut the EU's overall emissions from the non-ETS sectors by 10% by 2020 compared with 2005 levels such that, together with the reduction of the ETS, it will accomplish the overall emission reduction goal of the EU Climate and Energy package.
- Binding national targets for renewable energy which collectively aim to lift the average renewable share across the EU to 20% by 2020. The national targets range from a renewables share of 10% in Malta to 49% in Sweden.
- A legal framework to promote the development of carbon capture and storage (CCS) through establishing a network of CCS demonstration plants by 2015.

Although the Climate and Energy Package does create pressure to improve energy efficiency, it does not address it directly. The energy efficiency target does not have binding legal force and, instead, is supported by product standards and an energy efficiency action plan that focuses in particular on

[1] The EU leaders also offered to increase the EU's emissions reduction to 30% on condition that other major emitting countries in both the developed and developing world commit to do their fair share under a global climate agreement.

measures that member states should take to improve energy usage in the buildings and transport sectors. More recently, an Energy Efficiency Directive has been agreed that includes a legal obligation on member states to establish energy efficiency obligation schemes, or equivalent policy measures, which will deliver the required efficiency improvements by 2020.

The ETS lies at the heart of this complex tapestry of measures. It was intended to drive cost-effective reductions in industrial emissions and, thereby, provide some degree of certainty over the extent of overall emission reductions. More significantly, it was hoped that the ETS would stimulate the development of similar schemes elsewhere in the world with which it could be linked to form the basis of a global emissions trading scheme. Indeed, one of the central underlying principles of emissions trading is that all carbon emissions are equivalent, wherever they are produced or by whatever process. There is, therefore, an equivalent benefit from abatement within, or outside of, the EU and the ETS has been designed to include linking mechanisms that promote investment in carbon abatement in other countries.

Despite the conceptual simplicity of a cap and trade system, considerable complexity is required to ensure the policy works effectively. This complexity includes rules to determine permit allocation and auctioning, the monitoring and verification of installation emissions, market oversight, valuing international credits and linking with other schemes, and avoiding carbon leakage. Since the ETS was first established in 2005, the EU has developed considerable experience in addressing these issues and improving operation of the ETS, although it is unlikely that its full potential has yet been achieved given the complex political background within which these developments occur. There are, however, inherent limitations on the role that ETS can play in driving decarbonisation:

1. The ETS by itself is not sufficient to drive the necessary reductions in greenhouse gas emissions. The installations currently in the scheme account for only half of the EU's CO_2 emissions and 40% of its total greenhouse gas emissions and, although there is scope to expand the coverage of the scheme[2], there will remain a significant proportion of emissions not directly capped.
2. Policy makers have not been content to allow the ETS to be the sole policy determinant of operational and investment decisions in those sectors covered by the scheme and a variety of regulations and incentives are in place (e.g. renewable energy targets, efficiency measures), each having a significant impact on the way in which the overall emissions cap is achieved.

This paper considers the choice of instruments needed to drive decarbonisation in the power sector out to 2030 and beyond and, therefore, picks up on the second of these issues. In particular, it considers the role that carbon pricing and other complementary policies could play in creating a policy framework that meets the investment needs of market participants along with the political needs at both member state and EU levels.

Discussion issue: Does the EU experience with ETS tell us all we need to know about the potential

[2] The ETS will be further expanded when airlines join the scheme in 2012 and the petrochemicals, ammonia and aluminium industries join in 2013.

of a cap and trade scheme or could it deliver more in a less constrained political environment?

2.2 Lessons from history

There is much to learn from the design and implementation of policies across Europe and elsewhere over recent years. The ETS is now an established part of the EU power market with emissions allowances being widely traded across a range of forward timescales and the resulting carbon prices forming an integral part of operational and investment decisions. The clear conclusion is that an EU-wide ETS can be made to work and other similar schemes are beginning to emerge elsewhere in the world.

This is in contrast to the various attempts to introduce pan-European energy or carbon taxation where proposals from the Commission have been vehemently opposed by some member states on the basis of subsidiarity or industrial policy grounds. Existing EU tax legislation does set minimum tax levels and the Commission is currently adjusting these levels to more correctly reflect the carbon content of different energy sources. However, these proposals apply only to those sectors not covered by the ETS thereby reinforcing the centrality of the cap and trade mechanism in the power sector. Energy and carbon taxation instruments are applied variously at member state level, notably in Scandinavia, the Netherlands and Germany. More recently, the UK has decided to implement a tax on fuels with the aim of effectively introducing a floor to the carbon price. This new tax is due to be introduced from 2013.

The ETS has, therefore, emerged as the key policy instrument driving decarbonisation in the power sector and, when the carbon price has been sufficiently high, has proved effective in reducing the output from higher carbon emitting plant in favour of lower carbon alternatives that have already been built. This has been particularly significant in achieving decarbonisation targets in countries that have the opportunity to switch between coal-fired and gas-fired power plant. There is also some evidence that the carbon price has proved important for investors considering upgrades to existing power plant that will improve efficiency. However, carbon pricing in itself has proved less successful in driving significant levels of investment in new low carbon assets given that investors need to take a view on the level of carbon prices far into the future. This problem arises for a number of reasons:

1. The carbon cap and, therefore, the resulting carbon prices, are administered by politicians and subject to on-going adjustment as political circumstances dictate. In addition, there is significant political risk of overlapping policy measures that affect the scarcity of permits, such as biomass accountability rules, measures to promote electrification of other energy sectors or measures to improve efficiency in electricity usage. Investors require a high level of confidence in the future of these prices over many years and, sometimes, over several decades since they are vital in delivering project returns. The long term value of the carbon therefore tends to be discounted in an investment appraisal as a result of the risk of future policy change.

2. The adoption of stretching decarbonisation targets means that it will be necessary to deploy technologies that are relatively immature and it would require an extremely high carbon price to deliver returns on such projects. The level of carbon prices required to incentivise such investments, if applied across the whole market, would lead to significant increases in energy prices for consumers and industry, as well as windfall profits for cheaper low carbon plant. These distributional effects are generally regarded as unsustainable from a political perspective.

