Promoting co-operation mechanisms to reach RES targets

RECS Policy Forum | 31 March

INFORMED DECISIONS

COPENHAGEN ECONOMICS

COLOPHON

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Date: 31th March 2011

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EXECUTIVE SUMMARY

The EU and its member states have adopted ambitious long term climate change and energy security policies including the goal to reduce GHG emissions by 2020 by (at least) 20 per cent relative to its 1990 level and together with all developed countries a reduction of 85 to 90 per cent by 2050. This requires a massive roll-out of investments and deployment of low cost carbon technologies. Relying on more energy efficiency alone would entail a drastic reduction of living standards. The EU's directive on renewable energy, setting a target for renewable energy of 20 per cent in 2020, should be seen in this long term perspective. The big question is how? This study has two main and highly linked recommendations:

Strengthening the internal market. While the directive on the renewable energy allows member states to comply jointly with their national renewable energy targets, very few countries have so far shown any inclination to move in that direction. We find that this is a very costly strategy for EU for mainly three reasons. It adds further to the already substantial national compliance costs from complying with renewable energy targets, seriously increase investment risks for firms that operate under 27 constantly changing national support regimes, and finally it deprives EU producers of a strong and large domestic market that can provide a spring board to compete against main competitors in China, US, and other major regions. In practical terms we propose the following main actions:

- **Norway and Sweden** is about to establish a joint support schemes based on so-called Green Certificates to comply jointly with their targets under the renewable energy targets. The two countries have expressed an explicit interest in extending their co-operation to other countries and have the potential to expand relatively low cost production. This initiative could spearhead a more internal market based approach to target compliance, a potential that should be pursued.
- **Expansion of offshore wind** is projected to deliver a substantial part of the increase in renewable electricity production. We find that a voluntary co-operation among the key interested parties – primarily in the North and Baltic Sea – could deliver substantial benefits to energy companies, consumers and tax payers. The key aim of such a co-operation should be that: (1) the location should be based on underlying potential not the generosity of subsides; (2) an improved framework for financing the required offshore related expansion of the grid system.

Shifting over time from subsidies to deployment to support for innovation. A massive reduction in greenhouse gases requires a substantial increase in public support for innovation. EU needs major leaps of technological progress, not just marginal improvements of existing technologies. Hence higher carbon prices need to be supplemented with targeted technology policies. In our view there is though a risk that public support over the coming decade seem to be directed too much towards deployment in large quantities of immature and hence very costly technologies, while more targeted public support for basic and applied research, demonstration projects, is but a fraction of deployment subsidies. This is the wrong order of priorities.

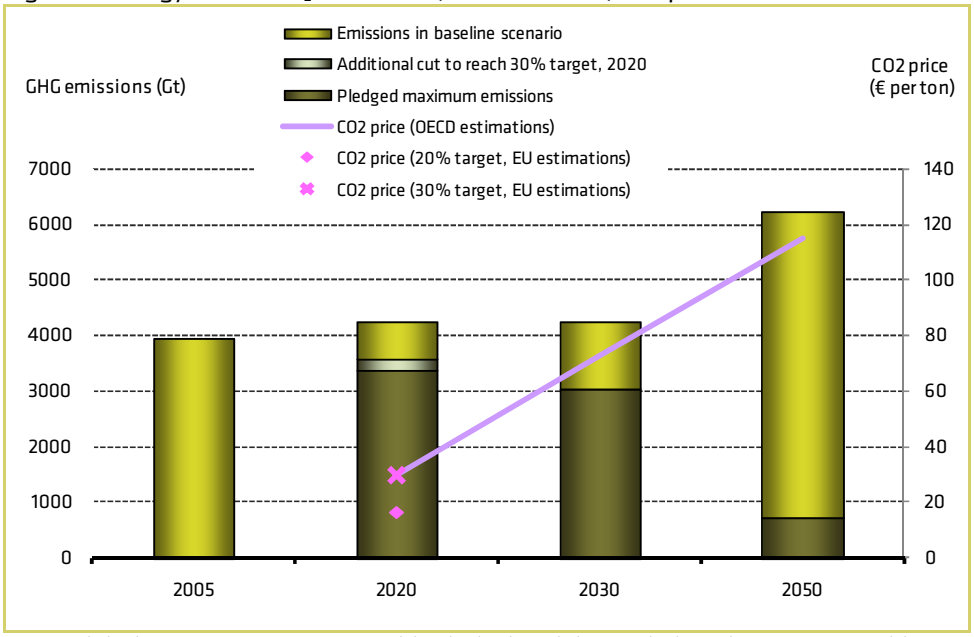
The two recommendations are strongly linked in practice. If member states co-operate on joint compliance, billions of Euros can be saved and used to boost focused innovation policies. The present fiscal crisis in EU in particular suggests the need for such a switch.

Chapter 1 THE BIG PICTURE REQUIREMENTS AND PROBLEMS

EU has committed itself to massive long term reductions in greenhouse gases to address climate change requiring a combination of energy savings and expansion of low/zero carbon energy sources. As recently as February 2011 at the European Council, EU confirmed its target of having GHG (greenhouse gas) emissions reduced by 2050[1] by 80 to 95 per cent relative to 1990. By 2020 the target is to reduce GHG emissions by 20 per cent (or 30 per cent if part of a global effort) while also increasing the share of RES (Renewable Energy Sources) in final energy consumption to 20 per cent[2].

To reach the targets, the EU has pledged to cut energy related greenhouse gas emissions (CO_2) by 20 per cent in 2020 relative to 1990 emissions (down to 3,400 Gt), and by 82 per cent in 2050 (down to 700 Gt), cf. Figure 1.1. Long term cuts in that order will make massive deployment of RES viable as a means to reduce GHG in general and energy related emissions in particular. Such a reduction in energy consumption from fossil fuels will also require a massive increase in carbon prices: from an estimated € 17-30 per ton in 2020 to € 117 per ton in 2050 cf. Figure 1.1.

Figure 1.1 Energy related CO_2 emissions (GHG emissions) and prices in EU



Note: Pledged emissions 2050 is represented by the level needed to reach the 2 degree target, stated but not pledged. Business as usual 2050 is calculated assuming that energy related greenhouse gas emissions will increase as much as all greenhouse gas emissions.

Source: EU Commission (2010), SEC (2010) 650, p 39-45. Capros et al. (2008) p 2. OECD (2009).

