New Gameplan – RES Support in the Nordics

ON BEHALF OF THE NORDIC WORKING GROUP FOR RENEWABLE ENERGY UNDER THE NORDIC COUNCIL OF MINISTERS

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Foreword

The long term goals for sustainable climate and energy are a global political issues of high priority. The UN Paris climate conference (COP21) in December 2015 resulted in an international agreement to keep the increase in global average temperature to well below 2°C above pre-industrial levels and to aim to limit the increase to 1.5°C, since this would significantly reduce risks and the impacts of climate change.

The Nordic countries have been at the forefront of the development to a sustainable and low carbon energy system, and there is an interest to explore the added value of further cooperation in this field.

The Nordic Working Group for Renewable Energy (AGFE) was established by the Nordic Council of Ministers, and is coordinating cooperation on policy development among the five Nordic countries in the field of renewable energy. The following report is the result of a study undertaken by SWECO and ECOFYS on behalf of The Nordic Working Group for Renewable Energy. The purpose of the study is to provide an overview of different means to support the development of renewable energy in the light of the European State Aid Guidelines from 2014. The study includes international experiences with various policy measures and alternative paths for the Nordic countries.

There is a special emphasis on current policy measures supporting renewable energy in the electricity and transport sectors.

This report – New Gameplan – is a result of a two-year process, starting in 2014 and completed in June 2016. During the process there have been two seminars with experts from industry and policy makers, allowing for an exchange of best practices and discussion on the different possible cooperation paths.

The Nordic Working Group for Renewable Energy would like to thank all those who have participated in this process.

Stockholm, October 2016

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Sammanfattning för beslutsfattare

Drivet av både EU:s statsstödsregler och en vilja att minska stödsystemkostnader för förnybar går utvecklingen mot mer marknadsbaserade stödsystem. Studien visar att både elcertifikatsystem och auktionsbaserade system är potentiella stödsystem till förnybart elproduktion efter 2020, då de bägge två kan utformas relativt marknadsbaserat, kostnadseffektiv och teknikneutralt. För drivmedel rekommenderas ett koldioxidbaserat policyinstrument, där antingen kvotsystem eller skattelättnader bedöms vara det mest lämpliga. Ett ökat nordiskt samarbete med en gemensam nordisk inriktning tros vara värdeskapande. Det långsiktiga målet bör vara att alla teknologier på sikt ska kunna stå på egna ben, utan stödsystem.

Av de befintliga nordiska stödsystemen är det svensk-norska elcertifikatsystemet överlag att betrakta som kostnadseffektivt, då det är teknikneutralt och effektivt på att få in stora mängder förnybart i systemet. Dock innebär det samtidigt viss risk för marknadens aktörer, speciellt de som agerar tidigt, eftersom det är öppet för nya investeringar över en så pass lång tidsperiod. Även de auktioner som genomförts bedöms ha varit relativt kostnadseffektiva och har i högre grad möjliggjort för mindre mogna förnybara tekniker, såsom exempelvis havsbaserad vindkraft. Dagens auktionsbaserade system har dock relativt höga transaktionskostnader, vilket gör att de lämpar sig bäst för medelstora till storskaliga projekt.

Traditionellt är stödsystem i mångt och mycket konstruerade med en strikt nationell inställning och för nationellt nyttjande, dock är en nordisk samordning möjligt. Med förändrade statsstödsregler och definierade livslängder för systemen såsom det svensk-norska certifikatsystemet finns det dock nu ett unikt tillfälle för en nordisk samordnad inriktning. Inom samordningen – som hanterar de grundläggande spelreglerna för stödsystemet - finns det utrymme för respektive land att anpassa delar av stödet givet landets behov. En nordisk samordning skulle därför innebära en ytterligare förbättring av den externa bilden av Norden som en politiskt och elmarknadsmässigt stabil region. Inriktningen är dessutom kompatibel med statsstödsreglerna, förmodat kostnadseffektiv, minskar transaktionskostnader, ger en tillräcklig grad av teknikneutralitet och möjliggör samtidigt för planerar förnybar elproduktion. Både elcertifikat och auktionering är tänkbara alternativ för en sådan nordisk inriktning. En auktionering kan dock sägas vara mest fördelaktigt eftersom den enklare möjliggör nationell anpassning av teknikkategorier och målsättningar nedbrutna i önskade, mindre, tidsintervaller.

Det förslagna samordnade auktionsbaserade systemet för RES-E använder sig av tre teknikkategorier: en för mogna teknologier (såsom vattenkraft och landbaserad vindkraft), en för mindre mogna teknologier (såsom

havsbaserad vindkraft) samt en för planerbar förnybar elproduktion (exempelvis biobaserad kraftvärme). Dessa bör ha årliga mål för auktionsvolymer och ett pristak per teknologi. Detta möjliggör i sin tur både för kostnadskontroll (via pristak och auktionsvolymer) samt eventuell högre diversifiering. Givet att ett långsiktigt förnybarmål sätts samt att de auktionerade volymerna ligger inom ett visst volymintervall över tiden, skulle det innebära en betydande säkerhet för investerare samt en bättre planeringshorisont för de nordiska TSOerna. Nordiska länder som är väldigt fokuserade på kostnadseffektivitet bör först och främst fokusera på mogna teknologier med låga totalkostnader. Införandet av *Nordic RES-E Cost Monitor* rekommenderas, en oberoende projektspecifik analys av utbudskurvan för förnybar elproduktion för beslutsfattare i syfte att skapa bättre förståelse för projektkostnader, kostnadskomponenter och potentiell kostnadsutveckling och därmed en bättre långsiktig transparens för stödsystemkostnaden.

För alternativa bränslen har kvotsystem i kombination med skattelättnader eller skatteundantag visat sig vara effektiva åtgärder för en snabb introduktion av förnybara bränslen. Dessa har kombinerats med stödsystem riktade mot produktionsanläggningar, infrastruktur och alternativa fordon. Många stödsystem som varit utformade för att vara teknikneutrala har dock visat sig vara mer fördelaktiga för vissa bränslen, på grund av olika nivåer av teknisk utveckling och kostnad. För biodrivmedel verkar policyinstrument relaterade till utsläpp av växthusgaser, såsom koldioxidskatt eller kvoter för växthusgasutsläpp, vara det bästa långsiktiga alternativet för att skapa marknadsbaserat stöd på ett policymässigt effektivt, teknikneutralt och sannolikt kostnadseffektivt sätt. Dessa instrument har varit effektiva vid införandet av biodrivmedel såhär långt och de är teknikneutrala i den meningen att de stödjer utsläppsminskningar och inte specifika teknologier. Även vad gäller alternativa drivmedel och laddinfrastruktur tros en gemensam nordisk inriktning vara gynnsam. Detta med avseende på policy, planering för infrastruktur och tekniska standarder för att göra Norden till en av de ledande marknaderna för dessa fordon.

För utvecklingen av policy kring förnybar energi samt lärande inom detta område finns det fördelar i att ha ett nordiskt forum för utbyte av information och erfarenheter samt best practice från olika stödsystem.

Summary for policy makers

Looking beyond 2020, designing new support schemes requires a thorough process and can be split into three phases: market analysis, drafting, and evaluation. This report focuses on the market analysis and drafting proposals for further analysis.

Within RES-E, the market analysis shows that most Nordic countries use a mix of a primary support scheme and supporting measures such as tax reliefs or investment aid, mainly depending on maturity of the technology. For mature technologies, all Nordic countries use support during the operation phase over investment aid, in which the primary Nordic RES-E support schemes differ considerably in terms of degree of market integration and investor risk. Financing differs, policy costs increase quickly and limiting them through policy design is key. Most Nordic RES-E support schemes are financed via the state budget, although some schemes, such as the Joint Certificate system, are financed directly by end-users via levies. The countries use different measures to control policy costs via the premium level, support duration or supported volumes.

The Danish offshore wind market is the most mature in the Nordics and its tender system is adopted to the strategic importance of offshore wind for the country. Apart from supporting a technology with higher costs in principle, the scheme must be seen as both policy-effective and rather cost-efficient. It is an example for a well-designed support scheme, it has delivered the targeted volumes and could be used a role-model for other offshore support schemes.

The joint Swedish-Norwegian certificate market is generally viewed as cost-efficient, as the final cost passed on to the end consumer bills is rather low compared to other countries. That is however only partly a result of an efficient support scheme; it is also a result of the excellent resources in the Nordics, mainly in the form of wind, and a consequence of a fast technologic development. On the other hand, setting up a technology-neutral certificate system with a dominant and quickly cost-reducing and price-setting technology, such as new onshore wind-power in the Swedish-Norwegian system, may provide challenges for early investors in the market. This is especially true, when the market is open for new investments over such a long period as from 2003-2020 and beyond. However, setting up a completely technology-neutral support and joint scheme is challenging.

Recent RES-experience from the Continent shows that Germany, the Netherlands, the UK, France and Italy have introduced competitive bidding procedures to determine the level of support for some types of renewable energy. No country has introduced competitive bidding for all types of renewable energy. Parallel support schemes persist. A wide array of options can be considered when a country decides to implement auctions. There is no “one size fits all” approach. In practice, one observes that the designs of the auction schemes differ, both between countries and – where technology specific schemes exist – within countries.

Auction schemes are more likely to apply to medium and large scale installations. Transaction costs of tender systems are relatively high for small projects. Furthermore, smaller actors with a small portfolio are often not as well positioned to deal with the additional risk of an auction compared to larger market players. Therefore, countries tend to choose administratively determined support levels for small-scale installations and make use of the de minimis rule.

No country introduced technology-neutral auctions for all renewables. Germany, Italy, and France introduced mono-technology auctions, whereas the UK distinguishes between immature, mature technologies, and biomass conversions, and the Netherlands introduced quasi technology-neutral auctions for all technologies except wind offshore. Overall, experiences with auction schemes are mixed; if properly designed and implemented, auctions may lead to more efficient results than other support policies. It can be observed that auctions led to lower prices than previous administratively set levels. Yet, introduced schemes needed to be fine-tuned to cope with initial flaws, particularly to increase the realisation rate of awarded projects. Even if different technologies compete against each other in a more technology-neutral scheme, one technology often dominates the results, leading to de-facto mono-technology auctions and a discontinuation of support for other technologies. We can conclude that short-term allocative efficiency is the main argument for technology-neutral auctions, and long-term dynamic efficiency and long-term target achievement justify technology-specific auctions.

For Nordic alternative fuels, quota obligations in combination with tax reliefs or exemptions have proven an effective policy for a fast introduction of renewable fuels. Exemptions from high fuel taxes naturally give a strong support for renewable fuels, but must be complemented by a range of other measures, such as regulatory measures and investment support. The Swedish case for biofuels has shown that support is needed across the whole chain during a relatively long time period to yield results, since Sweden started the introduction of biofuels several decades ago and has during periods had relatively strong support systems in place along the whole fuel chain. Tax exemptions have been combined with support systems directed at production facilities, infrastructure and alternative vehicles; these have come in the form of both regulatory measures, such as the obligation to provide renewable fuels, and investment support. This has resulted in Sweden having one of the highest shares of renewable transport fuels in Europe and has encouraged the development of a range of fuels.

Experiences from all Nordic countries have shown that setting up technology-neutral support schemes for alternative fuels successfully is very challenging in practice. Despite intentions, many support schemes which are designed as technology neutral have favoured specific fuels, due to different levels of technical development and cost.

For European transport, low-blend ethanol and biodiesel have been the two main options for introducing renewable energy. There are also other options such as high blends of these fuels, biomethane or electric vehicles. The two European main support systems for biofuels have so far been tax exemptions and quota obligations with fines for non-compliance. Tax exemptions have been a vital part of the support systems and all member states with significant biofuel volumes have used them at some point. Initially, many of the member states used tax exemptions and then switched to a quota obligation/blending obligation because governments were not willing or able to pay for the support schemes. Tax exemptions have been especially effective in countries with high fossil fuel taxes, where an exemption naturally provides the most significant support.

Our recommendations from this study include: focus on cost and increase market orientation of the support schemes over time to limit policy costs with increasing supported volumes and assure public and political acceptance. The long-term aim should be that all technologies can be invested in on their own merits. Nordic countries that are very conscious about cost efficiency should first and foremost focus on mature technologies with low LCOE and a market-compatible support scheme with low risk for investors. We recommend the establishment of a *Nordic RES-E Cost Monitor*, an independent RES-E supply curve analysis for policy makers in order to better understand project cost, its cost elements and their potential development.

There is no absolute must to design for complete technology-neutrality right away. Technology-neutrality should only be a mid- or long-term target. The main policy instrument options beyond 2020 are auctions and the Certificate scheme. If one is willing to accept a halt in RES build-out, there is an option to use the electricity market without additional support. If a country wants to increase its share of RES, the electricity market without additional support is not an option as it does not yet provide sufficient incentives for investment into RES. Supporting this, all three main policy instrument options – auctions with fixed or sliding premium or a certificate market - provide a high degree of market orientation, with a sliding premium providing less investor risk for the auction options.

Multiple auctioning baskets provide a good compromise between technology-neutrality and targeting specific purposes. While it is not the only way forward, our report outlines how such an auction could look like: the baskets could, for example, be split into three: one for mature technologies (e.g. hydro and onshore wind), one less mature technologies (e.g. offshore wind), and one firm RES-E capacity (e.g. bio-power CHP) with annual auction target volumes and ceiling prices per technology. This would allow budget control via ceiling prices and auction volumes and potentially more diversification, if required. Provided that a long-term target is set and annually auctioned volumes are within a corridor, this would also provide sufficient certainty to investors.

The discussed policy instruments can be handled in different pathways: the *traditional pathway* with an evolutionary, strictly nationally-focused RES policy development and the *Nordic alignment pathway* which provides a number of advantages to the Nordic countries and to investors (Nordisk “nytte”).

In the *traditional* pathway, new support schemes are essentially designed with a strictly national mindset and for national use. The schemes beyond 2020 are either developments of existing schemes or new schemes in order to comply with the State Aid Guidelines. Essentially, administratively set premiums become auction-based premiums and the certificate scheme undergoes only slight improvements. These schemes can however differ substantially between the Nordic countries. In the *traditional*, nationally focused, pathway, both auctions and certificate schemes – either national or joint - are viable options.

With changing state aid guidelines and the defined duration of the schemes such as the Swedish-Norwegian joint certificate market, there is however a unique opportunity for Nordic RES-E support alignment now. In the Nordic *alignment* pathway we still have national schemes and a national focus on the targets and needs. However, these national schemes are now aligned and focus on a market-based, and in large parts identical, common Nordic framework. Within this framework, there is room for tailoring and adapting details to each of the Nordic countries’ needs. Alignment does only mean agreeing on a common framework between the Nordic countries. It does not mean joint schemes. However, if joint schemes and/or auctions are a long-term aim or an option, aligned policy instruments would provide a good foundation to build on.

This alignment approach could further improve the external view of the Nordics as an organised and politically stable market with a common electricity market, with strong and increasing physical interconnection and now with even an aligned RES-E support framework. The approach is both compatible with state aid guidelines, presumably cost efficient, provides a certain technology neutrality and simplifies the investor view of the Nordics as a whole. In principle, even for the aligned pathway, both auctions and certificate schemes are viable options. We do see however advantages using auctions with multiple baskets which can easily be tailored nationally rather than the Certificate system for this alignment pathway.

For biofuels, the policy mechanisms related to greenhouse gas emissions, such as carbon dioxide tax or greenhouse gas quota obligation, appear to be the best options in the long term for providing market-based support in a policy-effective, technology-neutral and likely cost-efficient way. These policy mechanisms have been effective in the introduction of biofuels so far and they are technology neutral in the sense that they only support emission reductions and not specific technologies. This could possibly also provide a dynamic efficiency as it provides an incentive to develop more advanced technologies with higher greenhouse gas emission reductions, but this has not yet been proven for the greenhouse gas quota obligation. Furthermore, both policy mechanisms have the potential to be cost efficient, although this depends on the design and implementation of them. The quota system could be combined with a gradually increasing carbon dioxide tax that applies to the net life cycle GHG emissions for all fuels, including renewable fuels. The taxation of carbon dioxide has already been initiated in the Nordic countries and it is a pathway that can provide market stability and clearly steer towards the long-term goals of reducing emissions from the transport sector. It is a pathway that can give support to the diverse Nordic market of renewable fuels, including the parts of the value chain that are not connected to the distributors of fossil fuel.

For electric vehicles, support schemes should reflect the importance total cost of ownership and infrastructure as important aspects for successfully introducing electric vehicles to a market. Significantly reducing the extra cost of an electric vehicle by reducing the investment and operational cost for the owner, whether via registration fee exemption or another means, increases the number of potential customers. However, support throughout the entire value chain is required to yield results: high subsidies for the initial user cost itself and operational support are not sufficient if infrastructure is lagging behind. Infrastructure for EVs must be supported and developed. Preferably infrastructure support is ahead of the user experience to provide convenience rather than irritation. Additional user benefits, such as being able to use bus lanes, free parking, free charging, and fee exemptions, have considerable potential to increase the attractiveness of EVs, both in terms of convenience and economy for drivers.

The potential for *nordisk nytte* for the Nordic countries in working together to reach RES targets naturally depends on the extent of cooperation and alignment; these provide benefits for policy makers and investors alike. For the development of RES policy and policy learning, at the simplest level, there is a benefit from having a forum for information exchange of experiences and best practice from the various support schemes implemented in each country, such as provided within the working group for renewables, AGFE.

A further step already discussed within the report would be to create a Nordic RES-E supply curve for the coming years. This would serve as a cost monitor for Nordic RES-E, both enabling the tracking and forecasting of technology and project cost level development in the different countries. Regardless of policy instrument and pathway chosen, this would create a transparent base for cost efficient policy design in the Nordic countries.

Of the two main pathways described within the report, the *alignment* pathway seems to be the most promising in the near future with regards to Nordic benefits, because it holds immediate benefits by further increasing the attractiveness of the Nordic region for RES investors and reducing transaction costs, which could increase competition and thereby potentially reduce overall policy cost. Alignment would create a more politically stable environment for investors as the main framework of the support could not be changed so easily without consent of other countries, although the ability to tailoring the support to national needs would still be maintained. Nordic alignment also provides a simpler market environment for investors that is easier to understand and enter. The area of offshore wind auctions provides a potential area of focus for alignment and possible cooperation. As mentioned within the report, there are several aspects that would benefit from being aligned between the countries, such as aligned auction schedules which could increase participation and competition in tenders and thereby reduce costs.

Also for alternative fuels and transport, there are several potential opportunities for *nordisk nytte* in aligning the Nordic support mechanisms for biofuels. A combination of a GHG quota and a carbon dioxide tax in all the Nordic countries would provide a larger and more stable market for developing second generation biofuels or any other type of renewable fuel. Such a market with common regulations and predictable development would enable long-term investment decisions. If the Nordic countries develop a common methodology for calculating the life cycle GHG emissions from different fuels as a basis for these support systems, then a common effort can be made to introduce this system into the EU framework.

Furthermore, an alignment would reduce the possibilities for subsidy shopping, where fuels are produced with investment support in one country and then sold in a country with market support. Another possible negative effect of unaligned support that could be reduced with alignment are for biofuels with large GHG reductions to be exported to countries that incentivise their use while other biofuels with smaller GHG reductions are imported. However, as biofuels can be traded on a global market, the Nordic alignment can only reduce the mentioned effects and not remove them entirely; to do so would require further alignment with other EU member states.

In addition, the alignment of technical standards and planning for charging infrastructure for zero-emission vehicles could enable an effective development of the infrastructure and make the Nordics one of the leading markets for these vehicles.

Summary for analysts

The EU has set ambitious climate change and energy sustainability targets in particular as part of its EU 2020 strategy. The progress of the Nordic countries towards their 2020 targets is good.

Each Member State is required to adopt a national policy framework for the development of energy from renewable sources, alternative fuels in the transport sector and the deployment of relevant infrastructure. In order to streamline the decision process and increase efficiency, a fundamental reform of the rules used to assess the compatibility of state aid with the internal market was launched in 2012. The resulting reform package, known as state aid modernisation (SAM) programme, included the revision of various state aid guidelines. The resulting 2014 guidelines promote a more market-based and more cost-efficient design of support schemes for RES generation. State aid continues to be allowed under certain well-defined conditions, used to correct for market distortions and failures and at the same time aiming to be more market-based.

As for aid for electricity from renewable sources during the operational phase, the two key aspects here under the new guidelines (with some exceptions) involve transitions to competitive bidding processes and premium-based support schemes, and a clear statement on green certificates.

- ***Competitive bidding processes*** for granting state aid. If a tender is technology-neutral, the Commission will judge it as proportionate and non-distorting. Technology-specific schemes are permitted if the scheme would otherwise have sub-optimal results that a different process design could not correct.
- ***Premium-based support schemes***, where RES generators must bid their production into the market. If generators are granted support, they receive a premium on top on the electricity price and should bear balancing responsibilities.
- ***Green certificates***: The key message here is that green certificate schemes that are open to all technologies do not constitute state aid, provided that they fulfil certain conditions, such as not fixing certificate prices in advance.

As for operating aid for energy from renewable sources other than electricity, the key provisions are:

- ***Food-based biofuels***: Investment aid for new and existing capacity is not permitted. Operating aid may be granted to biofuels whose production started before 2014 until the plant is depreciated and no later than 2020.
- ***Biomass plants after depreciation***: Renewable energy plants (not electricity) can receive operating aid until the plant is fully depreciated according to normal accounting rules.
- ***All biofuels.*** Biofuels subject to an obligation for supply or blending cannot be provided state aid except if they otherwise would be too expensive to come to market with only the obligation.

Investment aid percentage for non-bidding processes has been significantly reduced. While bidding processes continue to allow for investment aid of 100% of the eligible costs, cost eligibility for non-bidding processes is decreased and differs according to company size. Generally, smaller companies are eligible for a higher percentage, larger companies for a smaller percentage. For all company sizes, the percentage is reduced from the higher levels in the 2008-2014 guidelines, to levels just above those in the 2001-2008 guidelines.

Looking beyond 2020, designing new support schemes requires a thorough process and can be split into three phases: market analysis, drafting, and evaluation. This report focuses on the market analysis and drafting proposals for further analysis.

Within RES-E, most Nordic countries use a mix of a primary support scheme and supporting measures such as tax reliefs or investment aid, mainly depending on maturity of the technology. Most of the measures can be deemed successful in terms of policy effectiveness, since they contributed to achieving the respective RES-E targets or are well on their way to doing so. The Nordic measures differ however in deployment, market risk exposure, whether they are national or joint schemes, and in whether they are considered state aid or not. The measures also differ in predictability, flexibility and cost efficiency.

For mature technologies, all Nordic countries use support during the operation phase over investment aid. Finland and Denmark use technology-specific premium-tariff-based systems, while Sweden and Norway have one main technology-neutral support scheme to support power production from renewables: the Joint Electricity

Certificate scheme, running from 2012-2035. For the support of less mature and small-scale technologies, the countries tend to use a wider range of measures.

The primary Nordic RES-E support schemes differ considerably in terms of degree of market integration and investor risk. Support levels are set differently depending on scheme with both price-based and volume-based schemes existing. Denmark is using a mix of auction-based levels feed-in premiums for the offshore wind projects and administratively-set levels for other RES-E, while Finland exclusively uses administratively-set levels currently. Remuneration periods may differ from 12 to 20 years. Price levels for green certificates used in Norway and Sweden on the other hand are market-based and set continuously by supply and demand, driving short-term cost efficiency but increasing uncertainty for investors.

Financing differs, policy costs increase quickly and limiting them through policy design is key. Most support schemes are financed via the state budget, although some schemes, such as the Joint Certificate system, are financed directly by end-users via levies. Both the Danish and Finnish scheme attempt to limit policy costs in different ways. Both schemes allow to control policy costs via the premium level, although supported volumes are not entirely known upfront. Furthermore, eligibility is either limited by duration (e.g. 12 years in Finland), volume or installed capacity (e.g. tendered offshore projects in Denmark or capacity for biogas and onshore wind in Finland) resulting in a maximum amount established in the project approval decision of the Energy Authority. However limiting the support duration doesn't necessarily reduces policy costs compared to other options, as it also increases the level of required support.

Both the Danish and Finnish premium-tariff system are rather administration intensive. In order to differentiate efficiently between technologies, project sizes and other limitations, a significant administration is required. However, the same holds true for auctions and certificate schemes and seen in relation to total policy costs, administration costs are likely a smaller cost and thus less relevant. Best support scheme practice includes an element of not paying support during hours with negative prices, as Denmark does for offshore wind (limited to 300 hours per year).

The Danish offshore wind market is the most mature in the Nordics and its tender system is adopted to the strategic importance of offshore wind for the country. Apart from supporting a technology with higher costs in principle, the scheme must be seen as both policy-effective and rather cost-efficient. It is an example for a well-designed support scheme and has delivered the targeted volumes. Site development is provided by the state, with the Danish Energy Authority (DEA) as the competent authority for Danish offshore wind power projects. The DEA provides a "one-stop-shop" throughout the permission process, which is an important aspect for the success. Other lessons learnt include that avoiding overlap with other international auctions is advantageous and that an open, structured and fair dialogue between investors and contracting authorities can lead better auction results. On the other hand, high penalties and inflexible auction design can lead to low participation and high bidding prices.

The joint certificate market is generally viewed as cost-efficient, as the final cost passed on to the end consumer bills is rather low compared to other countries. That is however only partly a result of an efficient support scheme; it is also a result of the excellent resources in the Nordics, mainly in the form of wind, and a consequence of a fast technologic development. Setting up a technology-neutral certificate system with a dominant and quickly cost-reducing and price-setting technology, such as new onshore wind-power in the Swedish-Norwegian system, may provide challenges for early investors in the market. This is especially true when the market is open for new investments over such a long period as from 2003-2020 and beyond.

Setting up a completely technology-neutral support and joint scheme is challenging. There will always be the risk for overcompensating some low-cost technologies and projects with excellent resources, while effectively excluding high-cost technologies and projects at the same time. Also, setting up joint support schemes can take time. While there is no absolute need to align all details in a joint scheme, but it helps to be aligned as much as possible. Most of the main parameters such as eligible technologies should be aligned. However, some differences must be acceptable to all countries involved: energy taxes, tax reductions and exemptions and depreciation will almost inevitably differ and cannot be completely aligned for the single purpose of the joint scheme.

Support measures in alternative fuels and transport should be significant and cover the entire value chain in order to provide results. Key lessons learned from the Norwegian EV case are that, firstly, low total cost of ownership is important, but also that a low total cost of ownership is only one part of introducing a new type of vehicle; also important for success are the other user incentives as well as the strategic implementation of infrastructure to support the whole value chain. Other policy instruments directed at EV users have provided convenience, time savings and significant economic support. Such lessons carry the caveat that Norwegian households often have two cars and the EV has been purchased as a second car for shorter driving, and hence might not be so readily applied elsewhere.

Strong and comprehensive policies to build an initial market and infrastructure are necessary to attract and include actors in technology implementation.

Experiences from all countries have shown that setting up technology-neutral support schemes for alternative fuels successfully is very challenging in practice. Despite intentions, many support schemes which are designed as technology neutral have favoured specific fuels, due to different levels of technical development and cost.

Quota obligations in combination with tax reliefs or exemptions have proven an effective policy for a fast introduction of renewable fuels. Exemptions from high fuel taxes naturally give a strong support for renewable fuels, but must be complemented by a range of other measures, such as regulatory measures and investment support.

The Swedish case for biofuels has shown that support is needed across the whole chain during a relatively long time period to yield results. Sweden started the introduction of biofuels several decades ago and has during periods had relatively strong support systems in place along the whole fuel chain. The incentive of tax exemptions has been combined with support systems directed at production facilities, infrastructure and alternative vehicles; these have come in the form of both regulatory measures, such as the obligation to provide renewable fuels, and investment support. This has resulted in Sweden having one of the highest shares of renewable transport fuels in Europe and has encouraged the development of a range of fuels.

On the Continent, we have seen that Germany, the Netherlands, the UK, France and Italy have introduced competitive bidding procedures to determine the level of support for some types of renewable energy. No country has introduced competitive bidding for all types of renewable energy. Parallel support schemes persist.

A wide array of options can be considered when a country decides to implement auctions. There is no "one size fits all" approach. In practice, one observes that the designs of the auction schemes differ, both between countries and – where technology specific schemes exist – within countries.

The main design elements that countries should consider include, among others:

- the choice of the auctioned and remunerated item (e.g. kWh or kW)
- the choice between multi- and single-item auctions
- the grouping of technologies
- the timing of the auction and the realisation period
- the qualification criteria and liabilities when awarded,
- the auction procedure
- the frequency of the auction
- evaluation criteria and the corresponding pricing rule

Auction schemes are more likely to apply to medium and large scale installations. Transaction costs of tender systems are relatively high for small projects. Furthermore, smaller actors with a small portfolio are often not as well positioned to deal with the additional risk of an auction compared to larger market players. Therefore, countries tend to choose administratively determined support levels for small-scale installations and make use of the de minimis rule.

No country introduced technology-neutral auctions for all renewables. Germany, Italy, and France introduced mono-technology auctions, whereas the UK distinguishes between immature, mature technologies, and biomass conversions, and the Netherlands introduced quasi technology-neutral auctions for all technologies except wind offshore.

Experiences with auction schemes are mixed; if properly designed and implemented, auctions may lead to more efficient results than other support policies. It can be observed that auctions led to lower prices than previous administratively set levels. Yet, introduced schemes needed to be fine-tuned to cope with initial flaws, particularly to increase the realisation rate of awarded projects.

If different technologies compete against each other, one technology often dominates the results, leading to de-facto mono-technology auctions and a discontinuation of support for other technologies. We can conclude that short-term allocative efficiency is the main argument for technology-neutral auctions, and long-term dynamic efficiency and long-term target achievement justify technology-specific auctions.

Besides the introduction of auctions, other measures are currently taken to increase the market integration of renewables. Germany is currently in negotiations with other Members States on the opening of PV auctions. Several countries reform their system to avoid incentives to feed-in during hours of negative prices and countries switch from feed-in-tariffs to a feed-in-premium.

In the transport sector within Europe, low-blend ethanol and biodiesel have been the two main options for introducing renewable energy, but there are also other options such as high blends of these fuels, biomethane or electric vehicles.

The two European main support systems for biofuels have so far been tax exemptions and quota obligations with fines for non-compliance. Tax exemptions have been a vital part of the support systems and all member states with significant biofuel volumes have used them at some point. Initially, many of the member states used tax exemptions and then switched to a quota obligation/blending obligation because governments were not willing or able to pay for the support schemes. Tax exemptions have been especially effective in countries with high fossil fuel taxes, where an exemption naturally provides the most significant support. Not surprisingly, experience also shows, that a combination of quota obligation and tax exemptions yields the highest annual growth rate for biofuels.

The countries with fast introduction rates for PHEVs and EVs, for example, the Netherlands and France, have supported them among other measures with exemption from registration tax and reduced company car taxation. The Netherlands has also used exemption from circulation tax, while France has used an "ecological bonus" and local incentives like free parking as extra incentives for EVs.

Our recommendations from this study include: focus on reducing cost and increase market orientation of the support schemes over time to limit policy costs with increasing supported volumes and assure public and political acceptance. Nordic countries that are very conscious about cost efficiency should first and foremost focus on mature technologies with low LCOE and a market-compatible support scheme with low risk for investors. The long-term aim should be that all technologies can be invested in on their own merits.

We recommend the establishment of a *Nordic RES-E Cost Monitor*, an independent RES-E supply curve analysis for policy makers in order to better understand project cost, its cost elements and their potential development. This project-specific cost analysis should use detailed knowledge of the available resources locally, e.g. wind speed, water depth and distance to shore or fuel prices for biofuels, for both current projects and also as a forecast 5-10 years ahead. This analysis and insight could be used by policy makers in the RES policy design.

In order to reach very high shares of RES it is important to diversify in the long run. Furthermore, long-term stability and predictability is key. Public and political acceptance contributes to that long-term stability. Broad political agreement on energy policy is key, preferably based on thorough analysis of economic, environmental, power market and power system effects.

There is no absolute must to design for complete technology-neutrality right away. Technology-neutrality should only be a mid- or long-term target. According to the state aid guidelines technology-specific tenders are allowed if a bidding process open to all technologies would risk a "suboptimal result that cannot be addressed in the process design". The issue on "longer-term potential of a given new and innovative technology" could however be difficult to address with a technology neutral design. In particular if the aim is to use support schemes in order to decrease costs of less mature technologies, approaches that are not open to all technologies should likely be favoured. Likewise, "network constraints and grid stability" might allow for a less technology-neutral approach.

The main policy instrument options beyond 2020 are auction based feed-in-premiums and certificate schemes. If a country wants to increase its share of RES, the electricity market without additional support is not an option as it does not yet provide sufficient incentives for investment into RES. All three main policy instrument options – auctions with fixed or sliding premium or a certificate market - provide a high degree of market orientation, with a sliding premium providing less investor risk for the auction options.

Auctions can be designed as technology specific, technology neutral (one basket), or have various baskets for different types of technologies. The benefits of a one-basket option lie in its technology-neutrality and increased competition, while its disadvantages lie in potentially favouring more mature volume technologies, resulting in less diversification and the risk for overcompensation. In addition, if a country wanted to focus on more firm RES-E for reasons of system stability, an entirely technology-neutral design does not provide the answer.

Multiple auctioning baskets provide a good compromise between technology-neutrality and targeting specific purposes. While it is not the only way forward, the following describes how such an auction could look like: these baskets could, for example, be split into three: one for mature technologies (e.g. hydro and onshore wind), one less mature technologies (e.g. offshore wind), and one firm RES-E capacity (e.g. bio-power CHP) with annual auction target volumes and ceiling prices per technology. This would allow budget control via ceiling prices and auction volumes and potentially more diversification, if required. Provided that a long-term target is set and annually auctioned volumes are within a corridor, this would also provide sufficient certainty to investors.

The discussed policy instruments can be handled in different pathways. Our recommendations focus on two potential pathways: the *traditional pathway* with an evolutionary, strictly nationally focused RES policy development and the *Nordic alignment pathway* which provides a number of advantages to the Nordic countries and to investors (Nordisk "nytte").

In the *traditional* pathway, new support schemes are essentially designed with a strictly national mindset and for national use. The schemes beyond 2020 are either developments of existing schemes or new schemes in order to comply with the State Aid Guidelines. Essentially, administratively set premiums become auction-based premiums and the certificate scheme undergoes only slight improvements. These schemes can however differ substantially between the Nordic countries. In the *traditional*, nationally-focused pathway, both auctions and certificate schemes – either national or joint – are viable options.

With changing state aid guidelines and the defined duration of the schemes such as the Swedish-Norwegian joint certificate market, there is now a unique opportunity for Nordic RES-E support alignment. In the Nordic *alignment* pathway we still have national schemes and a national focus on the targets and needs. However, these national schemes are now aligned and focus on a market-based, and in large parts identical, common Nordic framework. Within this framework, there is room for tailoring and adapting details to each of the Nordic countries' needs. Alignment does only mean agreeing on a common framework between the Nordic countries. It does not mean joint schemes. However, if joint schemes and/or auctions are a long-term aim or an option, aligned policy instruments would provide a good foundation to build on.

This alignment approach could further improve the external view of the Nordics as an organised and politically stable market with a common electricity market, with strong and increasing physical interconnection and now with even an aligned RES-E support framework. The approach is both compatible with state aid guidelines, presumably cost efficient, provides a certain technology neutrality and simplifies the investor view of the Nordics as a whole. In principle, even for the aligned pathway, both auctions and certificate schemes are viable options. We do see however advantages with using auctions with multiple baskets which can easily be tailored nationally rather than the Certificate system for this alignment pathway.

For biofuels, the policy mechanisms related to greenhouse gas emissions, such as carbon dioxide tax or greenhouse gas quota obligation, appear to be the best options in the long term for providing market-based support in a policy-effective, technology-neutral and likely cost-efficient way. These policy mechanisms have been effective in the introduction of biofuels so far and they are technology neutral in the sense that they only support emission reductions and not specific technologies. This could possibly also provide a dynamic efficiency as it provides an incentive to develop more advanced technologies with higher greenhouse gas emission reductions, but this has not yet been proven for the greenhouse gas quota obligation. Furthermore, both policy mechanisms have the potential to be cost effective, although this depends on the design and implementation of them.

Nevertheless, the general drawbacks of a quota obligation may be challenging to overcome, such as difficult implementation, less incentive to innovate, and variable economic support to producers. With increasing shares of different types of renewable fuels, it will be difficult to design and implement quota systems, for example when trying to reach a fossil-fuel-independent vehicle fleet. Furthermore, if large volumes of biofuels are based on lignocellulosic biomass and produced in large-scale facilities, a long-term, stable support is necessary. This cannot be provided solely by a quota system but to some extent by a carbon dioxide tax.

The quota system could be combined with a gradually increasing carbon dioxide tax that applies to the net life cycle GHG emissions for all fuels, including renewable fuels. The taxation of carbon dioxide has already been initiated in the Nordic countries and it is a pathway that can provide market stability and clearly steer towards the long-term goals of reducing emissions from the transport sector. It is a pathway that can give support to the diverse Nordic market of renewable fuels, including the parts of the value chain that are not connected to the distributors of fossil fuel.

For zero emission vehicles (ZEVs), support schemes should reflect the importance total cost of ownership and infrastructure as important aspects for successfully introducing these vehicles to a market. Significantly reducing the extra cost of an electric vehicle by reducing the investment and operational cost for the owner, whether via registration fee exemption or another means, increases the number of potential customers. However, support throughout the entire value chain is required to yield results: high subsidies for the initial user cost itself and operational support are not sufficient if infrastructure is lagging behind. Infrastructure for ZEVs must be supported and developed. Preferably infrastructure support is ahead of the user experience to provide convenience rather than irritation.

Other tangible and intangible benefits may have a huge positive impact. Additional user benefits, such as being able to use bus lanes, free parking, free charging and fee exemptions, have considerable potential to increase the attractiveness of ZEVs, both in terms of convenience and economy for drivers.

The potential for *nordisk nytte* for the Nordic countries in working together to reach RES targets naturally depends on the extent of cooperation and alignment; these provide benefits for policy makers and investors alike. For the development of RES policy and policy learning, at the simplest level, there is a benefit from having a forum for information exchange of experiences and best practice from the various support schemes implemented in each country, such as provided within the working group for renewables, AGFE.