3. As the power system progressively decarbonises, the proportion of the time in which carbon emitting plant will be operating will progressively decrease[3]. This will, therefore, decrease the proportion of time in which the carbon price will feed into the power price, potentially leading to extremely volatile prices and increased future earnings risk.

Discussion issue: Is it generally accepted the ETS has failed to drive investment and, if so, why?

Policy makers have, therefore, widely adopted additional mechanisms to encourage investment in low carbon emitting plant. This usually involves establishing a fixed price, or fixed price premium, payment for such plant, or through establishing an obligation on electricity suppliers to purchase a proportion of their electricity from particular low carbon sources. Indeed, these so-called feed-in-tariff or quota schemes are now a common feature of power markets around the world, often as the sole driver of decarbonisation. There is, therefore, extensive experience in the operation of such schemes with the need for political consistency in setting subsidy levels sitting at the heart of established best practise. However, existing policy mechanisms have generally been designed to drive early stage deployment of low carbon technologies and the applicability, or requirement for, such policy support mechanisms in power systems dominated by low carbon generation remains an open question. Also, support mechanisms and targets tend to be at a member state level and the scope for delivering ambition more cost-effectively through an EU-wide approach has not been tested[4].

Discussion issues: Should complementary measures be restricted to the support of early stage technologies or are they required more generally to support investment? What issues/opportunities might arise with EU-wide complementary measures as opposed to those deployed by individual member states?

[3] This will depend on the extend of the grid build-out and the analysis of Power Perspectives 2030 suggests that it is possible to envisage the development of a grid infrastructure that maintains fossil plant at the margin virtually all the time out to 2030 and beyond.
[4] The renewables target is an EU level regulation whilst the mechanisms to deliver the target are set by each member state.

Whilst there is little dispute that the policy framework should enable energy to be consumed efficiently, there is little evidence that this is happening. Many consumers continue to use, and pay for, energy that could be cost-effectively avoided through making a variety of investments in energy appliances and the built infrastructure. This suggests that a carbon pricing regime is, by itself, an insufficient mechanism to drive the efficient consumption of electricity. However, policy makers have been reluctant to adopt similar measure on the demand side of the market to those on the supply side. For example, there is no focus on implementing support mechanisms that drive early stage deployment of technologies to improve energy efficiency. This reticence is due to a number of factors:

1. There remains a dispute over the extent to which energy efficiency translates to demand reduction given the ability of consumers to increase energy consumption with the money saved through energy efficiency (the rebound effect).
2. It can be difficult to measure, monitor and verify the impact of energy efficiency measures given that consumers will increase or decrease consumption over time for various unrelated reasons.
3. Policy makers are unwilling to pay for actions that consumers may well have taken anyway, without policy intervention.
4. The demand side of the market is much more complicated, poorly understood and less amenable to simply analysis than the supply side of the market. The energy industry has been dominated by a 'predict and provide' mind-set and it would take significant effort to overturn this entrenched approach.

Discussion issue: Are complementary measures to support the efficient use of energy an inevitable part of the policy framework?

Nevertheless, the EU does now require member states to implement energy efficiency delivery policies and numerous approaches have been developed and implemented at national level. Although the details and relative merits of such schemes go beyond the scope of this paper, it is important to note the interactions with those policy measures designed to decarbonise the power sector. In particular, the level of overall demand has an extremely significant impact on the costs of decarbonisation and the level of carbon price. Recent events have illustrated that the value of the carbon price can fall well below anticipated levels as a result of recessionary effects supressing demand. The converse would also be true and failure to deliver anticipated demand reduction could lead to very high, and possibly unsustainable, carbon prices. Therefore, uncertainty in the level of demand creates significant supply side risks and effective action to reduce demand (or offset the increases arising from electrification of other sectors) can be considered as an important tool in risk managing delivery of a decarbonised power sector.

2.3 Future challenges

Although there is much to learn from experience with the current policy framework, the power market is likely to change significantly over the next two decades and these changes have been

explored in a variety of 'roadmaps', including one produced by the Commission. There are relatively few direct take-aways from the roadmaps relating to carbon pricing and complementary policies. For example, 'Roadmap 2050' produced by the European Climate Foundation and the 'Energy Revolution' produced by Greenpeace, both in 2010, assume a value for carbon as an input parameter to the analysis. The Energy Roadmap 2050 produced by the Commission in 2011, along with Eurelectric's 'Power Choices' from 2009, calculate a carbon price as the output of an optimisation by the PRIMES model which calculates the least cost way to achieve an overall carbon cap. None of these analysis attempt to model the investment decision process and, therefore, provide little insight into the potential roles of different carbon pricing and complementary measure policy options.

Perhaps the most significant conclusion from the various roadmap analyses is that, despite there being a range of technically and economically viable routes to decarbonisation, none of these appear likely to be achieved through the current policy framework. In future, the decarbonisation of the power system will increasingly require the replacement of existing high carbon assets with new low carbon assets since it will no longer be possible to achieve the level of decarbonisation required through the switching of generation between existing higher and lower carbon emitting assets. This, in turn, will mean that low carbon sources of generation will no longer form a minor part of the market that can be allowed to operate outside the core market rules. Instead, low carbon sources of generation will increase substantially and, by 2030, can be expected to produce the majority of EU power[5]. Indeed, overall levels of investment required in low carbon generation will be very high[6] and attracting sufficient volumes of low cost finance will be an increasing challenge.

Discussion issue: What are the key changes that are likely to arise in the market after 2020 that will affect the nature of the climate and energy policy package?