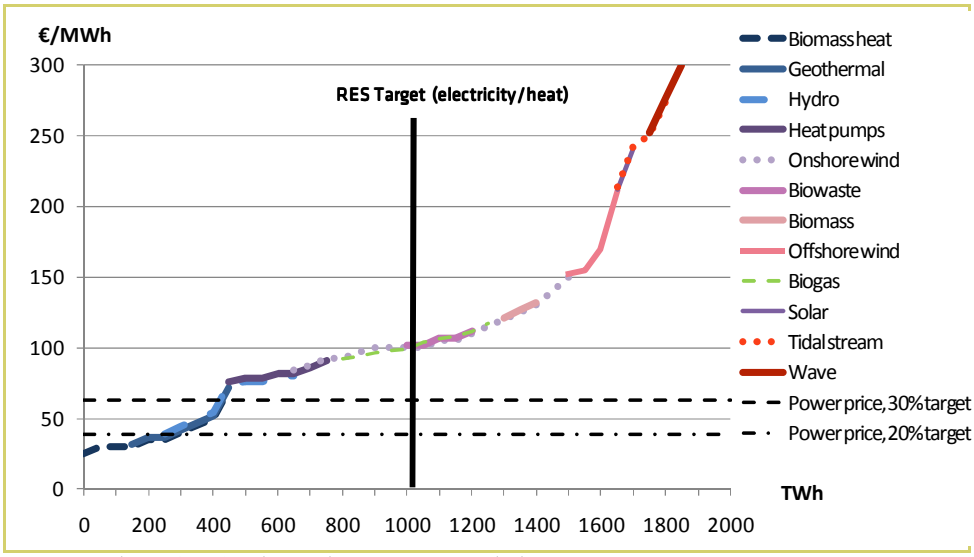
However, the GHG reduction target is far too low to drive up carbon prices consistent with prices needed to reach the 2020 renewable energy target. The power price from coal plants, the most likely alternative to renewable energy, in 2020 is expected to be just below € 40 per

[1] The 2050 objective is a reduction of 80 to 95 per cent by developed countries as a group. The 2020 and 2030 target is for EU specifically.

[2] European Council, Conclusions on Energy, 4 Februray 2011, European Council, Transport, Telecommunications and Energy, *Press release,* 28 Feb 2011, 6950/11

MWh [3] (with GHG emission reduction target of 20 per cent). Looking at renewable power generation (electricity and heat) which has the least cost options, at that price only 25 per cent of the renewable supply needed to reach the target[4] is economically viable. A 30 per cent reduction target for the ETS sector will lift power market price to just over € 60, and roughly 40 per cent of the RE target can be met, cf. Figure 1.2.

Figure 1.2 Stylised supply curve for output from electricity and heat generation in EU, 2020



Source: Eurelectric (2008) and Copenhagen Economics calculations

Assuming the most cost-efficient EU roll out of renewable energy supply in the power generation sector, a price around € 100 is required to make enough RE power production viable without specific support, cf. Figure 1.2[5]. Hence, support to RE will be required, an issue we discuss in the following section.

1.1. EU STRATEGY IS FAILING IN TWO MAJOR DIMENSIONS

While reaching the 2020 RE target will require very substantial subsidies in any case, the EU's implementation strategy *is failing in two main dimensions.*

First, there is too much focus on domestic compliance driving up costs further. The EU RES directive allows member states to reach target compliance by trading credits by various means, cf. Box 1.1 below, but very few countries have so far shown any inclination to do so.

[3] Power price from coal plants at 20 and 30 per cent reduction of GHG is based on a carbon price of € 30 and € 17 per ton, cf Figure 1.1. The carbon price is added to the electricity price from a marginal coal power plant, assuming cost effectiveness.

[4] To achieve 20% renewable energy in 2020, it is estimated that 1069 TWh electricity and heat will be needed, Eurelectric (2008), p 13.

[5] There is a link also to the use of renewable energy for heating due to the substantial use of co-generation in a number of countries where heating and power is produced at the same plant and ETS pricing thus affecting the supply of both heating and power.

As a consequence, some estimation indicate that overall costs of reaching targets may go up further € 8-17 billion per year by 2020 as a result[6].

Box 1.1 Co-operation mechanisms

The EU directive has set out four co-operation mechanisms:

1. Statistical transfers
2. Joint projects among EU Member States
3. Joint support systems
4. Joint projects among EU Member States and third countries

Statistical transfers
Member states that exceed their target can transfer (sell) target accounting units to countries that miss their target. Selling accounting units is only allowed if it does not affect the target of the selling country. The transfer must be reported to the commission no later than 3 months after the end of the year for which they are valid.

Joint projects among EU Member States
Two or more member states (and private operators) can share the financing of a project and share the realised target units. They have to specify the proportion or amount of electricity, heating or cooling from the project that will count towards the target of each member state and report this to the commission no later than 3 months after the end of the year for which the energy units are valid.

Joint support systems
Joint support systems require a high degree of cooperation between countries. Examples are feed-in tariffs or trade in green certificates. A certain amount of energy produced in one country may count towards the target for another country (statistical transfer or a distribution rule). A distribution rule must be reported to the commission no later than 3 months after the end of the first year it is in effect

Joint projects among EU Member States and third countries
Basically the same as "Joint projects among EU Member States" but including non-EU Member States.

Source: EU Directive 2009/28/EC, Article 6 (1)

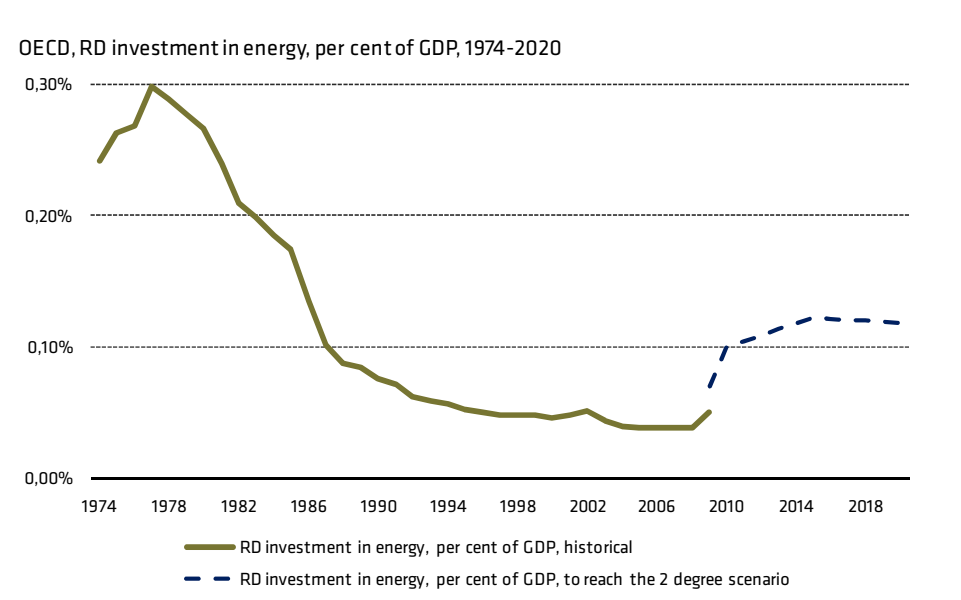
Secondly, there is an imbalance between costs associated with deployment of RE technologies over the coming 10 years running up to around € 80-100 billion per year by 2020[7], mostly in power generation, and the relatively speaking miserly low level of public funding for research, development and innovation which by 2009 at EU level reached € 3 billion per year[8].

Indeed, the scale of the challenge of meeting the global challenges of climate change, and the need to bring new technologies to the market, requires a massive increase in RDI. Known technologies such as biomass and wind power will become increasingly viable over the coming years as carbon prices increase and ongoing progress at the same time bring down deployment costs. However, there are limits on how far such sources can be expanded: biomass due to physical supply constraints, wind power due to its intermittence that require other controllable energy sources to provide balance power due to errors in day-ahead forecasting and back-up due to volatility in production[9]. As a result, we need research that can bring new technologies to the forefront, a job that private investors cannot provide alone even with much higher incentives from carbon prices given the huge uncertainties involved and the

[6] Eurelectric (2008), EWI (2009). A report focusing on joint implementation of renewable energy targets in the Baltic regions, also find sizeable gains from such trade (BDF(2009)). EU Impact assessment (2008).
[7] Eurelectric(2008) p 19 and Ecofys et al. (2011), p 90
[8] Investment and support to RDI: EU Commission SEC(2011) 131final, p 4
[9] Producing (growing) biomass is constrained by limited natural resources (land), ecological conditions and competes with other land use. EWI (2009) p. 66, and European Biomass Industry Association.

substantial public benefit nature of such R&D[10]. Based upon this reasoning, OECD has provided model calculations that suggest that public R&D investments should increase from their present 0.04 per cent of GDP in 2009 to perhaps 0.12 per cent in 2020, cf. Figure 1.3.

