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DEVELOPING EU RENEWABLE ENERGY SOURCES

THE MISSING INTERNAL MARKET DIMENSION 23TH APRIL 2010

INFORMED DECISIONS

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Executive summary

EU has adopted legally binding targets for the production of energy from renewable energy sources (RES): 20 per cent of final energy consumption for the EU as a whole is split up into 27 different minimum national targets. This raises the questions: what instruments should EU as a whole, as well as Member States use to implement that target? And, how should this policy be reviewed in a long term context of much larger ambitions in terms of reducing carbon emissions and promote alternative low carbon energy sources?

We argue that the approach adopted by EU and its Member States is a wrong and unnecessarily expensive route to take. It is based on national defined support systems and leads to next to no trade between Member States. This approach fails to exploit the comparative advantages of some regions in production of renewable energy. It will make dealing with climate change and energy security more expensive, and risks undermining the commitment to ambitious long term climate and energy policy goals and the support of a competitive EU energy sector.

The scepticism towards trade-based systems that undid the EU-Commission's early (unofficial) and more (internal) market friendly approach was at least partly based on a number of evaluation studies that had major failings. These studies tended to focus on a very narrow comparison between two kinds of support schemes; feed-in systems (FI), where each technology gets a support that is sufficiently high to make it viable for a private investor, and Tradable Green Certificates (TGC). With TGCs the support is driven by a legally binding target specifying the overall amount of renewable energy while the price of such certificates are set by the marginal supplier of renewable energy.

All evaluations agree that the TGC system is the best suited of the two in picking out the most efficient production but TGCs are often rejected for two reasons. *First*, as the (marginal) price set by the TGC system is determined by the most expensive supplier; low-cost producers are deemed to harvest "windfall" profits. *Second*, by its' nature TGC will not support very expensive technologies and hence lead to a smaller palette of deployed RE sources.

Neither of these two criticisms bears much scrutiny. *First*, if trade is indeed exploited by many Member States then the price of TGC will be set by relatively low-cost producers, avoiding the need to support, inter alia, more expensive off-shore wind. Windfall profits largely related to hydropower and well-placed land-based wind power utilities can be "socialised" by different mechanisms as, for instance, also used when granting rights to oil exploration. *Second*, TGCs are likely over time to price in expansion of hydropower, land based windmills, biomass and thermal power – itself a very diverse palette of technologies. Coupled with still cleaner coal and gas production, this should bring about a sizeable expansion in the diversity of energy sources in the coming decades. In addition, EU and its Member States have many other instruments in its place to support the development of renewable energy in a long term perspective. The use of feed-in mechanisms to advance innovation efforts and reduce future production costs ("learning costs") is a very costly and non-targeted way for the EU to meet the challenge of largely replacing EU's use of fossil sources over the coming decades with much cleaner technologies. This is a job much more effectively delivered by targeted RD policies.

We conclude that further research in this area is called for. In particular the potential gains from increased trade should be studied further. In this note we sketch out some of the key issues that need to be looked into and review some possible routes that can be taken towards long term reform. The EU Commission's review in 2014 on the functioning of the RE-directive, including its provisions for possible trade in renewable energy, should be used to establish this long term path based upon a careful review of the options.

Chapter 1 THE REAL SUCCESS CRITERIA FOR EVALUATION OF SUPPORT SCHEMES

A wide array of instruments and combinations of instruments to support renewable electricity are in place today. Two main support systems are dominant for near term deployment, feed-in support systems and Tradable Green Certificates of origin (TGC), cf. Box 1.1.

Box 1.1 Descriptions of feed-in support and TGC

Feed-in support system:

- In all variants of feed-in systems a support is applied to each potential technology ensuring that it is viable.
- In its fixed variant, the support tariff is provided to the producer, either *instead* of the power price offered in "ordinary" electricity spot markets to other producers, primarily coal or gas based or as a guaranteed minimum price where the tariffs "*fills up*" the difference between the actual power price and guaranteed minimum price .
- In its premium variant, the tariff is provided *on top* of the ordinary price with the total price thus fluctuating with market price.

Tradable Green Certificates of origin (TGC):

- Producers of certified renewable energy are provided with certificates that prove the renewable origin of the energy source.
- When traded it derives value from consumer obligations to purchase RE or simply from consumers' idealistic aim to support green energy. Consumers will face a penalty for non-compliance with obligations, hence creating an incentive to purchase certificates
- In the EU Commission approach, they gain potentially direct new value across countries by way of the new binding national targets for all countries that create obligations to attain specific shares of renewable energy.

There are also some cross-over models combining elements of TGC with feed-in tariffs. In UK, technologies with broadly similar costs and maturity-to-market characteristics are banded together in a group with one common support tariff to encourage competition between technologies.

Other countries combine either green certificate schemes (Sweden and UK) or feed-in schemes (for example The Netherlands and Denmark) with tendering mechanism to solicit market based offers to supply energy in new and potential high-cost segments in the market, e.g. off-shore wind. Furthermore, all countries provide government funding to research, development and innovation in the energy sector.