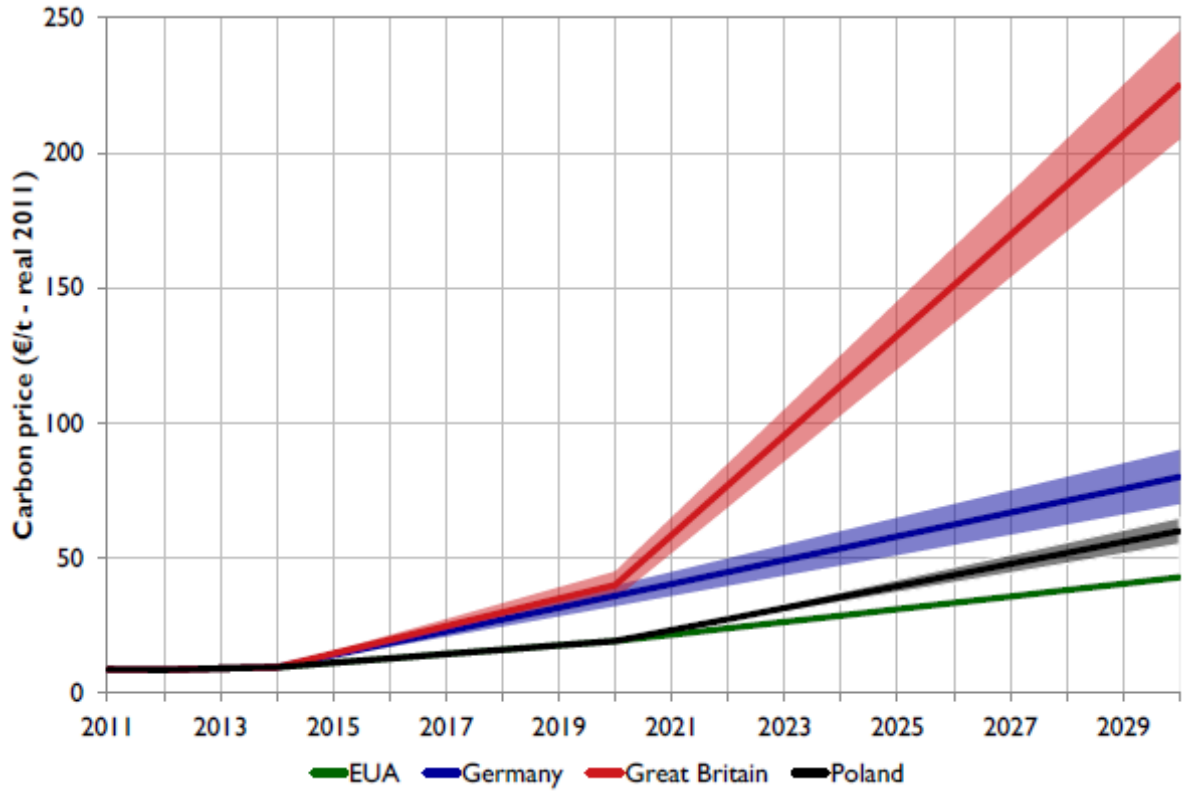
Alongside the pan-European roadmap studies, various member states have undertaken forward analysis of their national power systems or implemented energy strategies to meet national policy goals. A striking feature of these national policies is the inconsistency relating to the carbon prices that would be required to deliver these national policies and targets. E3G has recently undertaken a study with consultant Redpoint that investigates the price of carbon that would be necessary to deliver the national energy targets and strategies in UK, Germany and Poland[7]. The following chart shows that these carbon prices are not only different from each other but are higher than the projected carbon price in the EU Commissions Roadmap. This confirms that policy-makers across Europe are still some way from defining an appropriate set of internally consistent policy measures

[5] The EU Commission 2050 Roadmap suggested that between 50% and 60% of EU power would be produced from renewable sources by 2030.

[6] Around €1,000bn of investment will be required in new generation according to the Power Perspectives 2030 analysis.

[7] UK: Committee for Climate Change analysis underpinning national carbon budgets approved Spring 2012; Germany: 2011A scenario from the Leitstudie 2011 prepared by DLR, Frauenhofer IWES and IFnE for the German Federal Ministry for the Environment (BMU); Poland: updated modelling for the Polish Energy Strategy 2030 by Agencja Rynku Energii S.A., completed in September 2011

that will deliver the required decarbonisation and tend to be focused on the national situation rather than the broader EU-wide context.



Source: E3G/Repoint analysis - unpublished

Discussion issue: Can member states sustain different aspirations for the rate at which the power sector decarbonises?

Investors will be seeking a policy framework that is stable and consistent and allows them to plan and develop investment projects with confidence. The perception of high project risks will increase financing costs and potentially restrict the pool of investors prepared to commit finance to the market. However, policy-makers themselves face considerable uncertainty and there is no guaranteed route towards a least cost decarbonisation of the power sector that can be translated into a definitive set of policy targets and mechanisms. Instead, it is necessary for policy-makers to seek to risk manage delivery of policy objectives in the face of significant uncertainties. The key uncertainties that the policies need to manage are:

1. The ability to deploy low carbon technologies at scale
2. The relative costs of low carbon technologies
3. The potential emergence of new low cost technologies
4. The extent of electrification of other energy sectors
5. The impact of energy efficiency measures on electricity demand

6. The scope to achieve early decarbonisation in other sectors

Discussion issue: How far should policy makers seek to provide future price certainty to encourage investment?

The scenarios set out in this paper explore the options for a new climate and energy package such that the balance between the potentially conflicting needs of investors and policy makers and of EU and member state interests can be explored.

3.0 Required functions of climate policy

3.1 Delivering climate and energy policy objectives

The top level requirement of climate policies is that they create the lowest additional costs to society throughout the transition to a decarbonised economy, where the timescales of the transition are informed by climate science. A recent report by the IEA[8] elaborates what is meant by this 'lowest cost' objective and concludes that it involves three direct effects:

- The policies bring forward abatement actions broadly and evenly across different sectors of the economy (delivering static efficiency). If cheap opportunities are neglected in some sectors, more expensive actions will be needed elsewhere, increasing the total economy-wide cost of emission reductions.
- They encourage innovation and diffusion of clean technologies in order to lower future abatement costs (delivering dynamic efficiency).
- They cope effectively with uncertainties. It is not possible to predict accurately all abatement opportunities or how their costs will change and policies require built-in flexibility that allows them to find the lowest-cost mix of abatement options.

In addition to direct implementation costs, there may be significant impacts on the economy as a whole, e.g. through the rise of energy prices and economic benefits from the recycling of revenues from carbon pricing policies. These macro-economic effects can be large and could influence the choice and design of mitigation options pursued.