Figure 1.3 OECDs call for substantial increases in public R&D support



Source: IEA data services, Bosetti et al (2009, EIA home page, Copenhagen Economics calculations

This number of 0.12 per cent is however not a huge amount compared to historical spending before the late '80s.

1.2. How to set the strategy on the right track

We identified two main failings in the present EU strategy namely too little focus on the internal market as a driver for cost-efficient deployment and development of low carbon technologies, and too little focus on fostering long term innovation and investment in such technologies.

As the core of this project is a discussion about choice of support mechanisms for deployment of RES resources within the context of the existing RES directive, as described in Box 1.1. The task is to put this choice in the perspective of the larger challenges. In doing so we will favour a pragmatic, non-dogmatic approach that essentially accepts that progress will depend on a voluntary cluster of countries seeing the benefit of co-operating on RES de-

[10] A new innovation may create positive spillovers to other firms and the rest of the economy since innovations can be improved, standardized and create the basis for new technology classes. But the positive effects are not fully appropriated by the company financing the research. A tax that that lowers emissions might not increase the return on R&D investments enough to make investments high enough to achieve the economically optimal level (where spillover effects are taken into account).
An EU study concludes that the combination of rising carbon prices and up-front R&D support for green technologies yields the most favourable outcome. It also concludes, similar to an OECD study, that R&D support in the long run should not favour green technologies specifically, compared to all sectors of the economy. Copenhagen Economics (2010b).

ployment rather than relying exclusively on own resources for target compliance. The very fact that so few countries have so far been inclined to go down that route suggests that it needs to be demonstrated that this is a doable strategy and a way can be found to deal with the objections earlier raised by member states and evaluation studies against the use of internal market based mechanisms for target compliance such as Tradable Green Certificates (TGC).

Hence we have divided the rest of the report into three chapters:

- **Chapter two on Norway's and Sweden's TGC co-operation:** the two countries have signed a principal agreement for joint implementation of their RES targets. What are the main ingredients in this agreement and what could be the benefits of extending it to more countries as a practical application of a "joint support scheme" under the RES directive?
- **Chapter three on offshore wind**: Massive increases in production are projected but location of production is at substantial risk of being driven more by differences in generosity of support schemes than underlying cost advantage. What can the main scope and benefits of co-operation on deployment of offshore wind be, not the least as a practical application of the "joint project" mechanism within the RES directive?
- **Chapter four on TGC and the innovation and investment climate:** TGCs are in evaluation studies often held to be inferior to feed-in support schemes because they are seen as failing to provide support to innovation by being focused on mature RES technologies. It is argued that TGCs are less friendly to investors given perceived less certain returns on investments and providing excess returns to low cost RES producers. We suggest that these concerns are largely misplaced given proper overall policy design.

Chapter 2 USE OF CO-OPERATION MECHANISMS: THE NO-SE EXAMPLE

We listed in chapter 1 that there were three different approaches to using the co-operation instruments under the present RES directive: (1) statistical trading (2) joint support schemes and (3) joint projects. We will discuss joint projects largely in the context of offshore wind in chapter 4.

It is our conclusion that pure statistical trading without underlying market organisation and price formation lacks credibility: a buyer country is faced with risk of too low seller surplus. Harmonised feed-in tariffs could deliver within technology neutrality and hence allow comparative advantage in location to dominate, but may de facto be more difficult to agree on than TGC since it requires explicit agreement on subsidy rates for a wide range of technologies.

Hence we focus our attention on the Norwegian-Swedish TGC market as a means of using co-operation instruments for two reasons. *First,* the principal reasons listed above, which essentially are that TGC is the instrument designed to exploit low cost deployment options in an internal market context. *Second,* the Norway-Sweden agreement is so far the only prospective "game in town", no other countries are anywhere as far in doing joint compliance among EU and EEA countries.

2.1. KEY REQUIREMENTS FOR OPERATING A JOINT TGC SCHEME

The preparatory work for setting in motion a joint scheme for TGC between Norway and Sweden has provided a good testing ground for determining if key principles of such co-operation can be implemented in practice. In turn, these lessons are partly based upon the almost decade long experience Sweden has had in operating its own green certificate schemes since its inception in 2003.

The three prime objectives when setting up a joint TGC market is to (1) avoid distortions (2) have a transparent and smooth investment climate, and (3) obtain stabile prices for producers of renewable energy (relative to other energy producers)[11].

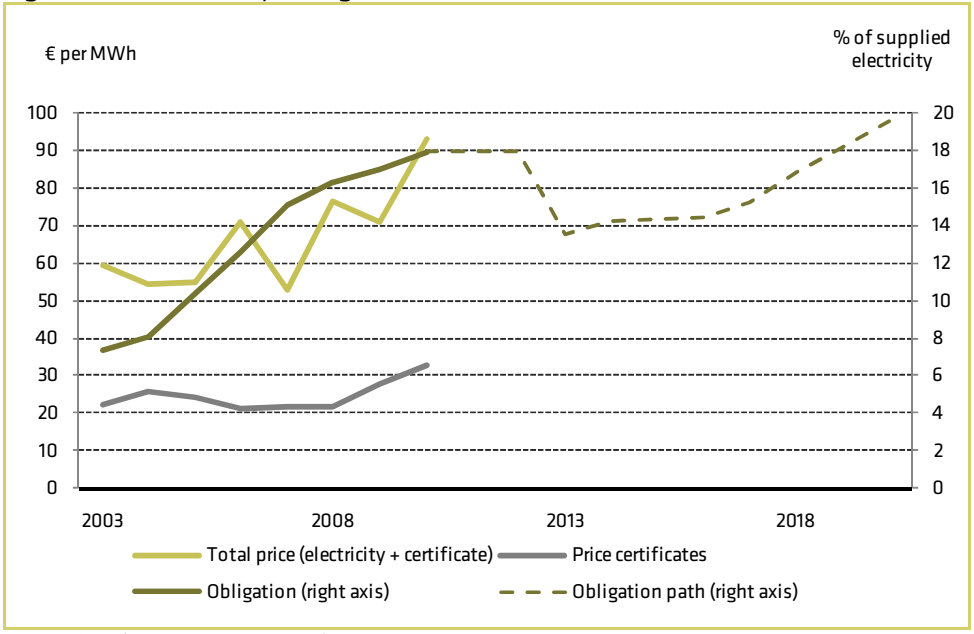
We will discuss important issues that need to be agreed upon in a joint TGC market. The issues are split into two levels of "urgency of priorities": *"must"* and *"should"*.

Must have

First of all there must be a well defined framework for determining a quota curve going forward. Such an agreement must define, over a foreseeable period, the level of buyer obligations to be reached, and specific rules for lowering/raising ambitions going forward. The point of this is to provide predictable signals to investors both in terms of overall expected deployment and prices. The experience from Sweden suggests that a well managed process can deliver very stable prices to the markets, hence prices have moved between 20 and 30 € per MWh since the opening of the market in 2003, cf. Figure 2.1.