Source: Copenhagen Economics

To decide which of the possible support schemes that is most successful, some kind of criteria for what the support schemes should achieve is needed. In their operational form such success criteria for support schemes for renewable energy are often rather narrow. As a consequence, comparisons between types of support schemes risk being too crude to achieve their goal; to decide if one type of support scheme is better than the others. Therefore, the Commission's conclusion that *"Well-adapted feed in tariff regimes are generally the most efficient and effective support schemes for promoting renewable electricity"*[1] is in our view not accurate.

We propose to evaluate the most effective way to deal with EUs 2020 RE objectives for RES-E by using five criteria. The criteria are in line with the policy goals of least cost, low consumer prices, encouragement of viable technologies, power system integration and co-functioning with other climate policy instruments, cf. Table 1.1.

[1] EC (2008), p.3

Table 1.1: Evaluation criteria for a successful support scheme for RES-E deployment

	Policy goal	Issues: the instrument should
1	Least cost implementation and competition in the internal market	Encourage choice of low-cost technologies Provide framework for trade with high-cost countries "importing" RES from low-cost countries
2	System integration issues	Contain supply driven volatility in spot markets Avoid negative spill-over effects between energy suppliers Encourage lower volatility in demand
3	Low consumer prices	Reduce risk of financial transfers to consumers by avoiding overcompensation to producers ("windfall profits") + low cost production
4	Encouraging *viable* new RES technologies	Support a broad and meaningful palette of RES technologies Underpin long-term and viable RES investment by reducing unwarranted uncertainty
5	Co-functioning with other climate policy instruments	Promote good interaction with ETS and other policies to encourage inter alia energy savings

Source: Copenhagen Economics (2008), "Best practice Climate Policies"

1.1. LEAST COST IMPLEMENTATION AND COMPETITION IN THE INTERNAL MARKET

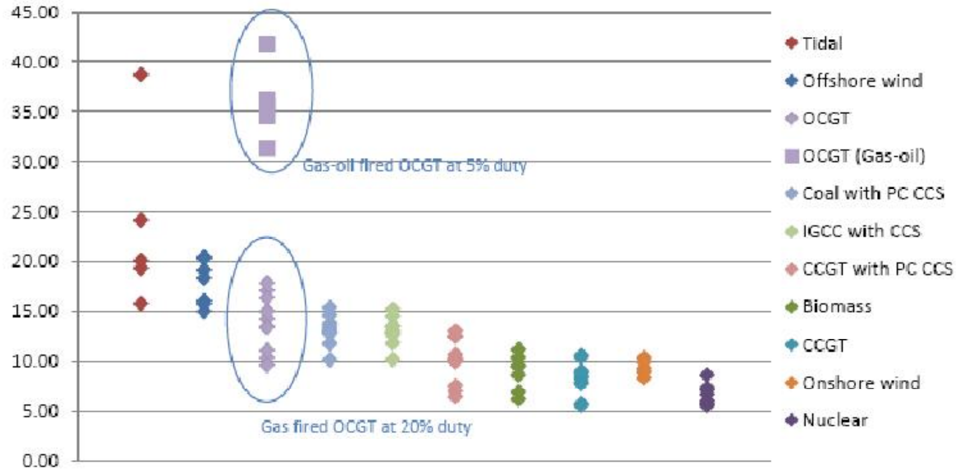
Least cost implementation of a target for renewable energy production means that the renewable energy should be produced as efficiently as possible. However, the concept of efficiency has in past evaluations of support schemes not been applied with sufficient rigour. Furthermore, the competition in the internal market is hindered by the diverse support schemes and related administrative barriers between countries which prevent least cost implementation from a European perspective. In particular, the fact that the "directive on the promotion of the use of energy from renewable sources" describes the conditions under which trade is allowed rather than defining very restrictive conditions under which trade may be disallowed is in starch contradiction with the internal market principle, one of the most fundamental ideas of the EU treaty.[2]

A fundamental goal from a welfare perspective is to meet the RES-E targets as cost-effectively as possible. Instruments relying on market mechanisms such as the TGC pick the low-hanging fruit and are likely to be most cost-effective. There are two arguments supporting this conclusion. *Firstly*, there is indeed some evidence that the overall EU 2020 target for renewable energy can be reached relying only on such relatively low-cost technologies such as on-shore wind and biomass fruit which have typical generation costs per MWh well below on-shore wind and tidal power etc. cf. figure 2.1 – and even more so photovoltaic and tidal power cf. box 1.2 – provided that trade is allowed between Member States [3]. *Secondly*, the major uncertainty as to the precise relative merits of technologies suggest that one should avoid trying to estimate the correct, long-term costs and merits of a long range of competing technologies, i.e. avoid to "pick the winners in advance" by offering technology-specific subsidy schemes such as feed-in tariffs since it may incentivise more costly technologies.

[2] DLA Piper (2008).

[3] Econ (2007).

Figure 1.1 UK study on generation costs of for different electricity technologies, € per MWh



Note: Costs for off-shore wind do not include investments costs associated with building the necessary grids to connect wind farms with main grids which provides a significant underestimation of the cost of off-shore wind. The data are collected in the context of exploring the generation costs in UK.