However, it is a series of subsidiary policy requirements that have often emerged as important factors in determining the optimum policy design and the effective delivery of climate and energy objectives. These subsidiary requirements are:

- Prevent 'lock-in' of high emission infrastructure
- Overcome barriers to finance
- Minimise costs to consumers

[8] Summing up the parts, Combining Policy Instruments for Least-Cost Climate Mitigation Strategies, Christina Hood, IEA, 2011

- Compensate for policy uncertainty or, at least, the perception of policy uncertainty
- Integrate policy package with wider policy priorities (e.g. the growth agenda)
- Improve political acceptability.
- Create conditions conducive to establishing binding international climate agreements

Notwithstanding the importance of these subsidiary objectives, the most tractable approach to policy design, and that recommended by the IEA in their report, is to develop the policy package with the primary objective of delivering the 'least cost' requirement. Delivery of the subsidiary requirements can then be considered through perturbations of this core policy package.

Discussion issue: Is 'least cost' the primary objective or are other requirements now more important?

3.2 Balancing EU and Member State interests

Designing a policy package to meet this complex array of requirements is daunting enough within the context of a single homogenous jurisdiction. However, policy development within the EU is complicated by the different national energy systems and policy agendas along with the way they interact. In particular, member states are unlikely to have the same asset replacement cycles and, therefore, the opportunities to cost effectively decarbonise the power sector may arise at different times on the pathway out to 2050. A single carbon reduction target for the trading sector will not be able to cope with this subtlety and may incentivise some member states to forego early abatement opportunities when high carbon assets come to the end of their operating life, whilst others may be forced to write-off relatively new assets. Moreover, the suite of subsidiary policy requirements may be very different between member states leading, amongst other things, to different views on the preferred technology mix and the extent to which this should be determined by Government or left to market forces to decide.

Therefore, an appropriate EU package of climate policies potentially needs to accommodate member states decarbonising the power sector at different rates and employing different energy mixes. Moreover, it is important that the policy package does not force or incentivise member states to adopt sub-optimal paths towards decarbonisation. In particular, member states should not be penalised for adopting a faster decarbonisation pathway and those member states adopting a slower power sector transition must demonstrate that this reflects a cost-effective strategy as opposed to an attempt to gain relative economic advantage through delaying decarbonisation.

Discussion issue: Is it possible to develop a climate package that prevents member states 'free-riding' and dragging ambition down to the 'lowest common denominator'?

An underlying assumption of this paper is that the EU adopts decarbonisation targets out to 2030, these reflect the overall rate of progress consistent with meeting 2050 goals and, therefore, they are endorsed by all member states. However, this does not mean that all member states are treated identically and one of the major challenges in the design of a policy package is that it accommodates a diverse set of national policy requirements.

3.3 Deficiencies in 20-20-20 approach going forward

Much has changed since the 20-20-20 targets were agreed in 2007, in particular with regard to the economic situation and the broader political environment. However, these changes do not necessarily mean that the structure of the existing climate policy package is inappropriate going forward since, at the highest level, the same 'least cost' requirement remains valid. There are, nevertheless, significant changes in the nature of the challenge associated with meeting both this and the subsidiary requirements that make the previous approach deficient. The following changes are most significant in considering a new policy package:

- It will no longer be possible to achieve the required reductions in carbon emissions solely through the early stage deployment of renewables and switching between coal and gas-fired generation. Instead, in many member states, it will be necessary to deploy at scale substantial new sources of low carbon generation that tend to have higher delivery risks than more traditional technologies. This significantly increases the uncertainties associated with the rate and costs of power sector decarbonisation and the policy mechanisms must demonstrate an effective management of these delivery risks.
- The scale of new finance required is enormous. This comes at a time of high future uncertainty and when investors are particularly cautious about committing to risky investments. Attracting sufficient, and efficiently priced, investment is, therefore, a major challenge.
- Few, if any, of the low carbon technology options can be considered as mature or to have reached their ultimate cost potential. There will, therefore, be innovation and diffusion considerations that are relevant to a large proportion of the required investments.
- Energy efficiency will be critical and policy makers cannot afford to continue with demand side policies that are only partially effective.
- With the need for increasingly deep cuts in emissions, differences in the preferred approach between member states will become more significant and accommodating this diversity, whilst maintaining the incentives that support the common interest, is likely to be a key dimension of the new package.

The evolving set of requirements makes it impossible to simply roll-over the current climate and energy policy package with appropriately enhanced targets. Instead, it is necessary to develop new policy options that are focused on delivering this new set of requirements.

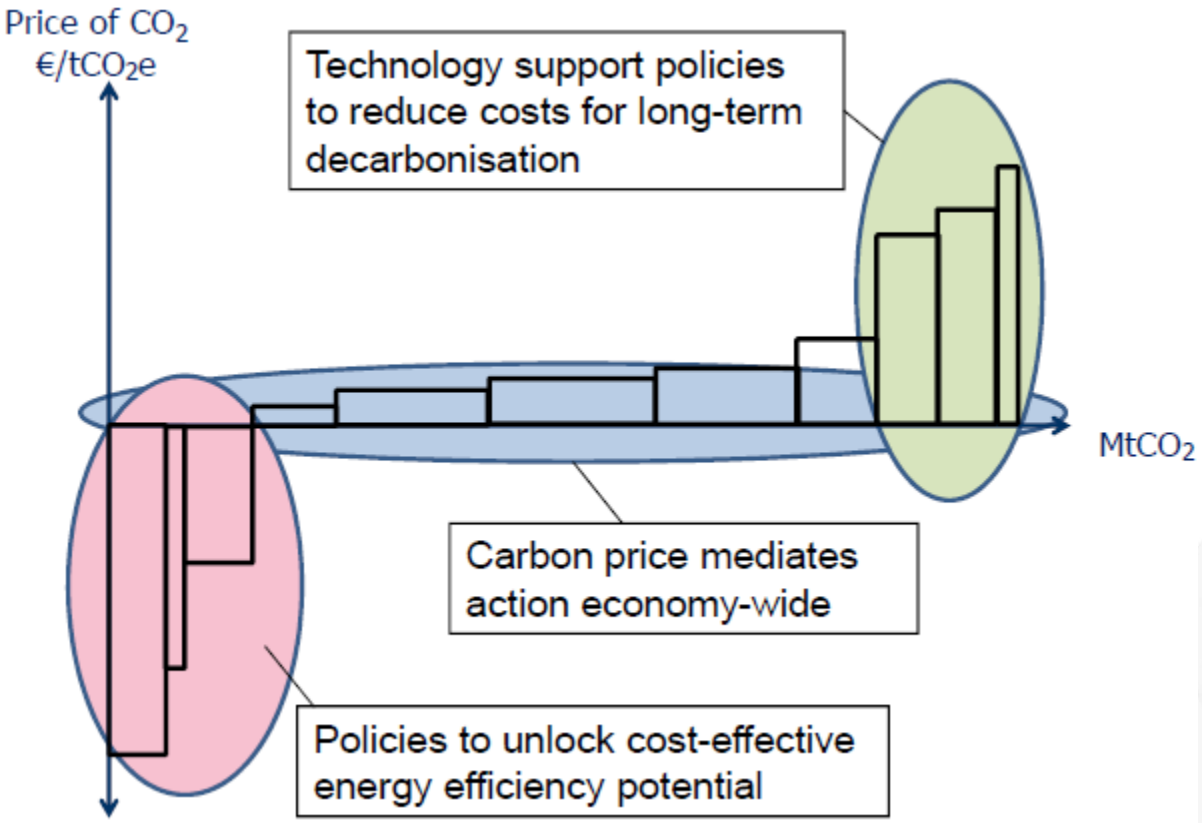
Discussion issue: Is it accepted that the 20-20-20 package cannot simply be continued with appropriately revised numbers?