[11] Swedish Energy Agency and Copenhagen Economics

Figure 2.1 Prices and buyer obligations for Swedish TGC, 2003-2020



Note: i) Exchange rate 9 SEK/€ used.
ii) After 2020 the obligations fall, reaching 0 after 2035. This is because the TGC is a temporary subsidy. After 2035 the market is supposed to supply enough green electricity on its own.
iii) Obligations planned for the Swedish system. Obligations for the Norwegian-Swedish TGC not yet set, but projected to follow a similar path.
Source: Swedish Energy Agency – Elcertifikat Kvotpliktig, Svenska Kraftnät – Cesar.

As the quota system is based on buyer obligations it needs to ensure full coverage and non-leakage. All suppliers of electricity have an obligation to deliver a set amount of green certificates (supply to the electricity intense industry can be exempted)[12]. If one of the suppliers is left outside the system, it gets cheaper costs and thus an unfair advantage compared to other suppliers.

To achieve stable prices a long term perspective and banking options are required. Swedish obligations are already set up until 2035 as a yearly percentage of electricity use, which provides stability for investors. Companies that have acquired certificates in excess of their obligations can bank or sell them. This provides sellers and buyers of green certificates a chance to counteract fluctuations on the market.

A joint control function is also important to make sure that the same rules apply and the certificate has the same value in all countries. This ensures a transparent and well functioning market.

Should

Rules such as what technologies to be included, length of support period, rules for updating certificates for existing installations running out of support period should be harmonized as much as possible. This also applies for implied network costs, priority access rules, balancing

[12] Swedish Energy Agency - Elcertifikat, Kvotpliktig

cost contributions and paying for additional grid investments. Rules do not have to be exactly the same but should be harmonized so that producers do not face different conditions in different countries and competition distortions are created. Norway and Sweden have started discussions on this topic, aiming at making conditions as equal as possible in the two countries[13].

A further issue to be solved is code of conduct for support outside the TGC system: how should countries deal with pilot and demonstration projects, and R&D support without creating competition distortions. A good proposal would be to use EU standard state aid rules for R&D rather than very weak rules applied for support to energy technologies.

2.2. Benefits of building on Norway-Sweden

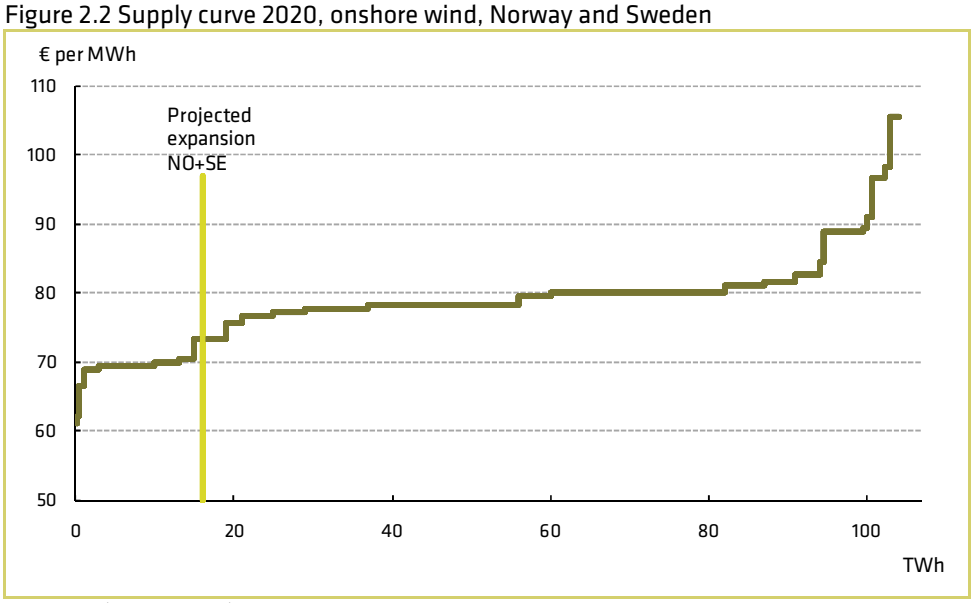
Sweden has expressed a willingness to expand the scheme to more countries. Studies show that there is substantial net additional capacity in the overall NO-SE system, mainly in hydro and wind power[14]. Options for countries that want to join are to either fully join, with reorganisation of national schemes, or to piggy back[15].

An expansion of the Scandinavian TGC market has its first mover advantages and disadvantages. It depends on the supply curve for land based wind power which is estimated to be the marginal supply element. Early-in as buyers could give low prices but also facing more teething problems.

The estimated potential and cost for onshore wind energy in Norway and Sweden in 2020 (in addition to existing wind power in 2008) are shown in Figure 2.2. The two countries are expecting to expand onshore wind by 16 TWh by 2020[16], which gives a marginal cost of around € 75 per MWh, where the cost of the tradable green certificate is approximately € 20 per MWh[17]. The combined goal will be reached by only utilising a small part of the potential wind power. The marginal cost curve of excess potential will be almost flat with an unused potential of almost 80 TWh, cf. Figure 2.2.

[13] Swedish Energy Agency (2010)
[14] Swedish Energy Agency (2010)
[15] Benefiting from the cheaper electricity from NO-SE, enabling a reduction of high (marginal) cost technologies, while still keeping national support schemes in place.
[16] NO+SE must together increase their renewable energy by 26.4 TWh by 2020. Norway is estimated to add 7 TWh water power and 1-2 TWh biofuel, Sweden could add 7-8 TWh biofuel and 0.5 TWh water power to existing renewable energy sources.
[17] Swedish Energy Agency (2010) pp. 54-62.

Figure 2.2 Supply curve 2020, onshore wind, Norway and Sweden



Note: Exchange rate used: 9 SEK/€.
Source: Swedish Energy Agency (2010), p. 29.

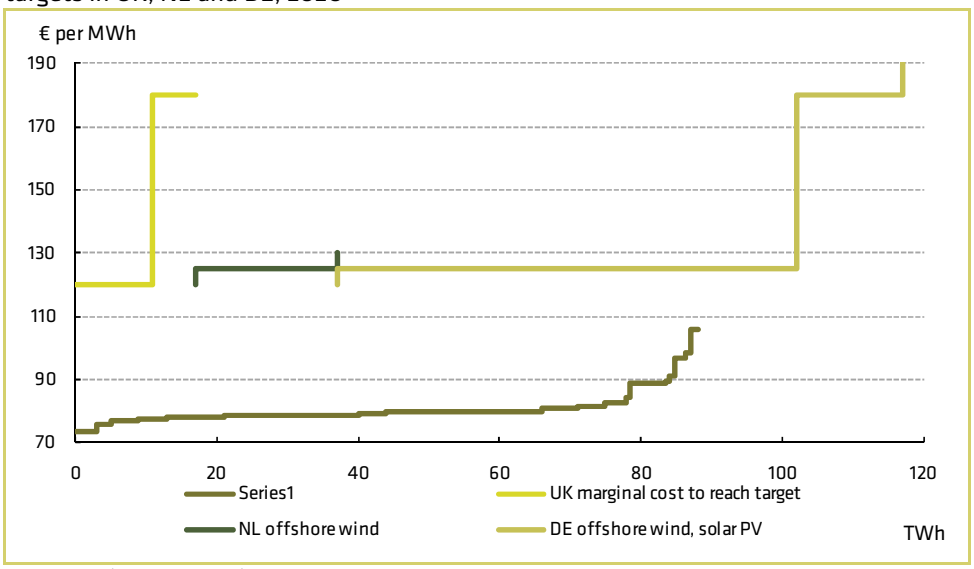
A number of countries should find the Norway-Sweden TGC prices attractive. According to estimations[18] in 2020 UK will have a marginal cost for renewable energy of approximately € 120-180 per MWh, for the last two steps to reach their national target. Netherlands is estimating a production of around 20 TWh offshore wind at a cost of € 120-135 per MWh to reach their target and Germany is projected to produce 15 TWh photovoltaic at €180-200 per MWh[19] and 65 TWh offshore wind at €120-135 per MWh, cf. Figure 2.3.