A further step already discussed within the report would be to create a Nordic RES-E supply curve for the coming years. This would serve as a cost monitor for Nordic RES-E, both enabling the tracking and forecasting of technology and project cost level development in the different countries. Regardless of policy instrument and pathway chosen, this would create a transparent base for cost efficient policy design in the Nordic countries.

Of the two main pathways described within the report, the *alignment* pathway seems to be the most promising in the near future because it holds immediate benefits for RES investors by further increasing the attractiveness of the Nordic region and reducing transaction costs, which could increase competition and thereby potentially reduce overall policy cost. Alignment would create a more politically stable environment for investors as the main framework of the support could not be changed so easily without consent of other countries, although the ability to tailoring the support to national needs would still be maintained. Nordic alignment also provides a simpler market environment for investors that is easier to understand and enter. The area of offshore wind auctions provides a potential area of focus for alignment and possible cooperation. As mentioned within the report, there are several aspects that would benefit from being aligned between the countries, such as aligned auction schedules which could increase participation and competition in tenders and thereby reduce costs.

As for alternative fuels and transport, there are several potential opportunities for *nordisk nytte* in aligning the Nordic support mechanisms for biofuels. A combination of a GHG quota and a carbon dioxide tax in all the Nordic countries would provide a larger and more stable market for developing second generation biofuels or any other type of renewable fuel. Such a market with common regulations and predictable development would enable long-term investment decisions. If the Nordic countries develop a common methodology for calculating the life cycle GHG emissions from different fuels as a basis for these support systems, then a common effort can be made to introduce this system into the EU framework.

Furthermore, an alignment would reduce the possibilities for subsidy shopping, where fuels are produced with investment support in one country and then sold in a country with market support. Another possible negative effect of unaligned support that could be reduced with alignment are for biofuels with large GHG reductions to be exported to countries that incentivise their use while other biofuels with smaller GHG reductions are imported. However, as biofuels can be traded on a global market, the Nordic alignment can only reduce the mentioned effects and not remove them entirely; to do so would require further alignment with other EU member states.

In addition, the alignment of technical standards and planning for charging infrastructure for zero emission vehicles could enable an effective development of the infrastructure and make the Nordics one of the leading markets for these vehicles.

1. Introduction

This section provides a short background for this study as well as a description of its scope.

1.1 Purpose of the study

Sweco Energuide AB, in cooperation with Ecofys, have been commissioned by Nordic Energy Research on behalf of the Working Group for Renewable Energy to investigate the impact of the revised Guidelines on current Nordic state aid measures in the form of support schemes designed to promote renewable energy in the Nordic countries. Sweco and Ecofys are solely responsible for the content of this report.

The key aims of this report are the following: to investigate a selection of the schemes that each Nordic country are currently using to increase the share of renewable energy in their electricity and transport sectors; to look towards the European continent and learn from experiences with RES support schemes, especially auction-based ones, there; to formulate recommendations for designing new policies post-2020 to increase the share of renewables in each Nordic country in the light of the new State Aid Guidelines and in the context that support is considered a requirement to reach RES targets.

The Working Group for Renewable Energy expects the results of this study to contribute to future discussions about possible changes to Nordic support schemes that beyond 2020.

1.2 Background for the study

Nordic co-operation will help to continue the development of a sustainable energy system in the Nordic region and also internationally. Exchange of experience about planning, support, implementation and integration of renewable energy in the energy system is important for the Nordic working group for renewable energy. This applies not least to the common Nordic electricity market.

The EU's directive on renewable energy from 2009 is now more central than ever for the work on renewable energy in the Nordic countries. The Directive establishes a common framework for the promotion of energy from renewable sources by 2020. In January 2014 the European Commission proposed a framework for climate and energy up to 2030. In this respect, renewable energy to play an important role in fostering a reduced dependence on imported energy in the EU. The Renewable Energy Directive from 2009 is the framework for climate and energy until 2030 without a national burden-sharing.

The Nordic countries have different support systems to promote renewable energy within electricity generation. Norway and Sweden have a joint electricity certificate market since 2012. Finland has renewed its support for renewable electricity in 2011 and adopted a system of "feed-in" tariffs. Support for renewable energy area to the electricity production in Denmark is mainly through feed-in premiums. Support for electricity generation from solar cells were converted in Denmark in 2013 to avoid an overcompensation to electricity producers. Iceland does not provide support for renewable energy in electricity and heat.

The European Commission adopted new guidelines for how Member States should provide state aid for environmental protection and energy during the period 2014-2020 in april 2014. The guidelines will be followed both by the three Nordic Member States (Denmark, Finland and Sweden) and the two EEA countries, Iceland and Norway. The Commission indicates in the new regulatory provisions that the principles of state aid apply until 2020, but simultaneously also should form the basis for achieving the objectives in the EU's energy - and climate framework for 2030. This means that the Nordic countries will have to consider whether the current support systems can continue unchanged or have to be modified within this time frame.

European Commission's new guidelines on state aid for environmental protection and energy are placing increased emphasis on the use of market instruments. As a general rule, support for renewable energy should be technology-neutral. A technology-specific bidding process will only be allowed if a bidding process open to all technologies would risk a “suboptimal result that cannot be addressed in the process design”.

If countries choose to use premium-tariffs, there is increased focus on bidding rounds ("a competitive bidding process") where all invited manufacturers can compete on the size of the aid on an equal level. Already in 2015 and 2016, at least 5 per cent of planned new electricity generation capacity from premium tariff RES must be granted through competitive bidding processes based on clear, transparent and non-discriminatory criteria.

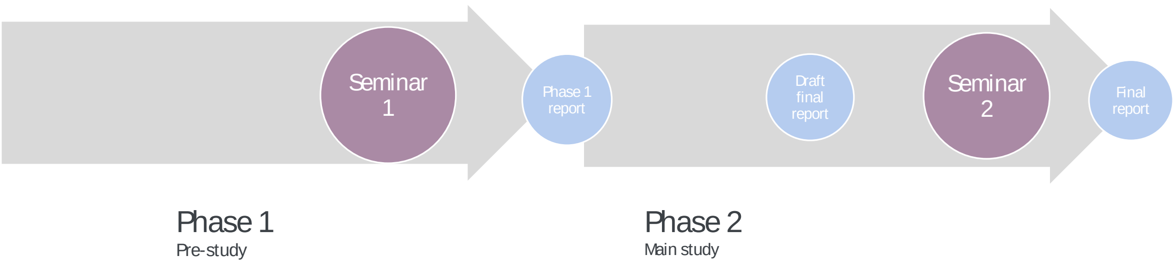
From January 1st 2017, EEA states must grant all state aid through competitive bidding processes, with few exceptions. Exceptions apply if it can be demonstrated that either only one or a very limited number of projects or sites could be eligible, competitive bidding would lead to higher support levels, for instance in cases of strategic bidding, or that competitive bidding would result in lower deployment, for instance in cases of underbidding. Increased use of bidding rounds is a development step compared to existing support systems in Denmark and Finland.

The European Commission stated already in the beginning of 2003 that the distribution of free electricity certificates to producers back frame for electricity certificate system does not involve any loss of state assets since the certificates are proof that the green electricity is produced. Then found the Commission that the benefit is awarded to producers of green electricity through the sale of electricity certificates on the market do not constitute state aid under EU law.

At EU level there are also targets for the share of renewable energy in the transport sector until 2020. Since the transport sector accounts for a large proportion of greenhouse gas emissions, the renewable energy and other CO2-efficient techniques in the transport sector still promoted after 2020. The new EU regulations in some cases change the requirements for granting support for renewable energy in the transport sector. For example, For example, the possibility of providing tax benefits for biofuels will be limited, a situation that is going to affect existing Swedish support measures forward.

1.3 Terms of reference

The project comprises a main study, and a pre-study leading to the main study. The complete terms of reference, as well as amendment agreed on at start-up meeting, are provided as Annex B and C to this report.



Phase 1: The pre-study

The purpose of the pre-study is to prepare for the main study, and consists of two tasks:

Phase 2: The main study

The terms of reference of the project require that the main study includes the following tasks:

Changes from the original terms of reference:

1.4 Structure of the report

The report is divided into the following sections:

- Chapter 2 - Overview of relevant EU Directives as well as the state aid guidelines, Nordic targets and achievement status as well as RES policy design.
- Chapter 3 - Status quo in the Nordics including national targets, policies and support measures for renewables with focus on the electricity and transport sectors. This chapter includes a relatively comprehensive summary of support schemes for RES within the electricity generation, transport and industrial use segments of the energy sector. The chapter concludes with lessons learned.
- Chapter 4 – Lessons learned from other EU member states. Focus is recent experiences with auctions and technology neutrality vs technology specific schemes
- Chapter 5 – Recommendations for the Nordics. Forward looking to 2030 and beyond, recommendations for design features of future support measures.

- Chapter 6 – Appendix: details on selected Nordic support measures
- Chapter 7 – Appendix: review of selected support measures from other EU member states. The emphasis of this chapter is to provide a sample of support measures with different characteristics for comparative purposes, and also includes an assessment of the selected measures.

2. Status quo: EU directives, state aid, and Nordic targets

The EU has set ambitious climate change and energy sustainability targets in particular as part of its EU 2020 strategy. The progress of the Nordic countries towards their 2020 targets is good. Although several EU legislative acts already support the achievement of these targets, such as the EU ETS, the Renewable Energy Directive (RED), the Fuel Quality Directive and the Alternative Fuel Infrastructure Directive (AFI), their implementation may not always result in the most efficient market outcome.

Each Member State is required to adopt a national policy framework for the development of energy from renewable sources, alternative fuels in the transport sector and the deployment of relevant infrastructure. This framework shall, inter alia, cover an assessment of the current state and future development of the market as regards alternative fuels in the transport sector and of the development of alternative fuels infrastructure and national targets concerning the number of recharge points for electric vehicles, inland waterway vessels, the number of refuelling points for LNG and the number of CNG refuelling points.

Despite the stated aims of these directives, market distortions and failures can occur; state aid, although generally not permitted, is allowed to correct for these. State aid in itself has the potential to distort competition and affect trade within the internal European market in a way that undermines the common European interest and is therefore generally banned. There are, however, numerous exceptions to this ban, allowing EEA States to grant state aid under certain circumstances: when state aid can achieve well-defined objectives of common European interest while facilitating improvements that markets alone would not deliver, for instance by correcting well-defined market failures.

The Commission highlighted **four issues** in particular that were **leading to market distortions** and requiring attention as the market share of renewable generation increases:

- Administratively set support levels has resulted in over-deployment of renewable generation in some Member States.
- Market fragmentation has led to subsidy shopping, whereby investment has ended up in the country with the largest subsidies.
- There are fewer incentives to invest in thermal generation capacity.
- Maturity of some technologies should prompt revision of support levels.

To address these market distortions and promote a more market-based and more cost-efficient design of support schemes for RES generation, the 2014 Guidelines thereby introduced significant policy shifts.

State aid continues to be allowed under certain well-defined conditions, used to correct for market distortions and failures and at the same time aiming to be more market-based. In order to streamline the decision process and increase efficiency, a fundamental reform of the rules used to assess the compatibility of state aid with the internal market was launched in 2012. The resulting reform package, known as state aid modernisation (SAM) programme, included the revision of various state aid guidelines. The resulting 2014 guidelines promote a more market-based and more cost-efficient design of support schemes for RES generation.

As for aid for electricity from renewable sources during the operational phase, the two key aspects here under the new guidelines (with some exceptions) involve transitions to competitive bidding processes and premium-based support schemes, and a clear statement on green certificates.

- ***Competitive bidding processes*** for granting state aid. If a tender is technology-neutral, the Commission will judge it as proportionate and non-distorting. Technology-specific schemes are permitted if the scheme would otherwise have sub-optimal results that a different process design could not correct.
- ***Premium-based support schemes***, where RES generators must bid their production into the market. If generators are granted support, they receive a premium on top on the electricity price and should bear balancing responsibilities.
- ***Green certificates***: The key message here is that green certificate schemes that are open to all technologies do not constitute state aid, provided that they fulfil certain conditions, such as not fixing certificate prices in advance.

As for operating aid for energy from renewable sources other than electricity, the key provisions are:

- ***Food-based biofuels***: Investment aid for new and existing capacity is not permitted. Operating aid may be granted to biofuels whose production started before 2014 until the plant is depreciated and no later than 2020.
- ***Biomass plants after depreciation***: Renewable energy plants (not electricity) can receive operating aid until the plant is fully depreciated according to normal accounting rules.
- ***All biofuels.*** Biofuels subject to an obligation for supply or blending cannot be provided state aid except if they otherwise would be too expensive to come to market with only the obligation.

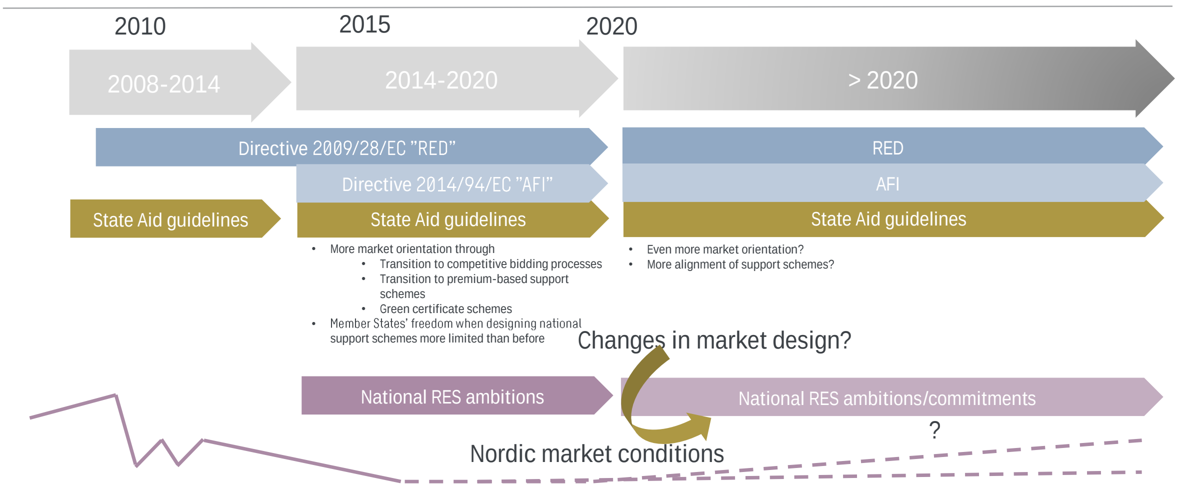
Investment aid percentage for non-bidding processes has been significantly reduced. While bidding processes continue to allow for investment aid of 100% of the eligible costs, cost eligibility for non-bidding processes is decreased and differs according to company size. Generally, smaller companies are eligible for a higher percentage, larger companies for a smaller percentage. For all company sizes, the percentage is reduced from the higher levels in the 2008-2014 guidelines, to levels just above those in the 2001-2008 guidelines.

Looking beyond 2020, designing new support schemes requires a thorough process and can be split into three phases: market analysis, drafting, and evaluation. In the *market analysis and lessons learnt phase*, a country's support schemes can be benchmarked against others and these can be checked for their applicability for the Nordic countries and analysed; an extensive cost analysis is also important. In the *drafting phase*, decisions about the instrument of choice have to be made and the various design elements and their options become important. In the *evaluation phase*, the drafted support schemes are assessed for the primary and secondary evaluation criteria, ranging from expected policy effectiveness, cost efficiency and socio-political acceptability to a check of their legal feasibility and compatibility with market principles.

EU Directives and State Aid Guidelines

In what follows we outline the relevant EU Directives and most relevant policy shifts introduced by the revision of the Guidelines on State Aid for Environmental Protection, with a main focus on state aid for energy from renewable sources.

Figure 1: Overall context for the development of renewables in the Nordics



Beyond this framework, the design of RES policies can be impacted by national ambitions and commitments, national and regional market conditions, and the existing market design, its challenges and any planned changes.

2.1.1 EU directives

In order to reach such goals as the reduction of greenhouse gas emissions and complying with the Kyoto Protocol, a common binding European framework was initially shaped via two directives to promote electricity from renewable energy sources and to promote the use of renewable fuels for transport.[1] These initial directives have developed into the following:

- Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources[2] ("the Renewables Directive", or "RED")
- Directive 2014/94/EU of 22 October 2014 on the deployment of alternative fuels infrastructure ("the AFI Directive")

2.1.1.1 Directive 2009/28/EC on the promotion of the use of energy from renewable sources[3]

The Directive aims at a common framework to promote energy from renewable sources. In the spring of 2009 a new directive on the promotion of the use of energy from renewable sources ("the Renewables Directive") entered into force. The directive is aimed at establishing a common framework for the promotion of energy from renewable resources. It contains mandatory national targets for the overall share of energy from renewable sources in the gross final consumption of energy and for the share of energy from renewable sources in transport.

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1 Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market and Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport.

2 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance).

3 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance).

The Renewables Directive has been incorporated into the EEA Agreement. This means that also Norway and Iceland have renewable energy targets.

Within the Directive, several measures are possible. The Renewables Directive further includes rules on statistical transfers between Member States, joint projects between Member States and with third countries, guarantees of origin, administrative procedures, information and training and access to the grid for energy from renewable sources. In addition is establishes sustainability criteria for biofuels and bio liquids. The scope of the directive relates to 'energy from renewable sources' which is defined as energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.[4]

Member States may, inter alia, apply support schemes or measures of cooperation between different Member States and with third countries in order to achieve their national overall targets. The Renewables Directive defines 'support schemes' as "*any instrument, scheme or mechanism applied by a Member State or a group of Member States, that promotes the use of energy from renewable sources by reducing the cost of that energy, increasing the price at which it can be sold, or increasing, by means of a renewable energy obligation or otherwise, the volume of such energy purchased. This includes, but is not restricted to, investment aid, tax exemptions or reductions, tax refunds, renewable energy obligation support schemes including those using green certificates and direct price support schemes including feed-in tariffs and premium payments*."[5]

A 'renewable energy obligation' is further defined as: "a national support scheme requiring energy producers to include a given proportion of energy from renewable sources in their production, requiring energy suppliers to include a given proportion of energy from renewable sources in their supply, or requiring energy consumers to include a given proportion of energy from renewable sources in their consumption. This includes schemes under which such requirements may be fulfilled by using green certificates."[6]

Member States have the right, without prejudice to Articles 107 and 108 TFEU, to decide to which extent they support energy from renewable sources which is produced in another Member State. In the Åland Vindkraft-case this freedom was contested.

A number of options for cooperation between Member States are contained in the Renewables Directive, including joint projects and statistical transfer. Joint projects between Member States and between Member States and third countries are allowed. All types of joint projects relating to the production of electricity, heating or cooling from renewable energy sources are possible.

In addition, Member States may agree on statistical transfer of a specified amount of energy from renewable sources from one Member State to another Member State. This will lead to a deduction from the amount of energy from renewable sources that is taken into account in measuring compliance by the Member State making the transfer and added to the amount of energy from renewable sources that is taken into account in measuring compliance by another Member State accepting the transfer. These arrangements must be notified to the Commission.[7]

Regular status reporting is required. National renewable energy action plans have been developed by each Member State and have been published on the Commission's transparency platform.[8] Progress reports on the promotion and use of energy from renewable sources have to be submitted to the Commission every two years. The most recent reports now available are from 2015.[9]

In 2015, changes were made in the Renewables Directive to reduce the indirect land use change (ILUC) caused by biofuels.[10] When biofuels are produced on cropland that previously was used to produce food or feed, the traditional agricultural production may be displaced to other types of land, such as forests or grasslands. This is called the ILUC-effect, and as forests and grasslands commonly can absorb CO_2, the conversion to cropland can

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[4] Article 2 (a) of the Renewables Directive.

[5] Article 2 (k) of the Renewables Directive.

[6] Article 2 (l) of the Renewables Directive.

[7] Article 6 of the Renewables Directive.

[8] http://ec.europa.eu/energy/node/71

[9] http://ec.europa.eu/energy/node/70

[10] Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

lead to increasing CO_2-levels in the atmosphere. The changes limits the amount of biofuels from crops grown on agricultural land to 7% in the fulfilment of the RES 2020 target. Moreover, they encourage the use of advanced biofuels and renewable electricity in the transport sector.

2.1.1.2 Directive 2014/94/EU on the deployment of alternative fuels infrastructure

A new directive concerning the deployment of alternative fuels infrastructure ("the AFI Directive") entered into force in late 2014. The focus of the Directive is to ensure that infrastructure is developed to facilitate the increase of alternative fuels in transport. The AFI Directive has been implemented into the EEA agreement, and needs to be implemented by 18 November 2016.

The AFI Directive defines alternative fuels as: "*fuels or power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport and which have the potential to contribute to its decarbonisation and enhance the environmental performance of the transport sector. They include, inter alia: electricity, hydrogen, biofuels as defined in point (i) of Article 2 of Directive 2009/28/EC, synthetic and paraffinic fuels, natural gas, including biomethane, in gaseous form (compressed natural gas (CNG)) and liquefied natural gas (LNG), and liquefied petroleum gas (LPG).*"

Each Member State is required to adopt a national policy framework for the development of the market as regards alternative fuels in the transport sector and the deployment of relevant infrastructure. This framework shall, inter alia, cover an assessment of the current state and future development of the market as regards alternative fuels in the transport sector and of the development of alternative fuels infrastructure and national targets concerning the number of recharge points for electric vehicles, inland waterway vessels, the number of refuelling points for LNG and the number of CNG refuelling points.

As regards the number of recharge points for electric vehicles, Member States should guarantee that an appropriate number of recharging points accessible to the public are available by 31 December 2020, ensuring that electric vehicles can circulate at least in urban areas.

Although these directives aim to promote their stated aims, state aid is used to correct for market distortions and failures.

2.1.2 State aid's compatibility with the internal market

State aid has the potential to distort competition and affect trade within the internal European market in a way that undermines the common European interest. The Agreement on the European Economic Area ("the EEA Agreement")[11] therefore contains a general ban preventing Governments from granting state aid[12].

There are, however, numerous exceptions to this ban, allowing EEA States to grant state aid under certain well-defined circumstances. When state aid can achieve well-defined objectives of common European interest while facilitating improvements that markets alone would not deliver, for instance by correcting well-defined market failures[13]. State aid that is granted an exception from the general ban on state aid is said to be *compatible with the internal market* or *compatible with the functioning of the EEA Agreement.*

State aid guidelines are provided to ensure compliance of state aid measures. To help EEA States understand how the Commission and the Authority will interpret and apply the provisions governing state aid, they have adopted various horizontal and sector-specific state aid guidelines. These guidelines set out the criteria for the analysis of the compatibility of notified state aid measures with the internal market, and provide an orientation as to how to design state aid measures and which conditions they should meet to ensure compliance.

11 The European Economic Area (EEA) unites the 28 EU Member States and three participating EFTA States (Iceland, Liechtenstein, and Norway) in an internal market governed by the same basic rules. The state aid rules in the EEA Agreement are broadly equivalent to state aid rules in the EC Treaty and which apply across the EU.

12 A measure constitutes state aid in the meaning of Article 107 of the EC Treaty if it fulfils, simultaneously, the following four criteria: (i) the aid is granted by a Member State or through state resources, (ii) the aid provides favours certain undertakings or the production of certain goods, (iii) aid is selective ("certain"), and (iv) the aid affects trade between Member States.

13 State Aid Action Plan — Less and better targeted State aid: A roadmap for State aid reform 2005-2009

2.1.3 State aid for environmental protection and energy

The first Guidelines for state aid for environmental protection were adopted in 1994, with the intention of coordinating the basis upon which aid was being granted by individual governments. They aimed to ensure that the positive effects of the aid outweighed its negative effects in terms of distortions of competition, while taking account of the polluter pays principle established by Article 174 of the EC Treaty. Since then, the Guidelines have been periodically revised to adapt to changing European environmental and energy policies.

In 2008, in the Community Guidelines on State Aid for Environmental Protection (2008/C 82/01), the allowed levels of investment aid for energy from renewable sources were significantly increased[14] as focus turned to decarbonisation of the electricity sector to deliver on environmental targets. Energy markets were deemed unlikely to deliver socially and macro-economically desirable levels of new and renewable forms of energy, and state aid was deemed necessary to incentivise investments that would otherwise not be sufficiently profitable.

2.1.3.1 Addressing evidence of market distortion

Although the general view of the Commission was that the 2008 Guidelines had served the common European interest well, they were revised as part of the SAM programme launched in 2012. Of most importance, the Commission found strong evidence that some forms of public intervention were having a serious negative impact on the effective functioning of the internal electricity market. Furthermore, they wished to account for technological developments in renewable energy technology and an increase in the internalisation of environmental costs.

1. **Administratively set support levels had resulted in over-deployment of renewable generation in some Member States.** Different Member States have implemented different types of support mechanisms for electricity generation from renewable energy sources (RES), the most common being feed-in-tariffs[15]. The Commission argued that because of information asymmetries between RES producers and the authorities determining the support level, administratively set feed-in-tariffs do not ensure cost-efficiency. The Commission therefore argued for the introduction of market-based cost discovery mechanisms to set the support levels of individual projects and technologies, for instance auctioning or competitive bidding to select beneficiaries of aid. The Commission also argued that auctioning or competitive bidding processes should normally also ensure that subsidies are kept to a minimum, thus paving the way for the phase-out of subsidies.
2. **Market fragmentation.** The Commission argued that the lack of consistency between the support schemes that different Member States have adopted - both in design but in particular regarding the level of support – has led to subsidy shopping, whereby investment will end up in whichever country provides the largest subsidies. The Commission noted that in some cases though, differences in support levels may be in line with different capital, financing and operating costs as well as load factors in the different Member States.
3. **Fewer incentives to invest in generation capacity.** Renewable generators have low, or zero, variable costs and hence enter the market whenever they produce and ahead of conventional plants, in particular gas-fired plants. As more RES generation enters the system, it depresses wholesale prices and can push conventional plants out of the market at times of optimal weather conditions. As price levels are reduced, as well as running hours, the profitability of traditional thermal generation is challenged.
4. **Maturity of some technologies.** When the 2008 Guidelines were set, most renewable technologies were technologically immature. Since then, some renewable technologies have matured and have a more limited scope for technological development or efficiency gains. Following the start of the review process, the Commission published therefore guidance on public intervention in the internal electricity market[16] setting out that as technologies mature and investment costs fall, the level of support should be adjusted for technological maturity and the market exposure of RES generators should increase.

To address these market distortions and promote a more market-based and more cost-efficient design of support schemes for RES generation, the 2014 Guidelines introduced significant policy shifts. This was considered vital as the 2014 Guidelines are meant to pave the way for achieving the objectives set in the 2030 framework for

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14 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52008XC0401(03)

[15] Feed-in premiums, quota obligations, tenders, tax exemptions and investment aid have also been implemented. The choice of mechanism usually determines the level of market exposure RES generators face, which in turn affects the generator's rate of return.

[16] *Delivering the internal electricity market and making the most of public intervention*, Communication from the Commission, Nov. 5th 2013.

climate and energy policies agreed by European leaders in October 2014. The Commission argued that established renewable energy sources are likely to become grid-competitive in the years leading up to 2030, signalling a phase-out of state aid and exemptions from balancing responsibilities in the longer term.

2.1.4 Guidelines on state aid for environmental production and energy 2014-2020

In April 2014, the Commission adopted the new Guidelines on state aid for environmental protection and energy and they are applicable between July 1st 2014 and December 31st 2020. They are seen as vital to pave the way for achieving the 2030 framework objectives for climate and energy policies agreed by European leaders in October 2014.

These 2014 Guidelines set out fourteen environmental and energy measures for which state aid may be considered compatible with the internal market; they build on the 2008 Guidelines to include aid for energy infrastructure and for adequacy measures.

- aid for energy from renewable sources
- aid for energy efficiency measures, including cogeneration and district heating and district cooling
- aid for resource efficiency measures, in particular waste management
- aid to carbon capture and storage (CCS)
- aid in the form of reductions in or exemptions from environmental taxes, and in the form of reductions in funding support for electricity from renewable sources
- aid to energy infrastructure,
- aid to generation adequacy measures, including capacity remuneration mechanisms
- aid in the form of tradable permit schemes
- aid for the relocation of undertakings

These additions aim to facilitate the integration of large volumes of energy from renewable sources at the same time as ensure security of supply in the European market. The Commission argued that sufficient investments would not take place without state aid.

2.1.4.1 General compatibility requirements

The Guidelines set out both general compatibility requirements and more specific requirements for certain categories of measures.

The general requirements specify that any notified state aid must contribute towards achieving a well-defined *objective of common European interest*, but must not result or threaten to result in undue *distortion of competition and trade*. EEA states must also demonstrate that there is a *need for state intervention*, and in particular that the aid is necessary to correct identified market or regulatory failures that would otherwise go uncorrected. The aid must also be an *appropriate* instrument to remedy the identified market or regulatory failures, as well as be coherent with any other measures that address the same failures. The aid must also have an *incentive effect* by inducing the beneficiary to change its behaviour to improve the functioning of a secure, affordable and sustainable energy market.

Finally, the aid must also be *proportional.* This means that the aid should not amount to more than the minimum necessary to achieve the objective pursued, while allowing the beneficiary to earn a reasonable rate of return. The net-extra cost approach is usually used to assess proportionality: this means that the amount of aid should correspond to the *net extra cost* necessary to achieve the pursued objective, compared to a scenario without state aid[17].

It should be noted, however, that the guidelines allow for significant legal uncertainty regarding both the concept of state aid as well as the issue of their compatibility with the provisions of the Treaty and the EEA Agreement.

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[17] Points (69) and (70) of the Guidelines.

2.1.4.2 Compatibility of aid to energy from renewable sources

EEA States may grant state aid to energy from renewable sources as *investment aid* or as *operating aid*, i.e. aid for the everyday operating cost of companies. Different conditions apply to both, and any investment aid received must be deducted from operating aid[18].

No later than January 1st 2016, EEA states must amend existing and approved schemes in order to bring them up to date with the 2014 Guidelines. However, existing operating aid schemes for renewable energy sources and cogeneration only need to be brought in line if the schemes are prolonged or adapted.

2.1.4.3 Key provisions on operating aid

Special provisions apply for operating aid for electricity from renewable energy sources, for certificate schemes, for energy from renewable sources other than electricity, and for food-based biofuels and existing biomass plants after depreciation.

(1) Operating aid for electricity from renewable energy sources

The changes introduced by the 2014 Guidelines are expected to have a significant impact on electricity markets, as EEA states' freedom when designing national support schemes is more limited than under the previous Guidelines. The two key aspects here (with some exceptions) involve transitions to competitive bidding processes and premium-based support schemes.

Transition to competitive bidding processes. Already in 2015 and 2016, at least 5 per cent of planned new electricity generation capacity from RES must be granted through competitive bidding processes based on clear, transparent and non-discriminatory criteria. From January 1st 2017, EEA states must grant all state aid through competitive bidding processes[19], except if it can be demonstrated that:

- only one or a very limited number of projects or sites could be eligible
- competitive bidding would lead to higher support levels, for instance in cases of strategic bidding, or
- competitive bidding would result in lower deployment, for instance in cases of underbidding.

As a rule, if tenders are open indistinct of technology to all RES generators, the Commission will regard the granted state aid as proportionate, and presume that it does not distort competition in a manner detrimental to the internal market. However, the Guidelines allow technology-specific tenders if a bidding process open to all technologies would risk a "*suboptimal result that cannot be addressed in the process design*", in particular in view of the following circumstances:

- the longer-term potential of a given new and innovative technology
- the need to achieve diversification
- network constraints and grid stability
- system (integration) costs
- the need to avoid distortions on raw material markets resulting from biomass support.

Exemptions: generators other than wind generators with an installed capacity of less than 1 MW, wind generators of up to 6 MW (or 6 generator units) and demonstration projects may be exempted from competitive bidding and continued to receive support in the form of administratively-set market premiums and feed-in-tariffs beyond January 1st 2017.

Transition to premium-based support schemes. In order to incentivise the market integration of electricity generation from RES, from January 1st 2016 onwards, all new operating aid granted to electricity generation from RES will be subject to the following requirements:

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[18] For investment aid schemes and individually notified investment aid, the conditions of section 3.2 General Compatibility provisions of the Guidelines apply. For operating aid schemes, the general provisions of section 3.2 are amended by specific provisions set out in section 3.3 Aid to energy from renewable sources. For individually notified operating aid the provisions set out in section 3.2 apply, if relevant taking into account the modifications made by section 3.3 for operating aid.

[19] Generator projects that

- all RES generators will be required to bid their production into the market. Aid will be granted in the form of a premium on top of a reference electricity market price.
- beneficiaries of state aid will be subject to balancing responsibility, except in markets with no liquid intra-day market[20].
- EEA states should put in place measures to ensure that there are no incentives to generate under negative prices.

Exemptions: wind generators with an installed capacity of up to 3MW (or 3 generation units) and all small-scale RES generators with an installed capacity of less than 500 kW are exempted from these requirements, and will be able to continue with feed-in tariffs. Demonstration projects are also exempted.

Green certificates: The offering of green certificates for free to generators does not constitute a loss of state resources, since the certificates are merely a proof that the green electricity has been produced. The Commission has therefore ruled that the advantage granted to generators of renewable electricity through the sale of green certificates on the market does not constitute state aid, for instance when assessing the Swedish green certificate scheme[21].

However, certain aspects of certificate schemes may be state aid. When implemented in 2003, the Swedish green certificate scheme had a guaranteed price for the certificates offered by the state. The Commission found that the guaranteed price, which was available as an option for producers of green electricity, constituted state aid to those generators when used. In the case of Sweden, the Commission rules that the aid was compatible with the EU Treaty. The guaranteed price was removed after 5 years.

The 2014 Guidelines set out that EEA states may grant aid to electricity generation from RES in the form of marked-based mechanisms like green certificates that allow all renewable energy generators to benefit from guaranteed demand for their production, at a price above the market price for conventional power.

In order to be compatible with the functioning of the EEA Agreement, certificate mechanisms are subject to a number of conditions:

- the price of the green certificates may not be fixed in advance.
- the aid must be essential to ensure the viability of the renewable energy sources concerned
- the aid does not, for the scheme in the aggregate, result in overcompensation over time and across technologies, or in overcompensation for individual less deployed technologies in so far as differentiated levels of certificates per unit of output are introduced.
- the aid does not de-incentivise renewable generators from becoming more competitive.
- no differentiation in support levels is allowed, unless an EEA state demonstrates a need for differentiation on the basis of the justifications acceptable for technology-specific bidding processes.
- the general conditions applicable to market premiums also apply to green certificate schemes.

(2) Operating aid for energy from renewable sources other than electricity

Operating aid to energy from renewable source other than electricity is required to satisfy the following conditions:

- the aid per unit of energy should not exceed the difference between the total levelised costs of producing energy (LCOE) from the particular technology in question and the market price of the form of energy concerned;

[20] As of 2013, RES generators in 8 Member States were fully responsible for their imbalances, while RES generators in 16 Member States were partially responsible.

[21] http://ec.europa.eu/competition/state_aid/cases/133918/133918_1503578_27_2.pdf

- the LCOE may include a normal return on capital. Investment aid is deducted from the total investment amount in calculating the LCOE;
- the production costs are updated regularly, at least every year; and
- aid is only granted until the plant has been fully depreciated according to normal accounting rules in order to avoid that operating aid based on LCOE exceeds the depreciation of the investment.

Special provisions for aid for food-based biofuels, biofuels subject to a supply or blending obligation and existing biomass plants after depreciation are outlined below.

Food-based biofuels. Because of overcapacity in the food-based biofuel market, the 2014 Guidelines set out that investment aid in new and existing capacity for food-based biofuel incompatible with the functioning of the EEA Agreement. However, food-based biofuel plants may seek investment aid for conversion into advanced biofuel plants. Operating aid to food-based biofuels can only be granted to plants that started operation before 31 December 31st 2013 until the plant is depreciated, but no later than 2020.

Biofuels subject to a supply or blending obligation. Where biofuels are subject to a legally binding supply or blending obligation, no operating aid is allowed unless a EEA state can demonstrate that the aid is limited to sustainable biofuels that are too expensive to come on the market with a supply or blending obligation only.

Biomass plants after depreciation. As mentioned before, operating aid for renewable energy may only be granted until the plant has been fully depreciated according to normal accounting rules. Biomass is exempted from this rule for two reasons. Firstly, biomass, contrary to other sources of renewable energy, has relatively low investment costs but high operating costs. Secondly, an existing biomass plant may use cheaper fossil fuels if it offers an economic advantage.

The 2014 Guidelines set out detailed criteria for compatible operating aid for existing biomass plants after depreciation.

If an EEA state can demonstrate that the operating costs of a beneficiary plant after plant depreciation are still higher than the market price of the energy concerned, the plant may be eligible for aid if the following conditions are met:

- the aid may only granted on the basis of the energy produced from renewable sources;
- the measure is designed such that it compensates the difference in operating costs borne by the beneficiary and the market price; and
- a monitoring mechanism is in place to verify whether the operating costs borne are still higher than the market price of energy. The monitoring mechanism needs to be based on updated production cost information and take place at least on an annual basis.