4.0 Policy and political options

There is potentially a huge number of ways that a climate and energy package can be constructed. At a detailed level, the choice of policy packages is bewildering and a higher level distillation of the options is required before any of the more detailed issues can be considered. This section therefore sets out only the highest level choices for further evaluation.

4.1 Policy options

The IEA 'Summing up the parts' report concludes that three core policy elements are required to meet the 'lowest cost' requirement as illustrated in the following diagram:



It is, therefore, proposed that starting point for developing policy packages is to assume that they must include each of these three elements: carbon pricing, measures to promote efficiency and measures to drive innovation and diffusion in early stage technologies.

Within this high level framework, it is necessary to consider some of the significant choices involved in the design of carbon pricing regimes and complementary measures. The high level choices for carbon pricing are:

- Volume driven – cap and trade
- Price drive – tax
- Hybrid – cap and trade system with adjustments to constrain carbon price (e.g. floor and/or ceiling prices).

Much experience has been gained in the design of complementary measures and these are the subject of significant on-going debate. However, the key high level choices relate to which technologies or measures should be supported and how much of each is required. These important choices are summarised below:

- Primary choice - what to support:
  - Energy efficiency measures and generation technologies in early stage of development
  - Energy efficiency measures and deployment of all low carbon generation technologies
  - Energy efficiency measures and all new build generation
- Secondary choices:
  - How much to support:
    - Targets based on measures deployed (MW or MWhrs)
    - Targets based on cost of support
  - Extent of competition between technologies:
    - Single technology (e.g. offshore wind)
    - Groups of technologies (e.g. low carbon generation, renewables, etc.)

4.2 Political options

There are a number of important design choices that arise as a consequence of different aspects of the policy framework being determined at EU and member state levels, particularly where member states may be targeting domestic carbon reduction levels in the power sector that are above those for Europe as a whole. In these circumstances, the EU members would need to decide whether to adjust the overall EU ambition, such that the remaining member states continue to meet the intended overall EU trajectory, or simply stick to the original target. The first of these would require foresight of individual member state targets such that a judgement can be made about the extent of any adjustment to the overall cap or, potentially, the ability to reduce the overall cap retrospectively where member states introduce high ambition targets after the cap has been set.

It is proposed that the interactions between EU and member state level policies are explored using the following five high level scenarios:

1. *EU only:* Carbon pricing and complementary measures are all pan-European
2. *EU focused:* Carbon pricing and most complementary measures are set at EU level but some complementary measures can be implemented by member states
3. *EU carbon:* Carbon pricing policies are set at EU level whilst complementary measures are determined by member states
4. *Member state focused:* The EU sets a basic carbon caps but member states are free to implement their own carbon pricing and complementary mechanism regimes
5. *Complex:* Different aspects of both carbon pricing mechanisms and complementary measures are established at both EU and member state levels.

5.0 Evaluation of design choices

The requirements outlined in Section 3 are grouped into 'primary requirements' – those necessary to meet the least cost objective – and 'subsidiary requirements'. This section considers how effectively the design choices set out in the previous section deliver these requirements and draws out the key trade-offs involved.

5.1 Carbon pricing

There is an extensive academic literature that discusses the relative merits of taxation versus cap and trade schemes[9]. In essence, the major advantage of a carbon tax is that it avoids the risk of prices that create very high short term costs to consumers for negligible environmental benefit whilst the key advantage of a cap and trade scheme is that it can guarantee emissions will remain within prescribed limits, as determined by policy-makers, and do so at least cost. Various authors have considered hybrid schemes, involving measures to constrain price within a trading framework, to explore if they can deliver the best of both worlds[10]. These arguments relate to the 'static efficiency' objective and the widely perceived inability of carbon pricing schemes (tax or cap and trade) alone to drive the development and commercialisation of new technologies (the 'dynamic efficiency' objective) has been the key arguments for the inclusion of complementary measures. The final 'least cost objective' relates to coping with uncertainty and, to the extent that the carbon pricing mechanism provides clear signals over investment timescales, independent investors should be making technological decisions in light of the uncertainties ahead. However, this requires that they have full knowledge of Government plans relating to complementary and other policies that will affect future market volume or price.

There is, therefore, little to choose between the principal carbon pricing options with respect to the 'least cost' objective and the subsidiary requirements are potentially more significant. In particular, the relative impact on financing investments is particularly important given the extent of the challenge. It is often argued that a fixed carbon price (tax) is more attractive to investors than the uncertain price emerging from a cap and trade scheme. However, it is likely that the perceived policy uncertainty of either approach would be the dominant factor for investors and this in turn will be driven by perceived long term political acceptability of the scheme. Consumer costs and tax or permit sales receipts are critical in this regard. Tax schemes guarantee future revenue for treasuries but potentially expose consumers to higher costs than required and risk missing carbon reduction targets. Cap and trade schemes allow consumers to take advantage of changes that reduce costs but provide uncertain earnings for treasuries and have the risk of very high or low prices that may trigger political intervention. This suggests that tax-based schemes are, on balance, potentially more attractive for investors.