Source: Parsons Brinckerhoff (2010)

While a TGC system is well suited to trade in renewable energy, feed-in systems have problems. With a Europe wide integrated green certificate market we will see RES-E production taking place where it is cheapest. The certificates will be exported to countries where RES-E production is more expensive. On the other hand, a basic premise in "feed-in countries" is that low cost producers get lower remuneration than high-cost producers. Therefore, producers may choose to produce with a more costly technology if the returns are greater, cf. Box 1.2.

Gains from a harmonised approach to renewable energy support schemes are more cost-efficient than other approaches. A number of studies suggest that the benefits of using a harmonised quota system, such as a European scope TGC system, are vast compared to current policies. Two recent studies[4] suggest that the annual savings could reach € 15 billion while the EUs own impact assessment for 2008 suggest annual savings of € 8 billion.

[4] Pöyry (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))

Box 1.2 Case study: Germany – Are photovoltaic (PV) investments efficient?

The German feed-in tariffs for photovoltaics (PV) rate very well according to the Optres criteria. However taking into account an additional criterion, namely lowest possible cost, it does not stand out as a particularly sound support scheme. The feed-in tariffs for PV were €380-€540 per MWh in 2006. This could be compared to a maximum of €82/MWh for onshore wind.

The feed-in tariff has been extraordinarily effective rendering an annual 72% growth, by far the fastest growth of all RES-E technologies, cf. Table 1.2.

Table 1.2 Growth in RES-E technology in Germany, 1997-2005

RES-E technology	1997 (GWh)	2005 (GWh)	Average annual growth (%)
Photovoltaics	17	1282	72%
Solid biomass	505	4647	32%
Wind onshore	3034	27229	32%
Biogas	751	4708	26%
Biowaste	1062	3038	14%
Hydro small-scale	6772	7959	2%
Hydro large-scale	11696	11622	0%

Source: Progress (2008).

It has also, under Optres' efficiency definition, been efficient under the condition that it has not provided the sellers of PV-generated electricity with any large profits. Consequently, based on Optres' criteria the German PV support is top notch. Does that make sense?

Evaluated as a means of deploying RES-E technology cost-effectively, not considering domestic employment and industry policy, we conclude that the PV-support scheme is a failure. PV is by far the most expensive RES-E production technology in use today with a production cost that is "off the chart", € 340-1260 per MWh, to be compared with e.g. onshore wind which produces at a cost of €30-80 per MWh, cf. Table 1.3.

Table 1.3 Production costs for RES-E technologies

Technology	Cost of electricity €/MWh
Photovoltaic	340-1260
Wind onshore	30-80
Wind offshore	45-120
Tide and wave	60-130
Solar thermal electricity	80-230
Hydro small-scale	25-130
Hydro large-scale	25-140
Geothermal electricity	30-90
Biowaste	10-80
(Solid) Biomass	40-190
(Solid) Biomass co-firing	25-75
Biogas	20-140

Note: The costs are long-run marginal costs, i.e. the cost of producing an extra MWh.
Source: Optres (2007), p.10.

One argument for an expensive support system like the German PV support is that deployment leads to learning effects, i.e. that the costs of electricity production through PV will fall over time due to learning-by-doing. In addition, it could be the case that there are economies of scale in the production of plants, such that average costs fall when the quantity increases.

Regarding learning effects, recent empirical studies show that learning effects are often marginal. It is rather persistent research and product development that leads to decreasing costs over time and no large scale deployment is necessary to achieve that, cf.:

"Learning derived from experience is only one of several explanations for the cost reductions in PV. Its role in enabling changes in the two most important factors identified in this study—plant size and module efficiency—is small compared to those of expected future demand, risk management, R&D, and knowledge spillovers. This weak relationship suggests careful consideration of the conditions under which we can rely on experience curves to predict technical change. "

Nemet (2006), Beyond the learning curve: factors influencing cost reductions in photovoltaics, p.11.

The economies of scale could be of greater importance, but the consistently high levels of support suggest that such effects at least do not come cheap.

Source: Progress (2008), Optres (2007), Nemet (2006).

1.2. SYSTEM INTEGRATION ISSUES

The fact that the renewable electricity has to be integrated into physical grids transporting electricity is important when evaluating support schemes. Deploying large amounts of a technology that is dependent on uncontrollable factors, like weather, introduces some risks that need to be kept in mind. In this context, we want to underline that renewable energy is to deliver two goods:

- A public good (mainly "clean air" understood as no CO_2, but also less fossil fuels, less energy dependence) which should be seen in a broader EU context.
- Delivery of electricity in a local market with local suppliers and buyers.

We advocate a dual system of support recognising the double goods character with a European determined price for the green aspect and local price-setting for the physical delivery of energy to a local grid. Wind produced at the wrong time and/or wrong place will get low local prices as it serves limited real function, cf. Box 1.3. Windmills on the moon will help no one, so to speak.