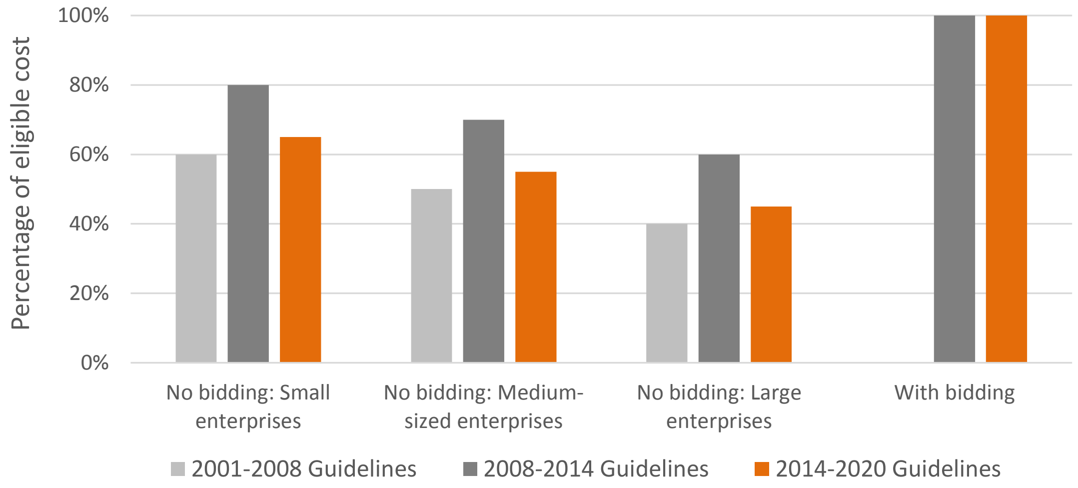
If an EEA state can demonstrate that, independent from the market price of the energy concerned, the use of fossil fuels as an input is more economically advantageous, the plant may be eligible for aid if the following conditions are met:

- the aid is only granted on the basis of the energy produced from renewable sources;
- the measure is designed such that it compensates the difference in operating costs borne by the beneficiary from biomass compared to the alternative fossil fuel input;
- credible evidence is provided that without the aid a switch from the use of biomass to fossil fuels would take place within the same plant; and
- a monitoring mechanism is in place to verify that the use of fossil fuels is more beneficial than the use of biomass. The monitoring mechanism needs to be based on updated cost information and take place at least on an annual basis.

2.1.4.4 Key provisions for investment aid

As was expected, the revised Guidelines introduced lower levels of investment aid. Figure 2 shows how aid intensities have developed over the last two revisions of the Guidelines.

Figure 2: Aid intensities for investment aid as a percentage of the eligible costs, depending on size of enterprise and existence of a bidding process

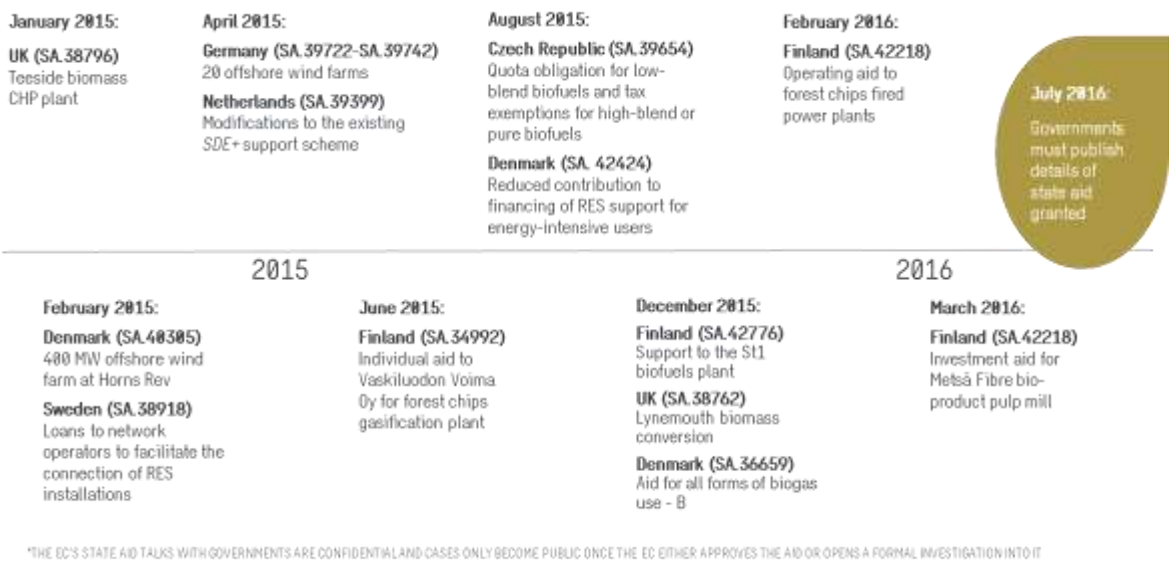


While bidding processes allow for investment aid of 100% of the eligible costs, cost eligibility for non-bidding processes differs according to enterprise size. Generally, smaller enterprises are eligible for a higher percentage, larger enterprises for a smaller percentage. For all enterprise sizes, the percentage is reduced from the higher levels in the 2008-2014 guidelines, to levels just above those in the 2001-2008 guidelines.

2.1.5 Recent examples of state aid measures for environmental protection and energy notified to the Commission

A selection of the most recent state aid measures which have received approval under the 2014 Guidelines are shown in Figure 3, including case numbers.

Figure 3: A selection of recent state aid measures notified under the 2014 Guidelines[22]



2.2 European targets, Nordic RES targets and status

Increasing the share of renewables is a target for both the EU and national governments. Countries have taken different measures and formulated various ambition levels to meet with these measures. This chapter considers current RES shares, and EU and national targets for 2020 and beyond.

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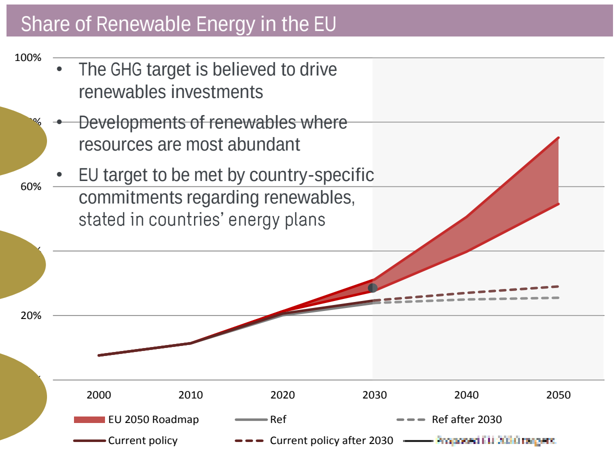
[22] [Cases found in European Commission's competition cases database, http://ec.europa.eu/competition/elojade/isef/index.cfm]

Figure 4: EU 2020 and proposed 2030 targets

EU targets 2020	Proposed EU targets 2030	
20% lowered GHG emissions	40% lowered GHG emissions compared to 1990 levels	Binding at EU level
20% renewable energy	At least 27% renewable energy	Binding at EU level
20% improved energy efficiency	At least 27 % energy savings compared with BA scenario	Indicative. Reviewed in 2020 having in mind a 30% target



2.2.1 Current targets and actual RES shares in the Nordics

As discussed earlier in section 2.1.1, the Renewable Energy Directive has set out national targets for the share of energy from renewable energy sources in final energy consumption that EEA states must achieve by the year 2020. These are legally binding targets for each member state for the share of renewable energy in gross final consumption, which differs between countries, and for the share of energy from renewable sources in final consumption in transport, which is set at a minimum of 10% for all countries. The national 2020 targets for overall renewable energy targets are shown in Table 1, contrasted with the respective 2005 figures.

Table 1: Mandatory national overall targets for the Nordic countries in 2020[23]

	Overall renewable energy share in gross final consumption: 2005	Overall renewable energy share in gross final consumption: 2020
Iceland[24]	63.4%	72.0%
Norway[25]	60.1%	67.5%
Sweden	39.8%	49.0%
Finland	28.5%	38.0%
Denmark	17.0%	30.0%

Of the countries in Table 1, Sweden alone has introduced a national 2020 target greater than the mandatory target, this is set at 50% (rather than 49%). The National Renewable Energy Action Plans (NREAPs) for each country, as outlined in Article 4 of the Renewable Energy Directive, detail the national sectoral targets for 2020 - for transport, electricity, and heating and cooling – that – that are needed to reach the overall RES target. The NREAPs map out a trajectory for these sectors up to 2020; these 2020 national targets are shown in Table 2, alongside the respective 2014 figures as reported in the 2015 Progress Reports.

[23] As detailed in Part A of Annex I to Directive 2009/28/EC

[24] NREAP Iceland, accessed from: [http://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans]

[25] NREAP Norway, accessed from: [http://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans]

Table 2: Estimated 2020[26] (and 2014 actual[27]) shares of RES energy in overall energy consumption and by sector in the Nordic countries

	Overall RES share[28]	Heating & cooling[29]	Electricity generation[30]	Transport[31]
Iceland[32]	76.8% (76.0%)	96.1% (96.0%)	100.0% (100.0%)	9.9% (0.9%)
Norway	67.5% (69.2%)	43.2% (32.5%)	113.6% (109.6%)	10.0% (4.8%)
Sweden	54.8%[33] (52.6%)	62.1% (68.1%)	62.9% (63.3%)	13.8% (19.2%)
Finland	38.0% (38.7%)	47.0% (52.0%)	33.0% (31.4%)	20.0% (21.6%)
Denmark	30.4% (28.5%)	39.8% (38.4%)	51.9% (48.5%)	10.1% (5.7%)

In general, it can be seen that the progress of the Nordic countries towards their 2020 targets is good. It is however worth noting that weather conditions each year can affect the apparent progress in a given year towards the targets – with, for example, colder years increasing consumption significantly, or high/low inflow in the hydro-dominated countries influencing how much energy can come from RES. This was particularly noted for Norway in their 2015 Progress Report with 2014 having high hydropower generation.

Iceland is the only Nordic country that has electricity which is produced solely from renewable resources.[34] The target for Iceland's share of renewables in the gross final consumption of energy in 2020 is 72%.[35] The overall RES share for Iceland was 76% in 2012, which is already above Iceland's 2020 target. On the other hand reducing the use of fossil fuels in the transport sector is a matter of high priority for Iceland. The RES share for transport was 1.9% in 2014. In line with the Renewables Directive, Iceland has a target of a 10% share of renewable energy in the transport sector. In this respect, it is an objective to replace imported energy by renewable energy sources, mainly replacing fossil fuels in the transport sector.[36] Whether Iceland will meet its transport target in 2020 in uncertain.

Norway has an ambitious target of a share of 67.5% of renewables in the gross final consumption of energy in 2020. Almost all of Norway's electricity generation is from hydropower, and this contributes to their considerably higher starting level of RES share in 2005 (see Table 1) compared to all other countries except Iceland. To move towards their target, focus has been on energy efficiency measures, increasing district heating, and bringing in more renewable electricity generation via the joint certificate market with Sweden. In 2014, the overall RES share was circa 69%, but as noted above this was partly due to warmer weather and a strong hydrological balance. On

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[26] The trajectory is estimated yearly up to 2020 in Table 3 of the NREAP for each country, accessed for all countries from: [http://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans]

[27] The 2014 figures are taken from Table 1 of the 2015 Progress Report for each country, accessed for all countries from: [https://ec.europa.eu/energy/en/topics/renewable-energy/progress-reports]

[28] Share of renewable energy in gross final energy consumption as defined in Part B of Annex I to Directive 2009/28/EC

[29] Share of renewable energy in heating and cooling: gross final consumption of energy from renewable sources for heating and cooling (as defined in Articles 5(1)b) and 5(4) of Directive 2009/28/EC) divided by gross final consumption of energy for heating and cooling.

[30] Share of renewable energy in electricity: gross final consumption of electricity from renewable sources for electricity (as defined in Articles 5(1)(a) and 5(3) of Directive 2009/28/EC) divided by total gross final consumption of electricity

[31] Share of renewable energy in transport: final energy from renewable sources consumed in transport (cf. Article 5(1)(c) and 5(5) of Directive 2009/28/EC) divided by the consumption in transport of 1) petrol; 2) diesel; 3) biofuels used in road and rail transport and 4) electricity in land transport

[32] The percentage in brackets for Iceland is for the year 2012, not 2014, since the most recent Progress Report for Iceland on the Commission's website is from 2013.

[33] Updated forecast taken from Table 11 in the 2015 Progress report for Sweden, accessed from: [https://ec.europa.eu/energy/en/topics/renewable-energy/progress-reports]

[34] Hydro power accounts for 71% and geothermal accounts for 29% of national electricity production. Source: http://os.is/gogn/os-onnur-rit/orkutolur_2013-enska.pdf

[35] Art. 22 Progress report 2014, p. 2.

[36] NREAP, Iceland, p. 5.

the transport side, progress has been made and the rise of electric vehicles has been substantial, but they still have some way to go to reach the 10% transport goal.

Sweden has set its goal for the share of energy from renewable sources in gross final consumption of energy in 2020 as 50%, which they have already achieved in 2014. This goal was above the EU target of 49%. Sweden also reached the targets in each of the three sectors of heating and cooling, electricity generation and transport in 2014.

In **Finland**, the RES Directive contains a national target of 38% for the share of energy from renewable resources in gross final consumption of energy in 2020. In 2014, this RES share was 38.7%. For transport Finland has set the target of a 20% share of renewables for 2020, which they have met in 2014. In October 2014, the Finnish Ministry for Employment and the Economy published an energy and climate roadmap for 2050.[37] This contains the long term aim to reduce Finnish greenhouse gas emittance by 80-95% in 2050, but with no specific policy roadmap on how to achieve this goal.

Denmark has a national target of 30% for the share of energy from renewable resources in gross final consumption of energy in 2020. In addition, Denmark has set itself national, non-binding, target of 35% RES in final consumption and 50% of electricity consumption to be covered wind generation in 2020.[38]

In 2012 a new energy policy agreement was reached in Denmark containing an ambitious strategy to meet the 2020 targets. In order to meet the 50% wind generation target, a capacity of 600 MW offshore wind turbines at Kriegers Flak and 400 MW offshore wind turbines at Horns Rev are to be built. In addition, the built of a capacity of 500 MW offshore wind turbines in coastal areas is foreseen. To increase net capacity of onshore wind plants by 500 MW, new planning tools will be used.[39] Furthermore, Denmark aims to construct new onshore wind turbines with a total capacity of 1800 MW before 2020.[40]

2.2.2 Targets for 2030 and beyond

In contrast to mandatory national 2020 targets, the EU targets for 2030 are set at an EU level. The focus has moved from increasing the share of renewable energy in energy consumption to GHG emission reduction in order to be more directly related to overall climate goals.

Norway has no specific quantitative RES targets for 2030 or 2050. Sweden's RES targets for 2030 are not yet defined, as the Swedish Energy Commission is currently working on the future energy strategy for the electricity sector.

Finland is working on the new national energy and climate strategy, the current being from 2013. The 2015 Government program cites however clean, coal-free and renewable energy including a high focus on bio-based energy in cost-efficient way as main targets. As part of that programme, the RES-share should reach 50% during the 2020s, biomass should be produced in a sustainable way, and the share of renewable fuels in transport should reach 40% by 2030.

Since the new Danish government came into office the national Danish 2020 targets are based on EU obligations: 20 % GHG reduction in non-ETS, 30 % share of RES-total and a sub-target of 10 % share of RES in transport. The new long term national target is that Denmark should to independent of fossil fuels in 2050 – meaning that Denmark will produce a total share of RES corresponding to the total gross energy consumption. No intermediate targets have been set for 2030 yet, but the new Energy Commission should come up with proposals for new national policies for the period 2020 to 2030.

2.3 Designing and evaluating new policy options

Designing new support schemes requires a thorough process. Any new policies to increase RES shares must be comply with the new State Aid guidelines as well as reach national goals such as cost efficiency. Whatever the national aim, it is worthwhile to consider best practices for the process of designing and evaluating the various options. In considering new policies to reach renewables targets, it is critical to think about policy design holistically. It is an advantage to have a long-term vision or specific target for RES development, taking a starting

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[37] http://www.tem.fi/sv/energi/energi-_och_klimatfardplan_2050

[38] "Energy Policy in Denmark", Danish Energy Agency, December 2012.

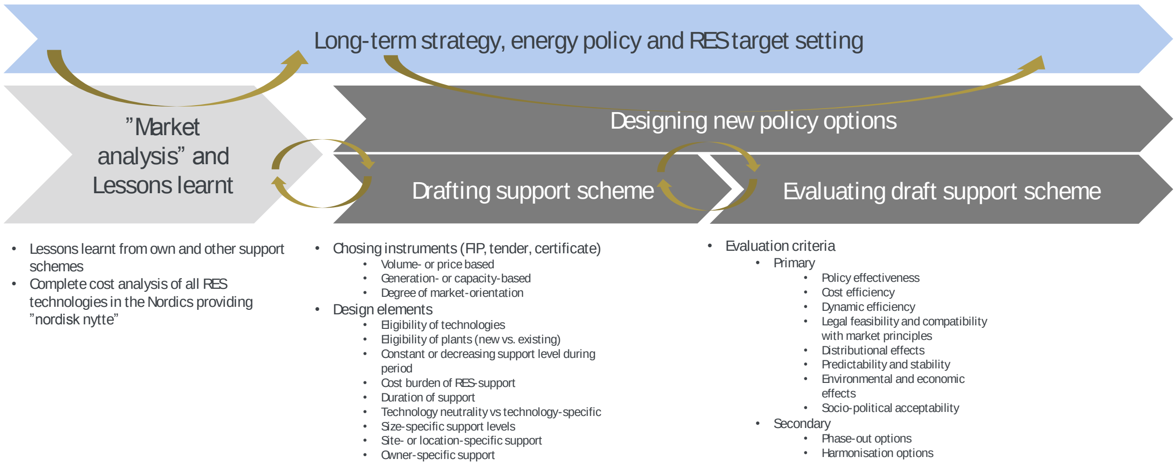
[39] "Energy Policy in Denmark", Danish Energy Agency, December 2012.

[40] Danish progress report under Renewable Directive, December 2013.

point in the long-term strategy and energy policy of a country. While we focus on the process to design the primary support schemes for RES-E, an adapted process can be used for alternative fuels and transport as well. The process (Figure 5) can then be divided into three phases, between which the borders might be fluent:

- Market analysis and lessons learnt
- Drafting the support scheme
- Evaluating the draft support scheme

Figure 5: Designing and evaluating new policy options



In the *market analysis and lessons learnt* phase, support schemes are benchmarked, checked for their applicability for the Nordic countries and potentially further analysed. Conclusions drawn could involve best practices for certain design elements or experiences with regards to policy effectiveness and cost efficiency. Furthermore, it is important both to understand the cost levels and potential cost development of different technologies already in this phase as discussed in chapter 3, and also to regularly update these cost analyses during the design policy process and throughout the duration of the support scheme.

In the *drafting phase*, decisions about the instrument of choice have to be made and the various design elements and their options become important. Decisions about the instrument as such mainly hinge on deciding about a volume- or price-driven scheme, deciding about support of generation or capacity and the degree of market orientation with feed-in systems, quota and tendering systems as main alternatives.

Designing the instruments in detail is more complex. Literature on renewable energy support policies has often been trapped into instrumentalism, frequently providing abstract and blackboard discussions on “which are the best instruments”.[41] However more recently researchers have stressed that the success or failure of instruments applied in the real world mostly depend on their design elements and market framework.[42] [43] [44] [45]

The following main design elements should be considered for RES-E.

- **Eligibility of technologies**. On an EU level, these are defined under the RE Directive (Directive 2009/28/EC). It is however one key question in the long-term strategy of a country: if and when to

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[41] Del Rio, Ecofys, et al (2015) What will be the main chal-lenges for the design of re-newable electricity policy in the EU? A report compiled within the European IEE project towards2030-dialogue.

[42] Ecofys et al (2014) Cooperation between EU Member States under the RES Directive. A report for the EC, DG Energy.

[43] Del Rio et al (2012) Are the interactions between the EU’s renewable energy support and its emissions trading system (ETS) really so negative? Paper prepared for the Climate Change and Renewable Energy Policy in the EU and Canada Workshop.

[44] IEA (2008) Policy instrument design to reduce financing costs in renewable energy technology projects

[45] IEA (2012) Optimised use of renewable energy through improved system design (OPTIMUM)

Ragwitz et al (2007): OPTRES. Assessment and Optimisation of Renewable Energy Support Schemes in the European Electricity Market: Fraunhofer IRB Verl., Stuttgart.

support certain technologies. Thus, it is also a key design element, together with the question of technology-neutral vs technology-specific support.

- **Eligibility of plants (new vs. existing)**. The aim of support schemes is mainly to promote new capacity thus making only new plants eligible. However, existing plants would be able to operate under current RES-E support schemes until these are phased-out.
- **Constant, volatile or decreasing support level during the support period**. This is mainly depending on the choice of instrument. However, in feed-in systems, decreasing support levels over time may be desired. If choosing a reduction over time it is important from an investor perspective that terms and conditions of this reduction are be transparent and known beforehand.
- **Cost burden of RES-E support**. The level of cost burden for RES-E support will be mainly determined by choice of technology/technologies and volume to support in addition to cost efficiency of the chosen instrument in a wider sense. However, the burden may be distributed either directly on electricity consumers or indirectly on taxpayers (via the state budget). The burden can be shared equally or unequally among consumers (e.g. using tax exemptions for power-intensive industry). In general, consumer-financed support is considered more stable than state-budget-financed.
- The **support duration** is a crucial design element regardless of instrument choice. The longer the period, the higher the certainty for investors, but also the higher the policy costs. The specialised literature shows that long (but not over-long) duration periods of between 15 and 20 years[46] provide low risks for investors and, thus, comply with the effectiveness and efficiency criteria.
- **Technology-specific or technology neutrality of the support**. The support scheme can be either technology neutral or technology specific, whereas the basic choice of instrument already directs in a certain way.
- **Project-size-specific support level**. Support levels can be differentiated according to the size of the installation, often measured in capacity terms. This takes into account that the LCOE of larger installations is often lower than for small-scale installations, and that governments may want to promote small-scale installations for a number of reasons (decentralised generation and social acceptability). In the Nordics, this project-size dependence is mainly valid for solar PV.
- **Site- or location-specific support**. Support levels might be differentiated according to the location of the plant (e.g. stepped FiT or differentiated FiP). This way, higher support levels could be given to locations with higher costs. Clearly, the main driving force would be guiding investments to desired areas.
- **Owner-specific support**. Support may be given to preferential types of investors, such as private households, in order to e.g. promote decentralised generation. This design element overlaps with the project-size element.

The above design elements and their effects are largely interlinked and not all can be realized for any chosen instrument.

In the *evaluation phase*, the drafted support schemes are assessed for the primary and secondary evaluation criteria, ranging from expected policy effectiveness, cost efficiency and socio-political acceptability to a check of their legal feasibility and compatibility with market principles. Several evaluation criteria have been used in the literature to assess the functioning and success of RES-E support instruments. While policy effectiveness and cost efficiency (also called static efficiency) are the most common, several contributions expand the set of relevant criteria to include other aspects, such as dynamic efficiency (timely adaptation of support levels), competitiveness, distributional effects, predictability and stability, and compatibility with market principles and other countries' support schemes. Trade-offs between the different criteria typically arise when designing a support scheme. In detail, the most important evaluation criteria can be described as follows.

- **Policy effectiveness**: the degree that a support instrument realises its targets, mainly triggering deployment for primary support schemes. This would clearly depend on the ambition of the target and the national potential.

[46] "Design and impact of a harmonized policy for renewable electricity in Europe", beyond2020 project group, February 2014

- **Cost efficiency** (or *static efficiency*): a measure of whether the scheme fulfils the predetermined target at the lowest possible overall cost, hence resulting in optimal resource allocation. It refers to total system costs and does not include distributional effects between different actor groups. A cost-efficient policy should only allocate support to those projects which could not otherwise be realized, rather than create windfall profits (distribution of benefits).
- **Dynamic efficiency**: this evaluates the costs of target achievement over the long-term and considers whether a policy instruments helps to drive down costs of less mature technologies. This measure both adds a time dimension to static efficiency, and also deals with technological diversity, private R&D investments, learning effects and technological competition.
- **Compatibility with market principles**: is increasingly important as the market integration of RES and its share in the generation mix increases. RES tenders should be open, transparent and technology-neutral, which facilitates competition in an auction and should allocate support efficiently. Furthermore, according to the State Aid Guidelines, competitive bidding processes should in principle be open to bidders from other Member States to reduce fragmentation of the internal market. This measure is expected to contribute to increased cost efficiency.
- **Competitiveness:** support schemes notified to the Commission from 2017 onwards must introduce competitive bidding to grant aid to renewables so as to comply with the revised State Aid Guidelines. Technology-neutral schemes promote competitiveness of mature technologies and projects. Both are expected to contribute to increased cost efficiency.
- **Distributional effects**: inevitably, policy changes will create winners and losers, since surplus is re-distributed from consumers to producers and in-between the producer and consumer group respectively. A policy should also avoid adverse effects on competitiveness on the overall economy and energy-intensive industry, and maintain public acceptance.
- **Predictability and stability**: commitment to policy goals and specific policy measures must be long-term and stable in order to attract investment. Schemes should be sufficiently transparent and reliable to inspire and maintain investor confidence as this would result in a lower risk premium and lower costs; at the same time they should be sufficiently flexible to be able to adapt to changing circumstances in a predictable way.
- **Socio-political acceptability.** With growing RES deployment, land-use and policy costs, public opinion against may grow, leading to lower social acceptability and challenged RES support. Political feasibility on the other hand refers to the attractiveness for policy-makers of a given RES-E support instrument or pathway.
- **Legal feasibility** refers to compatibility with EU as well as national law.

Slightly less important but therefore often neglected are three evaluation criteria which might become more important over time:

- **Environmental and economic effects.** RES-E deployment may bring positive economic effects on a local site-, country- or regional e.g. the Nordic level, including co-benefits such as net job creation, possibilities to create an RES industry, potential export of electricity and exports of renewable energy technology equipment. However, while there are obvious environmentally-positive effects such as reduced air pollution and GHG emissions, the growing deployment might also have a growing environmentally-negative, often local, effects, such as land-use, visual effects, noise and barriers for birds. These effects and external costs need to be considered when evaluating the socio-political acceptability.
- **Phase-out options** refer to the possibility of both phasing out the support over time (decreasing support levels), but also the possibility of replacing the support scheme with an alternative, e.g. more market compatible scheme.
- **Harmonisation options:** these options could refer to other regional possibilities beyond information exchange. They ensure that national support schemes can be harmonized, e.g. on a regional Nordic level, over time.

The above criteria overlap somewhat and many are mutually dependent on each other. Therefore, a wider perspective on the criteria and their interrelation is required. Social acceptability is e.g. influenced by cost efficiency, environmental, economic and distributional effects: negatively, if mainly consumers have to share the burden and policy costs are high. Political feasibility is very much linked to social acceptance and legal feasibility. Cost efficiency and competitiveness are strongly linked, but do not necessarily drive dynamic efficiency.

3. Lessons learned from the Nordics

Within RES-E, most countries use a mix of a primary support scheme and supporting measures such as tax reliefs or investment aid, mainly depending on maturity of the technology. Most of the measures can be deemed successful in terms of policy effectiveness, since they contributed to achieving the respective RES-E targets or are on a good way to do so. The Nordic measures differ however in deployment, market risk exposure, whether they are national or joint schemes or whether they are considered state aid or not. The measures also differ in predictability, flexibility and cost efficiency.

For mature technologies, all Nordic countries use support during the operation phase over investment aid. Finland and Denmark use technology-specific premium tariff-based systems, while Sweden and Norway have one main technology-neutral support scheme to support power production from renewables: the Joint Electricity Certificate scheme, running from 2012-2035. For the support of less mature and small-scale technologies, the countries tend to use a wider range of measures.

The primary Nordic RES-E support schemes differ considerably in terms of degree of market integration and investor risk. Support levels are set differently depending on scheme with both price-based and volume-based schemes existing. Denmark is using a mix of auction-based levels feed-in premiums for the offshore wind projects and administratively-set levels for other RES-E, while Finland exclusively uses administratively-set levels currently. Remuneration periods may differ from 12 to 20 years. Price levels for green certificates used in Norway and Sweden on the other hand are set continuously market-based by supply and demand, driving short-term cost-efficiency but increasing uncertainty for investors.

Financing differs, policy costs increase quickly and limiting them through policy design is key. Most support schemes are financed via the state budget, although some schemes, such as the Joint Certificate system, are financed directly by end-users via levies. Both the Danish and Finnish scheme attempt to limit policy costs in different ways. Both schemes allow to control policy costs via the premium level, although supported volumes are not entirely known upfront. Furthermore, eligibility is either limited by duration (e.g. 12 years in Finland), volume or installed capacity (e.g. tendered offshore projects in Denmark or capacity for biogas and onshore wind in Finland) resulting in a maximum amount established in the project approval decision of the Energy Authority. However limiting the support duration doesn't necessarily reduces policy costs compared to other options, as it also increases the level of required support.

Both the Danish and Finnish premium-tariff system are rather administration intensive. In order to differentiate efficiently between technologies, project sizes and other limitations, a significant administration is required. However, the same holds true for auctions and certificate schemes and seen in relation to total policy costs, administration costs are likely to a smaller cost and thus less relevant. Best support scheme practice includes an element of not paying support during hours with negative prices, as Denmark does for offshore wind, limited to 300 hours per year.

The Danish offshore wind market is the most mature in the Nordics and its tender system is adopted to the strategic importance of offshore wind for the country. Apart from supporting a technology with higher costs in principle, the scheme must be seen as both policy-effective and rather cost-efficient. It is an example for a well-designed support scheme and has delivered the targeted volumes. Site development is provided by the state, with the Danish Energy Authority (DEA) as the competent authority for Danish offshore wind power projects. The DEA provides a "one-stop-shop" throughout the permission process, which is an important aspect for the success. Other lessons learnt include that avoiding overlap with other international auctions is advantageous and that an open, structured and fair dialogue between investors and contracting authorities can lead better auction results. On the other hand, high penalties and inflexible auction design can lead to low participation and high bidding prices.

The joint certificate market is generally viewed as cost-efficient, as the final cost passed on to the end consumer bills is rather low compared to other countries. That is however only partly a result of an efficient support scheme; it is also a result of the excellent resources in the Nordics, mainly in the form of wind, and a consequence of a fast technologic development. Setting up a technology-neutral certificate system with a dominant and quickly cost-reducing and price-setting technology, such as new onshore wind-power in the Swedish-Norwegian system, may provide challenges for early investors in the market. This is especially true, when the market is open for new investments over such a long period as from 2003-2020 and beyond.

Setting up a completely technology-neutral support and joint scheme is challenging. There will always be the risk for overcompensating some low-cost technologies and projects with excellent resources, while effectively excluding high-cost technologies and projects at the same time. Also, setting up joint support schemes can take time. While there is no absolute need to align all details in a joint scheme, but it helps to be aligned as much as possible. Most of the main parameters such as eligible technologies should be aligned. However, some differences must be acceptable to all countries involved: energy taxes, tax reductions and exemptions and depreciation will almost inevitably differ and cannot be completely aligned for the single purpose of the joint scheme.

Support measures in alternative fuels and transport should be significant and cover the entire value chain in order to provide results. Key lessons learned from the Norwegian EV case are that, firstly, low total cost of ownership is important, but also that a low total cost of ownership is only one part of introducing a new type of vehicle; also important for success are the other user incentives as well as the strategic implementation of infrastructure to support the whole value chain. Other policy instruments directed at EV users have provided convenience, time savings and significant economic support. Such lessons carry the caveat that Norwegian households often have two cars and the EV has been purchased as a second car for shorter driving, and hence might not be so readily applied elsewhere. Strong and comprehensive policies to build an initial market and infrastructure are necessary to attract and include actors in technology implementation.

Experiences from all countries have shown that setting up technology-neutral support schemes for alternative fuels successfully is very challenging in practice. Despite intentions, many support schemes which are designed as technology neutral have favoured specific fuels, due to different levels of technical development and cost.

Quota obligations in combination with tax reliefs or exemptions have proven an effective policy for a fast introduction of renewable fuels. Exemptions from high fuel taxes naturally give a strong support for renewable fuels, but must be complemented by a range of other measures, such as regulatory measures and investment support.

The Swedish case for biofuels has shown that support is needed across the whole chain during a relatively long time period to yield results. Sweden started the introduction of biofuels several decades ago and has during periods had relatively strong support systems in place along the whole fuel chain. The incentive of tax exemptions has been combined with support systems directed at production facilities, infrastructure and alternative vehicles; these have come in the form of both regulatory measures, such as the obligation to provide renewable fuels, and investment support. This has resulted in Sweden having one of the highest shares of renewable transport fuels in Europe and has encouraged the development of a range of fuels.

This chapter reviews the status quo of RES support in the Nordic region at the country level. Looking first at the Nordic region as a whole, the chapter also looks at what has been done in the respective countries.

3.1 Support schemes - the Nordic experience

Here we describe in brief the current setup of support schemes and measures by country relevant for the lessons learned. The aim of this overview is not to be entirely complete or assess compatibility with EU state aid guidelines. Rather, we present an overview and a comprehensive data set on which to build lessons learned and recommendations for the design of future support measures. Therefore, we also include measures that were recently discontinued. Further detailed information can be found in the Appendix.

Table 3: Summary of current and recent support measures in each of the Nordic countries

Iceland	
Power generation	
Investment aid	"National Energy Fund": Subsidies for measures that aim to reduce the use of fossil fuels
Transport	
Operating aid via tax exemptions	Exemptions from excise and carbon dioxide tax for CO_2-neutral fuels
Norway	
Power generation	
Certificate scheme	Joint Electricity Certificate System with Sweden, does not constitute state aid
Investment aid	"Energy fund" Enova Investment subsidy for use of renewable resources in electricity generation
Transport	
Operating aid via tax exemptions & benefits	Within "Klimatforliket", Norway's Climate Agreement: benefits for zero-CO_2-emission vehicles
Investment aid	"Energy fund" Enova: Investment subsidy for biogas production at an industrial scale or for biofuel production based on waste, lignocellulosic material, or non-food cellulosic material
Investment aid	Innovation Norway: Investment subsidy for biogas installations for farms and forestry
Investment aid	"Energy fund" Enova/Transnova: Investment grants to charging infrastructure for EVs
Quota obligation	For biofuels to road transport, applies to fuel distributors, does not constitute staid aid
Operation aid	Biofuels volumes that exceed the quota obligation are not subject to the general fuel tax, does not constitute state aid
Sweden	
Power generation	
Certificate scheme	Joint Electricity Certificate System with Norway, does not constitute state aid
Investment aid	Government support for solar photovoltaic cells
Operating aid via tax reduction	Reduction of real estate tax for wind power
Operating aid via tax reduction	Tax reduction for micro-generation of electricity from renewable sources

Administrative aid via tax exemption	[Complete] Exemption from energy tax for non-commercial supply of electricity from wind energy (changed during 2015 as part of the re-negotiation of the Control station 2015 in the Joint Electricity Certificate system)
Investment aid	[Complete] Market introduction of wind power in cold climates and offshore
Subsidy for planning	[Complete] Support for planning initiatives for wind power
Transport	
Distribution obligation	Obligation for fuel distributors to provide renewable transport fuel
Operating aid via tax exemptions & benefits	Tax exemptions and benefits for owners of low-CO_2-emission vehicles
Operating aid via tax exemption	Exemption from or reduction of energy and carbon dioxide taxes for biofuels
Investment aid	For R&D in developing new technologies for generation, distribution and use of biogas and other renewable gases
Investment aid	Rural Development Programme: Aid for farm-based biogas production
Denmark	
Power generation	
Operation aid via premium tariff	Premium tariff for RES production connected to the main grid. Premium for offshore wind based on tenders. PV premiums currently administratively set, but tender planned for 2016.
Investment aid	Funds for small-scale renewable energy technologies connected to the main grid
Net metering	Net-metering discount for small RES, excluding geothermal
Guarantees: Planning	Loan guarantees for wind power feasibility studies
Transport	
Quota obligation	applies to fuel retailing companies
Premium tariff	Price-based premium tariff for sale of biogas for use in transport
Tax reduction	Tax reduction for biofuels
Investment aid	Applies to infrastructure for electricity, hydrogen and gas for heavy transport
Finland	
Power generation	
Operating aid via premium tariff	Premium tariff for power from wind, biogas, forest chips, and wood fuels
Subsidy: Research & Installations	Energy support for RES research and investigative projects
Transport	
Quota obligation	applies to fuel retailing companies
Operating aid via tax reduction	Tax reductions for biofuels

Of the mechanisms reviewed within renewable power generation, the Nordic countries have initially emphasised on investment aid and tax incentives mainly to support less mature and small-scale technologies. For more mature technologies, either premium tariffs (Denmark and Finland) or certificate systems (Norway and Sweden) are used. Technology-specific measures are more common than technology-neutral ones. Auctions are only performed in Denmark.

The EU state aid guidelines will have implications for the design of most support schemes currently in use, including tax incentives, investment support and feed-in tariffs.

3.1.1 Iceland

Iceland has a unique position in the Nordic region as it is the only country that has electricity generation which is solely based on renewable resources.[47] This explains the low number or absence of support schemes to stimulate electricity production from renewable sources.

3.1.1.1 RES support in Iceland

Iceland grants subsidies to promote the utilisation of geothermal energy in areas where geothermal heat has not yet been identified. In addition, the National Energy fund sponsors projects aimed at promoting the use of alternative fuels to replace fossil fuels. Support is not limited to certain renewable energy technologies and can be granted to energy utilities, municipalities or individuals. Grants shall not exceed 50% of the estimated costs of a given project.[48]

3.1.1.2 Alternative fuels and transport in Iceland

Iceland provides an exemption from excise and carbon dioxide tax for CO_2 neutral fuels (biodiesel, methane and methanol).

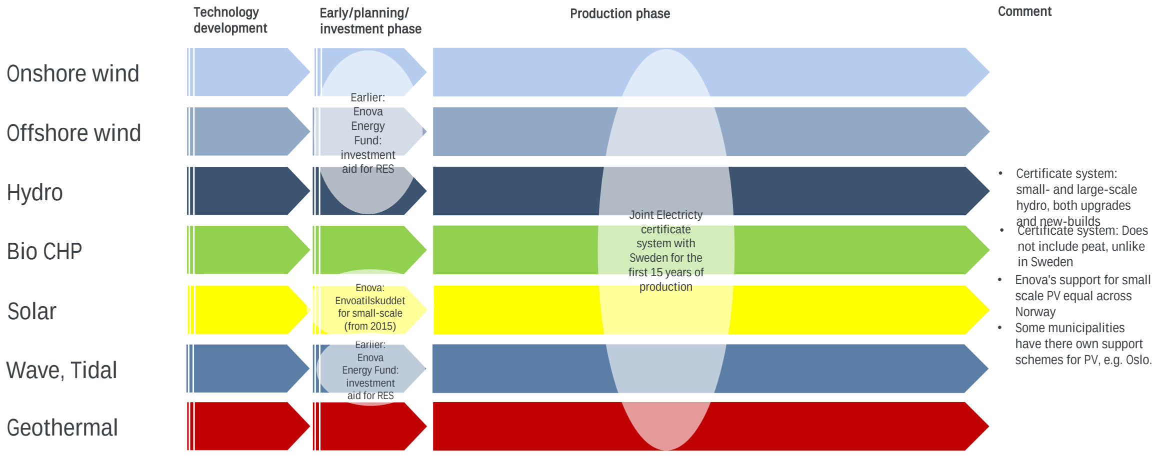
3.1.2 Norway

Norway has an ambitious state support policy in regards to the promoting of energy from renewable sources, mainly using the *Joint Electricity Certificate* scheme, Enova, Transnova and Innovation Norway to support the objectives. On 1 January 2015 Enova took over Transnova's tasks in relation to awarding subsidies for the transport sector.[49]

3.1.2.1 RES-E support in Norway

Norway has one main support scheme to support power production from renewables: the *Joint Electricity Certificate scheme* with Sweden, providing operating aid and running from 2012-2035. While the scheme provides effective support to generators, it is not considered as state aid. In addition, there is the *Enova energy fund*, which aims at support energy and climate measures.