[9] The following web page provides a useful summary of the issues: http://www.env-econ.net/carbon_tax_vs_capandtrade.html

[10] Cap-and-trade properties under different hybrid scheme designs, Georg Grüll and Luca Taschini, September 2010, Centre for Climate Change Economics and Policy Working Paper No. 35, Grantham Research Institute on Climate Change and the Environment Working Paper No. 26

The key advantage of cap and trade schemes is that it is possible to integrate trading over a wide geographical area. This has the potential to significantly reduce the costs of decarbonisation and recognises the principle that the environmental impact arising from carbon emissions is equivalent, regardless of the location from which it has arisen. In addition, cap and trade schemes that have broad geographical reach are likely to be governed by a more rigid set of rules and are less amenable to 'knee-jerk' political reactions by a single jurisdiction.

These considerations suggest that cap and trade schemes work best at broad geographical levels whilst tax schemes are more appropriate within individual countries and where there are particular investment challenges.

Discussion issue: Do cap and trade schemes work best across broader geographical areas whilst tax systems are more appropriate within individual countries?

5.2 Complementary mechanisms

Complementary mechanisms are introduced to improve both static efficiency, by addressing market failures that prevent the take-up of cost-effective measures, and dynamic efficiency, through the subsidisation of immature technologies with the potential to be cost-effective in the future. Also, the commercialisation of a range of promising technologies can help to manage future uncertainties by creating options for alternative technology pathways.

At one extreme, these measures could be focused on supporting energy efficiency investments to help particularly vulnerable customers along with targeted support for early stage demonstration of promising technologies. This approach would results in fairly restricted use of complementary measures. However, experience with renewables and energy efficiency deployment has suggested that much wider use of measures might be appropriate given the endemic barriers to the take-up of efficiency measures and generation technologies can take a considerable time to reach their least cost potential. Indeed, there is an argument that all low carbon technologies (renewables, CCS and nuclear) will require support for the foreseeable future with only limited exceptions.

At the other extreme, there are increasing suggestions that the future of the electricity market is so uncertain that all investments that are necessary to maintain the power system on the correct decarbonisation pathway require support in order that they can be financed. This debate is increasingly relevant for the significant investments in new gas-fired capacity that might be required and is often characterised by calls to introduce fixed payments for providing capacity[11].

As the scope of complementary measures increases, they will begin to swamp the static efficiency benefits delivered through carbon pricing mechanisms such that these only become relevant for operational decisions. Indeed, there is the possibility of a vicious cycle of 'policy cannibalism' whereby the increased use of complementary measures reduces the carbon price under ETS and this, in turn, further increases the requirement for complementary measures. This loss of efficiency

[11] This issue will be addressed in more detail in the third workshop on market design.

is only warranted if it is outweighed by overcoming the failures in the consumer and financial markets, increases in dynamic efficiency and the management of uncertainty through creating alternative technology options. Moreover, there is a risk that policy makers will 'lock-in' a significant proportion of the energy mix for a considerable period of time, and this will actually undermine the management of uncertainty since it will limit the potential to take advantage of unforeseen innovations that create alternative cheaper decarbonisation options.

Discussion issue: Is it inevitable that 'policy cannibalism' will arise between complementary measures and carbon pricing or can measures be designed that are mutually reinforcing?

Complementary measures require that a group of technologies or measures is identified for support, a target is defined for the amount of support to be deployed and a delivery body is identified to make sure the target is met. There are also many important decisions relating to the detailed nature of the support mechanisms that go beyond the scope of this paper. However, one critical factor in reducing the efficiency penalty, involves the extent of competition between technologies and the providers of technologies. A very narrowly defined group of technologies coupled with an ambitious target can significantly restrict the numbers of potential providers and levels of competitive intensity, leading to higher levels of subsidy than necessary[12]. Alternatively, a broad group of technologies, where there is more supply capacity than required, should lead to reduced subsidy levels and support might even be allocated via a competitive auction process.

In summary, the use of complementary measures is becoming an increasingly important vehicle in the delivery of carbon reduction targets, although these can create significant risks for consumer costs and, therefore, political acceptability. They require targets to be defined that are long-term and credible such that they create investor certainty and support decarbonisation objectives, whilst promoting supply chain efficiency through competition in provision and allowing flexibility to adapt to evolving situations. The significant impact that these measures can have on consumer costs makes them highly political and difficult to agree across different countries. However, the broader the geographical scope of the scheme, the more the opportunities to minimise the costs of delivering the targets.

Discussion issue: Is it credible that significant complementary measures can be agreed across the EU or will they inevitably be restricted to individual member states?

5.3 Interaction between EU and member state targets

The static efficiency that results from a pan-European carbon pricing scheme arises from market participants being able to confidently forecast future carbon prices on the basis of fundamental

[12] The current situation in the UK is an extreme example where the Government wishes to commence construction of new nuclear power plant and there is only one credible provider.

information that is equally available to all market participants. Where a carbon tax is employed, this forecasting risk is, in large part, transferred to customers or society as a whole, since it is Governments that need to assess whether the prescribed level of tax will deliver the required carbon abatement. Under a cap and trade scheme, the extent of the complementary measures implemented by member states, and the success in their delivery, will significantly affect the future supply and demand balance for emission permits. Where these measures are driven by member state Governments it may be very difficult for market participants to take a view on what the measure might be or the impact they will have on future carbon prices. This suggests there are efficiency arguments to support complementary measures being driven centrally, given the potential improvement in market transparency.

Discussion issue: How important is market transparency in the design of complementary measures and is it necessarily easier to deliver this with pan-EU instruments than with those determined at member state level?

However, member states may wish to implement their own complementary policies to promote domestic deployment of particular technologies, either for resource security or industrial development reasons, and, therefore, may not want to be tied into pan-European schemes. This freedom for member states may, therefore, represent and important factor for the political acceptability of the overall climate package.