With this perspective in mind TCG is the best long term solution with the feed-in premium also being useful. The point is that they offer a support which is a supplement to the market price while the fixed feed-in tariff provides support completely removed from the actual price formation in the market and the actual physical state of the power system for which the energy is produced. This may provide incentives to develop energy in the wrong time and place, cf. Box 1.3

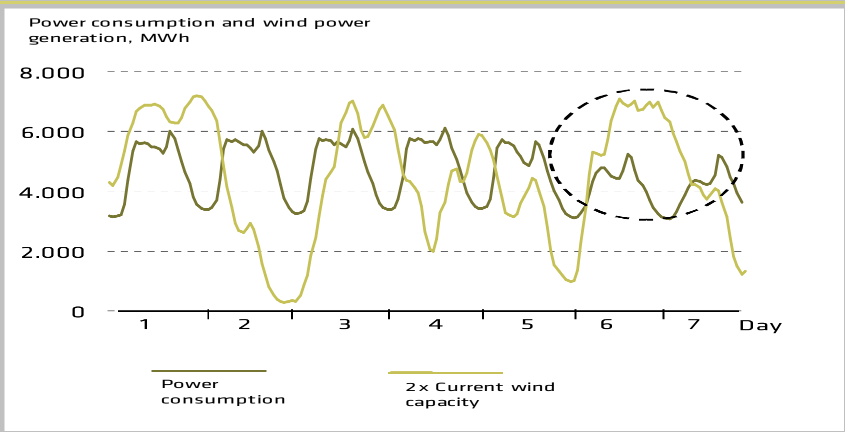
Box 1.3 Denmark - Wind power and system integration

Wind power is the largest RE power generation technology in Denmark with the share to increase further. Its large share of total power supply creates some problems regarding the match between supply and demand for electricity, also putting pressure on the grid system. Already today, in conjunction with other factors, it drives occasionally power prices below zero in Western part of Denmark where most wind mills are concentrated.

There are at least three problems with a large share of wind power. *Firstly*, the wind does not necessarily blow when the demand for power exists. When electricity production surpasses demand prices plummet, which typically happens during the night when demand is low. This leads to a lower average value of one MWh from wind power than of one MWh from power produced with a controllable technology. *Secondly*, since wind power generation exceeds power demand in some hours, a grid structure with an excessive transmission capacity for exports of electricity is required. In effect, this necessitates larger investments in grids than would have been necessary with a power generation technology that is more able to match demand. *Thirdly*, the uncontrollable volatility of the wind generation challenges the task of balancing the grid, as wind forecasting is not error-free. These problems all increases with increased deployment of wind power.

Figure 1. shows wind power production in Denmark West in a prospective situation where the share of wind power has increased further to 50 per cent[5] of total yearly demand while demand structure is derived from data in a recent historical week. Essentially, it suggests that we will see periods where the sole production of wind power exceeds the entire consumption of energy in the region (area with circle in figure 1). At the same time, there will be hours during normal weeks, where lack of wind will produce shortfalls of electricity. Essentially, Figure 1., illustrates the high volatility of wind power. This derived demand for grid investments is a hidden cost of wind power expansion which is routinely omitted in traditional analysis of costs of RES expansion and comparisons of RES support schemes.

Figure 1.2 Power consumption and demand with 50 per cent wind share



Source: Copenhagen Economics, Energinet.dk

[5] A share of 50 per cent of wind in the Danish power system was in fact included in a Danish policy note from 2007 (Ministry of Transport and Energy(2007))

1.3. Low consumer costs

While it is generally recognised that TGC has the best potential for reducing overall generation costs for renewable energy, the schemes have been criticised for leading to higher cost for consumers and large rents to the producers. The mechanism that creates these rents is that the support level is set at the marginal price, reflecting that the price for TGC is set to the level at which the most expensive unit is sold. The price of the last unit is hence typically set by the most expensive power generation technology which may provide profits to less expensive technologies, such as hydropower.

This is potentially a non-trivial issue, with the EU Commission estimating a windfall profit of up to 30 billion annually in 2020 by using a harmonised quota scheme for this purpose with a potentially lower estimate.[6] This surplus of compensation represents a transfer of financial resources from consumers to suppliers which could in principal be avoided by feed-in systems that suggest that wind fall profit should not be seen as a service problem.

However, we put forward four arguments all suggesting that windfall profits should not be seen as a serious problem.

Firstly of all, the rents from low-cost production such as hydropower and windmills in good positions can be extracted by tenders or rent taxation. In addition, even in the absence of any discussion of the trade of renewable energy, Member States will have an interest in taxing rents from low costs hydro producers (and on-shore windmills in good locations). They will in the coming years reap windfall profits from the rise in the price of fossil fuel based electricity, driven by stringent climate policy.

A natural parallel to the above discussion is production of oil in the North Sea. Denmark, among others, does not prevent drilling operators from selling the oil produced at the world market price but have put in place tax systems that link the level of taxation to the oil price, allowing investments of operators to respond to oil prices. The same principle should apply to inter alia hydropower. If carbon prices go up, then marginal investments in hydropower become more profitable for society, and we need RES-E support systems that allow for that. By contrast, increased net revenues from existing production could be wholly or partly neutralised by way of taxes and/or concession systems.

Secondly, rents are not equal to costs to society: they are transfers between citizens and enterprises which do not directly affect overall economic welfare. Consumers as a whole are shareholders of the benefiting companies, so excess profits are mostly an issue of moving incomes between different consumers.

Thirdly, it is noteworthy that the producers that have comparative advantages through controlling advantageous natural resources are often governmentally owned, implying that their profits are returned to the government also without rent taxation.

[6] EREF (2008).