Figure 6: Overview of RES-E support measures in Norway



[47] Hydro power accounts for 71% and geothermal accounts for 29% of national electricity production. Source: http://os.is/gogn/os-onnur-rit/orkutolur_2013-enska.pdf

[48] http://www.res-legal.eu/search-by-country/iceland/tools-list/c/iceland/s/res-e/t/promotion/sum/368/lpid/369/

[49] http://www.enova.no/finansiering/naring/transport/946/0/

The main support that Norway has to support RES-E is the Joint Certificate Market with Sweden. To promote electricity production from renewable sources Norway has a quota system which is a joint support scheme with Sweden, introduced in Sweden already in 2003. On January 1st 2012, Norway joined to create the Norwegian-Swedish electricity certificate market, which will contribute to the increased production of electricity from renewable sources. In Norway, the electricity certificate market replaced the Enova investment aid scheme, which until the end of 2011 granted investment support for e.g. onshore wind power projects, for the volume RES-E, although Norwegian generators could choose whether to receive the Enova support of being part of the certificate scheme during the first two years of the joint scheme with Sweden. All new electricity production based on renewable energy, according to directive 2009/28/EF, is eligible for electricity certificates in both Sweden[50] and Norway. Also, there is no attempt to completely level out differences in energy taxation and depreciation rules although changes were made recently.

The market has a volume target: Norway and Sweden together intend to expand their electricity production based on RES by 28.4 TWh, up from the earlier target of 26.4 TWh, between 2012 and 2020. The technology choice and how much of the investments will be made in Sweden or Norway is neither pre-determined nor clear - this is up to the market actors; it is only decided upfront how the costs should be shared between Norway and Sweden.

The power producers receive one electricity certificate per each produced MWh from renewable sources from the authorities and are free to *sell or bank* them for selling later. Electricity suppliers and some electricity users have a quota obligation and are required to *purchase* electricity certificates for a certain proportion ('quota') of the electricity they deliver or use. Thus, certificates are tradable assets. Certificate prices, and hence the amount of support new renewable electricity producers receive, are set according to demand and supply. The joint market permits trading in both Swedish and Norwegian certificates, and receiving certificates for renewable electricity production in either country.

In Norway, the build-out has not quite been according to initial expectations. After 2012, some wind parks were rather built with Enova support granted before 2012 than as part of the Certificate scheme, with investors citing the uncertainty in the market. Barriers to build-out are often related the grid connection and current investment climate.

Investment aid by the Enova energy fund. The Energy Fund is a government fund established to ensure a long-term, predictable and stable source of finance for the energy efficiency and renewable energy initiative. The state-owned enterprise Enova manages the Energy Fund. Enova's function is to promote a shift to more environmentally friendly consumption and production of energy in Norway and the development of new energy and climate technology. Enova's management of the fund is governed by a four-year agreement between the Ministry of Petroleum and Energy and Enova. The fund was established in 2002, is administered by Enova. The current four-year agreement will end on December 31st 2016 and be replaced by a new agreement.[51] The fund is financed via the state budget, a levy on the electricity grid tariffs and interest generated by the fund itself.

Enova directly supports renewable power generation on a smaller scale in households through the parts of *Enovatilskuddet* introduced in 2015, while main support for renewable power generation comes through the electricity certificate scheme with Sweden. Historically however and before the introduction of the joint certificate market, within RES-E it has e.g. contributed to the build of several onshore wind parks in Norway, which otherwise would not have been built. Under Enova's programme for new energy and climate technology Enova grants investment aid to new technologies for more efficient production of electricity from renewable sources.

3.1.2.2 Alternative fuels and transport

Measures here include both investment aid for biogas by Enova and Innovation Norway and operating aid for zero-emission vehicles through a number of tax exemptions and other tangible and intangible benefits for vehicle owners.

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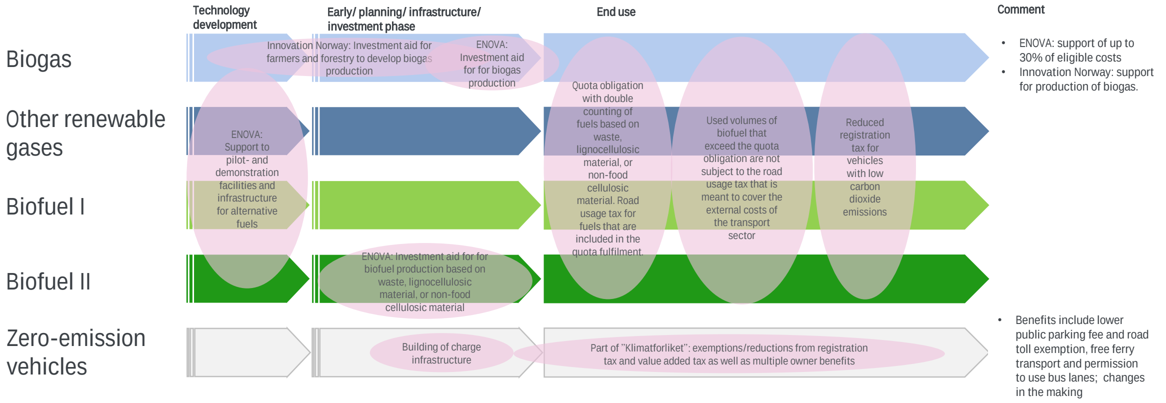
[50] In addition, peat is eligible in Sweden.

[51] EFTA Surveillance Authority Decision of 18 July 2011 on the Norwegian Energy Fund Scheme.

Figure 7: Overview of support measures for alternative fuels and transport in Norway



Quota obligation with double counting. The quota obligation was raised to 5.5% from October 2015 and will be raised to 7% from 2017[52]. The double counting of biofuels fuels based on waste, lignocellulosic material, or non-food cellulosic material is meant to steer towards more advanced and sustainable biofuels.

Scope of road usage tax. The external costs for road transport are covered by a tax that applies to fuels. This tax applies to the volumes of fossil fuels and biofuels reported in the fulfilment of the quota system, but biofuel volumes exceeding the quota fulfilment are not subject to this tax.

Investment aid to biogas production by the Enova energy fund. The aim of Enova's programme for biogas is to develop a market for the production and sale of biogas on an industrial scale and to contribute to technological development for the production of biogas.[53] Support is provided as an investment support for construction of facilities for biogas production and distribution. The project should have a biogas production at least 1 GWh. Plants eligible to receive a subsidy are those which produce biogas from biological waste, energy crops or forest timber and supply this gas to external customers. Investment subsidies are limited to what is necessary to trigger the investment, with maximum support ratio of 30% of eligible costs. Enova considers support needs against a similar return to normal returns for the industry. Projects are to compete for funds; projects with the highest energy yield will receive priority. Programme criteria are determined according to the provisions of the ESA approval of notification of the Energy Fund of 18 July 2011. In 2013, only one project applied for this investment subsidy and received support of 40 MNOK.[54]

Investment aid for biogas installations offered by Innovation Norway. In addition to the investment subsidy offered by Enova, the governmental organisation Innovation Norway offers investment subsidies to biogas installations.[55] The programme aims to stimulate farmers and forestry companies to produce, use and deliver bioenergy as a fuel or heat source. The subsidy is awarded for investment costs and research and development cost whereby the investment subsidy depends on the type of installation.[56]

Zero emission vehicle owners receive a number of tax exemptions and benefits, which have propelled Norway to become one of the most electricity vehicle friendly countries in the world. The incentives applies to both fuel cell electric vehicles and battery electric vehicles, but the main effect has so far been on the latter vehicle type. Norway is one of the leading markets for electric vehicles (EVs) due to a clear strategy and an abundance of policy instruments on both local and national level. Since the beginning of the late 1990s, Norway has supported zero-emission vehicles with an increasing number of policy instruments. However, it should be noted that Norwegian households normally keep two cars, and that the EV in most cases has filled the function of being the second car for short, day to day driving.

The core of the support policy for zero emission vehicles is the exemption from the registration fee that is significantly higher than in most European countries and the exemption from 25% VAT tax on the purchase of the

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[52] Norway 2013-2014 - Member State progress report under Directive 2009/28/EC.

[53] http://www.enova.no/finansiering/naring/programtekster/program-biogassproduksjon/245/295/

[54] Enova, Annual Report 2013, p. 61.

[55] http://www.innovasjonnorge.no/no/finansiering/bioenergiprogrammet/#.VT40aqNvnL_

[56] Innovasjon Norge, Bioenergiprogrammet – retningslinjer for saksbehandling og tildeling av tilskudd 2015.

vehicle.[57] This significantly lowers the initial vehicle owner cost and, in combination with the low operating costs for EVs, gives favourable total cost of ownership. This has probably been the most important pre-requisite for achieving the fast introduction of EVs in Norway[58], and the exemption from the VAT has given a higher economic incentive than exemption from the registration tax.

In general, vehicle ownership in Norway is subject to a large number of fees and taxes, e.g. fuel tax, vehicle registration fee, annual motor vehicle tax, etc. The registration fee is calculated on based on the vehicle's weight, engine power and the CO_2 emissions. The setup of the CO_2 component is so that cars emitting less than 105 g/km (2015 rules, reduced to 95 g/km in 2016) receives a deduction, meanwhile vehicles with emissions over the limit pays progressively higher tax.[59] Vehicles using electricity for propulsion (including fuel cells) are exempt from the tax. As an example, a car that emits 165g CO_2/km is subject to a 50,000 NOK fee (2015 rules).

Other important policy instruments directed at EV users include public parking fee exemption, road toll exemption, free ferry transport and permission to use bus lanes. These measures provide convenience, time savings and significant economic support. And has likely been important for many buyers of an EV. The permission to use bus lanes has commonly been pointed out as the most important incentive due the time saving it can give in areas with traffic congestion[60].

The development of the EV market has been supported by a development in infrastructure that is ongoing. Support has come from Transnova with a support programme launched in 2009, and is now managed by Enova which currently grants support for development of charging infrastructure on major routes in Norway.[61] Charging points are registered in an online database (NOBIL) accessible to the public and, in April 2015, there were almost 6500 EV charging points registered in Norway.[62]

Many of the EV incentives have been in place for quite a long time, but a parliamentary resolution from 2012 decided to protect the tax incentives until the end of 2017, or until the number of EVs exceeded 50 000[63]. Norway passed 50 000 EVs in April 2015, and the Government has now come to an agreement with the cooperating parties (Liberal Party and the Christian Democratic Party) concerning the future of these incentives[64]. Tax incentives are kept until the end of 2017. The VAT exemption, which is a higher incentive than the registration tax exemption, will then be considered replaced by a subsidy that is phased out gradually. The exemption from the registration fee will be kept until 2020. A process is started to lift measures such as decisions about free parking, free vehicle charging and access to bus lanes over to the municipality level.

3.1.3 Sweden

In addition to the operation aid in the form of Electricity Certificates, there are a number of support schemes in Sweden to promote renewable electricity generation, renewable energy use within the industry and renewable vehicle fuels both as investment aid and operation aid.

3.1.3.1 RES-E support in Sweden

Sweden has one main measure to support power production from renewables: the Joint Electricity Certificate System with Norway, and a few supporting measures, of which some are discontinued. The continued schemes include a *reduction of the real estate tax for wind power*, *governmental support for solar photovoltaic cells* and a *tax reduction for micro-generation of electricity from renewable sources* (Figure 8). The recently discontinued support schemes are include support for *planning initiatives for wind power*, *market introduction of wind power* and an *energy tax exemption for non-commercial wind power production*.

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[57] Mock & Yang, ICCT, 2014. Driving Electrification: A global comparison of fiscal incentive policy for electric vehicles. Available from: [http://www.theicct.org/driving-electrification-global-comparison-fiscal-policy-electric-vehicles]

[58] [Ole Henrik Hannisdahl, Håvard Vaggen Malvik, Guro Bøe Wensaas, The future is electric! The EV revolution in Norway – explanations and lessons learned, EVS27, 2013]

[59] https://lovdata.no/dokument/STV/forskrift/2014-12-15-1724/KAPITTEL_3-1#§5_1

[60] [Erik Figenbaum, Marika Kolbenstvedt, 2013, Electromobility in Norway - experiences and opportunities with Electric vehicles]

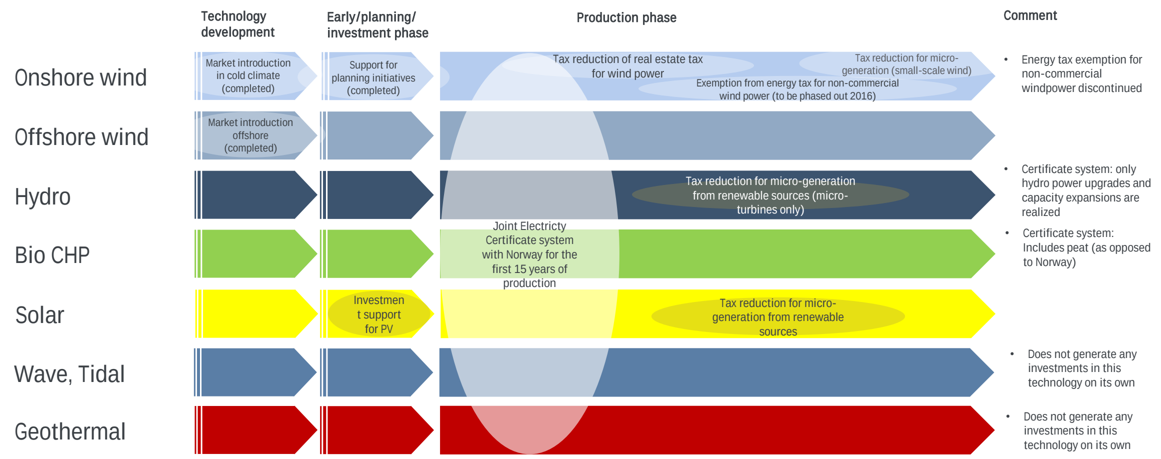
[61] Enova, 2015. Støtte til ladeinfrastruktur [http://www.enova.no/finansiering/naring/transport/stotte-til-ladeinfrastruktur/1034/0/]

[62] Enova, 2015. Strategi for ladestasjoner og infrastruktur for elbil: 2015-2016. Accessible from: [http://www.enova.no/finansiering/naring/transport/stotte-til-ladeinfrastruktur/1034/0/]

[63] [«Norsk klimapolitikk», https://www.stortinget.no/no/Saker-og-publikasjoner/Vedtak/Vedtak/Sak/?p=52754]

[64] [http://www.venstre.no/assets/BilavgiftsgjennomgangENIGHET_0605_2015.pdf]

Figure 8: Overview of RES-E support measures in Sweden



Joint Electricity Certificate System with Norway, running from 2012-2035. While the Certificate is not considered State Aid, it had and has an enormous influence on the deployment of RES-E in Sweden. The main incentive for the use of renewable energy sources is a quota system in terms of quota obligations and a certificate trading system.

The system came in to force on May 1st 2003 and is intended to increase the production of renewable electricity in a cost-efficient way. Norway joined the scheme on January 1st 2012, which increased liquidity in the market. The market has a volume target: Norway and Sweden together intend to expand their electricity production based on RES-E by 28.4 TWh, up from the earlier target of 26.4 TWh until 2020. All new electricity production based on renewable energy, according to directive 2009/28/EF, is eligible for electricity certificates in both Sweden and Norway. In addition peat is eligible for certificates in Sweden. Also, in contrast to Norway, investors in the Swedish certificate market can decide to invest after 2021, provided they are prepared to accept a shorter period of receiving certificates, which is limited to 2035.

The technology choice and how much of the investments will be made in Sweden or Norway is neither pre-determined nor clear - this is up to the market actors; it is only decided upfront how the costs should be shared between Norway and Sweden. Also, there is no attempt to have completely level out differences in energy taxation and depreciation rules although changes were made recently. Recent increases of the ambition level of the Certificate scheme resulted in discontinuation of the energy tax exemption for non-commercial wind power production in Sweden.

Power producers receive one electricity certificate per each produced MWh from renewable sources or peat from the authorities and are free to *sell or bank* them for selling later. Electricity suppliers and some electricity users have a quota obligation and are required to *purchase* electricity certificates for a certain proportion ('quota') of the electricity they deliver or use. Thus, certificates are tradable assets. Certificate prices, and hence the amount of support new renewable electricity producers receive, are set according to demand and supply. The joint market permits trading in both Swedish and Norwegian certificates, and receive certificates for renewable electricity production in either country.

In Sweden, the Certificate scheme has resulted in RES-E build according to or slightly above average targeted build-out rate until the end of 2014. Build-out activities and investment decisions have slowed down during 2015 in the wake of both lower electricity and certificate prices.

Reduction of the real estate tax for wind power. Owners of power stations or, under certain conditions, owners of land on which a power plant is located shall pay an annual real estate tax depending on the value of the power plant (§§ 1, 3 par. 1 d) Act No. 1984:1052). This real estate tax does not differ for renewable and fossil energy sources, except for wind energy, which is subject to a reduced tax payment, and hydro-electricity, which is subject to a higher tax rate (§ 3 par. 1 d), e) and f) Act No. 1984:1052), (see Table 12 in the appendix).

Government support for solar photovoltaic cells crucial for investments. Act (2009:689) authorises grants for the installation of on-grid photovoltaic installations. The support was introduced in 2009 and planned to continue to 2016. Between 2009 and March 2015, in total 467 MSEK were granted and 361 MSEK were paid out. An evaluation of the period 2009-2011 shows that the support scheme was crucial for the investments in photovoltaic systems.[65]

Eligible are PV-installations connected to either an internal (on the given property) or external grid. Installations generating both electricity and heat from solar energy (hybrid installations) are eligible only if the electricity generated amounts to at least 20 % of an installation's total annual production. Both private individuals, municipalities and enterprises are eligible. Grants amount to 43 % of the eligible costs. Eligible costs include labour costs, costs of materials and planning costs. The costs of the connection to an external electricity grid are excluded from the eligible costs. Grants awarded under this scheme cannot be received on top of other public grants, including those of the European Union or tax reduction for labour costs (§ 2 par. 1 Regulation No. 2009:689).

Tax reduction for micro-generation of electricity from renewable sources. Micro-production from photovoltaic systems, small-scale wind power and micro-turbines are eligible, for both physical and juridical persons. Fuse size should not be larger than 100 A. Introduced in 2015, the tax reduction is 0.6 SEK per kWh for a maximum 18 000 SEK per year. The maximum tax reduction is limited to the number of kWh that has been used at the connection point (Table 18).

Measures which have supported the development of RES power generation, but which have been recently discontinued include:

Support for planning initiatives for wind power. The objective of this measure was to facilitate the planning of wind power and thereby indirectly contribute to the deployment of wind power at a later point in time. Eligible were municipalities, county administrative boards, regional autonomous bodies and municipal cooperative bodies. A total of 212 municipalities and 14 counties applied for the support and have developed planning documents and/or worked with wind power in the regional master planning process.[66] Aid for planning initiatives for wind power was given between year 2007 and 2010 for a total of 84 MSEK (Table 14).

Exemption from energy tax for non-commercial wind power production. Up to June 2016, every producer that supplies electricity on a non-commercial basis is eligible for tax exemption (Chapter 11 § 2 Act No.1994:1776). The exemption has been lifted thereafter as a result of the necessary negotiations with Norway for increased ambition level in the Joint Electricity Certificate System during Control Station 2015.

Market introduction of wind power (until 2012). The program supported wind power demonstration projects between year 2003 and 2012, based on the Ordinance on grants for measures for efficient and environmentally friendly energy (2003:564). Phase 1 ended in 2007, phase 2 in 2012, with a total budget of 700 MSEK for both phases.

This measure aimed to reduce the costs of establishing new wind power plants and to increase knowledge of the effects of establishment in certain environments, whether that was wind power in cold climate or offshore. Aid was provided for technology development and market introduction in collaboration with trade and industry, as well as for environmental impact studies.

During Stage 1 the primary focus was on offshore establishment and to a certain degree in mountain environments. During Stage 2 the focus was primarily on woodland and mountain environments, where Swedish wind power currently primarily is developed and the need for knowledge was greatest at the time. According to the evaluation of the program[67], the greatest benefit to which the programme contributed was the knowledge and experience gained on wind power in a cold climate and de-icing of wind turbines. Even the knowledge of offshore wind has been very valuable. Furthermore, the evaluation shows that several of the projects would not have been realized without the support.

3.1.3.2 Alternative fuels and transport in Sweden

Current support measures include a wide range of measures, from an exemption from energy tax and carbon dioxide for biofuels, over an obligation to provide at least one renewable fuel at filling stations for transport fuel, the so-called "Pump Act", filling station support for extra investments to install renewable fuels other than E85 to

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[65] Elforsk, 2011. Report 11:76, Uppdatering av ÅF:s och Energibankens utvärdering av det statliga solcellsstödet.

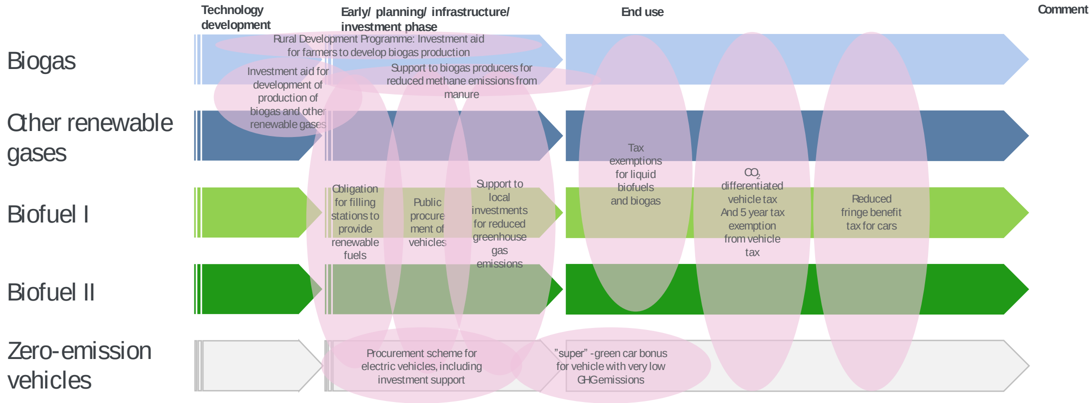
[66] Boverket, 2012. Report 2012:21, Utvärdering och uppföljning av stöd till

Planeringsinsatser för vindkraft

[67] Faugert, 2013, Evaluation of major demonstration projects in wind power

investment support for biogas and other renewable gases, see Figure 9 below. Furthermore, there are several measures targeting vehicle owners.

Figure 9: Overview of support measures within alternative fuels and transport in Sweden



Exemption from energy and carbon dioxide tax for biofuels. The tax exemption aims to increase the use of renewable fuel by compensating for its higher costs in relation to fossil fuels. It is the most important measure for increasing the use of biofuels. The tax exemptions for biofuels have been granted for short time periods of one to two years, as only temporary exemptions are granted due to EU legislation. The extent of the exemptions has varied through the years. Biofuels have always been exempt from carbon dioxide tax but the degree of the exemption from energy tax has varied. In later years, the exemptions have differentiated both between different kind of biofuels and between low-blend and high-blend fuels. Since 2010, the fuel supplier must have a sustainability decision from the Swedish Energy Agency to show that the biofuels fulfil the sustainability criteria for biofuels in Act (2010:598).

The Swedish National Audit Office (Riksrevisionen) in 2011[68] evaluated the tax exemptions as important for reaching the climate goals, but also as a relatively expensive way of achieving this. In the implementation of this policy instrument, the said evaluation pointed out that there was a lack of long-term, predictable conditions for biofuels, as the exemption were only given for short time periods. Moreover, it concluded that due to high expenses and regulations from EU, this policy instrument would not be sustainable in the long term.

Despite these shortcomings, the tax exemption has been very successful in increasing the share of biofuels in the transport sector, and Sweden has by far the largest share of biofuels in EU. In contrast with blending obligations, which are commonly used in EU, the tax exemption enables a market for high blend fuels and pure biofuels.

Obligation to provide at least one renewable fuel at filling stations for transport fuel, the so-called "Pump Act". The intention of this act is to increase the availability of renewable transport fuel at filling stations throughout Sweden. It only applies to stations selling petrol and diesel volumes larger than a specified annual volume limit; this limit has varied over time – from a relatively high level in 2006 when the act was introduced, to a lower level which affected more stations, and then slightly increased again in 2015. Fines can be issued to fuel distributors that do not comply. The expected outcomes of the measure were an increase in the availability of renewable fuels in general and that the results should be technology neutral.

The Pump Act was evaluated in 2009 by the Swedish National Audit Office[69]. The evaluation concluded that the availability of renewable transport fuels has increased significantly since the act was instated, with the number of filling stations offering biofuel more than quadrupling between 2005 and 2009. However, it was not technology neutral as intended due to the significantly lower investment cost of installing ethanol (E85) over other options, as well as the existing vehicle fleet powered by alternative fuels being greater for E85; this resulted in over 90%

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[68] Riksrevision, 2011. Biofuels for a better climate: How is the tax exemption used? http://www.riksrevisionen.se/PageFiles/13896/RiR_2011_10_Biofuels%20for%20a%20better%20climate_Anpassad.pdf

[69] Riksrevisionen, 2009. Rapport från riksdagen 2009/10:RFR7: Pumplagen - uppföljning av lagen om skyldighet att tillhandahålla förnybara drivmedel [http://www.riksdagen.se/sv/Dokument-Lagar/Utredningar/Rapporter-fran-riksdagen/Pumplagen---uppfoljning-av-lag_GX0WRFR7/]

of the biofuel offering from filling stations being E85 in 2009.[70] Additionally, in a few cases, the Pump Act may have caused filling stations to close due to the investment cost for the renewable fuel pump.

Measures targeting vehicle owners. Sweden has several measures which overall aim to lower the overall greenhouse gas emissions in the transport sector by focusing on vehicle owners and persuading them to purchase more fuel efficient and/or low-carbon vehicles. Although they are not all purely RES support schemes, they give a more holistic view of the Swedish strategy.

- The **carbon dioxide-differentiated vehicle tax**, introduced in 2006, relates a part of the vehicle tax directly to carbon dioxide emissions and applies to all vehicles. Cars with emissions lower than a certain limit are exempt from the CO_2-tax, while vehicles that exceed that limit pay CO_2 tax related to how much they exceed the limit. The limit is continuously lowered to encourage even more energy efficient vehicles with lower emissions.
- The **super-green car rebate** grants a rebate for the purchase of a low-emission vehicle up to a maximum of 40 000 SEK.
- **Five-year tax exemption** for the first five years for a low-carbon vehicle.
- **Lower taxable benefit for company cars**. The use by private individuals of cars owned by legal entities subjects the private individual to a tax which can be reduced if the car is electric, hybrid, or powered by natural gas or biogas.[71]

Rural Development Programme 2007-2013: Aid for farm-based biogas production. Aid for farm-based biogas production was included within the framework of the Rural Development Program from 2009. Between the years 2010 and 2012, 31 projects were granted, with approximately 0.3 TWh biogas produced in the biogas facilities built within these projects. Several of these would not have been realized without the support.[72] The Rural Development Programme 2014-2020[73] continues to support farm-based biogas production.

3.1.4 Finland

Finland has a number of schemes in place to promote renewables: for electricity from renewable energy resources operational aid in the form of *premium tariffs* and *investment aid* in the form of subsidies. To promote the use of biofuels in transport, Finland has a *biofuel quota obligation* that applies to fuel retailing companies and *tax reductions* in place.

3.1.4.1 RES-E support in Finland

To further the generation of electricity from renewable energy resources Finland has two schemes: operational aid in the form of *premium tariffs* for wind, biomass and biogas and investment aid in the form of *subsidies*. The support schemes are all financed via the state budget. The characteristics of each of these schemes are described in more detail below, (Figure 10).

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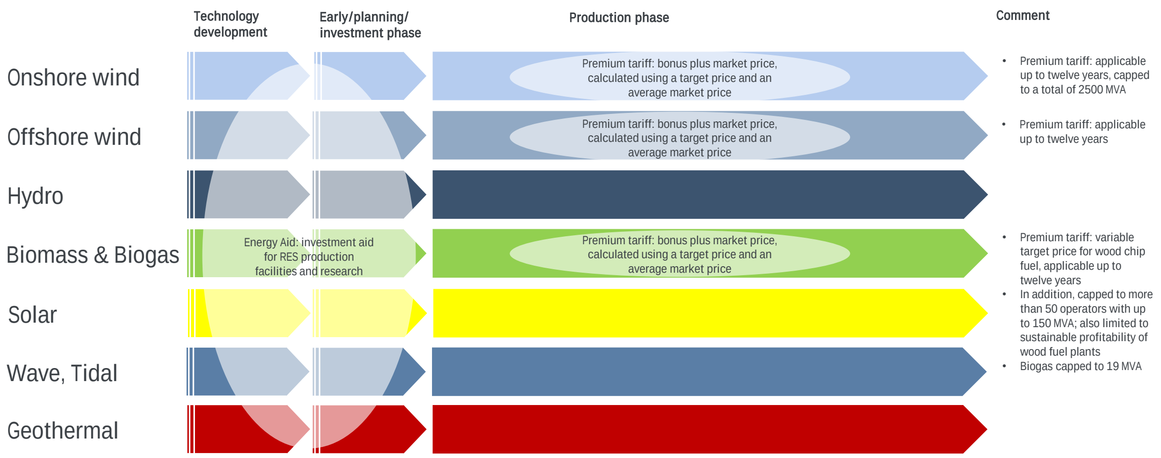
[70] Riksrevision, 2009. The Act on the Obligation to Supply Renewable Fuels – A follow-up report. Accessible from: [http://www.riksrevisionen.se/PageFiles/13896/RiR_2011_10_Biofuels%20for%20a%20better%20climate_Anpassad.pdf]

[71] Naturvårdsverket, 2015. Report for Sweden on assessment of projected progress, March 2015.
[https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/uppdelat-efter-omrade/klimat/prognoser-for-Sveriges-utslapp/report-sweden-assessment-projected-progress-2015.pdf]

[72] Sveriges riksdag, 2012, Uppföljning av vissa frågor inom landsbygdsprogrammet.

[73] Regeringskansliet, 2015, Sweden - Rural Development Programme (National)
[http://www.jordbruksverket.se/download/18.12cf1a5d150d42fca521ff0d/1446727626282/Landsbygdsprogrammet+2014-2020.pdf].

Figure 10: Overview of RES-E support schemes in Finland



Premium tariff. In order to further production from renewable sources, a premium tariff scheme was introduced in Finland in March 2011. The scheme gives certain producers the right to a premium on top of the market price for the electricity produced for 12 years from the date the right to the premium is established (subject to certain limitations[74]). The tariff scheme is applicable to electricity produced from wind, biogas, forest chip and wood fuel.[75]

The tariff system is specified in the Act on support for production of electricity from renewable energy sources ("Lag om stöd till produktion av el från förnybara energikällor"). The aim of this legislation is to promote production of electricity from renewable energy sources, improve the competitiveness of these energy sources, diversify electricity production and improve the self-sufficiency level for electricity.

Criteria differ from technology to technology. General and technology specific conditions apply for a plant to be approved for the tariff system. The plant must be situated in Finland or in Finnish territorial waters and be connected to the Finnish electricity grid. In addition, the power plants must fulfil operational and economic requirements for energy sources.[76]

Plants are not eligible to receive the premium if they also receive state support. There are however exceptions to this general rule in the form of the following:

- A forest chip plant could be eligible for a "gasification premium" on top of the premium tariff.[77]
- A pilot project for offshore wind power can receive investment aid as well the premium tariff.[78]
- A biogas power plant can in addition to the premium tariff be eligible for a heat bonus.[79]

In the case of the first two, approval of the European Commission on the compatibility of the aid with the internal market needs to be obtained, which is done for the second and underway or the first one with the notification process in the commission. Approval needs also be obtained in the case for a power plant whose capacity for production of renewable electricity will, due to the production support, exceed the threshold for detailed state aid research.[80]

The **premium tariff** constitutes the difference between the target price and the average value of the market price for electricity for three months in the area in which the power plant is situated. The calculated premium tariff must be at least 1 EUR/MWh.[81] The market price is calculated on the basis of the day ahead market prices

[74] §16, Act on support for production of electricity from renewable energy sources.
[75] §6, Act on support for production of electricity from renewable energy sources.
[76] §7, Act on support for production of electricity from renewable energy sources.
[77] §8, Act on support for production of electricity from renewable energy sources.
[78] §9, Act on support for production of electricity from renewable energy sources.
[79] §10, Act on support for production of electricity from renewable energy sources.
[80] §15, Regulation on support for production of electricity from renewable energy sources.
[81] §4, Regulation on support for production of electricity from renewable energy sources

established on the Nordic market for the bidding area in which the plant is situated. An average of the hourly prices for the three month period is used.[82]

If the average value of the market price for electricity for three months is under 30 EUR/MWh, the premium tariff is paid out on the basis of the target price reduced by 30 EUR/MWh.[83] The target price for electricity from wind power plant, biogas power plant or wood fuel plant is 83.50 EUR/MWh. Thus, for these plants a maximum premium tariff of 53.50 EUR/MWh applies.

Support for a forest chip plant is paid out on the basis of a changing support so that forest chip as a fuel keeps its competitive position in relation to peat with simultaneous production of electricity and heat.[84]

There is currently a very high focus on cost efficiency in Finland, due to Finlands economic situation which triggered a government evaluation of the premium tariff scheme.

Investment aid for RES production facilities and research. The second scheme in Finland to promote the use of electricity from renewable sources is in the form of subsidies for investment and energy audits in relation to the production and use of renewable energy. Support can be awarded to climate and environmentally friendly investment or investigative projects which promote the production or use of renewable energy, energy saving and efficiency, or reduce environmental damage of energy production or use of energy.[85]

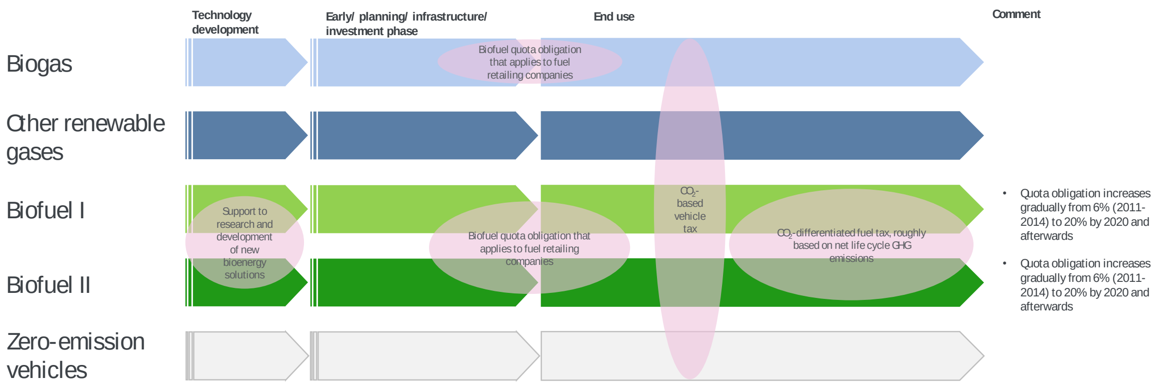
An investment project should concern an investment in fixed assets which are needed to implement one of these three aims. Investigative project are projects which relate to energy audits and energy analysis or other research which relates to the development of a new method or service.[86]

The party receiving aid for an eligible project must finance at least 25% of the costs themselves (excluding finance from public support sources). This requirement does not apply to projects carried out by a municipality or an association which is primarily owned by a municipality. Support can be awarded to companies, municipalities and certain other associations.[87]

3.1.4.2 Alternative fuels and transport in Finland

To promote the use of biofuels in transport, Finland has a *biofuel quota obligation* that applies to fuel retailing companies and *tax reductions* in place. The support schemes are all financed via the state budget. There is currently no specific support scheme for zero-emission vehicles. The characteristics of each of these schemes are described in more detail below.

Figure 11: Overview over measures within alternative fuels and transport in Finland



The quota obligation in Finland aims to support of the use of biofuels for transport. It states that biofuels should constitute a specific percentage (energy content) of the total amount of petrol, diesel and biofuels that are distributed[88]. Smaller fuel distributors are exempt from the quota obligation. The percentage was 6% during

[82] §3, Regulation on support for production of electricity from renewable energy sources.

[83] §25, Act on support for production of electricity from renewable energy sources.

[84] §23, Act on support for production of electricity from renewable energy sources.

[85] §5, Regulation on general conditions for the grant of energy support.

[86] §3, Regulation on general conditions for the grant of energy support.

[87] §6, Regulation on general conditions for the grant of energy support.

[88] [https://www.tem.fi/sv/energi/fornybara_energikallor/skyldighet_att_distribuera_biodrivmedel, http://www.finlex.fi/sv/laki/ajantasa/2007/20070446]

2011-2014, 8% in 2015 and it will gradually increase to 20% up to 2020. There is a penalty for not fulfilling the quota, which amounts to is 0.04 EUR per megajoule.

Biofuels that are produced from the following sources and fulfil the sustainability criteria in RED are counted double in the fulfilment of the quota: waste, by-products or cellulose from non-food crops, or lignocellulosic material.