Moreover, some member states may wish to decarbonise their power sector at a faster rate than the EU as a whole through the use of domestic targets[13] and this situation is more likely to be sustainable where any additional effort is not be cancelled out through the 'zero-sum-game' arithmetic of the cap and trade scheme. Encouraging high ambition is important for the political sustainability of the EU climate package and, in consequence, for the success of the broader international climate process. This requires the EU to be able to adjust the overall cap to compensate for the higher targets. Apart for the political advantages for climate diplomacy, this may improve the confidence of investors in forecasting carbon prices and, thereby, contribute to the static efficiency objective.

Whilst there are potential advantages from a 'least cost' perspective in centralising schemes at a European level, the political acceptability of an ambitious climate package may be significantly enhanced where member states implement their own carbon pricing or complementary measures to augment those at EU level. In these circumstances, the interactions between EU and member state level measures can have a critical impact on the effectiveness of the overall policy package.

Discussion issue: Does member state freedom to introduce national measures enhance or undermine the stability and ambition of political agreements?

[13] It is likely that member states will not only be motivated by climate policy considerations since domestic carbon pricing schemes can deliver significant revenues to Government treasuries.

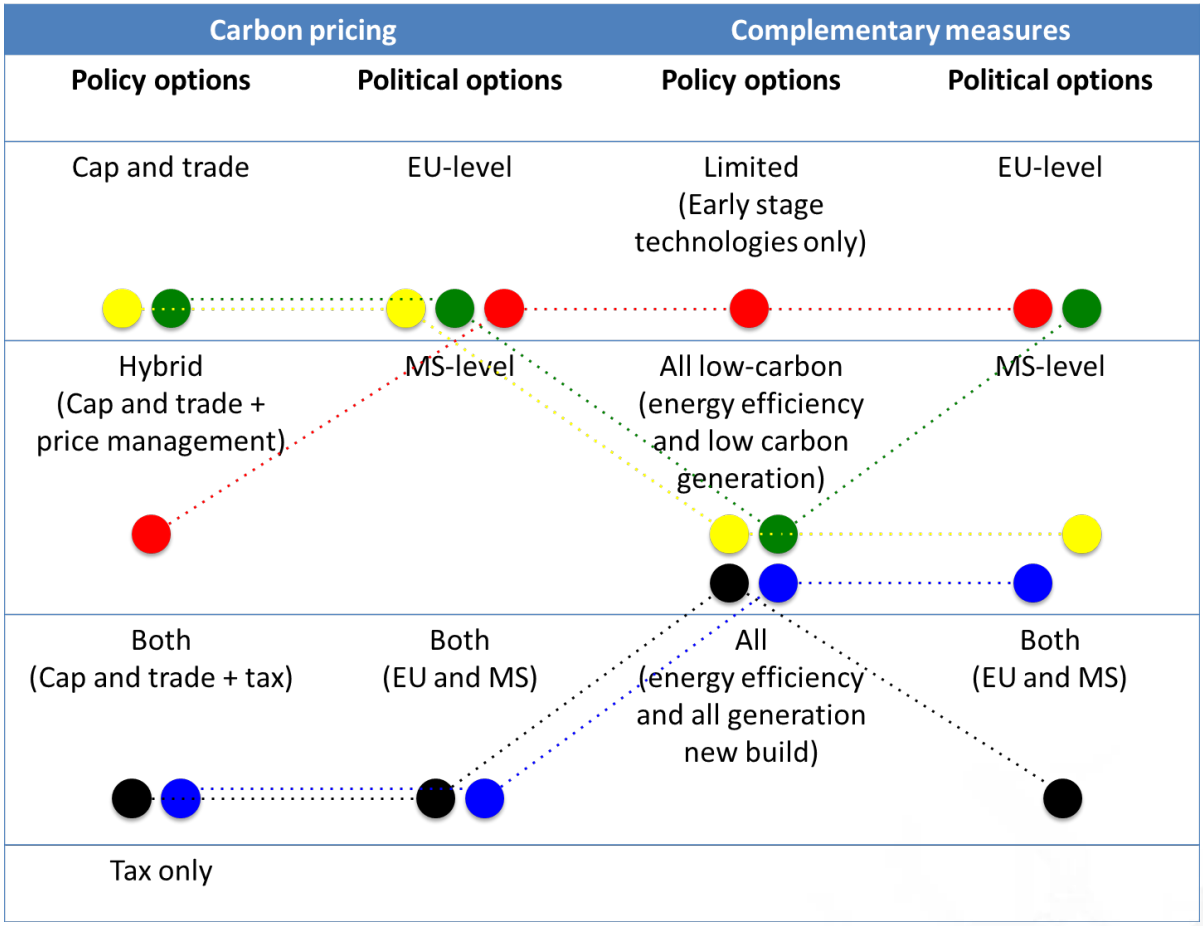
6.0 Potential policy packages

On the basis of thez discussion in the previous sections, it is possible to identify a number of scenarios of plausible EU climate policy packages. Each of these packages is based on different levels of centralisation of the policy mechanisms which, in turn, requires different level of agreement between member states. The packages proposed for analysis do not include all the potential combinations of policy and political options. For example, an EU-wide carbon tax is not included since it is considered an extremely unlikely scenario, whilst, although quite likely, complementary measures that incentivise all generation investments have not been included since this is an issue that relates more to market design than climate policy and will be considered in the third workshop.

It is not possible to argue that one package is necessarily better than the others on the basis of purely technical grounds since the viability of each of the packages will depend critically upon the political circumstance across the EU. However, analysis of these packages should help to reveal a better understanding of the trade-offs involved. The five hypothetical packages considered are summarised in the following table:

Package	Carbon Pricing	Complementary Measures
1. EU only	Hybrid EU level cap and trade scheme with price caps and floors to support investment	EU level schemes to promote leading edge technologies and energy efficiency in certain disadvantaged market segments
2. EU focused	Pure EU level cap and trade scheme	Broad ranging EU level schemes to support renewables and energy efficiency. Opt-outs available for member states on basis of equivalent action with alternative technologies.
3. EU carbon	Pure EU level cap and trade scheme	All complementary measures designed at member state level to support delivery of overall carbon cap
4.Member state focused	EU level cap and trade scheme with rules to reduce cap in line with reductions planned in high ambition states. Certain member states have their own carbon tax regimes.	All complementary measures designed at member state level to support delivery of carbon cap (domestic or EU-wide).
5. Complex	EU level cap and trade scheme with rules to reduce cap in line with reductions planned in high ambition states. Certain member states have their own carbon tax regimes.	Broad ranging EU level schemes to support renewables with opt-outs available for member states on basis of equivalent action with alternative technologies. Variety of measures designed and implemented at member state level.