The unused potential in the Norway-Sweden system could cover around 60-70 per cent of the offshore wind and solar PV in the UK, Germany and Netherlands, as illustrated in Figure 2.3. Co-operation with Norway and Sweden would allow the three countries to meet their target compliance at a lower cost than with national actions only.

As marginal production costs in Norway and Sweden for the excess potential are only marginally above remuneration in Norway and Sweden, we would see the risk of expansion in terms of providing "excess" profits (wind fall profits to Norwegian and Swedish producers) to be minimal and in reality without relevance for the buyers in other countries.

[18] ECN (2010) p. 22 , HM Government (2009) p. 40
[19] Estimated future PV price in requires large cost decreases from current levels. Average production cost in Germany in 2009 was €550 per MWh, spanning from € 250 to € 1050 (Ecofys p. 18). The subsidy rate (feed-in-tariff) for PV in 2009 was € 430 per MWh compared to a subsidy of € 92 per MWh to onshore wind (RWI p. 6).

Figure 2.3 Potential excess supply NO+SE and marginal cost for energy to reach RES-E targets in UK, NL and DE, 2020



Note: Exchange rates used: 9 SEK/€, 1,2 £/€
Source: Swedish Energy Agency, ECN and (UK source), and Copenhagen Economics calculations

Co-operation with Sweden and Norway can be done through (1) statistical transfers or (2) joint support systems. Statistical transfers could most effectively be implemented by committing to an announced trajectory of buying into an increasing quota level. Buying statistical units allows a country to cut back on the marginally most expensive production while still maintaining its own national support system. But there is a risk in making sure the selling countries produce in excess of their RE target, allowing them to sell accounting units. Joining the TGC system fully is a much larger commitment. A way to smoothly join an existing system is to design a national TGC market with similar conditions as the existing market for a couple of years before joining. Previous national support schemes need to be phased out. It requires a large preparation effort but potentially holds large benefits. In the Netherlands joining the Swedish-Norwegian TGC system has been evaluated as being the most cost-effective way to achieve the Dutch RE goals[20].

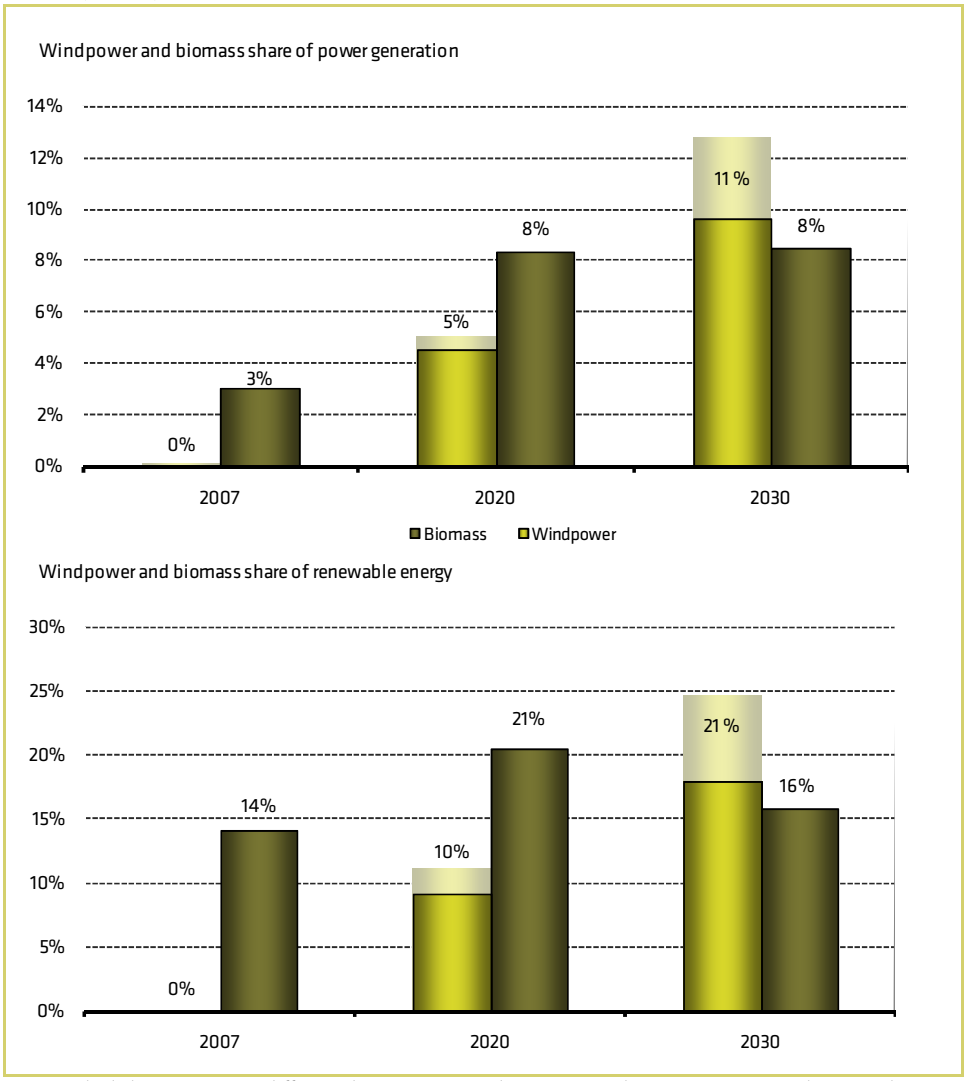
Expanding production of windmill based power production in Norway and Sweden to meet compliance based demand for green electricity in co-operating countries would strengthen further the need for integration of the Nordic power markets with the rest of the EU. This includes building more interconnectors to deal partly with the increased fluctuation of power production that follows from more wind power being introduced to the market and partly to deal with excess power being produced in the region relative to domestic demand. The strength of the latter argument depends on the extent to which more renewable energy in Norway and Sweden leads to an overall increase in power generation as opposed to an accelerated displacement of other sources of power generation.

[20] ECN (2011)

Chapter 3 OFFSHORE WIND

Projections of electricity generation in North-West Europe show a massive increase in offshore wind capacity as a response to EU and national ambitions to replace fossil based electricity generation with renewable energy. Rising from a very modest share of 0.1 per cent of power generation in 2010, offshore wind is set to rise to 5 per cent in 2020 and 10-13 per cent in 2030 cf. Figure 3.1, competing with biomass based production as the main source of expansion.