The taxation for energy was reformed in 2010 leading to taxation of all fuels based on their energy content and carbon dioxide emissions. The carbon dioxide tax for biofuels is roughly related to their life cycle carbon dioxide emissions. Biofuels that fulfil the sustainability criteria in RED have 50% of the carbon dioxide tax that is paid for fossil fuels while the fuels that fulfil the criteria for "double counting" have 0% carbon dioxide tax[89].

Investment support also exists for new energy technologies that support biogas (among other technologies) for transport and second-generation ethanol production[90].

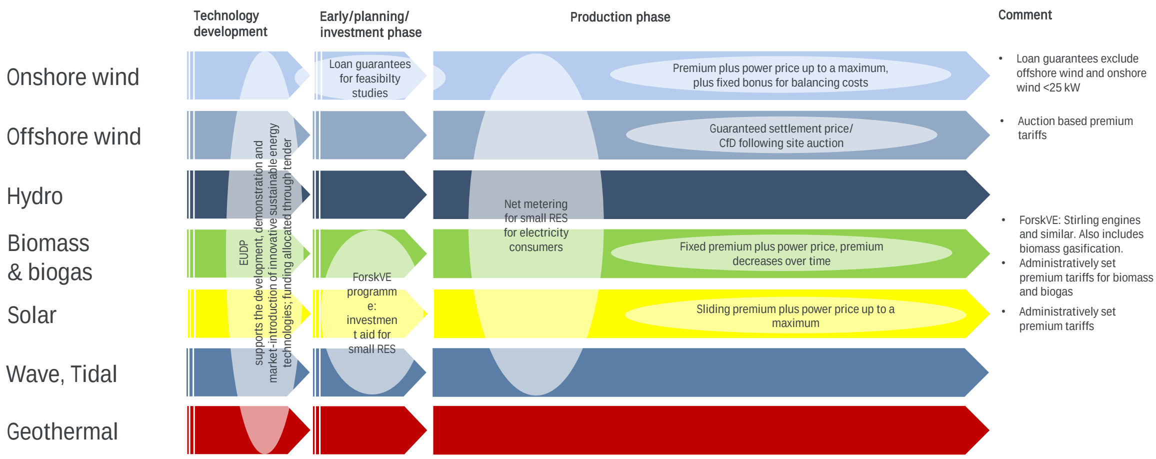
3.1.5 Denmark

Denmark has the most extensive set of support schemes for renewable energy in the Nordic countries. Below the schemes which are in force to promote the generation of electricity from renewable energy resources and the use of alternative fuels in the transport sector are described.

3.1.5.1 RES-E support schemes in Denmark

The Danish measures include mainly *technology-specific operating aid* in the form of premium tariffs, either administratively set or auction-based, but also *investment aid for small-scale RES* and supportive measures such as *net-metering* for certain small-scale producers *and loan guarantees for feasibility studies for onshore wind*, as outlined in Figure 12.

Figure 12: Overview of RES-E support measures in Denmark



The characteristics of each of these schemes are described in more detail below.

Premium tariffs for renewable electricity generation, financed through a public service obligation. Denmark promotes the main share of renewable electricity generation through operating aid via premium tariffs. These tariffs are either set administratively for small-scale or via auctions (offshore wind). The premium tariffs are financed via the PSO tariff (Public Service Obligation) and the total budget for premium tariffs amounted to 5449 MDKK in 2013, up from 3834 MDKK in 2012. Large consumers and installations that generate electricity for own consumption pay a reduced tariff or are exempt from paying the PSO tariff.

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[89] [Lagen om punktskatt på flytande bränslen (1472/1994), http://www.finlex.fi/sv/laki/ajantasa/1994/19941472?search%5Btype%5D=pika&search%5Bpika%5D=lagen%20om%20punktskatt%20p%C3%A5%20flytande%20br%C3%A4nslen]

[90] [https://www.tem.fi/sv/energi/energistod]

Due to a stable renewables policy and that the premium tariffs have been in force for quite a while, the scheme is in its entirety rather stable. On the other hand there have been a high number of changes to the scheme, allowing for the possibility to respond to changes in the market.

There are three forms of support: a Contract for difference (CfD), based on a sliding (or variable) premium, a fixed premium and a feed-in tariff, based on a guaranteed settlement price. Producers which receive a fixed premium or a sliding premium in a CfD sell their electricity on the market and receive the premium from Energinet.dk. In the case of a guaranteed settlement price, Energinet.dk buys the electricity from the producer at this price and sells the electricity on the market.

A *sliding premium* is received by producers on top of the market price. The premium varies according to the market price and the statutory maximum set for the sum of both the market price and the premium. The statutory maximum depends on the date of connection of a given plant and the source of energy used. In some cases, producers are granted a *fixed premium* on top of the market price. Premium levels may differ depending on RES-E technology, installation period, size and owner type. Therefore, the design features of the tariff scheme will be discussed per technology below.

Premium for onshore wind differ for installation periods, size and owner type. Turbines connected to the grid on 1 January 2014 or later, are eligible for a premium awarded from the date of grid connection.[91] The subsidy is applied to the sum of electricity production in 6 600 hours of full load hours and electricity generation of 5.6 MWh per square meter rotor. This corresponds to the production of the turbine during its first around 25000 full load hours in total, depending on the specific type of wind turbine. The fixed premium amounts to 0.25 DKK/kWh. The sum of the premium and the market price cannot exceed 0.58 DKK/kWh[92]. In addition, a fixed bonus of 0.018 DKK/kWh for balancing costs is awarded[93].

Electricity produced by onshore wind turbines connected to the grid in the period from 21 February 2008 to 31 December 2013, receive a fixed premium of 0.25 DKK/kWh for electricity production, corresponding to the output of the wind turbines installed capacity in the first 22 000 hours (full load hours) after the wind turbines grid connection.[94] Moreover, a fixed bonus of 0.018 DKK/kWh for balancing costs is paid out.

Special rules and tariffs apply for utility-financed wind turbines[95], wind turbines with an installed capacity of 25 kW or less which are connected to own consumption installations ("husstandsmøller"). Details can be found in the appendix (Table 25).

Wind turbines connected to the grid between 1 January 2005 and 20 February 2008 receive a fixed bonus of 0.10 DKK/ kWh for produced electricity and a fixed bonus of 0.018 DKK/kWh for balancing costs. These bonuses are awarded for a period of 20 years after grid connection.[96]

Offshore wind. Concessions for offshore wind plants are awarded on the basis of a tender, mainly as *site-specific* single-item auctions with a predefined size expressed as capacity, typically 200-400 MW. The tenderer is to quote a kWh price to be paid for a fixed amount of production corresponding to 50 000 full load hours, e.g. 20 TWh for 400 MW.[97] Since annual production and full load hours vary, the actual support duration in practices varies from 12-15 years. The concession will be awarded to the tenderer quoting the lowest price as pay-as-bid. The offshore wind plants will thus receive a guaranteed settlement price (sliding premium) which corresponds to the price bid in the tender. The following table gives an overview of the CfD levels per offshore wind farm established on the basis of a tender.

Table 4: Contracts for difference/guaranteed settlement prices per offshore wind farm

[91] § 35a, VE-Act.

[92] Energinet.dk determines the market prices on the basis of the principles of § 51 (2) of the VE-Act, depending on, amongst others, technology.

[93] This was revised from 1 January 2016 from 0.023 DKK/kWh to be in line with the average balancing cost between 2007-2014, as decreed by the European Commission (Energinet.dk, February 2016, accessed from: [http://energinet.dk/DA/El/Nyheder/Sider/Nye-regler-for-balancegodtgoerelse-til-vindmoeller-.aspx])

[94] § 36, VE-Act.

[95] Utility financed installations are defined in article 5 (2) of the VE-Act as facilities that are constructed or converted on the basis of a surcharge of §13 of Law nr. 54 of 25 February 1976 as amended by Law nr. 486 of 12 June 1996 or based on an agreement with the Climate, energy or building Ministry.

[96] § 38, VE-Act.

[97] http://www.ens.dk/sites/ens.dk/files/byggeri/final_tender_conditions_5_12_.pdf

Offshore wind plant	Guaranteed settlement price/CfD
Horns Rev 3	0.77 DKK per kWh
Horns Rev 2	0.518 DKK per kWh
Rødsand 2	0.629 DKK per kWh
Anholt	1.051 DKK per kWh

The support in the form of the guaranteed settlement price is awarded for a total of 10 TWh for the Horns Rev 2, Rødsand 2 plants and a total of 10 TWh for the Anholt plant. Moreover, the guaranteed prices are limited to a period of 20 years after the date of connection of the wind farm to the grid. Guaranteed prices will not be paid during hours in which the market price is negative, limited to a maximum of 300 hours a year.[98]

For electricity produced by a utility-financed wind turbines in territorial waters, a guaranteed settlement price of 0.35 DKK/kWh is awarded. The tariff is paid for electricity production corresponding to a production of 42 000 full load hours. In addition to the guaranteed settlement price, a fixed premium of 0.10 DKK/kWh is given[99].

The option of *non-site specific* tenders exist nearshore projects, which are also awarded pay-as-bid.

Qualification criteria are rather comprehensive and include a financial guarantee, a required minimum annual turnover over the last three years, and equity ratio higher than 20% *or* reasonable ratings as well as a technical track record for operation and maintenance, development and construction management of offshore wind farms. Consortia must fulfil these requirements in their sum. The number of participants in the tender is limited (for Horns Rev 3, a maximum of 10 participants were allowed). If the number of applicants is higher than 10, participants are selected based on their most relevant references for project development and construction management of offshore wind farms as well as their relevant use of environmental, quality and risk management.

Offshore turbines which are part of a pilot project can apply to the Ministry of Climate, Energy and Buildings for a guaranteed settlement price under certain conditions.[100]

Premium tariffs for solar PV and other small scale technologies. Since 2004 Denmark has an aid scheme for solar cell plants, wave power and renewable energy powered cells. The scheme was amended several times to incentivise investment in various solar plants and renewable energy technologies varying from small household installations to larger installations.

Danish solar energy capacity is to be expanded to 800 MW by 2020. The scheme has evolved and support has been given depending on connection year, installation size, where the installation is done (e.g. roof) and if the installation is stand-alone or joint. There is *basic support* and an *annual pool scheme* for certain PV installations. In the *basic scheme*, electricity from solar plants receive a guaranteed settlement price 0.60 DKK/kWh for the first ten years after connection and 0.40 DKK/kWh in the ten years after. This scheme is open to all PV installations which are not supported under the *annual pool scheme*, which includes PV categories eligible for higher support. Access is granted on a "first come, first served" basis. For the pool scheme, there are three categories:

For all solar pool scheme configurations, the guaranteed settlement price will be paid for 10 years with a decreasing level depending on the connection year. In general, higher support is paid for the high configuration (e.g. 1,45 DKK/kWh for connection year 2013) than for intermediate and low configuration, however decreasing towards 0,60 DKK/kWh in for the connection year 2018. For 2016, an open solar PV tender is planned with Germany.

Other small-scale RES than PV are supported within these three categories:

[98] § 37, VE-Act.

[99] § 40 (3), VE-Act.

[100] § 35b, VE-Act.

Biogas and biomass. Tariffs for biogas and biomass produced differ and are administratively set. Plants generating electricity by burning *biomass* can receive a fixed bonus of 0.15 DKK per kWh.[101]

Electricity produced though installations only using *biogas* or *gasification gas generated from biomass* receive a guaranteed settlement price of 0.81 DKK per kWh[102]. In the case of co-firing plants, for the proportion of electricity generated from the combustion of biogas, a fixed bonus[103] of 0.438 DKK/kWh applies. The same settlement price and bonus is applicable to electricity produced with use of Stirling engines and other special power generation plants with biomass as an energy source.

The guaranteed settlement price and the fixed bonus are calculated every year on 1 January and adjusted by 60% of the increase in the net price index of the previous year as compared to 2007.[104]

Additionally, electricity produced through installations only using *biogas* or *gasification gas generated from biomass* receives a fixed bonus of 0.26 DKK/kWh and a bonus of 0.10 DKK/kWh. From 1 January 2013, the 0.26 DKK bonus is adjusted annually, and from 1 January 2016, the 0.10 DKK bonus is reduced by 0.02 DKK annually, until it reaches 0 in 2020. Details on the bonus for electricity production can be found in the appendix.

Biogas which is upgraded to natural gas quality and subsequently fed into the natural gas network receives a guaranteed settlement price of 81 DKK per GJ, a fixed bonus of 26 DKK per GJ and a bonus of 10 DKK per GJ. These tariffs are adjusted in the same way as the tariffs for electricity production.[105]

Biogas used for heating purposes receives a fixed bonus of 26 DKK per GJ and a bonus of 10 DKK per GJ. These tariffs are adjusted in the same way as the tariffs for electricity production.[106]

Funds for small-scale renewable energy technologies (ForskVE-program). The aim of this grant scheme is to promote the spread of power generation plants with a smaller capacity, including solar cells, wave power and other renewable energy installations. In addition, grants for small scale pilot projects are included under this scheme.

Eligible installations must be connected to the grid[107] and only installations which are judged to be able to produce electricity on a regular basis are eligible.[108] The following plants are entitled to receive support:

- Solar panels integrated into buildings;
- Small wave power plants;
- power generation plants using gas produced through gasification of biomass,
- power generation plants using a Stirling engine and other similar installations with biomass as an energy source.[109]

The Danish transmission system operator, Energinet.dk, administers the grant funding which amounts to 25 million DKK annually through to the end of 2015.[110] A grant can be awarded in addition to a premium tariff.[111]

Loan guarantees for feasibility studies. Energinet.dk can decide on the granting of guarantees to local wind turbine committees or other local initiative groups for loans taken to finance feasibility studies, including the study of locations, technical and economic assessments and preparing applications for the authorities with a view to establishing one or more wind turbines.[112]

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101 § 45, VE-Act.

102 In 2014 price level.

103 For the sake of simplicity we call this a fixed bonus, even though the bonus is calculated every year and thus varies.

104 § 43a, par. 5 and 6, VE-Act.

105 § 35c, act on natural gas supply.

106 § 43d, VE-act.

107 §49, Law on the promotion of renewable energy.

108 §2, Regulation on grants to promote the development of electric power generated from renewable energy sources.

109 §1, Regulation on grants to promote the development of electric power generated from renewable energy sources.

110 §3, Regulation on grants to promote the development of electric power generated from renewable energy sources.

111 §49, Law on the promotion of renewable energy.

112 §21, Act on the promotion of renewable energy (VE-Act).

Turbines with an installed capacity of 25 kW or less which are connected to their own consumption installation and offshore wind turbines established via tender are excluded from the scheme.

A number of requirements apply to qualify for a guarantee, such as the committee size being at least 10 members, the majority of whom must live close (within 4.5 km) to the proposed site, and these members must have a controlling influence. The project must also be deemed feasible.

If a wind turbine project is not completed, guarantees are not required to be paid back, unless the wind turbine project was fully or partially transferred to another party.

Within a budget of 10 million DKK, Energinet.dk decides on the grant of a guarantee on application by the committee or initiative group. The guarantee is given for the then-available sum. The maximum grant warranty is 500 000 DKK per project.

Net metering can – for certain producers - reduce the PSO. This scheme aims to encourage RES production for purposes of own use. The net settlement under the provisions of the Regulation on net-metering exempts certain producers which use all or part of the electricity produced for their own needs, from paying the Public Service Obligation (PSO) or part of it. The public service obligation is a charge levied to support renewable energy.[113]

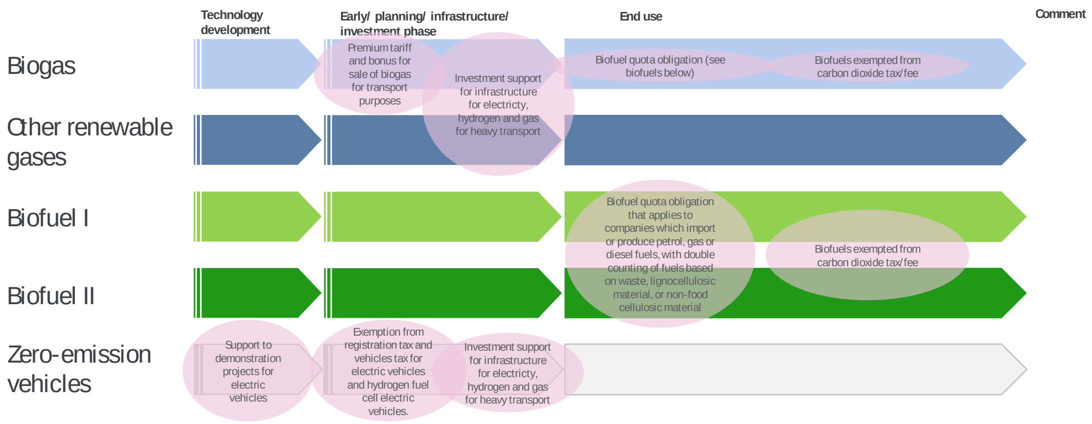
Net metering can, for example, apply to a household which has solar panels which cover part of its consumption. All technologies, with the exception of geothermal plants, are eligible for net-metering.

Exempt from the whole PSO fee are plants with a nominal effect of less than 50 kW for solar installations, 25 kW for wind turbines and 11 kW for other technologies. In addition, the production plant is required to be connected to the public electricity grid and must be owned fully by the producer/consumer.[114] Plants which are exempt from the surcharge for the support of renewable support, which is part of the PSO, are solar installations over 50 kW, wind turbines over 25 kW and other technologies of more than 11 kW.

3.1.5.2 Alternative fuels and transport in Denmark

Denmark has currently a focus on biogas and biofuels, but no support scheme for Electric vehicles in place, see Figure 13.

Figure 13: Overview over support measures for alternative fuels and transport in Denmark



The Act on Sustainable Biofuels is aimed at promoting the use of sustainable biofuels for land transport and to reduce life cycle greenhouse gas emissions from transport in order to contribute to the fulfilment of Denmark's international climate commitments.[115]

Denmark has three main schemes which relate to the promotion of alternative fuels in the transport sector:

- quota obligation;

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[113] §1, Regulation on net-metering.

[114] §3, Regulation on net-metering.

[115] § 1, Act on Sustainable Biofuels and the Reduction of Greenhouse Gas Emissions from Transport.

- premium tariff for biogas;
- tax deduction for biofuels.

Quota obligation with double counting. The quota obligation was raised to 5.75% in 2012[116]. The double counting of biofuels fuels based on waste, lignocellulosic material, or non-food cellulosic material is meant to steer towards more advanced and sustainable biofuels.

The premium tariff for biogas applies both to the sale of biogas for transport purposes and its use in industrial processes. The use of biogas in transport is promoted via a fixed premium tariff per gigajoule. There is a basic tariff of 39 DKK per sold gigajoule biogas. In addition, the biogas seller can receive a guaranteed bonus of 26 DKK per GJ and 10 DKK per GJ biogas.[117]. From 1 January 2013 onwards this bonus is lowered or increased on a yearly basis depending on the difference between the basic price of 53.2 DKK per GJ and the natural gas price.[118] The same premium tariff and bonus regime applies to the use of biogas in process purposes by businesses.[119]

Tax reduction for biofuels. Biofuels are subjected to the reduced tax rate in Denmark. If the taxed energy product (gas, diesel or petrol) is blended with biofuels, the amount of tax is reduced.[120] Companies producing, processing, receiving or dispatching energy products are obliged to pay the tax and thus can profit from this reduced tax.

Tax exemptions and benefits for mainly EV vehicles.

- The main tax incentive for electric and hydrogen vehicles in Denmark has been exemption from registration tax. Vehicles in Denmark are subject to a registration tax of between 105% and 180% of the vehicle's taxable value; this tax is also structured to be lower for more fuel-efficient vehicles (in contrast to most other EU countries, which focus directly on CO_2 emissions). Electric and hydrogen vehicles have been exempt from this tax up to the end of 2015, after which only electric vehicles weighing less than 2 tonne will be exempt.[121]
- Exemption from the "Grønne Afgifter" (green, or environmental, tax) for EVs, which is based on the fuel efficiency of the vehicle.
- Access to parking spaces exclusively reserved for EVs.[122]

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[116] Denmark 2013-2014 - Member State progress report under Directive 2009/28/EC.

[117] § 43b VE-Act.

[118] § 43e, VE-Act.

[119] § 43c, VE-Act.

[120] §2, Act on Carbon Dioxide Tax on certain energy products.

[121] The Danish Ecological Council, 2015. Fact Sheet: The Danish motor vehicle taxes. Available from: [http://www.ecocouncil.dk/economy-and-politics]

[122] Harryson, Ulmefors, & Kazlova, 2015. Overview and analysis of electric vehicle incentives applied across eight selected country markets. Available from: [http://www.bth.se/bloggar/sustaintrans/]

3.2 Lessons learned for RES-E from the Nordics

In this sub-chapter, the lessons which can be drawn from the various schemes and strategies which have been in place in the Nordics are discussed. They form the basis for recommendations made in Section 5.

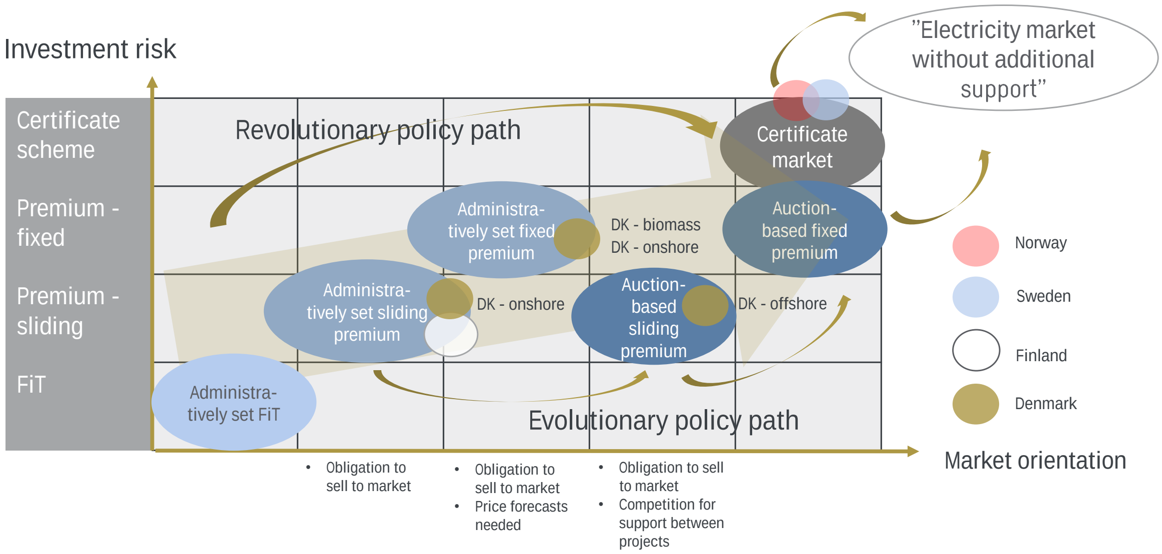
3.2.1 RES-E support

Most countries use a mix of a main support scheme and supporting measures such as tax-reliefs or investment aid, mainly depending on maturity of the technology. Most of the measures can be deemed successful in terms of policy effectiveness, since they have contributed to achieving the respective RES-E targets or are on a good way to doing so. The Nordic measures differ however in deployment, market risk exposure, whether they are national or joint schemes, and whether they are considered state aid or not. The measures also differ in predictability, flexibility and cost efficiency.

The Nordic countries use both national and joint schemes to promote investments in renewable electricity generation. Sweden and Norway have been using a joint scheme since 2012, while until recently, Denmark and Finland had only used national schemes. We understand however, that Denmark will soon start a tender for solar PV that will be partly opened for installations in Germany, as the state aid notification by the European Commission requires such opening.

For mature technologies, all Nordic countries use operation aid over investment aid. Finland and Denmark use technology-specific premium tariff-based systems, while Sweden and Norway have one main technology-neutral support scheme to support power production from renewables: the *Joint Electricity Certificate scheme,* providing operating aid and running from 2012-2035. All schemes award electricity generation, none awards capacity as such. Only Denmark disincentives electricity generation at negative prices, where guaranteed prices for offshore wind will not be paid during hours in which the market price is negative, however limited to a maximum of 300 hours a year.

Figure 14: Primary RES-E support schemes in the Nordic countries



The Nordic schemes differ considerably in terms of degree of market integration and investor risk. Figure 14 provides a simplified categorised overview[123]. Support levels are set differently depending on scheme with both price-based and volume-based schemes existing. Denmark is using a mix of auction-based levels for the offshore wind projects and administratively-set levels for other RES-E, while Finland exclusively uses administratively-set levels currently. In all these price-based schemes, prices are known upfront for the major part of a projects life, providing certainty to investors, although both details and remuneration periods may differ from 12 to 20 years. Feed-in premiums determined by auctions imply uncertainty to investors before the auction is held, but then provide certainty to the auction winners. Price levels for green certificates used in Norway and Sweden on the other hand are set continuously market-based by supply and demand, driving short-term cost-efficiency but increasing uncertainty for investors.

[123] Based on methodology in: Wege in ein wettbewerbliches Strommarktdesign für erneuerbare Energien (Arrhenius/Ecoys/Takon/MVV 2013)

Financing differs, policy costs are capped in principle. Some support schemes are financed via the state budget, others, such as the Joint Certificate system, are financed directly by end-users via levies. In addition to the limited time period, policy costs are capped additionally by a limit in the total number of full load hours eligible in Denmark, a MVA limit in Finland and implicitly by the targeted build-out volume in Sweden and Norway.

Resource conditions for RES-E and deployment differ considerably in the Nordic countries across most of the technologies, which is reflected in the support schemes. E.g. the lower wind resources in Finland and the will to kick-start onshore wind build-out are reflected in the rather high administratively-set premium for onshore wind.

For the support of less mature and small-scale technologies, the countries tend to use a wider range of measures. Norway provides investment aid via the Enovatilskuddet for renewable power generation in households since 2015. Denmark however uses operating aid in the premium tariffs for solar PV and other small scale technologies such as wave power, but also the fund for small-scale renewable energy technologies (ForskVE programme). Sweden uses investment aid for solar photovoltaic cells and a tax reduction for micro-generation of electricity from renewable sources. Finland provides investment aid for RES production facilities and research.

Other current supporting measures include net-metering for certain small-scale producers and loan guarantees for feasibility studies for onshore wind in Denmark and a reduction of the real estate tax reduction for wind power in Sweden. Earlier supporting measures included planning initiatives for wind power, market introduction of wind power, and an energy tax exemption for non-commercial wind power production in Sweden.

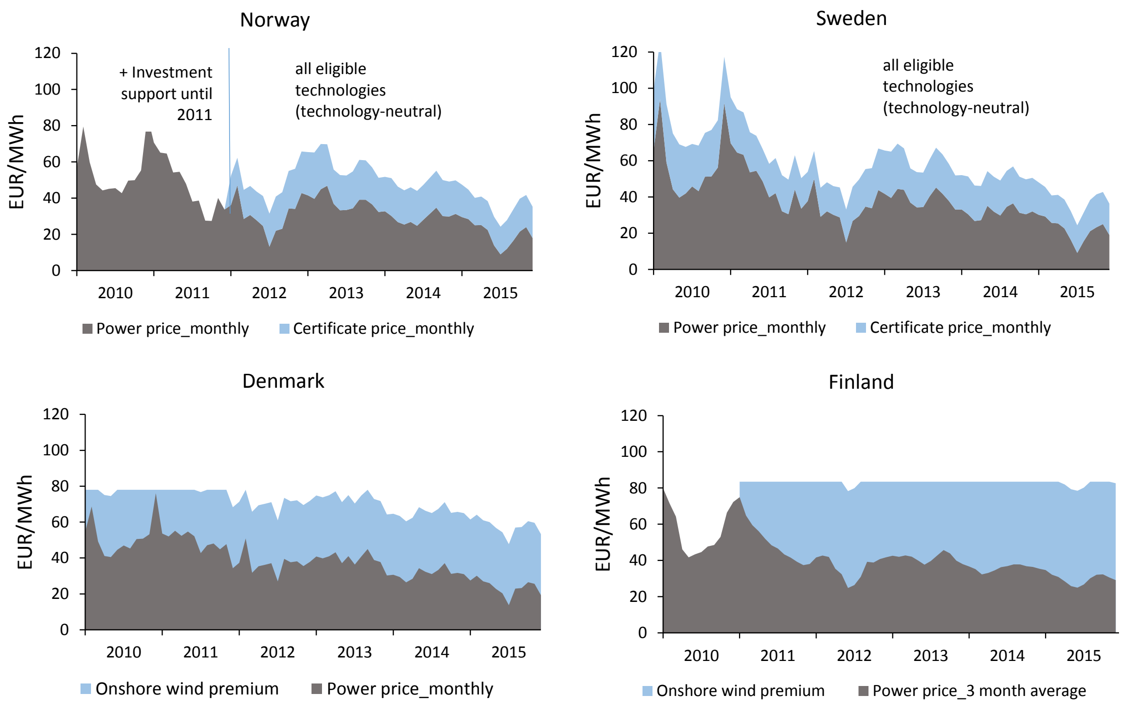
Independent of support schemes, one common issue in the countries with a fast increase in and a high share of variable RES-E is integration into the power system.

3.2.1.1 Overview of support levels

The below gives a rather high level overview of the support levels for onshore wind in the four Nordic countries. In addition the same levels apply to all other eligible technologies in Norway and Sweden (disregarding minor differences in power prices that can be achieved in relation to the power market price) and e.g.

Since support duration, resources available, technology and therefore costs differ, it is difficult to draw strong conclusions about cost-efficiency of the scheme or potential overcompensation.

Figure 15: Overview of income from power market and support scheme (mainly onshore wind, nominal)



3.2.1.2 Lessons learned from Nordic premium tariff systems

In the Nordics, only Denmark and Finland use technology-specific premium-tariffs, however for different technologies. Denmark is using a mix of auction-based determined support levels for the offshore wind projects and administratively set levels for other RES-E (solar, biomass and biogas), while Finland currently uses administratively set levels for all renewable electricity generation. Both countries differentiate between technologies and support levels. While the policies can be seen as effective in terms of triggering new investments in the targeted technologies, at least the Finnish premium for onshore wind power premium tariff is likely to overcompensate many projects, being rather generous and thus inefficient in terms of cost. On the other hand, the Danish offshore tendering is often viewed by Nordic market participants as an example for a well-designed support scheme.

Policy stability is key, but some changes can and should be made to adapt to changing circumstances. Due to a stable renewables policy and that the premium tariffs have been in force for quite a while the Danish scheme is in its entirety quite stable. On the other hand there have been a high number of changes to the scheme, allowing for the possibility to respond to changes in the market. The tariffs for biogas will be abolished by 2020 which compromises the stability for gas plant operators. The budget for premium tariffs amounted to 3834 MDKK in 2012 and 5449 MDKK in 2013.

The Finnish scheme was introduced in 2011 and has been changed a number of times over the last years. Since the parliamentary elections on 19th of April 2015, the general view was that support for biomass in energy production will increase while subsidies to wind power will be reduced since budgetary expenditures for the Finnish system accrued to 54.9 MEUR in 2013, up 33.2 MEUR the year before. After announcing the plans to reduce the accepted total generation capacity to the system, all the capacity and more was pre-booked. There are hence no plans to lower the tariff.

Policy costs increase quickly and limiting them through policy design is key. Both the Danish and Finnish scheme attempt to limit policy costs in different ways. Both schemes allow to control policy costs via the premium level, although supported volumes are not entirely known upfront. Furthermore, eligibility is either limited by duration (e.g. 12 years in Finland), volume or installed capacity (e.g. tendered offshore projects in Denmark or capacity for biogas and onshore wind in Finland) resulting in a maximum amount established in the project approval decision of the Energy Authority. However limiting e.g. the support duration doesn't necessarily reduces policy costs compared to other options, as it also increases the level of required support. In addition, Finland limits the eligibility of electricity produced in a wood fuel power plants to a premium tariff of 750 000 EUR for four consecutive price periods.

Both the Danish and Finnish premium-tariff system are rather administration intensive. In order to differentiate efficiently between technologies, project sizes and other limitations, a significant administration is required. However, the same holds true for auctions and certificate schemes and seen in relation to total policy costs, administration costs are likely to a smaller cost and thus less relevant.

Financing differs, but both countries provide discounts to exposed industrial consumers to lower their burden. While Denmark finances its premium tariffs via the PSO tariff, the Finnish scheme is financed via energy taxation, although no specific tax is earmarked to finance the feed-in tariff scheme. Large Danish consumers and installations that generate electricity for own consumption pay a reduced tariff or are exempted from paying the PSO tariff. In Finland, power intensive industry and data centres receive a discount on energy taxation.

Danish solar PV support and cost development resulted in fast deployment. In 2012 a new support scheme was introduced leading to a higher premium, especially for small installations (< 400 kW) and a fast deployment. At the same time, the costs for solar panels decreased significantly which contributed to this development.

Onshore wind Finland: administratively set levels can lead to fast deployment but also potentially overcompensation. The Finnish scheme was introduced in 2011 and by 2013, the installed capacity of wind power plants had doubled compared to 2011. Without the tariffs wind power would probably not have been built as building wind power plants in Finland is relatively expensive due to low wind and required higher heights for turbines. Finnish support levels for onshore wind are higher than in other Nordic countries. However, for an evaluation one must consider that wind resources are not as good as in other Nordic countries and that the support period is limited to the first twelve years of production. Still, with todays view and not when the levels were set, the levels appear rather high. Policy costs are limited by the total capacity of 2500 MVA earmarked for onshore wind.

The Danish offshore wind market is the most mature in the Nordics and its tender system is adopted to the strategic importance of offshore wind for the country. It is often cited by market participants in other Nordic countries as an example for a well-designed support scheme and has delivered the targeted volumes. Site development is provided by the state, with the Danish Energy Authority (DEA) as the competent authority for Danish offshore wind power projects. The DEA provides a "one-stop-shop" throughout the permission process, which is an important aspect for the success. Areas suitable for offshore wind are identified nationally. There are two options: either the government calls for a *tender,* which is the main option or the so-called *open-door procedure* is used. The two option mainly differ in who pre-develops the project and carries its initial project risks and in who carries the cost for the transformer station and transmission cable to land.

In the *government call for tender*, the DEA runs a tendering process for a specific offshore wind park project in a selected location. In this option, the investment and operational costs for the transformer station and the transmission of power to land are carried by the TSO and paid by the electricity consumers. Bidders are pre-selected based. This way, well-developed and prepared projects enter the bidding and realisation of the projects can be assured. As concessions for offshore wind plants are awarded on the basis of a kWh-tender to the lowest bidder and the number of bidders has been sufficient, the scheme is rather cost efficient. The guaranteed settlement price is pay-as-bid.

In the *open-door procedure*, the developer takes the initiative to propose and establish an offshore wind park project in a specific location outside areas already designated for offshore wind, and is only allowed if no major public interest blocks the implementation of the project. The investment and operational costs for the transformer station and the transmission of power to land are to be carried by the developer.

In the government call for tender, suitable, cost-efficient sites are picked and significant project costs and risks are avoided for tenderers. The fact that the Danish TSO pays for the grid connection provides certainty to investors and lowers the total investment cost significantly. Also, the tender process as such is efficient. Policy costs are limited to a period of 20 years after the date of connection of the wind farm to the grid. Furthermore, electricity generation during hours with negative market prices are effectively de-incentivised, since guaranteed prices will not be paid during these hours, although limited to a maximum of 300 hours a year.

Apart from supporting a technology with higher costs in principle, the Danish offshore tender must be seen as both policy-effective and rather cost-efficient. Awarded projects have been realised so far and with their contracted capacity, even though the tender process for Roedsand 2 had to be repeated since the winning consortium wanted to re-negotiate after the auction and finally withdrew from the project.

A participatory approach and auction timing are important. Other lessons learnt include[124] that avoiding overlap with other international auctions is advantageous and that an open, structured and fair dialogue between investors and contracting authorities can lead better auction results. On the other hand, high penalties and inflexible auction design can lead to low participation and high bidding prices. As for penalties, investors prefer reduced eligible production (duration support) over reduced support levels since reduced levels impact their position towards their loan-giving banks more.

Offshore turbines which are part of a pilot project can apply to the Ministry of Climate, Energy and Buildings for a guaranteed settlement price under certain conditions.

3.2.1.3 Lessons learned from a joint technology-neutral quota system

A Nordic first: lessons learned from the Joint Electricity Certificate system between Norway and Sweden. Sweden and Norway are the first Nordic countries to have engaged in a cooperation mechanism (joint support scheme). Several other Member States have however started to assess the use of cooperation mechanisms and have approached potential cooperating states. Denmark has recently decided to open a national auction for solar PV to Germany.

Setting up joint support schemes can take time. This is especially true if cost sharing is an issue. Sweden had been operating its certificate scheme since 2003, at which point also the first discussions between Sweden and Norway started[125]. These discussions however, came to a halt in 2006 when no agreement could be made regarding the cost sharing of the scheme. Following new negotiations in 2009, the joint scheme could start in

[124] AURES (2015): Auctions for Renewable Energy support in Denmark: instruments and lessons learnt

[125] Ecofys (2014): Cooperation between EU Member States under the RES Directive

2012, then with a 50-50 cost sharing agreement, but without having to install the new RES-E capacity equally between the two countries.

The certificate market has developed mature technologies generally viewed as cost-efficient, as the final cost passed on to the end consumer bills is rather low compared to other countries. That is however only partly a result of an efficient support scheme and the larger supply curve it provides access to. Partly it is also a result of the excellent resources in the Nordics, mainly in the form of wind, and partly a consequence of a fast technologic development, which is discussed in the next chapter. Policy costs are controlled implicitly by having defined a targeted volume. Dynamic efficiency must be considered as high, at least for the price-setting technology onshore wind.

In a joint support scheme, there is no absolute need to align all details, but it helps to be aligned as much as possible. Most of the main parameters such as eligible technologies should be aligned. In the case of Norway and Sweden, there are small differences in eligibility of technologies and the latest possible entry into the scheme. All new electricity production based on renewable energy is eligible for electricity certificates in both Sweden and Norway, while in addition peat is also eligible in Sweden. While the latest entry in Norway is 2021, the latest entry in Sweden is possible after 2020 and depending on the willingness of the investors to accept a reduced period for receiving certificates. Especially the latter point has caused discussions among market participants.