Fourthly, with more integration and trade, more of the demand for renewable electricity can be provided at low cost. Hence the marginal cost will drop, and as consequence so will the windfall profits. On study suggest that the reduction of real costs associated with trade and technology neutral support is far higher than the possible non-neutralised producer surpluses[7].

1.4. ENCOURAGING VIABLE RENEWABLE ENERGY

The encouragement issue can be seen as two separate issues; *first*, if there is *confidence among investors* that renewable energy will be viable to produce and sell in the market and *second*, if the *palette of renewable energy sources is broad* enough.

As regards the general *confidence issue* the development of renewable energy has for many years been held back by low prices of fossil fuels as well as weak legal commitment to develop renewable energy systems. The feed-in tariffs, often with generous support levels, have in this context been a strong historical instrument to support renewable energy by providing legally guaranteed financial subsidies to newly deployed installations typically for decades ahead. By contrast, existing TGC has operated at a purely national basis, and weak or non-existing obligations on consumers to buy green energy may have provided a less stable investment climate.

However, a lot of renewable energy sources will be viable without any specific additional support given a strengthened ETS while Member States at the same time have to respond to binding and ambitious legal targets for renewable energy. *If* these are enforced vigorously, then either system should provide certainty that demand for renewable energy will increase in the coming years for the EU market as a whole.

The concept of investor certainty should also be understood broadly. Yes, a fixed feed-in support system can provide a very high level of certainty that a given project in a given year, will receive sufficient income over its life time to make it viable for the investor. But it does not provide safety about the future viability of that technology. Over the next decades, subsidies for each technology are subject to specific negotiations; the outcome of which may be difficult to predict. Finally, more certainty for some players in the energy market such as RES producers, may have to paid for by more uncertainty for others such as producers of traditional energy sources. Increased uncertainty could reflected in higher power prices and less investments for example in clean coal technologies. A prime example is fixed feed-in tariffs and priority access for wind energy that leads to more volatility in power markets as described above. Providing safety for certain investors is very seldom a "free lunch" for society as a whole.

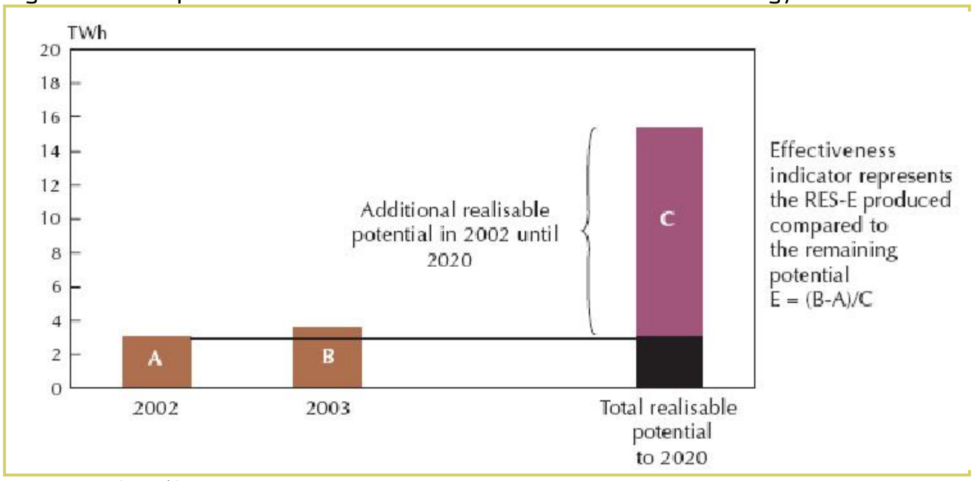
Achieving a *broad palette of technology platforms* has also been forwarded as an independent criterion for a successful renewable energy policy. So where does that leave us with re-

[7] Pöyry (2008), page 15.

spect to the support mechanism to be put in place? Projections show that hydropower, windmills and biomass will be the staple of renewable energy sources over the next decade.[8]

In order to achieve an even broader palette of technologies, there may be a case for supporting future technologies that are far from being mature today. With this perspective in mind, both IEA (2008) and Optres (2007) define an effectiveness indicator a*s* the ratio of actual new deployment to additional realisable potential technical deployment[9] as illustrated in Figure 1.. The actual deployment in 2003 is the difference between the columns B and A while the additional total realisable potential is illustrated by the column C. The more of the additional potential actually realised, the more effective the support scheme. This approach has the advantage that it takes account of country-specific effects by comparing the deployment to the country-specific potential.

Figure 1.3 Example of the effectiveness indicator for a RES-E technology



Source: IEA (2008b) p.89

Using the effectiveness criterion as defined requires some careful consideration of a number of factors. *First*, a realisable RES-E potential does not imply that it should be realised, exploitation of marginal RES-E technical capacity results in costs that are not proportionate with benefits. One of the benefits with a TGC scheme is that some of the expensive potential RES-E, e.g. early deployment of photovoltaic solar power, will be left unrealised and be substituted by trade with more cost-efficient technologies abroad to reach predefined goals. Thus, exploitation of technical capacity can never be a success criterion of its own.

Second, the effectiveness is evaluated per technology while it is the aggregate RES-E generation that really counts. A market based support scheme, e.g. TGC, leads to an efficient mix of technologies and attainment of objectives while a rigid fixed support scheme requires forecasts of demand and supply in order to be calibrated correctly. Such a system is both administratively burdensome and gives rise to regulatory uncertainty.