Figure 3.1 Share of biomass and offshore wind in total and renewable based power generation, 2008, 2020 and 2030



Note: Shaded area represents difference between estimated minimum and maximum. Average share stated. Biomass only from EWI.
Source: EWI (2010) and EWEA (2009)

Offshore wind production is a potentially attractive candidate for "joint projects". The point is that offshore wind farms are by nature placed in the sea between member states, suggesting that co-ordinated decisions about grid investments and their financing as well as the financing of the actual installation could be productive. Moreover, financing from companies or

countries not adjacent to the physical location of the installation could also be foreseen: the purpose for them would clearly be to get credits under national RE targets for the wind power produced. It could for example be a retail operator with a domestic national compliance target which could be off-set with such wind energy production.

However, there is also relatively widespread consensus that such projections and opportunities come with substantial caveats and raise a number of concerns for policy makers as well as investors.

While more or less model based, projections typically take relatively little account of the pressures such an increase in a volatile energy source put on absorption generation in power systems (or it is assumed these will be solved by massive expansion of grid investments and improvement in demand and supply management).

The absence of an agreed EU support framework implies that support schemes differ substantially in levels of generosity, structure of support, suppliers' contributions to pay for balancing costs as well as required grid investments, likely leading to substantial distortions to competition. And further, the absence of an agreed EU support framework also entails risk of "national competition" in subsidy schemes, especially for offshore wind, as the supply chain within offshore activities may show huge bottlenecks in the coming years, due to an expected steep increase in offshore deployment.

Current subsidy rates for offshore wind are very high relative to other renewable energy sources, reflecting that it has a long way to go before it can compete against lower costs renewable energy sources such as biomass, onshore wind and further expansion of hydro power, as demonstrated by Figure 1.2.

There is a considerable political risk that future subsidy rates may be challenged once actual deployment in depth starts affecting tax budgets and/or bills for electricity consumers. Current deployment of offshore wind accounts for less than 1 per cent of total power generation: as most subsidies are linked to production not investments, this implies that the financing cost has yet to find its way to consumers and tax payers.

The current crisis has already triggered reductions in subsidy levels in Germany and Spain (for solar cells), consideration of moving from fixed to premium feed in tariffs in Germany and a total freeze in the level of total subsidies to deployment of renewable energy in Netherlands[21]. Policy risks are particularly important for offshore wind over the next decade since the bulk[22] of total remuneration is derived from subsidies on top of the support from the ETS system.

[21] Duurzame Energie Koepel (2010). Bloomberg (2011), Guardian Environment Network (2010)

[22] One example is the Danish Anholt offshore wind park that will receive 40 to 70 per cent of its remuneration from subsidies. According to the tendered agreement, the park will receive 1.051 DKK per kWh. If the whole sale electricity price is 0.3 DKK per kWh 70 per cent of the payment will be subsidies over and above the level provided by the ETS system. With a market price of 0.6 DKK subsidies will make up 40 per cent of the payment.

Certain features make offshore wind deployment costs higher than necessary. One such feature in particular is the insistence that crediting of supply from installations requires physical connection into national grid systems. This has been demonstrated both in the case of the prospective Cobra line between Netherlands and Denmark as well as in the discussion of the Kriegers Flak project. German offshore wind turbines have a right to be directly connected to the German soil ultimately to be paid by German electricity consumers. Moreover, the wind farm can only receive German subsidies if the wind farms deliver the electricity physically on German soil[23]. Hence, in the case of the Cobra line the producers have every economic incentive to refuse an offer of building a shorter cable to interconnect with Cobra rather than a longer and more expensive line to Germany, even if this may be the best economic solution[24].

Now is probably a very good time to act to try to get some order into this investment climate, focusing on more transparent, reliable and efficient regulation of the offshore wind installations and the way production is credited against national RE targets:

- While the present RES directive is likely to stand largely unchanged in its main substance until the first major review in 2014, the fact that so little actual investments has taken place in the offshore sector suggest that "lock in" of national support schemes has not completely taken hold, hence there is still a good chance of establishing common support schemes for offshore wind.
- The fact that the physical location of installations is basically taken place in the North and Baltic Sea, requiring new grid systems to be produced, which in turn often requires joint financing from several countries, suggests that a common framework that defines levels and structures of support, as well as rules for crediting production against target compliance, could be of substantial value for investment certainty and transparency.

There are signs that the EU Commission would be willing to support such an approach, as can be seen in the quote below. There is no urgent need that they step forward quickly with any legally binding proposals or directive. They could in the first place act to facilitate a dialogue on developing guidelines or good practice in the area, which could become the linchpin for later legislation. Such an approach would allow the EU commission to play an actual role early without triggering a broader discussion about revising the EU directive now.

As the EU Energy Strategy notes, a greater convergence of national support schemes to facilitate trade and move towards a more pan-European approach to development of renewable energy sources must be pursued. This repeated call for convergence is not new, and is to flag up the need to start adjusting to a European electricity market in particular, where over a third of power will come from renewable energy. In some situations, such as offshore wind development, the need for an integrated strategy is imminent. In this instance, the relevant Member States and the Commission are acting, having just signed the Memorandum of Understanding of the North Seas Countries Offshore Grid

[23] Physically understood as 1) a connection to German soil, 2) submitting sales bid to the German power exchange EEX.

[24] However, more detailed calculations and market simulation must be conduction to decide on the economic best configuration of offshore connections and (trade driven) interconnections between national power systems.

Initiative. The Commission will closely follow this development and will report on the offshore wind and grid developments in 2012.

European Commission[25]

Indeed, a rapid expansion of offshore power in the North Sea region may require wider reviews of power market policies. That may include such issues as the number and geographical coverage of price zones. That depends inter alia on the specific location of the new installations, the ability of "smart grid" policies to reduce volatility in power markets and structure and capacity of new interconnectors as well as grid expansion within countries.

There might be overlapping interests for energy companies with ambitions to expand their offshore wind turbine capacity and wind turbine producers. They must weigh the risks of questioning the current system without knowing what they gain in return from the advantages that a more transparent and (a more) EU regulated system could bring to the stability and predictability of the overall investment climate. A more active approach, provided it succeeds in producing the desired solutions, could at the same increase the pressure on TSOs to bring forward the required grid investments and improved regulatory changes to deal with increased wind power production.

There are a number of options that could be looked at as possible features of a more common framework for support for offshore wind mills:

First there is a variety of support instrument that could be considered:

- Tendering approach, forcing private companies to come up with best bid offer (DK approach)[26].
- Feed-in, in principle fixing support levels at estimated lowest production costs in best location among collaborating countries.
- Green Certificate Instruments for offshore wind. This is by far the most ambitious schemes as it would require collaborating countries to agree on a commonly agreed trajectory for commitments to offshore wind to create a stable setting for investments and pricing.

Second more specific performance criteria could be included in award and support criteria. Offshore wind will continue to produce wind energy at costs well above competing renewable energy sources. Major reductions in costs are required to make offshore wind an economically viable contributor to EUs generation of electricity. This may suggest that the support systems may need to be broken up into several parts:

[25] Communication from the commission to the European Parliament, Jan 2011, *Renewable Energy: Progressing towards the 2020 target,* COM(2011) 31 final, p11.

[26] Offshore wind farms in Denmark are support by a fixed feed-in tariff. However, contrary to support by fixed feed-in of other RES-E in Denmark and also in many other countries the feed-in level is not set politically. The level is found by running an auction, where the bidder who accept the lowest feed-in to settle the generation will win the tender and the right to conduct to project put up for tendering.