However, in a joint scheme, some differences must be acceptable to all countries involved: energy taxes, tax reductions and exemptions and depreciation will almost inevitably differ and cannot be completely aligned for the single purpose of the joint scheme. Nevertheless, differences in Norwegian depreciation rules that were less favourable than Swedish ones and the Swedish tax exemption for non-commercial wind power were found to have decisive effect on the competitive position of the technologies in the two countries quickly after 2012. During the control station review, both countries agreed on adjusting the rules. However, the Norwegian change, approved by the parliament, is not yet approved by ESA[126].

It doesn't hurt and might increase public acceptance if cost levels and project pipelines are comparable in participating countries. While the volume of project pipeline might differ based on historic developments, too big differences in cost levels between technologies and countries in a joint scheme should be avoided, since investments would tend to go the lowest cost technologies and country. These cost differences could be caused by different resources such as wind speed, volumes available for certain technologies such as hydro, different taxation and depreciation rules.

Setting up a completely technology-neutral support scheme is challenging. There will always be the risk for overcompensating some low-cost technologies and projects with excellent resources, while effectively excluding high-cost technologies and projects at the same time. Initially, from 2003 on and long before Norway joint the Certificate market, biomass CHP was granted most of the certificates. This was partly since certificates was given to existing biomass plans, but also since the cost and time of biomass conversion were low. Later on on-shore wind has become dominating. The competition in the system has over time led to a strong focus on bringing down costs and choosing the best available projects. The competition is however mainly between biomass CHP, on-shore wind and to some extent hydro power. These mature RES technologies are currently at a stage where they are competitive, or very close to being competitive, towards conventional power generation technologies (new investments).

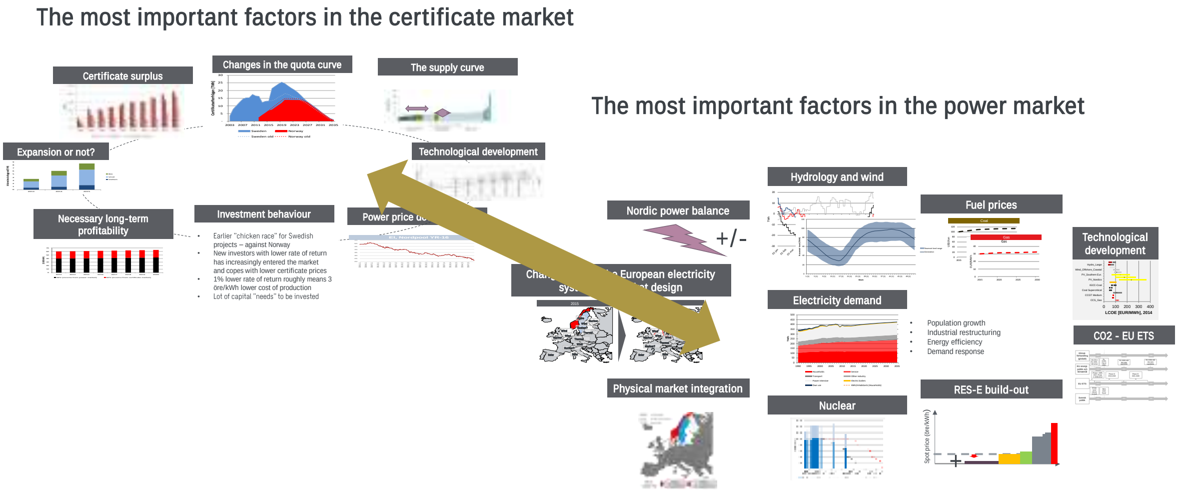
Setting up a technology-neutral certificate system with a dominant and quickly cost-reducing price-setting technology, such as onshore wind-power in the Swedish-Norwegian system, may provide challenges for early investors in the market. This is especially true, when the market is existing over such a long period. While it increases liquidity, early investors with smaller projects and less developed technologies leading to higher LCOE receive the same certificate price from the market that is received by investors in larger, optimized projects that could profit from fast technology and cost development over almost two decades (given the length of the scheme) leading to much lower LCOE. On the other hand, the competition for within onshore wind projects in the Certificate scheme is high and it can be argued that – while the general risk for overcompensation of other technologies exist – dynamic efficiency is high, implying that the support scheme contributed to driving down costs of at least the price setting technology.

The Swedish scheme has also contributed to dynamic efficiency. Initially biomass CHP was granted most of the certificates. This was partly since certificates was given to existing biomass plants, but also since the cost

126 https://www.regjeringen.no/contentassets/9f606a06423244848707b4ac236b015b/h_notat_14_4159_elhg.pdf

and time of biomass conversion were cost-competitive compared to other technologies at that time. Later on, onshore wind has become dominating. The competition in the system has over time led to a strong focus on bringing down costs and choosing the best available projects. The competition is however mainly between biomass CHP, on-shore wind and to some extent hydro power. These mature RES technologies are currently at a stage where they are competitive, or very close to being competitive, towards conventional power generation technologies (new investments). The main issue in terms of investment in these technologies is rather linked to an oversupply situation, leading to a lack of profitability for all generation technologies.

Figure 16: Important factors impacting investors in the Certificate market



Certificate price formation is complex and it has taken quite a while for the market to fully realize the high market exposure of the scheme. Price formation in the Certificate market is not only impacted by the already complex factors such as broad supply curve with many technologies, quotas depending on variable energy consumption and the market participants' expectations of technology cost and project development, but also the electricity market with its own complexity (see Figure 16). There is now an understanding among market actors that the scheme is an investment triggering scheme, not a profitability guarantee. However, even a few years back, many project developers and investors were not fully aware of the magnitude of this market exposure and its potential consequences. However, market prices react rather slow on longer-term changes of build-out speed and surplus, which provides a risk for investors in both ways.

This high market exposure also requires – more than for other less market-exposed schemes – stability. Central parameters should preferably not be changed after they have been set initially, including ambition level. From an investor point of view, quotas should preferably be expressed in absolute terms, rather than as share of a variable consumption.

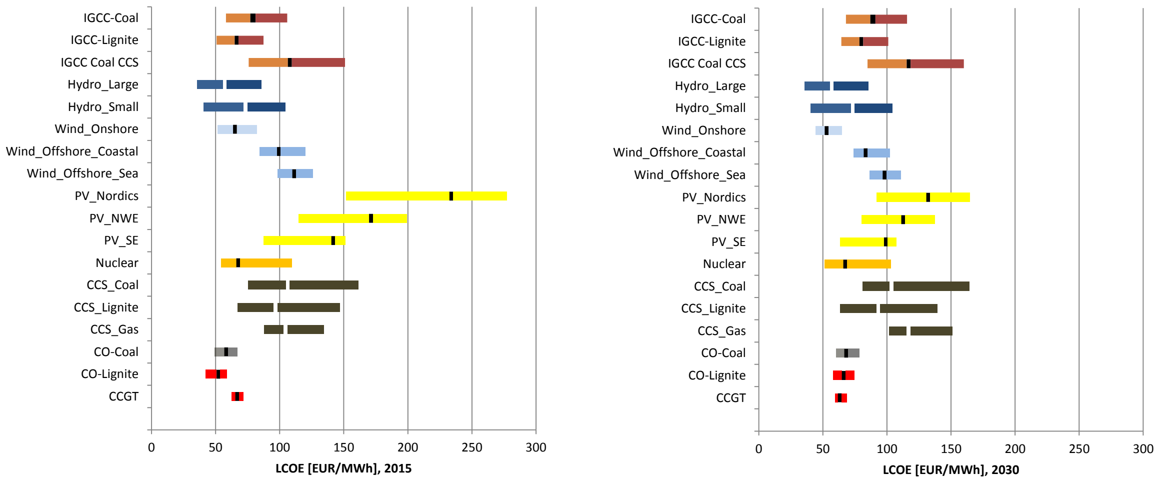
Long-term stability and predictability is often cited as a direct result from a joint scheme, since, once settled, agreements and a treaty need to be re-negotiated to achieve significant changes. However, recent experiences show that changes in the political landscape can trigger significant changes such as the increased ambition level towards 2020 initiated by Sweden. The joint certificate system has provided more liquidity and reduced volatility to the market. Its market compatibility is high, but consequently also the risk exposure for investors, which have to consider both uncertainties from the power and certificate market in parallel.

3.2.2 Understanding technology cost development is important for the design of new support schemes

The cost efficiency of the measures will not only depend on the support system as such, but also on the expected technology cost development. While it is important to understand and track current cost, understanding cost development trends are even more important when reviewing or designing new support schemes. One example of such a projection for the main power generation technologies compares 2015 and 2030, shown in Figure 17 below.

Fast technology development requires adaptive support schemes which both give incentives to invest in new RES-E, while avoiding overcompensation and without hampering profitability of early-bird investments. We expect thermal power technologies to increase their LCOE mainly due to an increase in CO_2 prices over the longer term. For RES-E, we expect close to 3% in average annual cost reduction for new solar between 2015 and 2030 and about 1% for on-and offshore wind. For both technologies, we expect higher cost reductions at the beginning and lower at the end of the period. We assume hydro power costs to remain at the same level.

Figure 17: LCOE cost development for different power technologies 2015-2030 (real 2015 terms)



Source: Sweco

In the following sub-section, the main renewable volume technologies in the Nordics are considered, as well as their main cost drivers.

3.2.3 Technology cost development – example Nordic onshore wind power

The main parameters defining the LCOE for wind power systems are capital costs, wind resources, technical characteristics of the wind turbines and the discount rate. Other costs are variable costs, which include operations and maintenance costs, grid tariffs, taxes, administration, insurance of the turbines and dismantling costs. Of these parameters, the capital cost is the most significant, with the wind turbines themselves accounting for 65-85%, with a narrow range of 70-80% of total installed project cost.

Nordic wind resources are good to excellent but differ considerably between countries and regions. In Norway, the whole west coast has excellent wind resources. As investors in Sweden continue to look for large projects, the shift towards projects in the north is expected to continue. This shift results, together with higher hub heights, in stronger average wind speeds for the Swedish projects. On the other hand, the onshore wind resources in Finland are the weakest among the Nordic countries, compared at the same hub height. However, hub heights up to and above 140 m are already being built in Finland making mediocre wind resources exploitable. The generous feed-in tariff system has probably caused some projects being built even where the wind resources are less favourable, leading to higher LCOE. Finland may be the market out of the four Nordic countries that will gain most from the rapid development of low wind turbines, an area of development that has historically been one step ahead of the development of high wind turbines. Denmark has good onshore wind conditions, but the Danish onshore market will most likely mainly see a repowering of older sites. New installations will probably be done at the current hub heights, indicating that the average wind resource for new projects will remain rather constant.

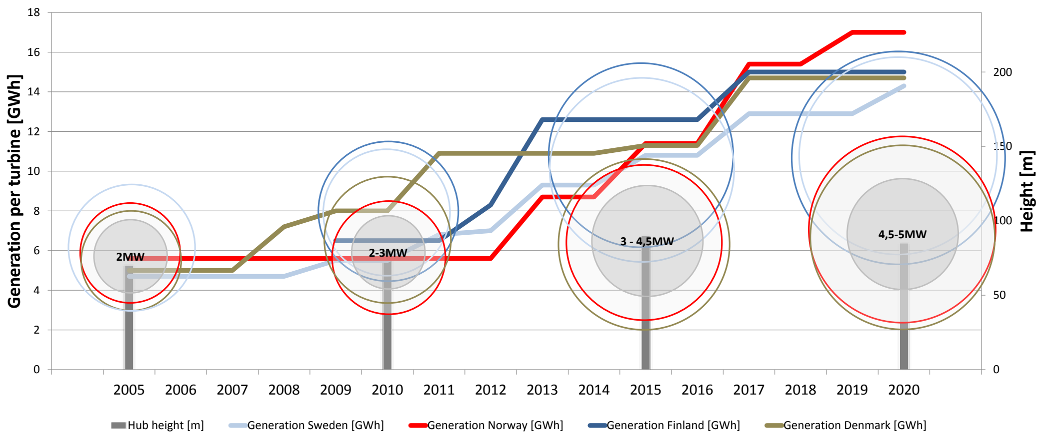
The technology that will be utilised in a certain market is dependent on both wind conditions and also the regulations and permit conditions given. Figure 18 shows Nordics trends in hub and total turbine heights – with Sweden and Finland being more similar, and Norway and Denmark closer together – and also the more similar development in energy yield per turbine over the years.

In addition to increased hub height, the trend to increased turbine capacity continues. Historically, both Denmark and Sweden have a long tradition of building smaller turbines, some even as single turbines connected to farms, while Norway and Finland started their wind power build-out later and thus profit from the availability of better technology in the form of turbines with increased capacity.

Increasing rotor diameters within all wind classes together with higher hub heights have proven to be a key development for more cost- and energy-efficient wind turbines, both on- and offshore. During the last ten years, there has been a gradual technical development in wind power, improving both energy yield and cost efficiency; this is most notable in the development of higher towers and larger rotors. The reasons for these developments are that a larger rotor makes it possible to capture more wind and to increase the nominal capacity and with a higher tower it is possible to reach better wind conditions, resulting in a higher energy yield per unit. As the turbines get bigger and the average wind speed for new projects are expected to increase in some countries, the generation per turbine increases significantly.

Different technical developments are likely to be utilised in the different countries in the Nordic market. This depends on several factors, but the two main reasons are the wind conditions and the permit conditions. In Denmark – similar to the southern part of Sweden - the total height for onshore wind projects is often limited to 150 m and therefore high towers will not be applied, which also limits the size of the rotors. Whereas in Finland, often the highest onshore wind towers possible are applied, with hub heights around 140 m. In Norway where the projects have stronger wind conditions together with high extreme wind and turbulence-levels the rotors applied are smaller and towers lower.

Figure 18: One potential scenario towards 2020 for onshore wind: increasing hub height and rotor diameter could result in significantly increased generation per turbine, while the solutions differ from country to country



Source: Sweco

There is a clear downward trend in installed project cost (CAPEX) per MW in all Nordic countries. We see the lowest specific costs in Denmark due to easy site access, low hub height, favourable climate and the fact that the majority of the installations towards 2020 are expected to be repowering. On the other hand, we expect higher specific costs in Sweden and Finland due to higher hub height (120-140 m) and larger rotor diameter as well as higher construction costs including transport to remote locations. In Norway, where climate can be harsh and locations remote as well, we expect hub heights of 80-95 m which drive towards lower specific investment costs for the turbines.

In general, onshore wind OPEX costs are expected to decrease in all Nordic countries. Maintenance (service and components) costs are expected to decrease, land-lease costs to remain constant or slightly decrease, dismantling costs to remain constant and grid costs to increase. However, the absolute development of grid costs and insurance costs can be considered as the areas with the highest uncertainty.

Service and maintenance is an area where there is still a large potential for development and optimisation. Together with the latest generation of wind turbines, there is a trend towards an annual scheduled service interval which will increase the possibility of planning the service to low wind occasions with decreased production losses as a result. The main types of owners in each market will to large extent impact the market for third party service providers. Turbine manufacturers are prepared to offer long-term full service agreements as well as training together with spare part management agreements to utility-type customers who do not have their own service organisations.

Capacity factor increases, CAPEX decreases, so LCOE decreases. With CAPEX and OPEX falling, LCOE is falling as well in all Nordic countries. The drivers however, are different: in Norway, excellent wind resources but rather normal hub heights keep CAPEX low and production high, which results in low LCOE. In Sweden, wind resources are good but higher hub heights are required to utilise this wind. Thus CAPEX is slightly higher than in Norway, resulting in a slightly higher LCOE. In Finland, the highest and largest turbines are installed to utilise the low wind. This results in a high CAPEX and together with average wind resources in the highest onshore wind production costs in the Nordic countries. The low Danish investment costs along with low OPEX cost due to easy access and good wind resources result in the lowest cost per energy unit of all Nordic countries.

3.2.3.1 Technology cost development – example Nordic offshore wind power

Cost development for offshore wind is driven by development in turbine cost, distance to shore and water depth, which in turn are mainly driving foundation and grid connection costs, but also serviceability and thus OPEX costs. In general, Finnish offshore projects are located much closer to shore and at a lower water depth than most Danish projects. The Danish projects differ considerably between North Sea and Baltic Sea projects. But even within the Danish North Sea projects, there are projects located far off the coast as well projects located near shore. Turbines in harsh North Sea conditions must be designed for both higher wind speeds and turbulence, but also for a more corrosive environment, adding to turbine costs. In addition, Danish North Sea locations are on average located further away from shore than Danish Baltic Sea projects increasing grid connection cost, while higher water depth requires slightly higher foundation costs.

Capacity factors are already high for the latest Danish projects (Horns Rev 2, Anholt) and are generally higher in the Danish North Sea. Finnish Baltic Sea locations on the other hand have the advantage of low water depth and proximity to the shore. Together with less turbulent winds and the lower salt content in the Baltic Sea, this enables the use of less expensive "onshore-type" turbines. Important to mention that, in addition to wind conditions, our capacity factor assumptions are mainly depending on the relation between generator size and rotor diameter. Therefore, forecasts may change significantly with different turbines configurations used and should be used with care for strategic assessments.

Anecdotal evidence from e.g. the Danish offshore bidding rounds shows, that there is a downward trend in cost per MW installed. Although good historic data on CAPEX and OPEX for single countries is rare, comparing a number of projects for comparable locations such as the North Sea allows the conclusion, that there is a downward trend in cost per MW installed. We generally expect Danish Baltic Sea projects at lower costs than the Danish North Sea projects. We expect Finnish offshore OPEX to decrease, driven by good accessibility of the sites. Swedish offshore wind power projects are comparable to Danish Baltic Sea projects with hindsight to wind speed, water depth and corrosiveness of the environment.

3.3 Alternative fuels and transport support

Most Nordic countries use a combination of several support mechanisms to support the introduction and use of biofuels in the transport sector, and the main support mechanisms are commonly quota obligations for biofuels and/or reductions or exemptions from fuel taxes. These mechanisms have been combined with investment support for production facilities, infrastructure and vehicles or, as in Sweden also an obligation to provide infrastructure for renewable transport fuels. Furthermore, a variety of support mechanisms have been directed at vehicle owners, for instance, clean car premiums, reduced vehicle tax, free parking, exemptions from congestion fees, and access to bus lanes.

3.3.1 Lessons learnt for biofuels from the Nordics

Finland, Sweden, Norway, and to some extent Denmark have high shares of renewable energy in the transport sector compared to other European countries. Sweden over the past few years has had the highest share of renewable transport fuels among the Nordic countries and also among the European countries. Sweden was also early in supporting different types of biofuels and had a relatively fast increase in biofuels since then. Finland and Denmark have followed closely behind; in both countries the introduction of significant amounts of renewable transport fuels started later than in Sweden but has taken off in recent years.

When considering these developments, the policy effectiveness of the overall support schemes can be considered to be relatively high. However, other evaluation criteria, such as cost efficiency, technology neutrality and predictability vary among the support systems. Most countries have used a mixture of technology-neutral and technology-specific systems, but in practice it has been difficult to design truly technology-neutral mechanisms. The reason for this is that the different fuels and technologies have different cost levels as a consequence of them being in different development stages and also differing from the current transport regime in different ways. For example, gaseous fuels require changes in vehicles and infrastructure to a larger extent than liquid biofuels. Sweden has tried to design technology-neutral support schemes, and also shown that this is very difficult to achieve in practice. Despite intentions, several of the support schemes have favoured certain fuels, such as the Pump Act (the obligation to provide renewable fuels) which in practice mainly targeted high-blend ethanol; or the filling stations support that was added later to also support the introduction of other fuels, but which mainly targeted filling stations to develop compressed methane. Quota systems are designed as technology neutral, but they mainly support the low-cost biofuels that already are implemented on the market and they are directed at suppliers of fossil fuels.

Both Finland and Denmark have used quota obligations in combination with differentiated tax levels which has proven to be effective for a fast introduction of renewable fuels, at least in the first introduction phase. The combination of these two support mechanisms can help to overcome some of the drawbacks that occur when they are used separately and also combine the benefits of both mechanisms. This combination of support mechanisms will be allowed for several types of fuels until at least 2020, if it can be shown that they are too expensive to be introduced with support only from a quota obligation. This combination could therefore be considered as a policy effective tool and considered for use in all cases when it is allowed according to the state aid regulations.

Exemptions from high fuel taxes naturally give a strong support for renewable fuels, but should likely be complemented by a range of other measures, such as regulation and investment support. The Swedish case for biofuels has shown that support is needed across the whole chain during a relatively long time period to yield substantial results. The main support system in Sweden has been exemptions from the relatively high tax applied to fuels that is principally divided into carbon dioxide tax and energy tax. This has provided significant support and, in spite of a relatively short-term decision period, has been a very effective support to renewable fuels. Sweden started the introduction of biofuels several decades ago and has during periods had relatively strong support systems in place along the whole fuel chain. The incentive of tax exemptions has been combined with support systems directed at production facilities, infrastructure and alternative vehicles. The support has been both regulatory measures, such as the obligation to provide renewable fuels, and investment support.

Furthermore, the relatively diverse and comprehensive support system in Sweden has allowed development of several fuels distributed in both low- and high blends, including widespread infrastructure for different high-blend ethanol fuels and compressed methane (a mix of biogas and natural gas). The high share of high-blend fuels is relatively unique and is a significant step in moving towards the goal of eventually replacing fossil fuels.

Both tax exemptions and quota obligations can be cost-efficient support mechanisms and allow dynamic competition on the market. However, as tax exemptions are paid by taxpayers, this support mechanism may be perceived as a large expense for the state. For the Swedish state, the losses in tax revenues have been significant and it is not considered a cost effective policy instrument for achieving reduced GHG emissions according to an evaluation by the Swedish National Audit Office[127]. In the mentioned evaluation, it should be noted that, the cost efficiency is compared to measures in any sector to reduce greenhouse gas emissions, i.e. it is not only focused on the transport sector. However, in this report, the cost efficiency for support mechanisms in the transport sector is only evaluated in relation to other mechanisms in the same sector. It is challenging to evaluate the cost efficiency of quota systems, but with this policy mechanism the costs are covered by the users of the road transport system instead of all taxpayers.

Other factors that are related to both policy effectiveness and cost efficiency of the tax exemptions in Sweden are their legality and their predictability. In Sweden, the tax exemptions have only been guaranteed during short time periods, as only temporary exemptions from the EU state aid regulations have been given. The predictability and stability of the main support mechanism has therefore been very low and this uncertainty will remain if Sweden choses to continue with this system. This has likely reduced both policy effectiveness and cost effectiveness of the support mechanism, as investments and business development require predictable conditions in the foreseeable future.

The predictability of the support level from tax exemptions are further reduced because it is related to the prices of fossil fuels which can be volatile. The EU regulations do not allow overcompensation, i.e. that biofuels are

[127] Riksrevisionen. 2011. Biodrivmedel för bättre klimat – Hur används skattebefrielsen? RiR 2011:10.

supported with an incentive that is higher than the cost difference between biofuels and fossil fuels. The support level must therefore every year be adapted to the fossil fuel prices.

The quota obligations have provided more predictability and stability in the longer term compared to tax exemptions. They have been in place for longer time periods than the tax exemptions and the support level is not related to the prices of fossil fuels in the same way.

3.3.2 Lessons learned for electric vehicles from the Nordics

Key lessons learned for electric vehicles are mainly drawn from the Norwegian case, which has become the largest market for electric vehicles (EVs) in the world due to their range of support measures.

Norway has since the beginning of the late 1990s supported zero-emission vehicles with an increasing number of policy instruments. The core of the support policy system is the exemption from VAT on the vehicle purchase price and exemption from registration tax, which is significantly higher than in most European countries. This significantly lowers the initial owner cost and, in combination with the low operating costs for EVs, gives favourable total cost of ownership. This has probably been the most important pre-requisite for achieving the fast introduction of EVs in Norway[128].

While low total cost of ownership is a key success factor for introducing a new type of vehicle, also important for success are other user incentives, as well as the strategic implementation of infrastructure to support the whole value chain. Norway has become one of the leading markets for EVs due to a clear strategy and an abundance of policy instruments on both a local and national level. It therefore achieved its target of 50 000 EVs earlier than planned.

It can also be contrasted with Sweden, where the incentives directed at zero-emission vehicles are significantly less. In both Sweden and Denmark, EVs must pay the same VAT rate as conventional vehicles, which due to their relatively higher purchase price, increases the difference in cost further. In Denmark, however, EVs weighing less than 2 tonne (which includes most models[129]) are exempt from registration tax; this amounts to a significant saving on the purchase of a vehicle given the high level of this tax.

Sweden's main measure to reduce the total cost of ownership is the super green car rebate of 40 000 SEK on the purchase of a low-emission vehicle. This rebate was not fully funded in 2015 and some payments have been delayed to 2016. Additionally, there is a reduction in the addition of the taxable value of a company car that is added to the taxable personal income of an employee if the company car is an EV compared to a conventional vehicle; there is a cap to this reduction of 16 000 SEK[130]. Overall, the lower level of this support compared to that given in Norway could at least partly explain the lower market share of EVs in Sweden.

Other policy instruments directed at EV users in Norway have provided convenience, time savings and significant economic support. These measures include public parking fee exemption, road toll exemption, free ferry transport and permission to use bus lanes, which have likely been important for many buyers of an EV. The permission to use bus lanes has commonly been pointed out as the most important incentive due the time-saving it can give in areas with traffic congestion[131]. The relatively high level of support given to (most) EVs in Denmark mentioned above, yet their relatively lower market share, emphasises how it is not only the total ownership cost that is of importance, whilst also noting that support started much later there. It is also worth noting that Norwegian households often have two cars and the EV has been purchased as a second car for shorter driving.

Strong and comprehensive policies to build an initial market and infrastructure are necessary to attract and include actors in technology implementation. Another lesson from the EV introduction in Norway show that such policies can convince car manufacturers to prioritise this market and offer a range of vehicles that can in turn attract customers[128]. This approach can be generalised to other technologies, insomuch as involving

[128] [Ole Henrik Hannisdahl, Håvard Vaggen Malvik, Guro Bøe Wensaas, 2013, The future is electric! The EV revolution in Norway – explanations and lessons learned, EVS27.]

[129] ICCT, 2015. European vehicle market statistics: Pocketbook 2015/16. Available from: [http://eupocketbook.theicct.org/]

[130] Harryson, Ulmefors, & Kazlova, 2015. Overview and analysis of electric vehicle incentives applied across eight selected country markets. Available from: [http://www.bth.se/bloggar/sustaintrans/]

[131] [Erik Figenbaum, Marika Kolbenstvedt, 2013, Electromobility in Norway - experiences and opportunities with Electric vehicles]

suppliers and actors in the implementation of the technology and thereby creating confidence across the value chain.

When comparing experiences from the introduction of electric vehicles it is clear that high subsidies to the user are not effective unless the infrastructure is available[132] [133]. This is also clearly supported by the results in Norway where construction of infrastructure has been supported. However, while the Norwegian support provided significant support to the vehicle owner, its policy costs are with 4-5 bn NOK/year rather high.

[132] [Sierzchula W, Bakker S, Maat K and van Wee B. 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy Policy 68, 183-94.]

[133] [Gass V, Schmidt J and Schmidt E., 2014. Analysis of alternative policy instruments to promote electric vehicles in Austria. Renewable Energy 61, 96-101.]

4. Lessons from selected other EU member states

On the Continent, we have seen that Germany, the Netherlands, the UK, France and Italy have introduced competitive bidding procedures to determine the level of support for some types of renewable energy. No country has introduced competitive bidding for all types of renewable energy. Parallel support schemes persist.

A wide array of options can be considered when a country decides to implement auctions. There is no "one size fits all" approach. In practice, one observes that the designs of the auction schemes differ, both between countries and – where technology specific schemes exist – within countries.

The main design elements that countries should consider include, among others:

- the choice of the auctioned and remunerated item (eg. kWh or kW)
- the choice between multi- and single-item auctions
- the grouping of technologies
- the timing of the auction and the realisation period
- the qualification criteria and liabilities when awarded,
- the auction procedure
- the frequency of the auction
- evaluation criteria and the corresponding pricing rule

Auction schemes are more likely to apply to medium and large scale installations. Transaction costs of tender systems are relatively high for small projects. Furthermore, smaller actors with a small portfolio are often not as well positioned to deal with the additional risk of an auction compared to larger market players. Therefore, countries tend to choose administratively determined support levels for small-scale installations and make use of the de minimis rule.

No country introduced technology-neutral auctions for all renewables. Germany, Italy, and France introduced mono-technology auctions, whereas the UK distinguishes between immature, mature technologies, and biomass conversions, and the Netherlands introduced quasi technology-neutral auctions for all technologies except wind offshore.

Experiences with auction schemes are mixed; if properly designed and implemented, auctions may lead to more efficient results than other support policies. It can be observed that auctions led to lower prices than previous administratively set levels. Yet, introduced schemes needed to be fine-tuned to cope with initial flaws, particularly to increase the realisation rate of awarded projects.

If different technologies compete against each other, one technology often dominates the results, leading to de-facto mono-technology auctions and a discontinuation of support for other technologies. We can conclude that short-term allocative efficiency is the main argument for technology-neutral auctions, and long-term dynamic efficiency and long-term target achievement justify technology-specific auctions.

Besides the introduction of auctions, other measures are currently taken to increase the market integration of renewables. Germany is currently in negotiations with other Members States on the opening of PV auctions. Several countries reform their system to avoid incentives to feed-in during hours of negative prices and countries switch from feed-in-tariffs to a feed-in-premium.

In the transport sector within Europe, low-blend ethanol and biodiesel have been the two main options for introducing renewable energy, but there are also other options such as high blends of these fuels, biomethane or electric vehicles.

The two European main support systems for biofuels have so far been tax exemptions and quota obligations with fines for non-compliance. Tax exemptions have been a vital part of the support systems and all member states with significant biofuel volumes have used them at some point. Initially, many of the member states used tax exemptions and then switched to a quota obligation/blending obligation because governments were not willing or able to pay for the support schemes. Tax exemptions have been especially effective in countries with high fossil fuel taxes, where an exemption naturally provides the most significant support. Not surprisingly, experience also shows, that a combination of quota obligation and tax exemptions yields the highest annual growth rate for biofuels.

The countries with fast introduction rates for PHEVs and EVs, for example, the Netherlands and France, have supported them with exemption from registration tax and reduced company car taxation. The Netherlands has also used exemption from circulation tax, while France has used an "ecological bonus" and local incentives like free parking as extra incentives for EVs.

The following chapter summarizes how selected countries have modified or are currently modifying their support schemes for renewable electricity in order to comply with the new guidelines outlined in chapter 2. The most important trend is the introduction of competitive bidding mechanisms to determine the level of support. Therefore, we outline the key lessons learned from their introduction. The analysis draws upon developments in the UK, the Netherlands, Germany, France, and Italy, namely the support schemes mentioned in Table 5.

Table 5 Other EU Support schemes characterised and assessed

Country	Name of support scheme	Since
UK	Contracts for Difference (CfD)	2014
NL	Stimulering Duurzame Energie (SDE+)	2011
DE	PV-Freiflächen-Verordnung, Erneuerbare Energien Gesetz (Renewable Energy Act)	2015
FR	Décret n°2002-1434 du 4 décembre 2002 relatif à la procédure d'appel d'offres pour les installations de production d'électricité	2004
IT	Referred to as DM 06/07/12 (Ministerial Decree 6 July 2012)	2012

4.1 Recent experiences from competitive bidding/auctions

The State Aid Guidelines require the introduction of competitive bidding for RE support.

In the evaluation of the Member States' policies, the Commission argued that because of information asymmetries between RES producers and the authorities determining the support level, administratively set feed-in-tariffs and premiums do not ensure cost-efficiency (see Appendix). Consequentially, the state aid guidelines require a transition to competitive bidding processes for operating and investment aid (see Appendix). Aiming to replace administratively determined support levels fully by 2017, at least 5% of the planned RE capacity shall be auctioned already in 2015/2016.

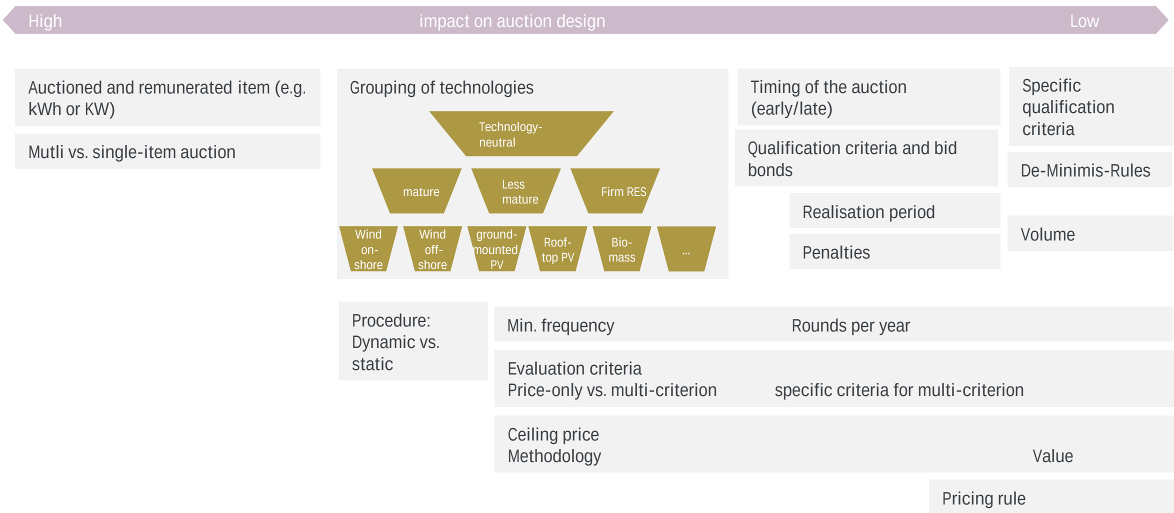
All five analysed countries – Germany, the Netherlands, the UK, Italy and France - have introduced competitive bidding procedures to determine the level of operating support for some types of renewable energy. The trend is in line with international experiences. While being only applied in some developing countries and occasionally used (and discontinued) in Europe in the 1990s, in 2013, 45 countries had competitive bidding mechanisms in place.[134] The number further increased to 60 in early 2015.[135]

Expected benefits of competitive bidding explain the renaissance of RES auctions, yet challenges arise.

In the light of rising shares of renewables, many governments wish to control the volume of installed capacity and the overall support cost. At the start of an auction mechanism, the auctioneer defines the volume, thereby automatically leading to volume control. As the support level is determined by the market, not the administration, the problem of information asymmetry is reduced. As RES-E producers have to compete, one also expects lower prices compared to administratively set levels. These benefits make auctions attractive for policy makers yet experience shows that their successful implementation is challenging. In several countries it is difficult to ensure high realisation rates. The higher risk for RES-E producers in tendency favours bigger, more risk affine actors and may crowd-out smaller players. Common value problems, uncertainty over project cost, and unexperienced bidders may lead to the "winner's curse" problem and a risk of strategic behaviour (collusion) may ultimately lead to higher prices and support costs than necessary. Hence, the designing auctions properly is difficult and one should pay attention to the details of the design elements chosen in the five analysed countries.

A wide array of options can be considered when a country decides to implement auctions. There is no "one size fits all" approach. In practice, the designs of the analysed auction schemes differ, both between countries and – where technology specific schemes exist – within countries. The main factors impacting the auction design include the maturity of the technology, the maturity and composition of the market, socio-economic and political goals. Figure 19 gives an overview on the design elements of auctions and shows which design elements have a large impact on the design itself (not on the success of the auction).

Figure 19: Design elements and their impact on the auction design

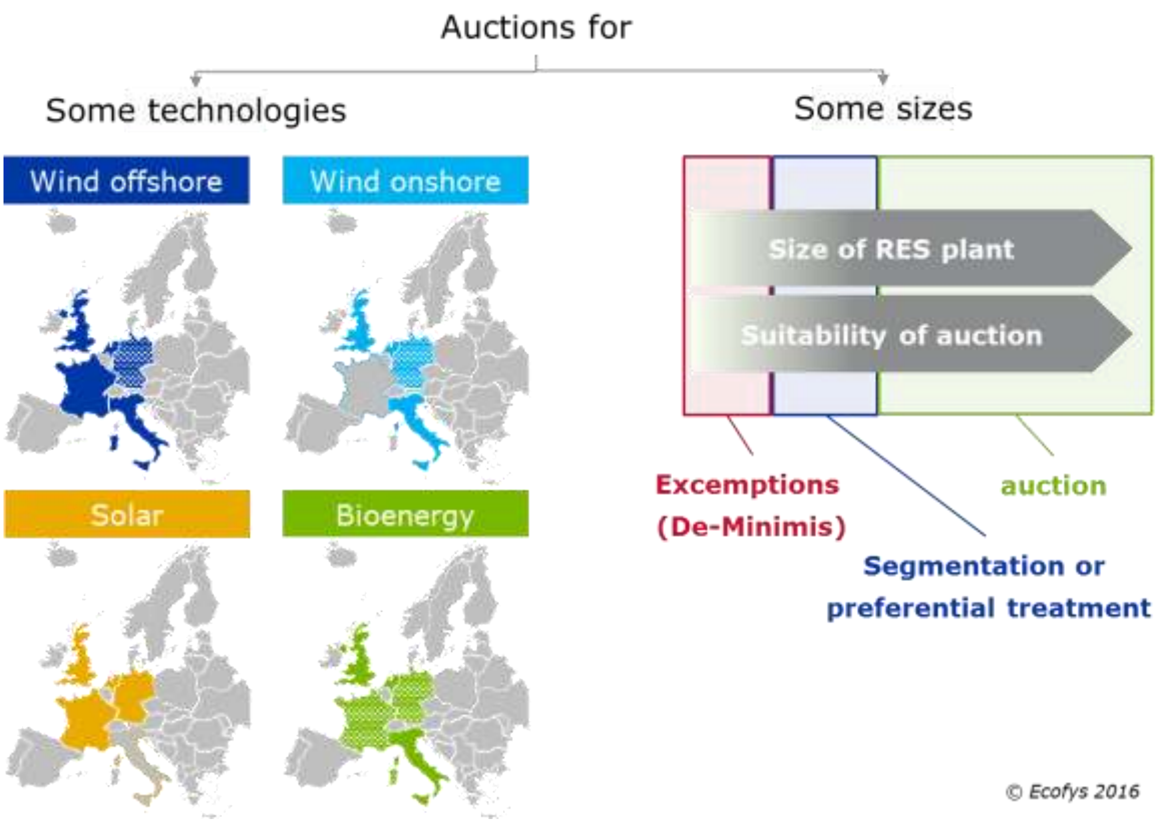


[134] World Bank (2014): Performance of Renewable Energy Auctions. Experience in Brazil, China and India. Available at: *http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2014/10/14/000158349_20141014104927/Rendered/PDF/WPS7062.pdf* (last accessed: 23.04.15).

