EFFICIENT SUPPORT MECHANISMS FOR RENEWABLE ENERGY

STUDY PROPOSAL FOR NORDIC COUNCIL OF MINISTERS| 19TH DECEMBER 2011

INFORMED DECISIONS

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COLOPHON

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TABLE OF CONTENTS

BACKGROUND FOR THE STUDY

Miljö- och ekonomigruppen inbjuder er härmed att ge anbud till ett projekt om effektiva styrmedel för förnybar energi i Norden.

BAKGRUND

De nordiska länderna subventionerar producenterna av förnybar energi, i form av feed-in tariffer, handel med energicertifikat, befrielse från energi och Co2-skatten, etablerings stöd etc. samt stödjer förnybar energi via andra initiativ och politiska beslut. Förnybar energi är ett viktigt politikområde inte minst för klimatpolitiken, men kan också ha stor betydelse för andra miljömål, för andra mål inom energipolitiken som försörjningstrygghet, konkurrenskraft, grön företagsutveckling etc., och kan även vara negativt, till exempel för biologiskt mångfald. Vi behöver bättre underlag för beslut om vilka satsningar som ska göras på förnybar energi.

PROJEKTETS MÅLSÄTTNING

Syftet med projektet är att ge en översikt över tillgänglig kunskap och erfarenhet omkring styrmedel för främjande av utveckling och användning av förnybar energi, att bedöma effekten av olika styrmedel och former for förnybar energi för den totala klimatpolitiken och andra miljömål, att analysera kostnadseffektivitet av de nordiska ländernas styrmedel för förnybar energi, och att identifiera slutsatser gällande styrmedel för förnybar energi i Norden (vattenkraft, vindkraft, solenergi, bioenergi, geotermisk energi).

Konsulten ska utarbeta en rapport på engelska som analyserar nordiska ländernas politik om förnybar energi, med bakgrund i en genomgång av litteraturen (en state-of-the-art översikt) och empiriska studier om kostnadseffektivitet av nordiska ländernas politik. Nordiska studier (material som redan har framtagits i olika nordiska arbets¬grupper, särskilt Arbetsgruppen för förnybar energi (AGFE), och inte minst Energimyndigheter i nordiska länderna) bör vara i fokus men även EU:s, IEA:s och OECD:s arbete ska inkluderas, bland annat och senaste uttalandet från EEAs vetskapskommitté om ”Greenhouse Gas Accounting in Relation to Bioenergy” (15.09.2011).

Förnybar energi används i både elsektorn, värmesektorn och transportsektorn. Denna studie är begränsad till att analysera både produktion av elektricitet och värme, men täcker inte förnybar energi användt som transportbränsle.

Chapter 1 | THE SPECIFIC CONTENT OF THE STUDY

The Terms of Reference (ToR) specifies some key questions that the study should provide answers to. We intend to address these questions under four headings.

1. Description of the problem
   Including Levels of support, link between support levels and degree of development, possible overcompensation
2. Analysis
   Including: Development of evaluation tools, interaction with other energy and climate policy instruments, power markets etc)
3. Evaluation
   Including: Best practice within Nordic countries etc
4. Recommendations

1.1. DESCRIPTION

- Vilken nivå av stöd till förnybar energi tillämpas i de nordiska länderna för olika förnybara energiformer som producerar energi?
- Finns det ett samband mellan stödnivåer och graden av utbyggnad av förnybar energi (valuta för pengarna)?
- Kan man identifiera teknologier för förnybar energi, som får överkompensation i det nationella stödsystemet?

Source: ToR

While all descriptive and empirical in nature, the three questions moves somewhat from pure descriptive questions to issues that are somewhat more analytical and normative. Our approachwill be the following:

Level of support:

First we need to develop a conceptual framework for assessing the level of support. This requires us to describe the "neutral" benchmark and what is meant by non-support. We will mention a few key ingredients in this part of the work:

- All Nordic countries tax fossil fuels albeit not at the same levels. This implies that the implicit support to renewable energy from carbon pricing will vary. The study will focus on power generation which implies that the ETS allowance price has a uniform support level across all countries. However the tax treatment of biomass for the production of heat and power differs, this has implications for assessment of absolute and relative support levels from carbon pricing. Example: energy inputs to produce central heating is subject to both a CO_2 tax and an energy tax. "Pure" biomass is exempted by nature from the CO_2 tax, but also from the energy taxes which provides a de facto subsidy.
- The countries use different support mechanism and different support levels for the same technologies (feed-in tariffs, green certificates, direct expenditure support and tax expenditures). We will based our work on published sources (references in footnote), moreover we will verify our

findings on these rules with study group reports. However, the differences between countries also impliy that the effective estimated support level in some cases requires specific assumptions about power market developments: a fixed feed in tariff provides a support equal to the difference between the power market price and the tariff. A green certificate/premium certificate scheme provides a subsidy which is a mark-up on the power market price. Hence, the actual remuneration is independent of power market in the first place and dependent on the price in second case.

- What matters for investments in renewable energy, is the expected ex ante return over the life time of the assets of technologies in questions. Important is both the actual levels as well as its predictability. However, most of the previous assessment studies made focus on simple ex ante calculation, leaving out variability of return which affect risk premia and capital costs. In this part of the study we will also use this second simplified approach and address the issues about investment climate in the analytical part.
- To summarize, we will develop an indicator of the support to different technologies in the different countries which is essentially the support per unit of delivered energy over its life time. To ensure consistency we will look at the effect of both tax and direct support elements.

Link between support level and expansion of renewable energy

We will approach the question of the link between support levels and the expansion of renewable energy from a relatively non-normative angle as we are dealing with the rationality and role of renewable energy in the "Evaluation" and "Recommendation parts. In this part we will review thisquestion from x approaches:

- Simplistic approach: overall average level of support to renewable energy per unit against the share of renewable energy in power generation. We will look at this in a multiyear perspective
- A bit more advanced approach: we know that generation costs for renewable energy both on average and on the margin is substantially different within the Nordic countries (hydro power being on average substantially less costly than power from gas or coal fired plants). Will therefore also review the extent to which individual countries are expanding renewable energy along a cost-efficient national growth path, that is, if countries are rolling out the least costly technologies (or indeed using options for joint implementation of EU renewable energy targets).
- When evaluating the link between the support scheme and the level of support, it is important to note the differences in the Nordic countries' process of approving renewable energy investments, especially wind power. In some countries, this is increasingly becoming an obstacle for efficient geographic renewable energy deployment. In Sweden in particular, approval of wind power installations are to a large degree decided on the municipality level, where other incentives than efficiency from a cost and

wind condition perspective.[1] When considering the level of deployment from a specific support scheme, attention should also be paid to concrete legal approval processes.

Overcompensation of individual technologies

The concept of "overcompensation" for a technology is typically linked to remuneration exceeding the average or marginal generation costs for a particular technology. In other words the owners receive more than required to cover the operational costs including return on capital. We will approach this question from two main angles:

- Are there specific programs within the Nordic countries where there is clearly identifiable risks of overcompensation?
- What measures are Nordic countries taking to minimise the risk of "over"compensation"
- To what extent are overcompensation linked to resource rents? One example: the generation of hydro power is a low cost energy source. Over time, the required carbon pricing will provide a return to owners that far exceeds their average generation costs, but that does not imply that such source should not receive the same marginal support as technologies with higher average generation costs, at the margin. Our point is that the issues of overcompensation should not be reviewed in isolation from other factors affecting remuneration such as carbon pricing nor should the options for addressing "overcompensation" by targeted taxation of resource rents.

1.2. Analysis

- Projektet kan ta fram ett verktyg som kan fungera som stöd för beslut om satsning på utveckling av förnybar energi.
- Var det lönsamt på kort/lång sikt? Fanns en tekniktröskel som det inledningsvis krävdes statliga incitament för att komma över? Vad kan man lära sig för framtida satsningar?
- Vilka olika faktorer ska man ta hänsyn till vid ett sådant beslut? Tekniktrösklar, läroeffekter, inlärningskurvor, långsiktig potential, kostnadseffektivitet på kort och lång sikt, möjliga konflikter med andre miljömål (som biologisk mångfald) etc.
- I vilka faser av FOU-kedjan (utveckling, ibruktagande, utbud, efterfrågan) är olika stödordninger mest nödvändiga och effektiva? Eventuellt skulle man kunna utvärdera bakåt – titta på ett par olika exempel där man satsat på utveckling av ny teknik på detta område.