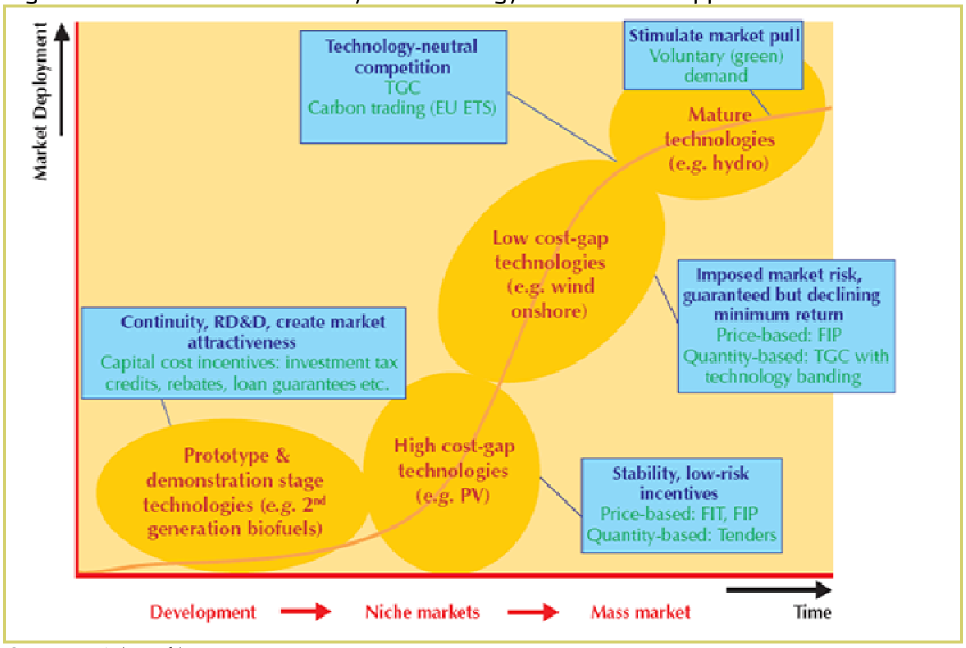
[8] See for instance EWI (2009).

[9] Optres (2007), p.33.

Third, a general point about support to renewable electricity generation technologies is that the support has many purposes; from supporting research in new technologies to accelerating deployment of mature technologies.

In line with the International Energy Agency, we suggest that different support systems are needed for the different purposes cf figure 1.3. Mature technologies such as hydropower and on-shore wind are largely profitable with the levels of carbon pricing via the "ETS allowances" foreseen for the EU in the electricity markets over the next decade, particularly with a bit more stringent carbon constraints. These technologies are placed to the very right in the figure as being close to the market. Potentially, additional and marginal support can be achieved by technology-neutral TCG. At the other end, we have support to basic research which is often receiving large public funding and where the benefits are often distributed free of charge. Second and even third generation biofuels are examples here. In between are technologies still in "development" which may need "demonstration project funding", more advanced in "high cost-gap" such as PV which can be supported for example by tender mechanisms (where a fixed volume is purchased from the producer who is willing to produce it at the lowest cost). Finally, we have "low cost-gap" technologies that may require some technology specific subsidy above the level of what TCG can provide, which *could* be provided by a premium feed in tariff system for example for off-shore wind perhaps also with a total cap of production to contain costs.

Figure 1.4 Link between maturity of technology and suitable support instrument



Source: IEA (2008b).

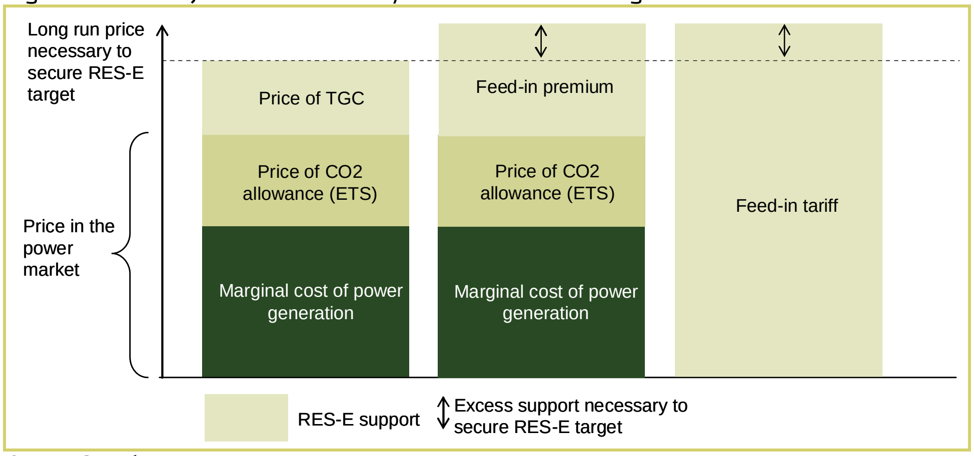
1.5. Co-functioning with other climate policy instruments

The role of support instruments for renewable electricity sources is basically to close the gap between what the new and strengthened ETS may provide and the target being set for renewable energy as a share of total electricity. With a TGC system, the support for renewable energy will in theory be equal to the cost-gap of the marginal option to the electricity price while with a fixed feed-in system; the support needs constantly to be reset by government action to close the gap.