[135] IRENA (2015) Renewable Energy Auctions. A Guide to Design. Available at http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=603 (last accessed: 11.10.15)

The technologies and the size of the eligible projects differ. As a general rule, support for large projects is more likely to be allocated via competitive bidding mechanisms. The UK introduced Contracts for Difference (CfD) to competitively determine support for on- and offshore-wind, large-scale PV, waste, tidal and wave, biomass.[136] By 2017, the CfD will have fully replaced the previous Renewable Purchase Obligation and will be the main policy that supports large-scale renewable energies.[137] The Dutch *Stimulering Duurzame Energieproductie (SDE+)* exists since 2011 and applies for technologies that fall under the broad categories RES-E, RES-H&C and biogas. Germany is currently conducting auctions for ground-mounted solar PV as a pilot scheme[138] and is planning auctions for wind offshore, wind onshore, and large roof-top-mounted PV from 2017 onwards.[139] France introduced two different auction systems for small and large scale solar PV. In 2012, the Italian Ministerial Decree DM 06/07/12 introduced competitive bidding procedures in Italy. Depending on the size of the projects, two different competitive bidding procedures exist. Together, they comprise almost all large RES-E except PV. Its validity ends in the end of 2015 and will most likely be extended with minor changes until the end of 2016. The system that may become effective in Italy from 2017 onwards is not yet under preparation.[140]

Figure 20: Implementation and suitability of auctions, Note: Bioenergy includes biomass, biogas and waste (full colour: introduced auctions, pattern fill: planned auctions)



Single- and multi-item auctions work fundamentally different. In a multi-item auction the private actor is solely responsible for developing the project. The actor's project enters the auction and competes against other projects at different locations and developed by different actors. In a single-item auction several private actors compete for the right to realise a project at the same location. In most countries and for almost all technologies,

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[136] http://www.energy-uk.org.uk/policy/electricity-market-reform.html and https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/307060/cfd_policy_drafting_update.pdf

[137] Recently, the UK announced the end of support for some types of renewables. Compared to other support schemes, the CfD were regarded as relatively successful yet the announcement of a new round of auctions is still pending.

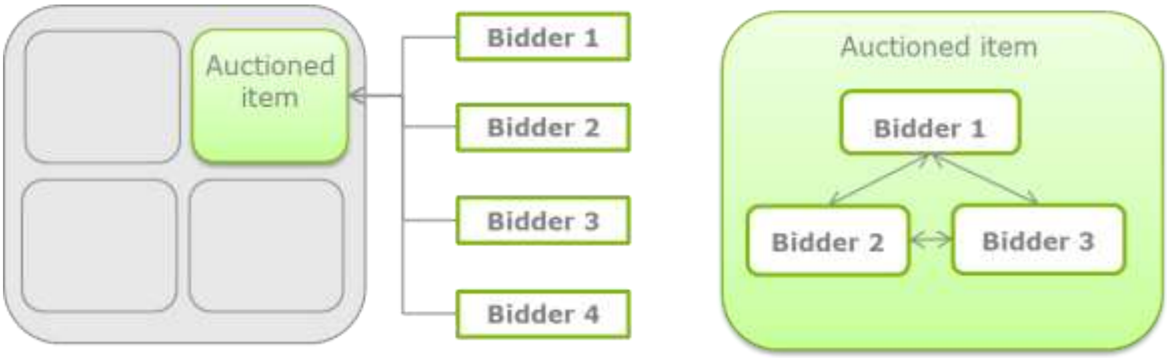
[138] Verordnung zur Ausschreibung der finanziellen Förderung für Freiflächenanlagen – Freiflächenausschreibungsverordnung; Available at: http://www.gesetze-im-internet.de/ffav/BJNR010810015.html

[139] BMWi (2014) Eckpunktepapier "Ausschreibungen für die Förderung von Erneuerbare-Energien-Anlagen". Available at: http://www.bmwi.de/BMWi/Redaktion/PDF/Publikationen/ausschreibungen-foerderung-erneuerbare-energien-anlage,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf

[140] Ministerial Decree DM 06/07/12, expert interviews by Ecofys

one observes multi-item auctions. The only exception is observed in auctions for large-scale RES, particularly offshore, where the Danish auction model becomes more and more common. Here, a state actor develops predefined areas and private actors compete for having the right to develop the project further. Figure 21 illustrates the differences.

Figure 21: Single item (left) compared to multi-item (right) auctions



Ecofys 2016 based on Fraunhofer ISI 2015

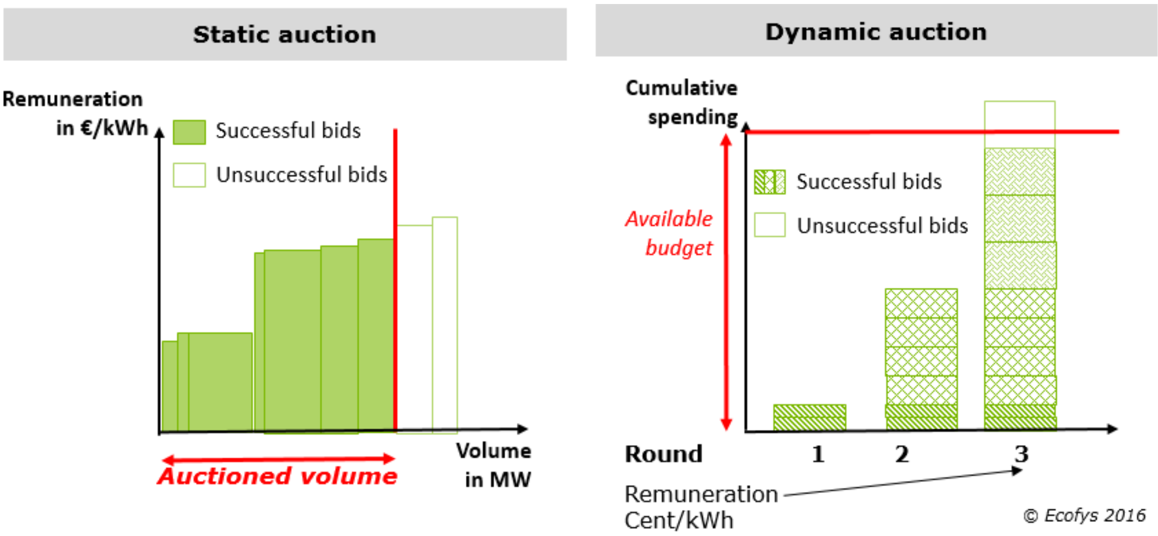
Auction rounds differ in frequency: they may take place annually or can be split into several rounds per year. Several rounds per year lead to more continuity. In Germany and France several rounds per year take place, while Italy only invites auctions once a year. The UK is meant to have several rounds but so far only one has been conducted and it is unclear when and if a second one takes place. The Netherlands recently increased the frequency to two rounds that consist of several sub-rounds. If the budget determined per round is met, further sub-rounds are cancelled. Bidders should know the auctioned volume and the timing beforehand. They may than optimise their pipeline and thereby balance levels of competition between auction rounds. For smaller countries that have a small market, aligning auction schedules with neighbouring countries may be an option to balance the level of competition between rounds.

The timing of the auction is crucial. The auctions all take place during the planning stage of projects that is before construction starts. Some take place at the very beginning of the planning, others just before construction. A "late auction" just before construction requires relatively high expenditures by the participants of the auction without knowing if the project will be successful. Some actors that are unwilling to take this risk may refrain from participation and the late auction might act as a market entry barrier. If one chooses an "early auction", the realisation rate of project that were awarded in the auction declines due to the inherent risk in the planning process.

The regulator decides on the timing of the auction by defining the qualification criteria that a project needs to fulfil in order to participate. In the UK, participants have to provide evidence of planning consent for the establishment of a project at a certain site and for the grid connection, as well as a connection agreement, which leads to relatively late auctions. The Netherlands initially required that participants only provide evidence that they have the right to use a specific site, have obtained an environmental permit and provide a (technical) description of the project, which is a relatively early auction. Due to initially low realisation rates, an additional feasibility study for project larger than 500 kWp resp. 50 Nm³/hr was introduced. In Germany, the auction takes place at a rather early stage. Participants need to prove that a solar project may be constructed at the indicated location. Voluntarily, they may choose to provide evidence of advanced planning which would reduce the financial risk. France requires a wide range of qualifications, ranging from building and business plans over descriptions of the involved actors and their liability to a CO_2-balance calculation of the plant. In Italy, participants need to have a production license, a connection offer from the grid operator as well as a proof of their capacity to finance the project.

The selected auction procedure differentiates auctions fundamentally from each other, yet both static and dynamic auction can work smoothly. A transparent auction scheme defines beforehand how bids are selected. Almost all selection mechanisms refer fully or partially to the offered price per kWh. Once a project passes the qualification criteria in Germany or the UK, only the indicated price by the participant decides on its success in the auction. Successful bids are then awarded with the uniform price (pay-as-clear) or the indicated price in the particular offer (pay-as-bid). Germany defines the uniform price as the price of the highest successful bid, the UK as the highest successful bid of a project that is realised in the same year. In Italy, the auction for large plants works similar but project developers have to offer a digression from the predefined maximum price in percent. Developers with the highest digression are awarded first. The Dutch system works differently as they apply a dynamic procedure (see Figure 22). The auctioning body defines the base price per sub-round. All projects willing to realise at this price are awarded with a contract. If the predetermined budget is exceeded in one sub-round, the overall round stops. If the budget is not exceeded, the auctioning body rises the base amount and bidders are allowed to submit new applications. However, there is also a "free category" in each bidding round, in which project developers have the opportunity to request a lower level of compensation than the one of the respective bidding round. In practice, this led to a system that is somewhat similar to the Italian case, as most of the bidders participated in the free category with individual bids. In 2013, France included the carbon footprint of a panel as an additional criterion accounting for 1/3 of the final grade (2/3 based on the price) and is therefore the only analysed country that applies a multi-criterion selection mechanism. The Italian system for medium size plants (Registry) is the only one that does not refer to the price at all but ranks bids based on predefined qualitative criteria. Winning bids are awarded a contract at an administratively set price. All schemes introduced implicit or explicit technology specific ceiling prices. Italy is the only country that also set a minimal price to avoid underbidding.

Figure 22: Illustration of static and dynamic auction procedures



Once being successful, the actor is responsible for realising the project in a predefined time ("realisation period"). The UK is the only country that closely monitors the progress of the project before the realisation period ends. In all countries, the periods depend on the technologies, with shortest time frames for solar and longest for large-scale installations, particularly offshore-wind.

Experiences with auction schemes are mixed. It can be observed that auctions led to lower prices than the previously set administrative levels. If properly designed and implemented, auctions may lead to more efficient results than other support policies. Yet introduced schemes have often been adopted and fine-tuned to cope with initial flaws. One important problem are low or late realisation of projects, which decrease the effectiveness of the auction in terms of timely target achievement. In the UK, serious underbidding by two solar PV projects let to problems, because awarded prices were too low to realise projects in an economically efficient manner. In the absence of financial penalties, the winning participants withdrew their bid. Furthermore, the qualification and eligibility criteria under the CfD had a counterproductive effect on technology bias as they effectively selected large projects with long lead times.[141] In the Netherlands, realisation rates were initially very low, leading to a high share of unused budget. In Italy, for some technologies, the number of participants is not sufficient to meet the target volume. Others projects are sometimes substantially delayed. In Germany, the targeted volume could easily be met. It is too early to say, though, if German projects will be realised as the realisation period did not yet end.

In order to avoid underbidding and have high realisation rates, securities in the form of bid bonds or penalties can be included in the auction design. Bid bonds are usually refunded once the contracts are signed,

[141] REA (2015): Evaluation of the first round of EMR Delivery and the Final Investment Decision Enabling for Renewable Process. Available at: *http://www.r-e-a.net/upload/150329_uk_solar_response_to_cfd_policy_review_final.pdf* (last accessed: 23.04.15).

but are lost in case the bidder does not follow through with the project. France, Italy and Germany have penalties in place. The Netherlands introduced penalties after low realisation rates for installations that have a budget claim larger than 400 M€. In practice, however, single installations are virtually never that large. Successful bidders in Germany who do not apply for a certificate of support within a period of 18 months have to pay a penalty. The amount depends on the state of planning of the PV plant during the time of the bid and can amount to up to € 50/kW. In the case of construction delays in France, the duration of support is reduced by the delay, multiplied by two. While being able to rise the realisation rate of successful projects and avoid speculation, bid bonds can also act as a market entry barrier, particularly for small actors.

Summarising, auction schemes may be efficient and market compatible, and are often considered as such. However, experiences with such schemes are mixed; in practice, the efficiency of auctions depends highly on design. Also the market environment and liquidity of the market have a large impact on the efficiency of auctions.

4.2 Technology neutrality and other State Aid Guidelines

As outlined in chapter 2, the Commission will regard the granted state aid as proportionate and presume that it does not distort competition in a manner detrimental to the internal market, if auctions are open indistinct of technology to all RES generators. The theory of classical macroeconomics says that – under some conditions – technology-neutral auctions lead to more efficient results (static efficiency). This is why the guidelines of the Commission request technology-neutral tenders from 2017 onwards. The Commission allows some exceptions from this rule, particularly in view of the longer-term potential of a given new and innovative technology, the need to achieve diversification, network constraints and grid stability, system (integration) costs and the need to avoid distortions on raw material markets resulting from biomass support (see Appendix).

While it is possible to have technology-neutral auctions, technology-specific and multi-technology auctions are more common. As mentioned above, the main differentiating criteria are the size of eligible projects, the resource (wind, solar, biomass, etc.), and the maturity of the technologies. The main argument for a differentiation according to the size are the following: Small-scale renewable generation, which has a geographical spread of installations and a good proximity to loads as well as reduced environmental impacts, is often desired by policymakers. Transaction costs of tender systems are relatively high for small projects. Smaller actors with a small portfolio are often not as well positioned to deal with the additional risk of an auction compared to larger market players. Therefore, countries tend to choose administratively determined support levels for small-scale installations and make use of the de minimis rule. For example, the German pilot scheme excludes plants smaller than 100 kW and is planning to rise the lower boundary to 1 MW from the end of 2016 onwards. In the UK plants below 5 MW are not included in the auction. France and Italy introduced separate auctions for mediums scale plants. France did so by using an online auction for smaller scale solar PV. Italy introduced the so called Registry, a distinguished auction in which the selection is not based on price at all (see above). In the Netherlands smaller actors (SME's, municipalities, schools etc.) are entitled to some supporting policies such as subsidised advisory services.

In none of the analysed schemes, technologies using a different resource compete on equal grounds. Germany, Italy, and France introduced mono-technology auctions. In Italy, the available volumes per resource are related by an overall budget constrain but the different technologies do not directly compete against each other. The current system is valid until the end of 2016. According to expert interviews conducted by Ecofys, it is unclear to Italian policy makers if the system may continue post 2016 precisely because the system is not technology neutral yet no alternatives are currently planned.

The UK distinguishes between established technologies (Pot 1)[142], less established technologies (Pot 2)[143], and biomass conversions. The rational between different pots and particularly the separation of biomass is to "avoid lessening competitive pressure in Pot 1 which predominately have lower strike prices, or distorting competition in Pot 2 due to its size and relative strike prices". The cited independent evaluation criticises that the choice of pots is non-transparent and not well argued for but that in principle even "some further separation may provide

[142] established technologies (Pot 1): onshore wind (>5 MW), solar photovoltaic (PV) (>5 MW), energy from Waste with CHP, Hydro (>5 MW and <50 MW), landfill gas, sewage gas

[143] Less established technologies (Pot 2): offshore wind, wave, tidal stream, advanced conversion technologies, anaerobic digestion, dedicated biomass with combined heat and power, geothermal, Scottish Island onshore wind projects (subject to state aid approval)

a more economically efficient auction outcome".[144] The reason they give is that several factors cause inefficiency in a technology-neutral auction, particularly:

- substantial differences in technology cost;
- increased uncertainty over the likelihood of success and therefore increased risk of project development
- over or under evaluation of positive and negative externalities of certain types of renewables like flexibility or visual impact, and;
- interactions with other (technology-specific) policies.

The experience in the UK shows, that in practice, one technology dominates the pots: onshore wind in Pot 1 "established technologies" and offshore wind in Pot 2 "less established" technologies. Therefore, a diverse deployment is not guaranteed anymore.

The Dutch scheme, too, highlights that it is difficult to integrate some technology specific characteristics in a de facto technology neutral auction. In the SDE+ the auctioning body sets a technology specific base price and determines the budget that should be allocated to a specific technology in one round. All bidders that are willing to realise projects of this technology for the base price are awarded with a contract. Additionally, if a bidder is willing to realise a project of any technology for a lower price than the lowest base price, the bidder gets a preferential treatment. In practice, this leads to a technology-neutral scheme where all technologies compete against each other. The technology-specific auctions introduced in France, Germany and Italy instead are allowed to fine-tune the auction scheme to the specific technology. Furthermore, they all managed to bring down cost of support, which is a sign of efficiency even in technology-specific auctions.

In summary, experiences in practice show that it is difficult to support a diverse mix of technologies by having a real or de facto technology-neutral scheme. As a result, only a few technologies dominate the auction. In the short run, this may result in an efficient allocation of available resources as the less expensive technologies are supported. In the long run, however, it is likely that, to meet RES targets, a wider range of technologies is needed. Furthermore, to benefit from dynamic efficiency gains the deployment of technologies need to be continuous (e.g. to build up supply chains). In the long run, a technology-specific auction might therefore provide more incentives to reduce cost of a particular technology and therefore improve the long-term efficiency of the overall system.

Besides technology neutrality, the Commission asks some Member States to open parts of their support schemes to participants from outside of the country. The process is slowly starting. For example, Germany is currently in negotiations with neighbouring countries to open parts of its support scheme to foreign participants and thereby create opened or joined support schemes. Furthermore, the guidelines require a transition to premium-based support schemes. A shift towards market integration may well be observed in all recent changed of the support schemes.[145] For example, the UK CfD as well as the German support scheme guarantee successful bidders a sliding feed-in premium. Italy supports RES except photovoltaics with a fixed feed-in tariff for plants with a capacity below 1 MW and a sliding feed-in premium for plants with a capacity above 1 MW.

While some argue that a fixed market premium increases the market integration of renewables, it bears some additional problems in combination with a competitive bidding procedure. A fix premium means that bidders need to estimate the market revenue in the future in order to make an informed offer in an auction. None of the bidders knows for sure, what the market revenue will be and is therefore a common unknown. If a common unknown exists, experience with several auctions and the theory of competitive bidding highlights the following: it is not the project with the lowest cost that wins the auction, but the bidder that overestimated the revenue from the common unknown the most. Hence, winning projects are more likely to not be economically viable. While this is not the place to argue for or against a fixed or sliding market premium, it should be noticed, that a complex interaction exists between the different changes required by the guidelines; they lead to counterintuitive results and make the design of an auction scheme a complex endeavour.

4.3 Experiences in the alternative fuel and transport Sector

In addition to taking experiences from the power sector on the Continent, several countries offer lessons when it comes to the introduction of biofuels which can help to form the basis for developing general recommendations.

[144] GrantThornton and Pöyry (2015) Independent evaluation of the Electricity Market Reform: p. 97

[145] A detailed assessment of the support schemes regarding the market integration, balancing responsibilities and measures against negative prices is out of scope as the regulations are often quite technical.

In this sub-chapter, an introduction to mechanisms to support biofuels in the United Kingdom, Germany, and the Czech Republic follows. They serve as a brief introduction to policy measures whose application to the Nordics will be further discussed in the recommendations in Section 5.

In the EU, low-blend ethanol and biodiesel have been the two main options for introducing renewable energy in the transport sector, but there are also other options such as high blends of these fuels, biomethane or electric vehicles.

In Europe, the two main support systems for biofuels have so far been tax exemptions and quota obligations with fines for non-compliance. The main focus for policy intervention has been the demand side and the costs for the policy mechanisms. Initially, many of the member states used tax exemptions and then switched to a quota obligation/blending obligation because governments were not willing or able to pay for the support schemes. Several general benefits and drawbacks have been identified in a report from the European Commission[146] during the use of these two systems and are shown in the following two tables.

Tax exemptions have been a vital part of the support systems and all member states with significant biofuel volumes have used them at some point. They have been especially effective in countries with high fossil fuel taxes, where an exemption naturally provides the most significant support.

Table 6: Strengths and weaknesses of tax exemptions as a support mechanism

Strengths	Weaknesses
Easy to implement Few market risks More incentive for innovation (than quotas) Suitable for early stages of development	Losses in fiscal revenues Risks of overcompensation Requires a high initial excise tax to be effective

Table 7: Strengths and weaknesses of quota obligations as a support mechanism

Strengths	Weaknesses
Provides certainty for the producers Does not involve costs from the public budget Suitable for more advanced stages of the development	Higher prices for customers Less incentive to innovate (than tax exemptions) Higher price variability Difficult to implement

Experience also shows that a combination of a quota obligation and tax exemptions gives the highest annual growth rate for biofuels, as expected when two support systems are in place. The study also showed that a switch from a tax relief/exemption to a quota obligation lead to a lower growth rate.

The incentive to innovate provided by the two types of support mechanisms must also be handled in a broader perspective. When tax exemptions are replaced by a quota system, there are further opportunities in the state budget to finance R&D, demonstration and support to infrastructure and vehicles. In this perspective, the incentive to innovate can be as high or even higher with a quota system.

Due to the strengths and weaknesses in these two systems, and also due to the diversity of the fuel markets (for example, the numerous alternative fuels and vehicles that are in different development stages and with different strengths and weaknesses), different designs and combinations of such systems are used.

4.3.1 Germany: Greenhouse gas reductions quota obligation

In 2015, Germany introduced the greenhouse gas (GHG) reductions quota, meaning that the share of greenhouse gases from gasoline and diesel must be reduced according to the following scheme:

- by 3% by the end of 2015;
- by 4.5% by the end of 2016;

[146] [European Commission, 2009. The Renewable Energy Progress Report]

- by 7% from 2020 onwards.

The GHG emissions from biofuels are calculated according to the guidelines in the fuel quality directive, and the 7% reduction in greenhouse gases are assumed to correspond to a share of renewable energy of about 12%. The penalty for not fulfilling the quota is 470 EUR per tonne[147].

4.3.2 United Kingdom: Quota obligation with certificates

In the United Kingdom, support to renewable fuels consists of a quota obligation and a connected certificate system[148]. The biofuel producer gets a renewable transport fuel certificate for each litre of produced biofuel, and two certificates if the fuel is produced from waste or by-products. Fuel distributors are obliged to obtain a certain amount of certificates in relation to the amount of fuel they sell. The certificates are traded on an open market and there is no guaranteed minimum level of support to the producer. The quota was ramped up from about 2.5% to about 5% between 2008 and 2013, and thereafter the level is about 5%.

As in other cases, the quota obligation has been an effective policy instrument for introducing renewable transport fuels. However, it has been difficult to support a diversity of fuels and technologies with this scheme and to maintain a well-functioning certificate market with a reasonable minimum certificate price. In the impact assessment[149] of this scheme, a range of policy improvements were suggested. The following could be of specific interest for the Nordic countries:

- Setting a minimum certificate price to reduce the risks;
- Splitting the quota by fuel type;
- Setting longer term trajectories;
- Linking certificates to GHG savings.

These changes could steer more towards the more advanced fuels that are needed to achieve the long-term goals.

4.3.3 Czech Republic: Quota obligation for low-blend fuels

The policy system for supporting both high-blend and low-blend renewable transport fuels in the Czech Republic was recently approved by the European Commission and is thus in line with the current state aid regulations[150].This system is planned to be in place from 2014-2020 and was approved by the Commission after implementation.

The Czech Republic has two main mechanisms for supporting renewable transport fuels: a quota obligation for low-blend fuels and tax exemptions for pure Biofuels and high-blend mixtures of biofuels with fossil fuels.

The following high-blend fuels will be granted reductions or exemptions from excise taxes: FAME B100, vegetable oil (in particular pure rapeseed oil), MDF B30 (mixed diesel fuel with a minimum share of 30% volume of FAME/RME), ethanol E85, ethanol E95 and biogas. These high-blend fuels cannot be used to fulfil the biofuel quota, i.e. only low-blends of biofuels in petrol and diesel can be used for this. Currently, the quota obligation requires 4.1% biofuels in petrol and 6% in diesel.

It is still early to draw lessons regarding the policy effectiveness from this support scheme, but this example shows that support to high blend fuels, no matter the origin and production method, is allowed according to the EU state aid regulations. It is not obvious in the state aid regulations that operation support such as reductions or exemptions from taxes could be given to first generation biofuels, but in this decision it is allowed for pure and high-blend biofuels.

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[147] [http://www.ufop.de/english/news/introduction-of-legal-greenhouse-gas-reduction-requirements-from-2015-in-germany-possible-consequences-for-the-biodiesel-sector/]

[148] [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/307437/impact-assessment-pir.pdf]

[149] [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/307437/impact-assessment-pir.pdf]

[150] [European Commission, Brussels, 12.8.2015, State aid SA.39654 (2015/NN) Multi-annual support to biofuels for transport]

4.3.4 General experiences from the use of investment support for alternative fuels

Investment support is most likely an effective policy instrument for introducing new technologies, as it provides strong incentives and reduces the risks for investors, but comes with a risk of overcompensation and low cost efficiency.

Research in 2009 into biofuel support policies in Europe[151] concluded that investment support was in many cases not needed for first-generation biofuels when they were introduced in the EU, as the fixed costs for such production facilities were relatively small in relation to the feedstock costs – about 7% for biodiesel and 30% for bioethanol. However, in the results from this study they[151] emphasized that investment support schemes may be needed for advanced renewable fuels with higher investment costs.

Grönkvist et al [152] argues that in general, variable support such as tax exemptions connected to output or input of the fuel production may be a more cost-efficient policy instrument than investment grants, because such support generates similar effects for all actors in the market and it can also stimulate technical development. Furthermore, they suggest that recurring investment support programmes may influence investors to delay financially rational investments in anticipation of another investment programme, and thus can be counterproductive. However, the advantage of investment grants is that they can provide certainty for investors in long-term investments, whereas variable support may change during its lifespan or some may perceive a risk that it can change.

An investigation in 2011 into the cost-efficiency of financial policy instruments for ethanol in North America[153] suggested that a combination of investment grants and variable support would be more cost-effective than separate use of the instruments. Furthermore, they noted a combination of the two would reduce risks of overcompensation and also effectively reduce the perceived risks among investors.

4.3.5 Netherlands: Electric vehicles and plug-in hybrids

The Netherlands has several measures to encourage lower-emission vehicles. Measures are mainly in the form of fiscal incentives. Notably for the Netherlands, the incentive for EVs and plug-in hybrids for company car purchases is rather large compared to private car purchases.

- **Registration tax exemption** for low-emission vehicles from July 2013
- **Exemption from annual circulation tax** for cars with emissions lower than approximately 100 g CO_2/km, this level was lowered to 50 g CO_2/km from January 2014
- **Company car taxation**. Employees who have a company car are subject to income tax on 25% of the vehicle's value; in 2013, for company cars emitting less than 50 g CO_2/km, individuals were exempt from this tax. This amounts to several thousand euros per year, and was applicable up to 5 years. In 2014, the exemption was removed, but individuals with such company cars continue to pay a lower income tax than higher-emission vehicles.[154]

The measures in the Netherlands have led to them taking second place behind Norway in Europe in introducing EVs and PHEVs, with growth of market sales of PHEVs quadrupling between 2012 and 2013. The reduction of several of the incentives after 2013 has led to a reduction in sales in 2014 and 2015 compared to the 2013 levels.[156] [155]

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[151] Wiesenthal T, Leduc G, Christidis P, Schade B, Pelkmans L, Govaerts L and Georgopoulos P. 2009. Biofuel support policies in Europe: lessons learnt for the long way ahead. Renewable and Sustainable Energy Reviews. 13, 789–800.

[152] Grönkvist S, Peck, P, Silveira S, Åkerman J, Larsson M and Khedkar P. 2013. Policy Instruments Directed at Renewable Transportation Fuels – an International Comparison, 2013:15. f3 The Swedish Knowledge Centre for Renewable Transportation Fuels, Sweden.

[153] Leach A, Doucet J and Nickel T. 2011. Renewable fuels: policy effectiveness and project risk. Energy Policy 39, 4007–15.

[154] Harryson S, Ulmefors M, & Kazlova A, 2015. Overview and analysis of electric vehicle incentives applied across eight selected country markets. Available from: [http://www.bth.se/bloggar/sustaintrans/]

[155] Mock & Yang, ICCT, 2014. Driving Electrification: A global comparison of fiscal incentive policy for electric vehicles. Available from: [http://www.theicct.org/driving-electrification-global-com]

4.3.6 France

France follow the Netherlands in terms of market share of sales of plug-in hybrids.[156] They have several incentives, both in the form of subsidies and fiscal incentives:

- A so-called "ecological bonus" for EVs as they have zero emissions, this is currently up to 7000 EUR (but cannot exceed 30% of the vehicle's value plus VAT). From April 2015, this bonus was increased to 10 000 EUR if the owner was replacing a diesel car older than 13 years with a new EV. For vehicles with emissions between 21-50 g CO_2/km, the bonus is slightly lower.
- EVs receive exemption from vehicle registration tax, which is based on engine power.
- **Company car taxation**. There is a personal income tax on company cars which is based on CO_2 emissions, and cars emitting less than 50 g CO_2/km are exempt from this tax. This is however a lower tax than in the Netherlands and hence not as significant.
- Certain cities offer further support to EVs in the form of free parking and a 30% tax break on installing private charging stations in residential areas. [157] [158]

4.3.7 Germany

Relative to the Netherlands and France, Germany lies somewhat behind in market share of sales of EVs and PHEVs. They do however have very ambitious targets of introducing one million EVs by 2020. They have two incentives which are described here:

- **Exemption from annual circulation tax** (this is already low for low-emission vehicles) for ten years
- **Company car taxation.** There is an increase on personal income tax for company cars of 1% of vehicle value per month; there is a reduction in this percentage for EVs.
- **Free parking and use of bus lanes**. From September 2014, certain types of EVs and PHEVs are granted free parking and the use of bus lanes.

It is noted however that the greater VAT amount that EVs pay compared to traditional vehicles (since they have a higher purchase price) amounts to more than the above incentives, and could go some way to explaining the relatively lacklustre uptake of EVs in Germany, despite ambitious targets. Indeed it could be considered surprising that they have as many EVs on the road as they do. [157] [158]

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[156] ICCT, 2015. European vehicle market statistics: Pocketbook 2015/16. Available from: [http://eupocketbook.theicct.org/]

[157] Harryson, Ulmefors, & Kazlova, 2015. Overview and analysis of electric vehicle incentives applied across eight selected country markets. Available from: [http://www.bth.se/bloggar/sustaintrans/]

[158] Mock & Yang, ICCT, 2014. Driving Electrification: A global comparison of fiscal incentive policy for electric vehicles. Available from: [http://www.theicct.org/driving-electrification-global-com]

5. Recommendations

Our recommendations from this study include: focus on reducing cost and increase market orientation of the support schemes over time to limit policy costs with increasing supported volumes and assure public and political acceptance. Nordic countries that are very conscious about cost efficiency should first and foremost focus on mature technologies with low LCOE and a market-compatible support scheme with low risk for investors. The long-term aim should be that all technologies can be invested in on their own merits.

We recommend the establishment of a *Nordic RES-E Cost Monitor*, an independent RES-E supply curve analysis for policy makers in order to better understand project cost, its cost elements and their potential development. This project-specific cost analysis should use detailed knowledge of the available resources locally, e.g. wind speed, water depth and distance to shore or fuel prices for biofuels, for both current projects and also as a forecast 5 to 10 years ahead. This analysis and insight could be used by policy makers in the RES policy design.

In order to reach very high shares of RES it is important to diversify in the long run. Furthermore, long-term stability and predictability is key. Public and political acceptance contributes to that long-term stability. Broad political agreement on energy policy is key, preferably based on thorough analysis of economic, environmental, power market and power system effects.

There is no absolute must to design for complete technology-neutrality right away. Technology-neutrality should only be a mid- or long-term target. According to the state aid guidelines technology-specific tenders are allowed if a bidding process open to all technologies would risk a "suboptimal result that cannot be addressed in the process design". The issue on "longer-term potential of a given new and innovative technology" could however be difficult to address with a technology-neutral design. In particular if the aim is to use support schemes in order to decrease costs of less mature technologies, approaches that are not open to all technologies should likely be favoured. Likewise, "network constraints and grid stability" might allow for a less technology-neutral approach.

The main policy instrument options beyond 2020 are auction based feed-in-premiums and certificate schemes. If a country wants to increase its share of RES, the electricity market without additional support is not an option as it does not yet provide sufficient incentives for investment into RES. All three main policy instrument options – auctions with fixed or sliding premium or a certificate market - provide a high degree of market orientation, with a sliding premium providing less investor risk for the auction options.

Auctions can be designed technology-specific, technology neutral (one basket), or have various baskets for different types of technologies. The benefits of a one-basket option lie in its technology-neutrality and increased competition, while its disadvantages lie in potentially favouring more mature volume technologies, resulting in less diversification and the risk for overcompensation. In addition, if a country wanted to focus on more firm RES-E for reasons of system stability, an entirely technology-neutral design does not provide the answer.

Multiple auctioning baskets provide a good compromise between technology-neutrality and targeting specific purposes. While it is not the only way forward, the following describes how such an auction could look like: these baskets could, for example, be split into three: one for mature technologies (e.g. hydro and onshore wind), one less mature technologies (e.g. offshore wind), and one firm RES-E capacity (e.g. bio-power CHP) with annual auction target volumes and ceiling prices per technology. This would allow budget control via ceiling prices and auction volumes and potentially more diversification, if required. Provided that a long-term target is set and annually auctioned volumes are within a corridor, this would also provide sufficient certainty to investors.

The discussed policy instruments can be handled in different pathways. Our recommendations focus on two potential pathways: the *traditional pathway* with an evolutionary, strictly nationally focused RES policy development and the *Nordic alignment pathway* which provides a number of advantages to the Nordic countries and to investors (Nordisk "nytte").

In the *traditional* pathway, new support schemes are essentially designed with a strictly national mindset and for national use. The schemes beyond 2020 are either developments of existing schemes or new schemes in order to comply with the State Aid Guidelines. Essentially, administratively set premiums become auction-based premiums and the certificate scheme undergoes only slight improvements. These schemes can however differ substantially between the Nordic countries. In the *traditional*, nationally-focused pathway, both auctions and certificate schemes – either national or joint – are viable options.

With changing state aid guidelines and the defined duration of the schemes such as the Swedish-Norwegian joint certificate market, there is now a unique opportunity for Nordic RES-E support alignment. In the Nordic *alignment* pathway we still have national schemes and a national focus on the targets and needs. However, the national schemes become increasingly aligned. Following a market-based approach, support schemes become in large parts identical and integrated into a common Nordic framework. Within this framework, there is room for tailoring and adapting details to each of the Nordic countries' needs. Alignment does only mean agreeing on a common framework between the Nordic countries. It does not necessarily mean joint schemes. However, if joint schemes such as joined auctions are a long-term aim or an option, aligned policy instruments would provide a good foundation to build on.

This alignment approach could further improve the external view of the Nordics as an organised and politically stable market with a common electricity market, with strong and increasing physical interconnection and now with even an aligned RES-E support framework. The approach is both compatible with state aid guidelines, presumably cost efficient, provides a certain technology neutrality and simplifies the investor view of the Nordics as a whole. In principle, even for the aligned pathway, both auctions and certificate schemes are viable options. We do see however advantages using auctions with multiple baskets which can easily be tailored nationally rather than the Certificate system for this alignment pathway.

For biofuels, the policy mechanisms related to greenhouse gas emissions, such as carbon dioxide tax or greenhouse gas quota obligation, appear to be the best options in the long term for providing market-based support in a policy-effective, technology-neutral and likely cost-efficient way. These policy mechanisms have been effective in the introduction of biofuels so far and they are technology neutral in the sense that they only support the emission reductions and not specific technologies. This could possibly also provide a dynamic efficiency as it provides an incentive to develop more advanced technologies with higher greenhouse gas emission reductions, but this has not yet been proven for the greenhouse gas quota obligation. Furthermore, both policy mechanisms have the potential to be cost-effective, although this depends on the design and implementation of them.

Nevertheless, the general drawbacks of a quota obligation may be challenging to overcome, such as difficult implementation, less incentive to innovate, and variable economic support to producers. With increasing shares of different types of renewable fuels, it will be difficult to design and implement quota systems, for example when trying to reach a fossil-fuel independent vehicle fleet. Furthermore, if large volumes of biofuels are based on lignocellulosic biomass and produced in large scale facilities, a long term, stable support is necessary. This cannot be provided solely by a quota system but to some extent by a carbon dioxide tax.

The quota system could be combined with a gradually increasing carbon dioxide tax that applies to the net life cycle GHG emissions for all fuels, including renewable fuels. The taxation of carbon dioxide has already been initiated in the Nordic countries and it is a pathway that can provide market stability and clearly steer towards the long-term goals of reducing emissions from the transport sector. It is a pathway that can give support to the diverse Nordic market of renewable fuels, including the parts of the value chain that are not connected to the distributors of fossil fuels.

For electric vehicles, support schemes should reflect the importance total cost of ownership and infrastructure as important aspects for successfully introducing electric vehicles to a market. Significantly reducing the extra cost of an electric vehicle by reducing the investment and operational cost for the owner, whether via registration fee exemption or another means, increases the number of potential customers. However, support throughout the entire value chain is required to yield results: high subsidies for the initial user cost itself and operational support are not sufficient if infrastructure is lagging behind. Infrastructure for EVs must be supported and developed. Preferably infrastructure support is ahead of the user experience to provide convenience rather than irritation.