[1] Pettersson et. al (2010)

We will build our evaluation of support instruments on four evaluation criteria that we have developed in three former studies we have made in this area:

- The role and interaction of renewable energy instruments with wider energy related policies
- Ability to drive innovation
- Ensuring a strong investment climate for generation of renewable energy
- Reaching specific renewable energy targets at lowest costs

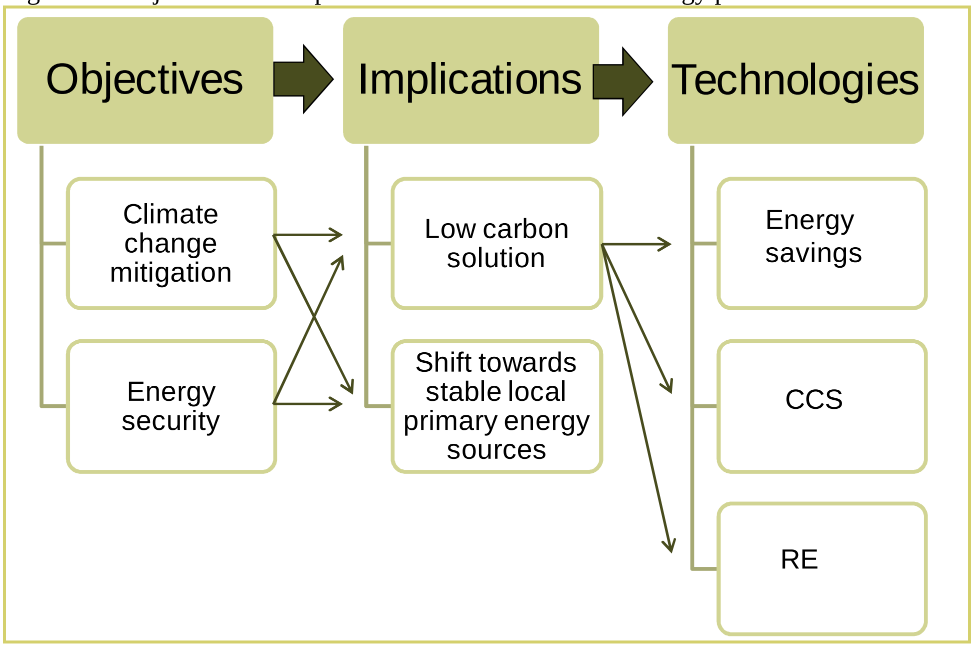
Within these headings we will adress the questions raised in the ToR

1.3. THE ROLE OF RENEWABLE ENERGY IN WIDER POLICY CONTEXT

Before discussing specific instruments and targets, we will recap the central objectives behind EU and member states energy policies. The first objective is to deal with the goals concerning climate change that requires a massive reduction in GHG emissions over time, particularly energy related CO2 emissions. The second objective is directly linked to energy security where renewable energy may reduce the dependency of imports of fossil fuels from what is projected to be an ever decreasing group of producers, located in potentially unstable regions of the world.

These two objectives have implications. Reducing energy related CO2 emissions requires low carbon solutions to energy production in the form of energy savings and deployment of (close to) zero carbon technologies such as CCS, wind power, biomass etc. The objective concerning energy security may also be attained by low carbon solutions (which lead to less import of fossil fuels) but ultimately it requires a more general shift towards the use of primary energy sources. Preferably produced "at home", or at the very least, produced in stable and friendly regions. When energy technologies are ranked after origin in this way, most renewable energy technologies come out top while coal is better than gas and gas is better than oil cf, FIGURE 1.2

Figure 1.1 Objectives and implications in EUs climate and energy policies



SOURCE: COPENHAGEN ECONOMICS

The next challenge is to convert the central objectives into specific and meaningful policy targets. Climate change, policy targets are, at least on paper, relatively straightforward: the central driving force in climate change is the level of accumulated emissions. We therefore need a path for emissions reductions that is both consistent with long term requirements and economically efficient (more about that below). The objective concerning energy security is substantially more difficult to operationalise: what is actually meant by being dependent and what is the willingness to pay for less dependency? We would propose a pragmatic strategy where climate change is the primary driver of policies while energy security is the secondary. One could also rank solutions that achieve the same emission reduction ambition according to their achievements in terms of energy security (IEA has in earlier work made a heroic attempt to establish such indicators).[2]