For example, underestimation of how much the ETS system helps renewable energy producers leads to an excess supply of renewable energy through too high feed-in support tariffs and vice versa. So TGC and premium feed-in systems is the best match with the ETS system.

Another aspect of co-functioning is that energy savings compete with renewable energy as the best instrument to help reduce CO_2 emissions and enhance energy security. Within the constraints of having set legally binding renewable energy targets, we find that TGC has the best fit in terms of automatic adjustments to the effects of energy savings. With higher energy saving than expected, the need for renewable energy decrease as the target is determined as a share of total energy consumption. With a TCG system this happens automatically: energy savings drive down the price of CO_2 allowances and hence also the marginal support to renewable energy, while support levels stay unchanged with feed-in systems, cf. Figure 1..

Figure 1.5 TGC adjusts automatically to the renewable target level



Source: Copenhagen Economics.

Chapter 2 Projected RES trading: the policy perspective

2.1. Modest RES trading projected

During the first months of 2010 all Member States have submitted their forecast of their ability to reach their target share of renewable energy and to what extent they envisage to make use of the cooperation mechanisms in the directive. A review of the forecasts shows that eleven Member States consider using cooperation mechanisms with focus on joint projects whereas seven Member States also express interest in statistical transfers. In addition, four Member States note that they may use cooperation mechanisms to develop energy in third countries. In conclusion, some interest has been shown although the administrative framework for cooperation mechanisms is not set yet.[10]

The trade that may take place is however not of great significance. The forecasted deficit of renewable energy adds up to less than 1% of the total renewable energy produced if the directive's target is met. The surpluses from Member States overreaching their targets are somewhat larger, around 2% of the production needed in 2020. Hence, even if the cooperation mechanisms are used, current support schemes will not lead to any extensive trade and therefore also not to any large cost savings.

2.2. RES trade: good or bad?

An important aspect of the interpretation of the possible trade, given the forecasts, is whether the surpluses seen in many Member States are due to comparative advantages in production of renewable energy or if the surpluses are simply the result of (too) generous support systems. An illustrative example is the case of Germany, which is projected to have the second highest surplus in absolute numbers (exceeded only by Spain). Their surplus relative to their target is forecasted to be close to 20 GWh in 2020[11] while their production of electricity from photovoltaics is projected to be 32 GWh.[12] Therefore, all trade from Germany in 2020 may arguably be photovoltaic energy, being their marginal and most expensive power production.[13] This is clearly a consequence of the German support system and not of any comparative advantage relating to sites for extracting solar energy. Indeed, in EUs Commission original impact assessment of the climate and energy and climate package, Germany would be a net importer, not net exporter, of green electricity cf. figure 2.1.

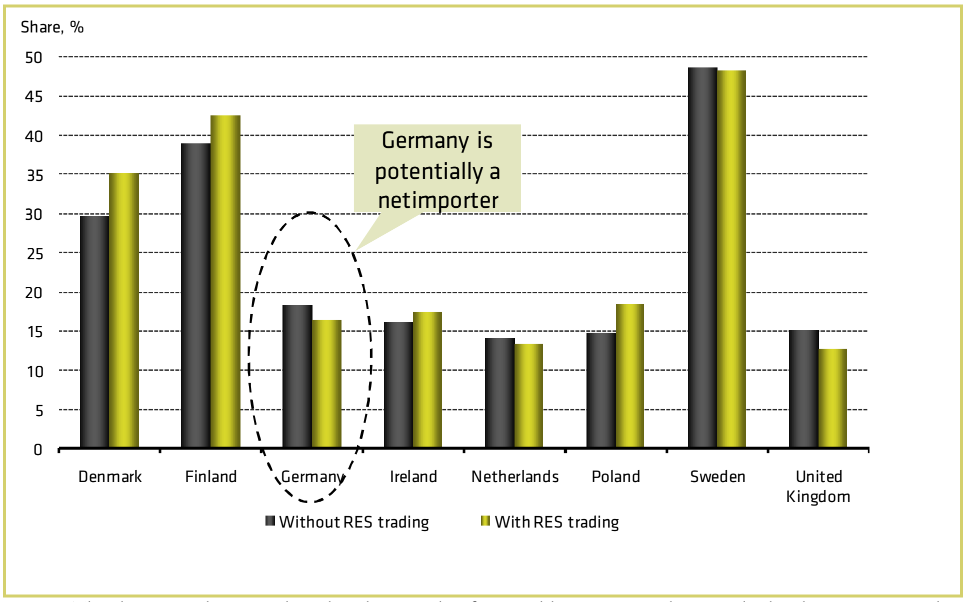
[10] EC (2010), Summary of the Member State forecast documents, available at http://ec.europa.eu/energy/renewables/transparency_platform/forecast_documents_en.htm.

[11] Germany stated a surplus of 1700 ktoe. The conversion factor is: 1 ktoe = 11.63 GWh.

[12] EPIA (2009) p.29.