These packages are also illustrated in the following table that sets out the policy and political options:



EU only	
EU focused	
EU carbon	
Member state focused	
Complex	

6.1 EU only

The purest policy package involves only pan-EU carbon pricing and complementary measures and would arise where there is close alignment across all member states in terms of the policy objectives and the value of EU-wide co-operation in delivering least cost outcomes. This package would be largely based on a cap and trade scheme that would involve price caps and floors to improve confidence in the future carbon price for investors and help political acceptability within member states. Complementary measures would be restricted to a pan-EU scheme to promote energy efficiency investments in certain prescribed situations (e.g. vulnerable customers) and a targeted support of emerging technologies (e.g. CCS demonstration, marine renewables) to avoid significantly distorting the energy mix.

The success of this package would depend critically on investor confidence in the long term integrity of the carbon price signal. This would result in investors (on both the supply and demand side of the market) developing a range of technologies that would effectively deliver a robustness to future uncertainty and a degree of dynamic efficiency. The key risk with this package is that it would not support a sufficient range of investments or, if it does support investment, then these would be focused on a limited number of 'winning' technologies (e.g. unabated CCGTs) that would reduce dynamic efficiency and robustness to future uncertainty. In addition, such a package may not support the political conditions for sufficiently ambitious targets with discussions being settled at the 'lowest common denominator'.

6.2 EU focused

In this package, the EU drives a comprehensive set of pan-EU measures. A basic cap and trade scheme is augmented by strong efficiency and broadly-based technology (probably renewables) targets. However, this scenario recognises some significant differences in objectives between member states and, to ensure political acceptability, individual member states would be able to opt-out of a proportion of the technology targets under strictly defined rules that require deployment of alternative technologies (e.g. CCS) that deliver equivalent carbon abatement.

The key challenge for this package would be to gain political acceptance for the pan-European technology targets and the definition of the opt-out arrangements are critical in this regard. Also, the detailed nature of the complementary measures would be extremely important and critical to the success of the package in attracting investment, delivering dynamic efficiency and managing uncertainty. The advantage of a broadly-based scheme is that it would deliver more competitive provision against the risk that it would not encourage a sufficiently broad range of technologies to manage future uncertainty.

6.3 EU carbon

In this package, the responsibility for carbon pricing and complementary measures is split between the EU and member states. In effect, the political agreements would be restricted to the overall carbon trajectory through a cap and trade scheme and member states would have complete freedom to implement those complementary measures deemed necessary to deliver the targets in ways that are deemed most advantageous domestically. It is likely that the complementary measures would involve both energy efficiency schemes and technology support mechanisms that bring forward those investments considered necessary in each country.

The simplicity of this package from an EU perspective would expedite political agreement around science-driven decarbonisation targets. However, it is likely to spawn a significant number of member state specific support arrangements and market reforms. Apart from the risk that it would be difficult to ensure these schemes all give efficient outcomes, there is a risk that many of the wider efficiency benefits of the single energy market will begin to be compromised. In addition, there is less chance that individual member states will support leading edge and high cost technologies that might be required to deliver dynamic efficiency and manage the future uncertainties unless there is a perceived direct industrial benefit.

6.4 Member state driven

In this package, it is assumed that some member states wish to decarbonise at a faster rate than the EU baseline. The role of EU policy would therefore be to establish an underlying carbon trading mechanism that supports member states in their carbon reduction programmes by encouraging those states wishing to decarbonise at a faster rate than the EU average trajectory. An EU cap and trade scheme would be agreed based on a baseline decarbonisation trajectory. Member states wishing to decarbonise at a faster rate through domestic complementary measures and/or carbon tax could apply to have the overall EU cap reduced in line with the expected additional benefit achieved through the domestic measures. As with the 'EU carbon' package, individual member states would implement a range of complementary measures to meet their domestic agenda. However, it is also likely that a number of member states would implement their own additional carbon pricing regimes, probably in the form of a carbon tax.

This package would raise many of the issues in common with the 'EU carbon' package. In addition, it would be more complex to define in advance a process for reducing the overall carbon cap. However, the advantage is that it provides a framework for encouraging high ambition by taking advantage of the different member state situations.

6.5 Complex

The most complicated situation arises where carbon pricing and complementary measures exist at both member state and EU levels. This could be the outcome of an extensive political negotiation in which individual member state issues are addressed through a series of opt-outs and specific national mechanisms. It is most likely that this package would revolve around an EU cap and trade system, again potentially involving rules to adjust the cap in light of certain member states aiming for a higher domestic rate of reductions. There would be an array of member state complementary measures and some carbon pricing regimes. However, in this package, member states will have agreed that some of the technology targets (say, renewables) are best delivered at an EU level such that resources can be efficiently pooled across Europe, although it is likely that such schemes would involve opt-outs for member states wishing to pursue different technology mixes. It is also possible that some targets are agreed at a regional level to expedite the political process.

This would be a complicated package to negotiate but the complexity provides a large number of levers that can be used to aid the negotiation process. There is the strong risk that the efficiency benefits of the various measures may become lost in the negotiation process. In particular, the package may not be well designed to cope with the range of future uncertainties.

7.0 Next Steps

This paper has, by necessity, sought to cover significant ground. A robust climate package beyond 2020 needs to be based on:

1. An understanding of the complex tapestry of requirements that the package is seeking to fulfil,

2. The experience that has been gained with the performance of carbon pricing and complementary policies to-date,
3. The evolving nature of the decarbonisation challenge,
4. The diverse political objectives that exist across member states, and
5. An assessment of how various political and policy scenarios may evolve.

All of these elements are worthy of debate and challenge. The aim is that this discussion will help to identify those aspects of the policy package that are low regret and should be pursued regardless of the state of the political discussion along with those policy options that should be kept open and, where appropriate, deployed as political agreements emerge.

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