It is much more difficult to set targets for energy savings and deployment of low carbon technologies. Essentially these are competing solutions to the same problem and the proper mix should be based on cost-efficiency. Most certainly, it is highly unlikely that one, in advance, can design a mutually consistent mix of targets that are also cost efficient. We may be able to guess the generation costs of renewable energy in 10 years time and compare it to our estimates of marginal costs of energy savings, but that is unlikely to match reality in 2050 or just by 2020.

[2] IEA (2007), *ENERGY SECURITY AND CLIMATE POLICY: ASSESSING INDICATORS*

The conclusion to be drawn is that the most rational strategy to achieve the two overall objectives, given the large uncertainty about energy demand, costs, and technologies, is a mix of hard policy targets for GHG reductions and indicative implications for energy savings and deployment of renewable strategy.

As the EU policy framework is effectively binding for most of the Nordic area, the proposed evaluation strategy under this part will be:

- Are there arguments for Nordic countries to go beyond legally binding minimum targets for renewable energy given that overall emissions are determined by the ETS system?
- What do longer term considerations suggest about setting renewable energy targets beyond 2020?
- How do such changes relate to other policy instruments such as targets for the EU ETS system which determine prices in power markets and hence also partly the viability of renewable energy?
- To what extent will renewable energy policies help achieve strategic energy security. How will inclusion of such criteria as energy security and wider environmental sustainability affect ranking of renewable energy technologies?

1.4. Ability to drive 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[3]. However, tax induced innovation is not sufficient: returns on investment in innovation with benefits only to be reaped in one to two decades time are very uncertain and 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.

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[3] 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.

Hence, our shot at the best policy mix towards 2020, based substantially on work done by IEA/OECD has the following ingredients:

- Carbon pricing such as ETS can help the most mature renewable technologies to reach target compliance[4].
- On top of that, a TCG scheme – such as the joint Norwegian-Swedish scheme -- including also the most mature technologies (hydro power, biomass and land based wind power) can encouragehealthy competition among such already near stand alone technologies while further ensuring target compliance. Moreover, the safety net function of of a TGC – higher ETS price means lower TGC price and vice versa[5] – could reduce investment risks linked to the flucation of prices of ETS allowances.
- Furthermore, we also need public support for less mature technologies. Offshore wind is one of the most promising long term sources for renewable energy and is projected to see massive increases in the coming years. Given still high generation costs and investment risks, standard advice is to suggest fixed feed in tariffs as well as strong technology support to drive innovation.

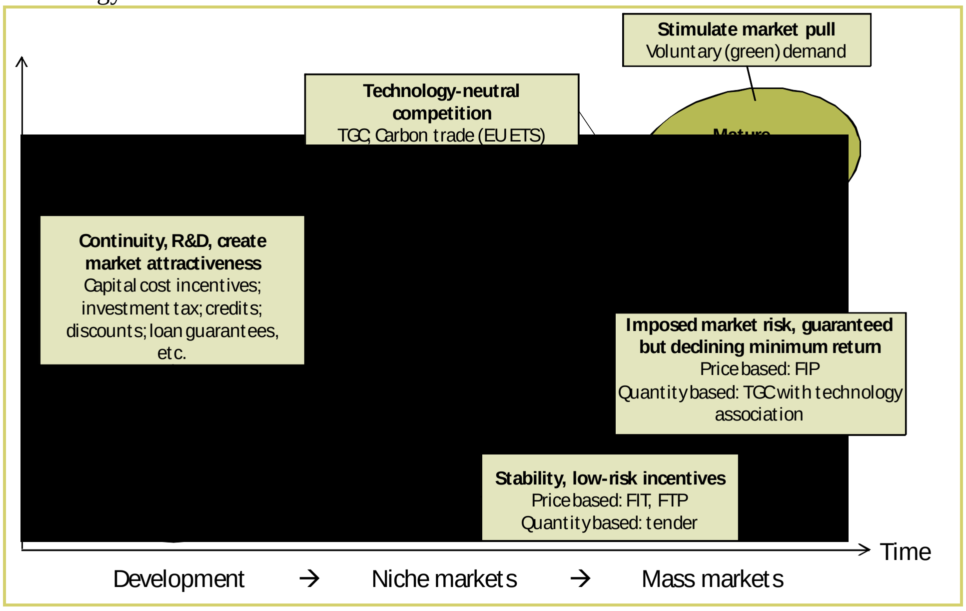
The study will focus on the appropriate mix between specific technology policies to boost research, development and innovation and support to deployment to achieve policy objectives. We will also discuss this in the context of the appropriate investment climate. An example: off shore wind development has extremely long investment cycles from the project phase to last year of deployment, making it potentially very vulnerable to change in support policies in the decades to come.