[13] In 2006, the subsidy to photovoltaics was 380-543 €/MWh to be compared to 72-150 €/MWh for geothermal energy or 80-110 €/MWh for biomass and biogas, cf. Optres (2008).

Figure 2.1 RES share of final energy consumption in selected countries of North West EU

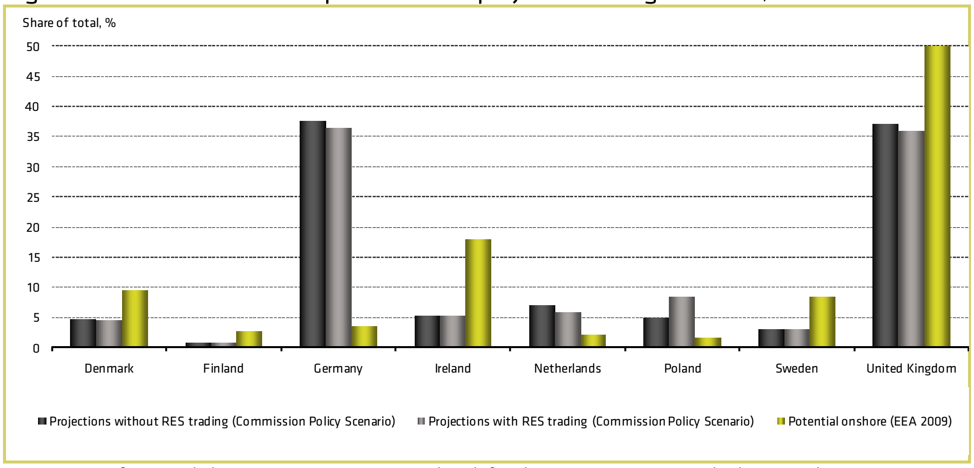


Note: The shares are shown with and without trade of renewable energy. Without trade the shares correspond to the RES target cf. the RES Directive

Source: Capros, P., L. Mantzos, V. Papandreou and N. Tasios (2008), Model-based Analysis of the 2008 EU Policy Package on Climate Change and Renewables

The imbalance between projected wind power generation and underlying economic potential is also apparent in figure 2.2, underlying the risk of major distortions in EU power market. Again focusing on Germany, which in a number of projections due to high support schemes are expected to increase wind power, indeed has low potential for low cost on-shore Wind power, and indeed also for off-shore wind where UK, Ireland has much better opportunities. The imbalances between economic potential and projections indicated the failings of an EU energy policy that forgotten on the importance of the internal market in helping attaining policy objectives. While we would not like to overemphasise the importance of ex-ante calculations of ex-ante comparative advantage, such analysis do suggest that a review of EUs policies towards RES goals are warranted.

Figure 2.2 National shares of potential and projected wind generation, 2020



Note: Sum of national shares sum to 100. Potential is defined as economic potential where wind generation up to the coast level of 5.5 euro cent / kwh are within economic potential

Source: Capros, P., L. Mantzos, V. Papandreou and N. Tasios (2008), Model-based Analysis of the 2008 EU Policy Package on Climate Change and Renewables, European Environment Agency (2009), Europe's onshore and offshore wind energy potential

2.3. THE WAY FORWARD: POLICY AND POLICY ADVICE

In the light of the limited prospects for gains from trade under the current support schemes and given the shortcomings of past evaluations of support schemes some fundamental questions and research topics emerge. We have defined two such questions of overall importance:

1. How can support schemes be evaluated in a broader and more comprehensive way than has been done so far helping long term reform? Especially, we expect that focusing on the gains from trading will potentially shift the conclusions concerning which type of support scheme has the greatest potential to lead to cost-effective deployment of RES-E capacity over the longet term
2. What can be done to exploit trade-based opportunities for compliance within the existing RES Directive in a near term perspective?

In our view, a promising approach to gain more insight in these topics would be to develop a model that can be used to estimate the gains of a common TGC market while combining that with complimentary instruments where relevant. Under the current RES directive trade is voluntary and there are mechanisms both for statistical transfers and joint projects between Member States.[14] The voluntary nature of trade under the current directive necessitates a forward looking approach to take into the national action plans that will be submitted to the Commission. With such a model, a set of scenarios could be developed and analysed to demonstrate the specific features of TGC that are not fully captured in hitherto published evaluations, namely:

[14] See article 6 through 8 of the EC (2009)

- *Low cost generation,* due to optimal location of capacity and by way of trading opportunities
- *Low consumer prices* in conjunction with rent taxation
- *Encouragement of viable new RES technologies* as money saved from expensive deployment of non-mature/non-viable technologies are spend on R&D
- *System integration* as TGC better than fixed feed-in systems punish technologies (wind) that are put up in areas and hence with the consequence that high amounts of power are supplied out of sync with market demand
- *Co-functioning with other climate instruments:* more tight climate policies (fewer allowances) or weaker general economic conditions (falling energy demand) automatically feeds in the pricing of TGC in a more productive way than feed-in tariffs

As regards the near future, it is worth considering whether a more harmonised EU approach could be accelerated in support areas where international co-operation is highly needed now. A prime example is off-shore wind located between the member states. In addition to more equal support rates to reduce distortions of competition, financing of the necessary grid investments between countries as well common rules for crediting the produced electricity against national RE-targets could be on the agenda.

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