- Potential direct integration of offshore wind production in international green certificate schemes of near-land, lower cost "offshore" wind with no limits to level of deployment.
- Moderate to high support to more "bulk" oriented offshore wind production, focusing on technologies and types of location that allows production costs close to, or not far ahead of, onshore wind power, with overall support potentially controlled by tendering procedures.
- Higher support levels to projects with promising, but yet far from proven, offshore wind technologies. Such projects could be said to represent the next step from purely research testing in laboratory conditions to on site, i.e. in the sea, conditions.
- Pure research funding in the pre-deployment phase.

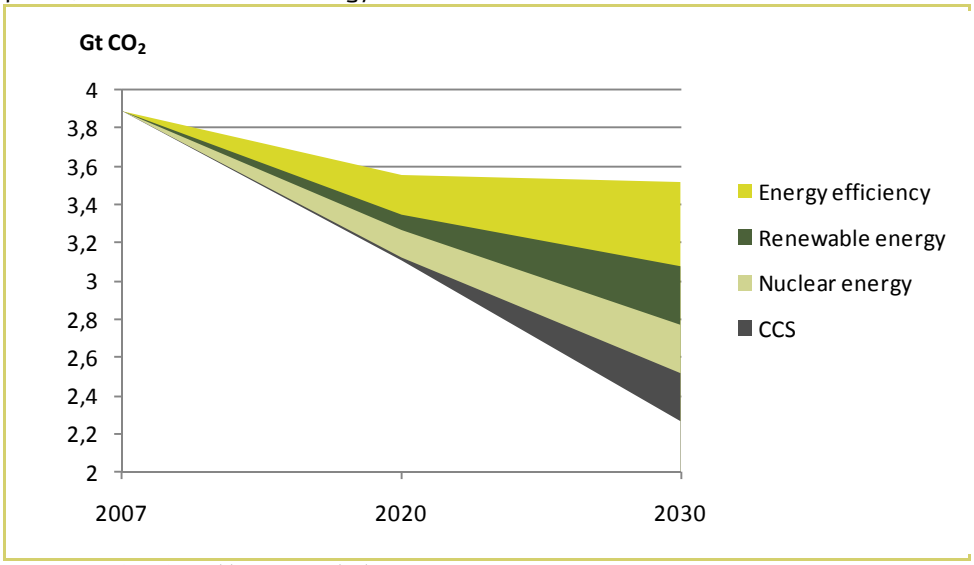
As a whole, we consider it important to choose a mix of instruments that reflect a number of important characteristics of offshore wind *as well as the need to underpin a competitive EU energy industry over the longer term:*

- Different locations present very different generation costs, so broader, potentially regulated support schemes should shift production in the direction of location of high load and low maintenance cost locations.
- As many other energy technologies, offshore wind production is not one technology. Different generations exist at the same time, and support instruments need to be tailored to the maturity of the technology.
- The long term perspective: projections of carbon prices consistent with ambitious global climate policies will dramatically increase the viability of renewable energy over the coming decade. Intelligent support schemes explicitly recognise such timing issues.
- The interests of ambitious EU energy companies might best be served by helping them to develop the competitive solutions for the future rather than focus on rapid and massive deployment of high cost generations.

Chapter 4 INNOVATION, INVESTMENT CLIMATE AND EXTERNAL COMPETIVENESS

The choice of support mechanisms for compliance with EU renewable energy targets over the coming years needs to be narrowly linked to the policy requirements for the next four decades. As underlined in the introductory chapter 1, expansion of renewable energy becomes steadily more important as lower hanging fruits of energy savings are already harvested and cuts become ever more binding. Indeed, projections from IEA and OECD show the decline in the relative contribution from improved energy efficiency towards reduction of energy related CO_2 emissions towards 2030 and the increasing role of CCS and renewable energy cf. Figure 4.1. Energy efficiency accounts for 46 per cent of the emission reduction in 2020 and 35 percent in 2030 whereas the reduction contribution from renewable energy and CCS increases from 18 and 4 per cent respectively in 2020 to 25 and 20 per cent in 2030.

Figure 4.1 Contributions to CO_2 emissions reduction from energy efficiency, nuclear power, CCS and renewable energy



Source: IEA (2009) World Energy Outlook

4.1. BOOSTING INNOVATION

There is strong consensus in empirical research that a wide palette of instruments is necessary to drive forward the needed investments in deployment and innovation of new technologies. Carbon pricing is required to provide economic incentives to deploy energy saving and low carbon technologies as well as investment in innovation; entirely new research show that firms patenting activity related to energy saving technologies is strongly related to energy taxes[27]. However, tax induced innovation is not sufficient: returns on investment on innovation with benefits only to be reaped in one to two decades time are very uncertain and

[27]Popp (2006), Johnstone et al (2009) and Copenhagen Economics for DG TAXUD (2010) show that higher energy prices provide incentives for investments in R&D, which leads to patents, since higher prices change the relative returns to the benefit of energy and GHG displacing technologies. A one per cent increase in energy prices (through for example taxes) implies approximately a 0.4 per cent increase in energy technology patenting. The literature acknowledges a time lag between the price signal and new patents: typically half of the induced innovations have occurred 3-5 years after the price increase.

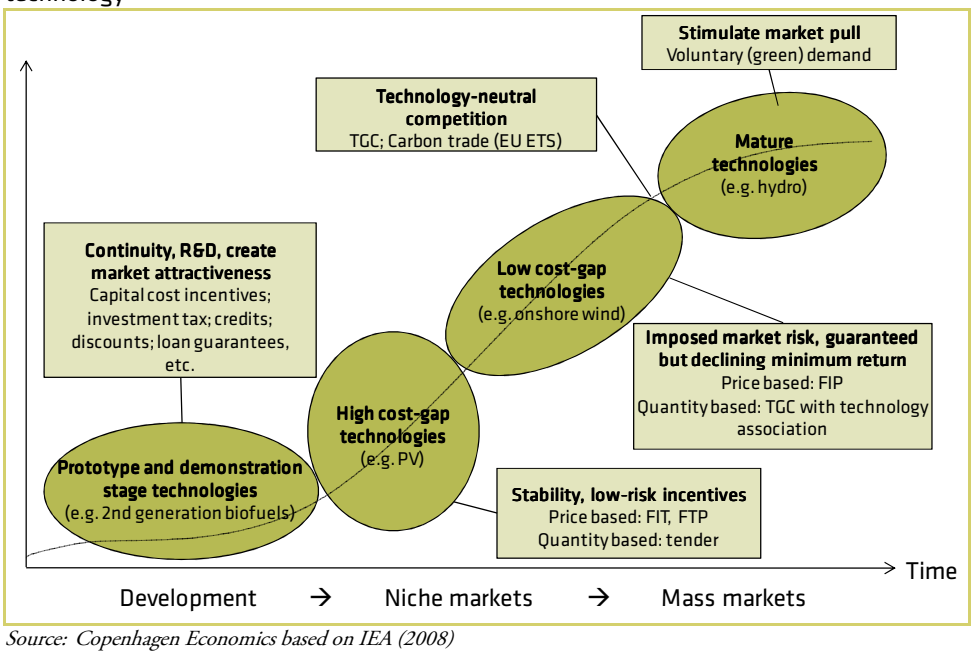
the benefits from such innovation will often come to society at large, not just the private firms providing the funding. Thus public sector funding for research, development and innovation is required as well.