The success criterion for technology oriented policies 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 1.2. 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).

[4] 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 the level that was foreseen at the adoption of the Energy and Climate package in 2009

[5] 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 1.2 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 doubtful. 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 gaps6.

1.5. Ensuring a strong investment climate

There is a strong consensus in the literature that financing the huge expansion of renewable energy that is required to reach renewable energy targets will be a major challenge. After two decades with relative modest investments, Nordic countries as well as the rest of the EU will have to expand investment in power generation massively. In so doing, new types of investors will have to be tapped as traditional investors (mainly utilities) cannot finance this investment increase on the back of their own balance sheets. At the same time it is clear that current levels of carbon pricing within the EU is far too low to ensure viability, massive increases in public support is required. The literature suggest that reducing costs of capital - another

[6] COPENHAGEN ECONOMICS FORDG TAXUD (2010)

way of suggesting a strong investment climate – requires three conditions to be fulfilled. These conditions are;
1) The support is **high** enough (self evident)
2) Support is provided over a **long period**to ensure viability of longer term commitments
3) The support has strong **legal backing**

We will evaluate the commonly existing support mechanism and provide a guide to how they most effectively can be applied to deliver on these criteria. We will suggest that a wide palette of instruments are required as suggested above under the innovation discussion and that governments can do a lot to anchor investment expectations of future policies. We will do so in the context of concrete examples inside and outside the Nordic area. In this context we will draw on anongoing project for a major renewable energy company. That we are currently conducting, a project that will be finalised before the work with this proposed study would begin.

1.6. REACHING TARGETS AT LOW COSTS

In this part of the study, we will draw on the comparatively rich literature of studies. We will discuss and compare the different conclusions drawn and the assumptions on which they are based.

We will strongly underline that a simplistic choice between for example TGC schemes and feed-in tariffs are not meaningful: we have already underlined that different types of schemes is needed for technologies at different levels of maturity. The trick is to suggest a combination of instruments that both deliver a short to medium term target compliance for example as defined by the EU law while also promotes long term innovation of energy technologies which are required to deal with longer term and much sharper required reductions of emissions as agreed within the EU and much accepted and promoted within Nordic countries.

1.7. EVALUATION

Kan man identifiera "best practices"?

This part will essentially combine the two parts above namely the “descriptive” and “analytical” part. What is the current set up of policies in the Nordic countries and how do they match the four evaluation criteria that we have defined. Based upon this we can suggest some best practice among Nordic countries for each evaluation criteria as well as the overall performance. We will draw on our work for the Dutch ministry of economics in 2008 where we benchmarked all EU countries on climate and energy policies, including on renewable energy policies as well as EU as a whole.

1.8. Recommendations

Rapporten bör slutligen avslutas med slutsatser gällande styrmedel om förnybar energi i Norden.

Based upon all three parts above, but in particular the best practice evaluation we will provide recommendations to the Nordic countries in three dimensions and in this order:

- Given the strong dependence on the decisions taken at the EU level in relation to climate and energy policies, what should the priorities be in order to underpin the ability of Nordic government's investors and consumers, to make the most efficient decisions in the area of promotion of renewable energy in the wider policy context?
- What can the Nordic area do as a region to underpin performance at the national level? We will in particular focus on possible extension of the NO-Swedish TGC for mature technologies, possible increased research co-operation in areas of strong mutual interest, the importance of grid investment to facilitate the integration of massive increases in wind energy etc.?
- How could individual Nordic governments adopt their current national policies in this wider framework of international co-operation?