Hence, our shot at the best policy mix towards 2020 has the following ingredients: carbon pricing such as ETS can help the most mature renewable technologies to reach target compliance[28]; on top of that we recommend a TCG scheme that includes also the most mature technologies mainly hydro power, biomass and land based wind power with the NO-SE market as a possible forerunner of a wider European based system. Healthy competition among such already near stand alone technologies with the safety net of a TGC – higher ETS price means lower TGC price et vice versa[29] – could help ensure that investment and innovation is focused on the most promising areas.

Furthermore, we also need public support for less mature technologies. We have already discussed offshore wind in the previous chapter, so we will focus the discussion here on other issues and technologies. The essential point is that the support for non-mature technologies should be about speeding up progress of technology not deployment per se. The success criterion is to bring down future costs of mitigation, not reducing emissions today and tomorrow: for that we need carbon taxes and some measured support for mature technologies. Hence for the least mature technologies, e.g. 2nd generation biofuels, we need demonstration projects, capital cost incentives, credits etc, cf. Figure 4.2. Other more developed non-mature technologies need feed-in tariffs, either fixed or tendered (high cost-gap technologies, e.g. PV) or TGCs (low cost-gap technologies, e.g. onshore wind).

[28] It may be worthwhile to follow the EU Commission May 2010 proposal to go with the 30 per cent reduction target for 2020: it could bring the ETS allowance price up to € 30, which is still less than the € 41 needed to reach the 20 per cent goal foreseen by DG TREN "Trends to 2030 – Update 2007", before the economic downturn.
[29] If the ETS prices go up, the price of carbon dioxide goes up. This makes renewable energy relatively cheaper and more renewable energy is produced, and that lowers the TGC price.

Figure 4.2 From research to market deployment: instruments tailored to maturity of technology



Source: Copenhagen Economics based on IEA (2008)

A part of the economic literature suggests that massive early deployment can reduce future costs through "learning"; we suggest that this is very doubtful at best. Indeed, there seems to be a tendency to assign too much of the costs reductions over time for technologies to historical deployment and far too little to independent as well as research driven cost savings over time. Consider, for instance, the case of solar energy. Despite research efforts that began during the energy crises of the 1970s, solar energy is still only cost competitive in niche markets, such as remote off-grid locations. This leaves a potential role for government sponsored R&D to fill in the gaps[30].

4.2. Investment climate

One of the most prevailing criticisms towards TGC vis-à-vis the main alternative, namely feed-in tariffs, is that it provides less investor safety and has proven less capable of driving expansion of renewable energy. A (fixed) feed-in tariff provides a legal guarantee by a member state that production from a given installation for a given time period receives a predefined remuneration level. This is presumably better than being part of a TGC market where prices can go up and down.

The most significant form of operating support for electricity, heating and transport are feed in tariffs and obligations. Reviewing the relationship between project risk and instrument choice, the empirical evidence suggests that the more reliable revenue stream provided by feed in tariffs is generally more effective in driving renewable energy growth, particularly for a broad range of technologies. Obligations and tradable green

[30] Copenhagen Economics for DG TAXUD (2010)

> *certificates often suffer from revenue volatility and require payment of a risk premium, which appears to make them both less effective and efficient.*
>
> European Commission[31]

However, this argument should be weighed against a number of counter arguments.

First, investor confidence cannot be narrowed down to certainty about return of one year's deployment. What matters for an investor is the probability that deployment and investments in innovation in low carbon technologies in the coming decades are being rewarded in the market place. We would argue that an international binding agreement between a group of member states committing to buying renewable energy in a predictable and pre-announced trajectory in the context of EU wide binding legal targets may provide as much investor confidence as relying on the willingness of individual member states to provide subsidies over the annual budget also in the future.

Second, a well functioning TGC scheme can provide very stable investment signals and rewards, which the Swedish version is a clear example of. A clearly announced trajectory, adjusted on an ongoing basis to take into account new assessments of supply potential can provide a flexible instrument to achieve targets while keeping economic incentives stable as discussed in chapter 2.

Third, an overall support structure that unnecessarily inflates costs is at risks of a policy backlash. As noted several times in this report, actual subsidy levels to renewable energy in EU member states are presently far below the level needed to deliver at 2020 targets even with the most efficient approach. As actual costs rise going forward, support for the most expensive technologies may be at risk of being discontinued or reduced sharply downwards. Indeed, the current crisis has led to some countries scaling down their subsidies to renewable energy, first of all in Germany, Spain and Netherlands.

Fourthly, providing investment guarantees to one specific part of the economy, in this case investors in renewable energy, has a cost for other actors in the energy market, often other divisions within the same energy companies. To provide an example: if producers of renewable energy are "protected" from more general market forces for example a longer period of lower wholesale power market prices, they may reinforce this market weakness by maintaining higher production and investments, leading to even more depressed earnings for coal and gas based producers. Such policy induced transfers of risk between producers illustrate that there is no "free lunch": higher risk premium for producers of fossil based production may hold back needed investments in "clean" coal and gas based production. For decades still, EU will continue to need such production to provide electricity and district heating to its consumers.

[31] Commission staff working document, *Review of European and national financing of renewable energy in accordance with Article 23(7) of Directive 2009/28/EC*, accompanying document to *Communication from the commission to the council and the European parliament, Renewable Energy: Progressing to 2020.* (2009)

4.3. THE INDUSTRIAL PERSPECTIVE: INTERNATIONAL COMPETIVENESS

Over the coming 10 years, as much € 60 to 70 billion[32] are to be invested in deployment of renewable energy, most of that in power generation, to meet the 20 per cent renewable energy target. This provides a massive home market for EU producers to deploy their products, such as new generations of wind power, new technologies that combines co-firing of biomass with coal and gas etc. which can be exploited outside EU as well. European producers are increasingly focusing their marketing efforts also outside EU as the climate and energy agenda is spreading to large emerging economies such as China and India as well as US and Canada.

The lack of a strong internal market dimension to this massive expansion of renewable energy within EU may hurt EUs own industry and is strongly at odds with the EU 2020 agenda that emphasises "smart, green growth". Continuing to operate with 27 fragmented national markets with 27 different support schemes constantly being revised prevents EU firms from exploiting the potential economies of scale and scope that in other fields of EU industrial policy is seen as essential for competiveness. Indeed, denying the benefits of an internal market to precisely the industry that is marked to a drive for new jobs and growth over the coming 10 years appears to be a major industrial policy failure.

Indeed there is a risk that a renewable energy policy too much focused on larger scale deployment of non-mature technologies in the context of fragmented markets will fail to provide EU firms with the required edge in EU and export markets. The very substantial support to deployment of solar cells in Germany (and Spain) over the last 10 years may provide the best example of this. It has cost Germany electricity consumers more than € 50 billion[33] while failing to bring production costs to anything close to levels that justify major deployment: the shadow price of each ton of CO_2 replaced still exceeds € 700 [34], far above the level of ETS allowances prices of usually around € 20-25. At the same time, the market is now largely dominated by producers from China and Taiwan that in 2009 accounted for over 50 per cent of the world market (and their market share is projected to grow) while German producers account for a market share under steady decline, now around 10 per cent.

[32] EU Commission, COM(2011) 31 final, p 7.
[33] Copenhagen Economics for Danish Energy Association (2010)
[34] RWI, p 13.

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