Other tangible and intangible benefits may have a huge positive impact. Additional user benefits, such as being able to use bus lanes, free parking, free charging and fee exemptions, have considerable potential to increase the attractiveness of EVs, both in terms of convenience and economy for drivers.

The potential for *nordisk nytte* for the Nordic countries in working together to reach RES targets naturally depends on the extent of cooperation and alignment; these provide benefits for policy makers and investors alike. For the development of RES policy and policy learning, at the simplest level, there is a benefit from having a forum for information exchange of experiences and best practice from the various support schemes implemented in each country, such as provided within the working group for renewables, AGFE.

A further step already discussed within the report would be to create a Nordic RES-E supply curve for the coming years. This would serve as a cost monitor for Nordic RES-E, both enabling the tracking and forecasting of technology and project cost level development in the different countries. Regardless of policy instrument and pathway chosen, this would create a transparent base for cost efficient policy design in the Nordic countries.

Of the two main pathways described within the report, the *alignment* pathway seems to be the most promising in the near future because it holds immediate benefits for RES investors by further increasing the attractiveness of the Nordic region and reducing transaction costs, which could increase competition and thereby potentially reduce overall policy cost. Alignment would create a more politically stable environment for investors as the main framework of the support could not be changed so easily without consent of other countries, although the ability to tailoring the support to national needs would still be maintained. Nordic alignment also provides a simpler market environment for investors that is easier to understand and enter. The area of offshore wind auctions provides a potential area of focus for alignment and possible cooperation. As mentioned within the report, there are several aspects that would benefit from being aligned between the countries, such as aligned auction schedules which could increase participation and competition in tenders and thereby reduce costs.

As for alternative fuels and transport, there are several potential opportunities for *nordisk nytte* in aligning the Nordic support mechanisms for biofuels. A combination of a GHG quota and a carbon dioxide tax in all the Nordic countries would provide a larger and more stable market for developing second generation biofuels or any other type of renewable fuel. Such a market with common regulations and predictable development would enable long-term investment decisions. If the Nordic countries develop a common methodology for calculating the life cycle GHG emissions from different fuels as a basis for these support systems, then a common effort can be made to introduce this system into the EU framework.

Furthermore, an alignment would reduce the possibilities for subsidy shopping, where fuels are produced with investment support in one country and then sold in a country with market support. Another possible negative effect of unaligned support that could be reduced with alignment are for biofuels with large GHG reductions to be exported to countries that incentivise their use while other biofuels with smaller GHG reductions are imported. However, as biofuels can be traded on a global market, the Nordic alignment can only reduce the mentioned effects and not remove them entirely; to do so would require further alignment with other EU member states.

In addition, the alignment of technical standards and planning for charging infrastructure for zero emission vehicles could enable an effective development of the infrastructure and make the Nordics one of the leading markets for these vehicles.

5.1 Recommendations for renewable electricity generation support

The recommendations will consist of a discussion of the various focus areas mentioned by the Nordic countries (e.g. "designing for cost-efficiency"), an overview of the actual policy options for the primary support schemes after 2020, a discussion about national and Nordic aligned pathways and country-specific recommendations.

5.1.1 General Design Recommendations

There can be several objectives in the creation and development of new RES-E policies; these can range from national renewables goals, security of supply, and cost efficiency, to job creation and self-sufficiency. These differ in importance between countries, and identifying the aspects critical to each country forms the pathway to developing the key policies for supporting RES-E in the Nordics in the years after 2020.

Achieving 100% renewables in the long-run and designing support schemes for it requires thorough preparation and a long-term strategy. It requires balancing long-term policy analysis and interventions with the use of market-based support schemes. Policies will be used to find good ways regarding grid planning and market design. For the design of support schemes cost efficiency as well as public and political acceptability are key. Mid- and long-term the need for dynamic efficiency and diversification arises in addition.

5.1.1.1 Designing for cost efficiency in RES-E

Cost focus is important and market orientation of the support schemes should increase over time to limit policy costs with increasing supported volumes and assure public and political acceptance. The long-term aim should be that all technologies can be invested in on their own merits. Therefore, and in order to keep policy costs low, they should be gradually more exposed to market mechanisms. Without short-term cost efficiency, public and political acceptance risks to be low, potentially limiting the possible options to reach the 100%-renewable target. Cost focus also includes exposing investors to market signals and their volatility. Providing disincentives to electricity generation at negative prices, such as the Danish offshore wind example, will be highly important with a growing share of variable RES-E and is a solution supported by TSOs.[159] Such disincentives may be limited to an absolute level in terms of hours per year in order to limit investor risk.

Nordic countries that are very conscious about cost efficiency should first and foremost focus on mature technologies with low LCOE and a market-compatible support scheme with low risk for investors. Mature technologies with low LCOE have by definition low generation cost. As they are mature, competitive mechanisms may be used to determine the level of support, which allows for further efficiency gains and reduces problems of information asymmetry between policy makers and the market. In addition, low transaction cost are preferable while guiding investments into areas of electricity demand and growth.

We recommend the establishment of a *Nordic RES-E Cost Monitor*, an independent RES-E supply curve analysis in order to better understand costs elements and their potential development. This project-specific cost analysis should use detailed knowledge of the available resources locally, e.g. wind speed, water depth and distance to shore or fuel prices for biofuels, for both current projects and also as a forecast 5-10 years ahead. This analysis could be used by policy makers in the RES policy design. Capital costs are heavily influenced by the risk premium investors use, which is in turn both technology-specific and related to the expected stability of income from the support scheme. Less mature technologies require a higher risk premium and thus result in higher generation costs (LCOE). A higher risk premium would also be used for support schemes which are seen as less stable and predictable or those with a higher exposure to market risk. Last but not least, since taxes are also part of operational costs, secondary support measures such as tax reliefs or exemptions can also affect generation costs.

In order to limit transmission costs, guiding investments into areas closer to where the electricity is consumed should not be ruled out as an option. Investments in RES might trigger investments first of all in the main and distribution grid, especially if electricity demand and favourable locations for RES-E generation are at longer distances from each other. While transmission costs may be difficult to directly link to specific support schemes, some transmission cost increases can be traced to large-scale installations or generation of RES in remote areas. However, most research shows that it is cheaper to build RES in good locations and invest in transmission.

Thus, there is a trade-off in cost efficiency between generation and policy cost as well as transmission cost. Moving RES-E closer to consumption may decrease social acceptability via the NIMBY effect, which in turn may also affect the political feasibility of deploying larger volumes of RES-E.

Furthermore, since a large share of current RES-E technologies are intermittent in nature, ensuring security of supply will be an important consideration and there will likely be a need for increased back-up capacity. The need for back-up capacity can partly be offset by diversification in terms of technology and geographical

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[159] Anpassning av elsystemet med en stor mängd förnybar, SvK 2015

location. Geographic diversification however would require a strong build-out of the grid and thus higher transmission costs. Technology diversification including bio-powered CHP might provide firm capacity, but would require a demand for the heat as well, a demand whose growth is limited to a few locations in the Nordics.

Transaction cost can occur both for public administration or investors and are heavily influenced by the choice of instrument, but also detailed support scheme design. Higher transaction costs can deter smaller market participants, so the number of policy details should be adapted to the scale of the projects.

5.1.1.2 Designing for 100% renewables in the long run

In order to reach very high shares of RES it is important to diversify in the long run. Dynamic efficiency takes the long-term aspect of driving down technology cost into account. In the short term a certain policy may be very cost effective in terms of deploying a large amount of RES at the lowest possible cost. Such policies are likely to support the most mature RES technologies, but will not in the same way contribute to further development of less mature technologies. Support policies that instead focus on bringing down the overall cost and developing the supply chains of less mature technologies may instead lead to increased dynamic efficiency and lower costs long-term, while not necessarily being the most cost efficient in a short-term perspective[160].

Examples of dynamic efficiency in the Nordics are the cost development of Danish offshore wind, which despite high initial costs has been tremendous, and onshore wind in the Norwegian-Swedish certificate system. The latter made huge progress in terms of cost reduction over the last ten years, also driven by a large number of potential projects, a rather flat supply curve and thus intense competition arguably beyond what had been the case without the Certificate system. An increased focus on the longer term dynamic efficiency seems thus warranted. This relates to development of both the technologies and their supply chains, and also of the overall system costs. There is an increasing discussion on the overall development of the power system, grid integration and the supply of the necessary system services. Here there will be an interplay between support schemes and the market design. However, one important point is that a generation-based support of variable generation technologies may lead to a situation where there is an insufficient amount of resources providing necessary system services and reliable capacity. This could in turn create a need for compensation mechanisms to ensure a functioning system.

Furthermore, long-term stability and predictability is key. Stop-and-go support should be avoided, as this could lead to a rush and fast build-out during periods, requiring the same rush in 20-25 years' time to replace those plants. Ideally, that means also limiting switching between support instruments, unless absolutely necessary, for increased market orientation and cost efficiency. Long-term stability and predictability also assures investor confidence and keeps their risk premium low, thus decreasing the need for support. However, long-term stability requires also public and political acceptance. And in order to reach public acceptance, limited policy costs and cost efficiency are key, together with a clear view that the country is not losing ground economically mid- or long-term as a consequence of these policies.

Public and political acceptance contributes to that long-term stability. Broad political agreement on energy policy is key, preferably based on thorough analysis of environmental, power market and power system effects. This includes also taking into account and minimizing negative local effects caused by RES-E plants, aiming to avoid NIMBY effects. It also includes assessing welfare distributional effects caused for various producer and consumer groups with a special focus on keeping consumer costs reasonable and avoiding the burdening of power-intensive export industry with too high costs, hampering their competitiveness.

Technology-neutrality should only be a mid- or long-term target. This includes moving from technology-specific support schemes to technology-neutral ones as the costs of the involved technologies become more similar. At the same time and in order to have a wider range of feasible technology options in the future, support to research and development of less mature technologies, e.g. for their adaption to the Nordic climate, is advisable.

In order to better physically integrate renewables with the power system, a transparent project pipeline and good foresight of likely build-out is preferable from a TSO and DSO perspective. A better long-term geographical planning is preferred, which for e.g. offshore wind can be realized with site-specific auctions.

5.1.1.3 Designing for technology neutrality

Experience shows that support schemes that are formally designed to be technology neutral in practice mainly support one or a few dominating technologies. The advantage of this is that the least costly volume technology

[160] Although some claim this has been the case for the Norwegian-Swedish Certificate market

is typically supported, thus increasing the cost efficiency, and that the policy maker does not have to "pick winners", while actually doing so in practice. The disadvantages include that the scheme does not contribute to the development of less mature technologies, but possibly also that it could lead to an "unbalanced" system with one technology dominating. The latter is to a large extent also naturally dependent on how the support scheme is designed.

While even a well-designed technology-neutral support scheme will tend to *over-compensate* some low-cost projects and technologies, total over-compensation is limited by volumes. However, the volume of these low-cost technologies namely hydro and partially bio-powered CHP is limited, at least in the Nordic countries currently using a technology-neutral system. Therefore, the supply curve is rather steep in the beginning and rather flat for the bulk of the price-setting technology, onshore wind. Thus, total overcompensation is rather limited. Only in the case of a technology neutral system that is generous enough to also provide sufficient support to less developed technologies, will it likely lead to a significant over-compensation for the more mature technologies.

On the other hand, technology-neutral systems with fast developing technologies existing over a longer duration may lead to *under-compensation* of first movers. This is an experience from the Norwegian-Swedish Certificate scheme and an often-overlooked issue. During its initial solely-Swedish phase from 2003-2011, projects with an LCOE of 75-80 EUR/MWh were built early on, looking profitable at the time but clearly not being profitable currently and for the foreseeable future.

There is no absolute must to design for complete technology-neutrality right away. As discussed in chapter 4.2, in the long run, a technology-specific auction might provide more incentives to reduce the cost of a particular technology and thereby improve the long-term efficiency of the overall system. According to the state aid guidelines technology-specific tenders are allowed if a bidding process open to all technologies would risk a "*suboptimal result that cannot be addressed in the process design*", in particular in view of the following circumstances:

- the longer-term potential of a given new and innovative technology
- the need to achieve diversification
- network constraints and grid stability
- system (integration) costs
- the need to avoid distortions on raw material markets resulting from biomass support.

Some of these circumstances could possibly be addressed in the market design and/or through setting up the appropriate requirements. In particular the issue on "longer-term potential of a given new and innovative technology" could however be difficult to address with a technology neutral design. In particular if the aim is to use support schemes in order to decrease costs of less mature technologies, approaches that are not open to all technologies should likely be favoured. Likewise, "network constraints and grid stability" might allow for a less technology-neutral approach.

One key issue in the design of technology-specific auctioning schemes for large-scale RES-E in the Nordic countries is that the market may be small with few market participants. This would in particular be the case for large scale technologies such as off-shore wind power, with relatively few projects available. In many cases these projects are already being developed by private investors. In particular for technology specific multi-item auctions, this could lead to situations with very limited competition in the bidding.

5.1.1.4 Introducing aligned policies

In this report, we understand alignment as a process in which countries jointly decide on the direction in which their support schemes should develop. The results are more similar designs and procedures but not necessary common support mechanisms. The benefits of alignment are an increased efficiency and improved investor friendliness by avoiding regulatory and market fragmentation.

For the Nordics, the most obvious and most promising case for alignment are offshore support policies. At the moment, the differences between offshore policies are rather large: There is little to no support in Finland, Sweden and Norway, and a huge body of experiences in Denmark. The Danish model where several private actors compete for a pre-developed side by the state is currently becoming more and more excepted in Europe. An information exchange between Swedish, Finnish and Danish authorities and regulators would be easy to implement and Sweden and Finland can learn best-practices and caveats from Denmark. If countries furthermore agree on an auction schedules they can increase competition and therefore reduce cost and thereby create an important Nordic market for offshore. Such market can be complemented by joined side development and grid planning, which would further support the offshore sector in the Nordics.

Other promising areas include the following:

- Align regulations concerning permitting process, which would reduce transaction costs for project developers.
- Agree on a common methodology on how to calculate LCOE to either administratively determine the support level for RES or to set maximum prices in auctions, as such a common methodology can decrease incidents of regulatory capture.
- Find similar rules for grid connection and compensation, which is particularly when increasing market integration of renewables into joined electricity market. In case auctions should be introduced, there is also a case for broader alignment in other RES sectors. We elaborate this issue further in the section on "aligned pathways".

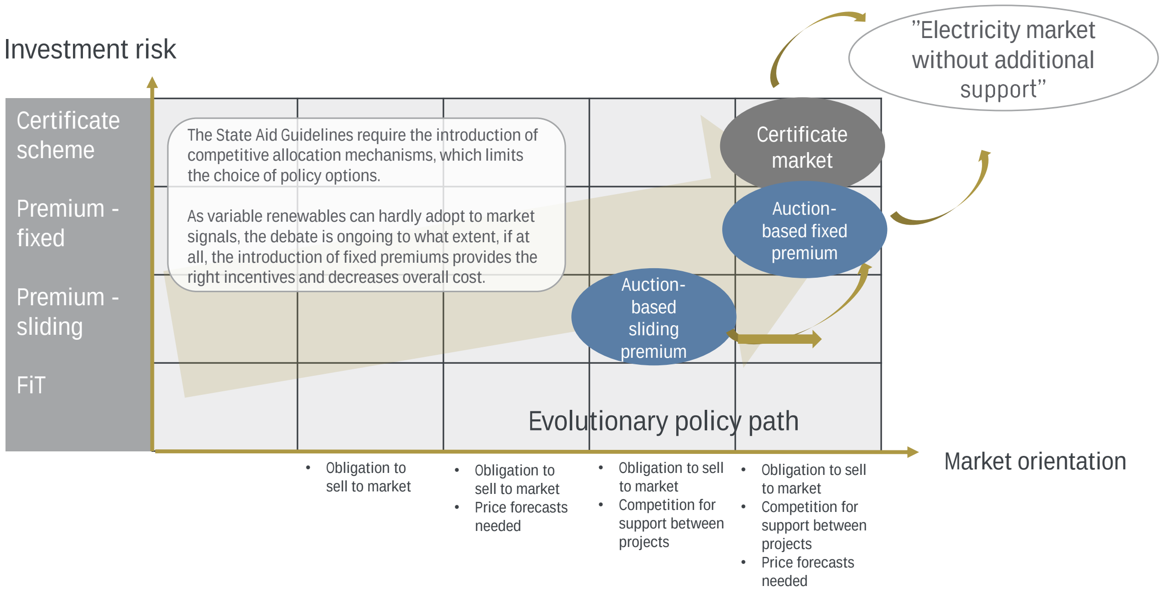
Besides alignment, often also referred to as convergence, two other mechanisms exist that would also lead to similar policies: top-down harmonization and cooperation. Harmonization of support schemes if often a top-down process, in Europe mainly driven by European policies. Countries would for example increase market integration of renewables and switch from administratively set production support to auction system to avoid political conflict with the European Commission. The other process is cooperation. Here, countries would try to reach targets effectively and efficiently through joint schemes. The Swedish-Norwegian-quote system is an example of cooperation. In the Nordics, there are two options where such cooperation could be further explored, either to expand the Swedish-Norwegian quota system to other countries or to create joined auction scheme(s) with countries that are geographically close and interconnected, and have similar resource conditions.

5.1.2 Policy instrument options

The main policy instrument options beyond 2020 are auctions and the Certificate scheme. As shown in Figure 23, the main support schemes options for primary RES-E support can be mapped in the two dimensions "investment risk" and "market orientation". While there is clearly an option to use the electricity market without additional support, all three main policy instrument options – auctions with fixed or sliding premium or a certificate market - provide a high degree of market orientation, with a sliding premium providing less investor risk for the auction options.

Norway and Sweden have so far chosen a highly market-oriented technology-neutral policy instrument with high investor risk with the certificate market; potential challenges lie more in keeping investor confidence. The main focus for Finland is cost efficiency, while Denmark is mostly focusing on compatibility with State Aid guidelines and technology neutrality. Both Sweden and Finland are considering offshore wind support schemes, with auctions as the given policy instrument.

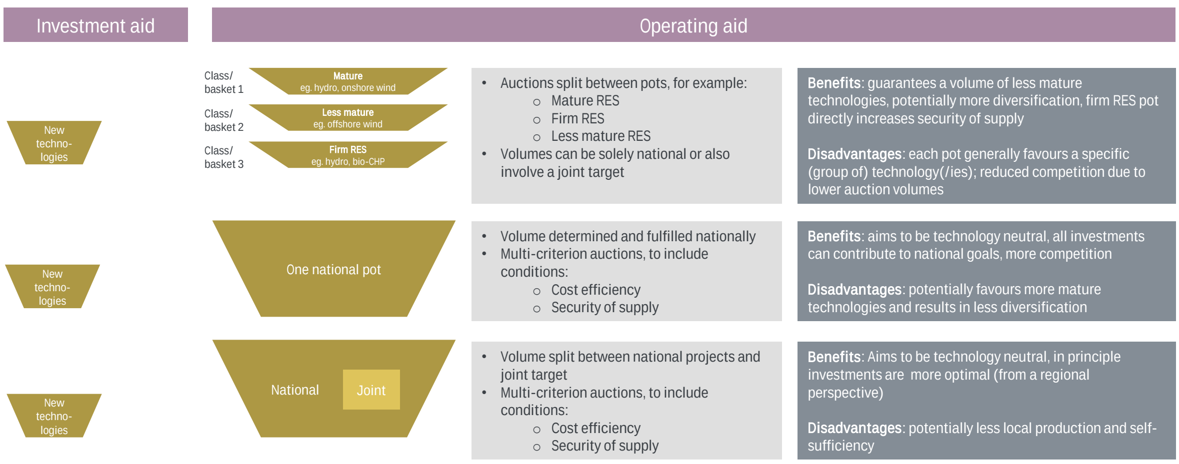
Figure 23: Policy instrument options for primary RES-support schemes beyond 2020



5.1.2.1 Nordic auctions beyond 2020

Auctions can be designed technology-specific, technology neutral (one basket), or have various baskets for different types of technologies, as shown in Figure 24**Error! Reference source not found.**. Technology-specific auctions however, should after 2020 only be used for special and well explained reasons. Auctions can stand by themselves or being introduced for specific technologies in addition to a certificate market.

Figure 24: Various basket options for auction design



The benefits of a one-basket option lie in its technology-neutrality and increased competition, while its disadvantages lie in potentially favouring more mature volume technologies, resulting in less diversification and the risk for overcompensation. In addition, if a country wanted to focus on more firm RES-E for reasons of system stability, an entirely technology-neutral design does not provide the answer.

Multiple auctioning baskets provide a good compromise between technology-neutrality and targeting specific purposes. While it is not the only way forward, the following describes how such an auction could look like: these baskets could, for example, be split into three: one for mature technologies (e.g. hydro and onshore wind), one less mature technologies (e.g. offshore wind), and one firm RES-E capacity (e.g. bio-power CHP) with annual auction target volumes and ceiling prices per technology. This would allow budget control via ceiling prices and auction volumes and potentially more diversification, if required. Provided that a long-term target is set and annually auctioned volumes are within a corridor, this would also provide sufficient certainty to investors.

Disadvantages of the multiple auctioning baskets are on the one hand reduced competition in comparison to a technology-neutral auction due to lower auction volumes and on the other hand the likely disadvantage of certain technologies compared to a technology-specific auction. However, favouring specific groups of technologies can also be seen as an opportunity to better guide build-out volumes. Especially the possibility of introducing firm RES as a means to provide stability to the power system with increased variable production are arguments against a complete technology-neutral scheme.

For each of the technologies in the baskets, ceiling prices would be defined to allow budget control, together with the auctioned volumes. These ceiling prices could be defined by the respective Energy Agencies based on the proposed Nordic project-specific RES-E supply curve, the *Nordic RES-E Cost Monitor*, which gives an overview about expected LCOE levels, is preferable updated annually thus can serve as a Nordic benchmark.

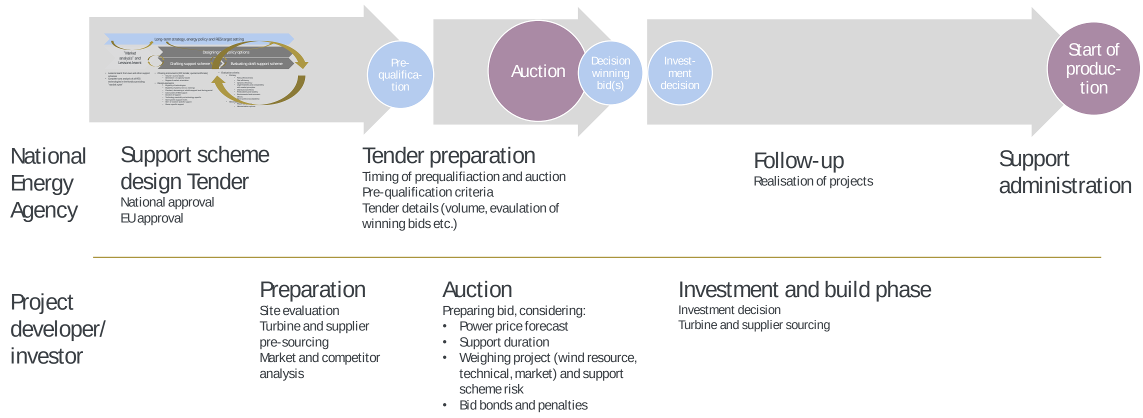
To evaluate bids, one could use the offered price per generated energy unit. An evaluation based on the price only is the most simple to implement and allows for the most efficient outcome. The pricing rule could by pay-as-bid or pay-as-cleared. Under perfect information both methods would result in the same outcome. In practice bidders do not have perfect information. Bidders need more information to make rational bids under the pay-as-bid pricing rule, which speaks in favour of pay-as-cleared. International experiences show, however, that pay-as-bid is more robust against instances of underbidding, particularly in markets with inexperienced bidders and high levels of competition. Under pay-as-cleared auctions, bidders have provided low bids in order to ensure that they are accepted into the auction, hoping for higher bids to set the price. If too many bidders behave in this seemingly irrational way, the financial viability of some projects may be undermined. Bid bonds or other types of requirements (penalties) could be put in place to avoid such behaviour and assure realisation of projects. Another argument against a pay-as-cleared scheme is that you expect a large difference between the marginal bid and the second bid. This would then result in a substantial over-compensation to the infra-marginal bids, which may be regarded as non-desirable from a distributional point of view. We therefore cannot give a general recommendation regarding the pricing rule.

Auction qualification criteria should differ depending on class/basket and scale of the project. While less mature but large-scale technologies such as offshore wind in basket 2 will require a rather comprehensive list including financial statements, technical experience and project management criteria, a sufficient qualification criteria for class/basket 1 might be as simple as an environmental permit. Thus, timing of the auctions for basket 1 might be rather early in the development process, while auction timing for basket 2 might have to be later in order to allow for qualification. Support duration might also need to differ between the baskets: using a fixed support duration of 15 years for basket 1 and 3; and having a limitation in terms of full load hours for basket 2, potentially with a fixed support duration for selected technologies.

Offshore wind auctions should be aligned. Offshore wind is a less mature technology which requires slightly more attention, if a country choses to focus on it. At the same time, there are good experiences with the Danish model on which one could built on. The Danish model is a single-item site-specific auction in which different project developers compete for the right to implement a project at a pre-developed site. This auction type allows for better long-term planning and a better control of realised volumes. A site-specific auction option is also clearly preferable from a grid planning point of view. Due to its success in Denmark, the model is currently becoming dominant in Europe and e.g. implemented in Germany and the Netherlands. Aligning the auction schedule with other international and especially Nordic auctions is advantageous.

An alternative would be to implement *non-site specific* multiple-item auctions, or *site-specific* (single item) auctioning. A pre-condition for successful *non-site specific* multiple-item auctions is that the pre-developed sites by private actors are comparable and that there are enough developers involved to ensure sufficient competition in the auction. Also, since transaction costs for tenders of this scale are rather high, that would affect smaller projects negatively compared with larger ones. Since the market environment and liquidity highly influence the efficiency of the auction, if competition is small, it is not obvious that non-site specific auctions are the most cost-efficient alternative. Non-site specific multiple-item auctions seem to be feasible for a transit period, e.g. when countries move from an administratively set feed-in-premium to a competitive model.

Figure 25: From new policy design to offshore tender process



Regardless of auction type option, the bidding rounds need to be sized so that larger projects (200-600 MW) can realise their economies of scale and are not limited by the bidding round volume. Bidding rounds need to be held regularly, so that bidders losing out in the last round have a new chance without losing interest in the market, but also so that auctioned volumes are sufficient, based on an explicit long-term target for offshore and a communicated "corridor" of planned auctions and their capacity. However, with lower RES build-out targets it will be more challenging to achieve both targets – regular auctions and larger projects – at the same time.

We recommend that bidding should be per generated unit [currency unit/kWh]. With hindsight to the limited recent experience with offshore projects in Sweden and referring to the good Danish experience, a sliding premium may reduce investor risk and thus be preferable over a fixed premium[161].

A pre-qualification procedure to select eligible bidders is highly recommended in order to ensure that the bidders have the capability of realising the projects. This pre-qualification should include financial statements, technical experience and project management criteria. On the other hand, high penalties and inflexible auction design can lead to low participation and high bidding prices.

The support costs would be put on the consumers as a levy. To expose the projects to market mechanisms, we recommend to include a clause on not paying support for hours with negative prices.

A participatory auction-related dialogue between investors and the auctioning body is recommended. Clarifying questions and proposals for adjusting the auction design if clear cost improvements can be made by the bidders. The Danish example has shown that an open, structured and fair dialogue between investors and contracting authorities can lead better auction results.

The long-term potential for Swedish and Finnish offshore wind grid connection paid by the respective TSO, as currently in Denmark, should be analysed. If the grid connection is paid by the TSOs (and indirectly by the rate-payers), it would imply that the developers would not have to take the grid costs into consideration, which typically amount to 20-30% of the project cost for offshore wind. This would also limit bidder risks, likely result in more auction participants and thus result in lower bids. With this approach, a more centralised approach for selecting sites for offshore projects would be needed, another argument for single item auctions following the Danish model. These changes would likely include substantial changes in national law (if possible at all) and in addition require state aid approval.

5.1.2.2 Nordic certificate scheme beyond 2020

The second policy instrument option possible for all countries is a certificate scheme, with either a national or a joint market. For Sweden and Norway, this would involve prolonging the current system (preferably with some adjustments) beyond 2020 or creating a new certificate market; for Finland and Denmark, it would mean either creating a national certificate market or joining the joint certificate market. The existing certificate scheme is highly market-oriented, it has been effective and has driven cost reductions of the current price-setting technology, onshore wind. It has also generated rather low policy costs so far.

If investor confidence is in focus, a prolonged certificate scheme for Sweden and Norway or Sweden alone should be reformed to better reflect fast technical development of the price-setting technologies and the

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[161] Recommended by the Swedish Energy Agency

challenges for investors. It should provide further improved transparency in the market, e.g. with regards to project pipeline.

One option to continue the certificate system and better account for fast technical development would be to separate the current certificate market and from the future certificate market after 2020, rather than simply extending the current scheme and using one single certificate market. This new separate market would yield a separate certificate price, which might help avoiding undermining the financial viability of the existing investments (assuming lower costs for new investments). Separating the current certificate scheme from the new and extended scheme would however impact its liquidity especially if Norway decided not to extend its participation. Furthermore, it would increase complexity for investors, since two market prices would need to be handled. These two options must therefore be thoroughly evaluated.

If further increased market-orientation is in focus, the need for adjustments are different. New investments could e.g. be allocated fewer certificates per MWh and potentially with a gradual reduction of certificate allocation depending on commissioning year after 2020 (e.g. 0.85 certificates per MWh in 2023, 0.8 in 2024, etc.), as proposed by market actors. This would imply a decreasing support level over time. Such an alternative would however have to be analysed in more detail. The system would be somewhat more complicated, since the allocation of certificates would have to take the commissioning year into account.

Evaluations of certificate schemes in Finland and Denmark should take the long experience in Sweden and Norway into account, whether these schemes are meant to be national or joint. While we do believe that joint certificate schemes are challenging between countries with different natural resource conditions, we recommend at least exploratory discussions for the participation of Finland and/or Denmark in the joint market. We would expect it however to create a fairer market to integrate Sweden and Finland or Denmark as an alternative to Norway and Sweden rather than three or all four countries, since we expect LCOE levels in the three or four countries to differ considerably but be closer together in neighbouring countries for the price-setting technology, onshore wind. Divergent LCOE levels would lead to a build-out of the most cost-efficient mature projects, which likely would be limited in Finland; there could, however, be some mutual gains. A joint market would have a clear volume target and lead to a more liquid and better functioning market than a purely national market, especially if Norway should decide to not extend their system.

One further recommendation for a reformed certificate scheme, whatever the form of the certificate market and regardless of the participating countries, is the inclusion of a clause to not give certificates for hours at negative prices.

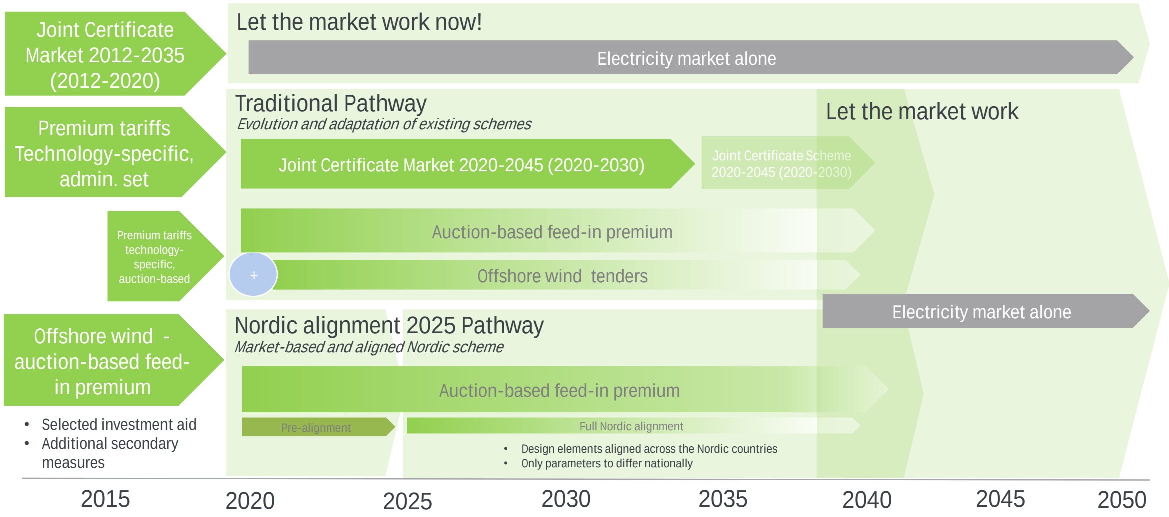
5.1.2.3 Investment aid to immature and innovative technologies

We expect that support for immature technologies such as solar can still be handled as investment support after 2020, if on small-scale. While decentralised micro-generation might be desired from a political perspective, it is not obvious to do this in significant volume with solar in the Nordics within the near future.

5.1.3 Possible pathways for RES-E support in the Nordic countries

The discussed policy instruments can be handled in different pathways. Our recommendations focus on two potential pathways: the *traditional* pathway with an evolutionary, strictly nationally focused policy development and the *Nordic alignment* pathway which provides a number of advantages to the Nordic countries and to investors (Nordisk "nytte").

Figure 26: Nordic RES-E pathways: traditional vs Nordic alignment



In the *traditional* pathway, new support schemes are essentially designed with a strictly national mindset and for national use. The schemes beyond 2020 are either developments of existing schemes or new schemes in order to comply with the State Aid Guidelines. Essentially, administratively set premiums become auction-based premiums and the certificate scheme undergoes only slight improvements. They schemes can however differ substantially between the Nordic countries. In the *traditional,* nationally focused, pathway, both auctions and certificate schemes are viable options.

With changing state aid guidelines and the defined duration of the schemes such as the Swedish-Norwegian joint certificate market, there is now a unique opportunity for Nordic RES-E support alignment. In the Nordic alignment pathway we still have national schemes and a national focus on the targets and needs. However, these national schemes are now aligned and focus on a market-based and in large parts identical as part of a common Nordic framework. Within this framework, there is room for that can be tailoring and adaptation of details to each of the Nordic countries' needs. Alignment does only mean agreeing on a common framework between the Nordic countries. It doesn't mean joint schemes. However, if joint schemes and or auctions are a long-term aim or an option, aligned policy instruments would provide a fertile ground, without needing to lead to it.

This alignment approach could further improve the external view of the Nordics as an organised and politically stable market with a common electricity market, strong and increasing physical interconnection and now even an aligned RES-E support framework. The approach is both compatible with state aid guidelines, is cost-efficient, provides a certain technology neutrality and simplifies the investor view of the Nordics as a whole. The degree of alignment, as mentioned earlier, can vary.

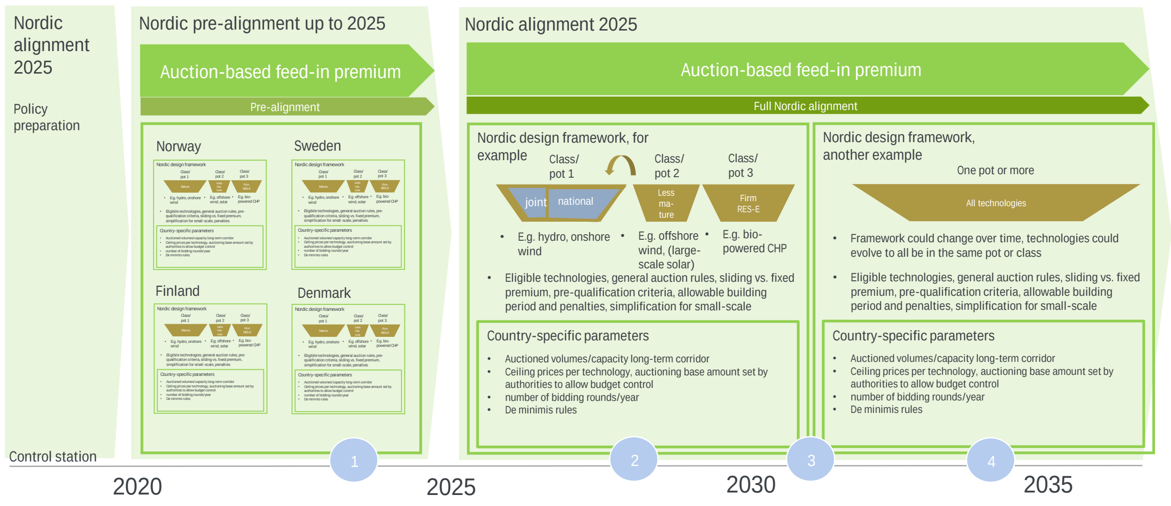
In order to align the Nordic RES-E support schemes within the next 8-9 years, we have chosen an approach which gives an *overall framework* for all Nordic countries using common design elements while at the same time allowing sufficient *adaptation to national preferences* by allowing to define country-specific parameters.

In principle, even for the *aligned* pathway, both auctions and certificate schemes are viable options. We do see however advantages using auction-based premium tariffs which can easily be tailored nationally rather than the Certificate system for this alignment pathway.

5.1.3.1 Alignment Pathway

The main elements of the aligned pathway are: auctions are conducted for multiple technology classes or baskets. *Mature variable RES-E* (e.g. onshore wind), *less mature variable RES-E* (e.g. offshore wind and large-scale solar) and *firm RES-E* (e.g. bio-power CHP), the latter in order to assure that firm capacity is available in an increasingly variable electricity generation, see Figure 27. Furthermore, the framework includes and details eligible technologies, general auction rules including pre-qualification criteria, the use of ceiling prices, bid bonds and penalties, support duration, the use of sliding vs. fixed premium and simplification for smaller-scale generation. Auction design parameters that should and those who could be aligned are detailed in Figure 28. Small-scale generation below a certain size will be treated outside of this scheme.

Figure 27: Nordic alignment 2025 pathway for RES-E

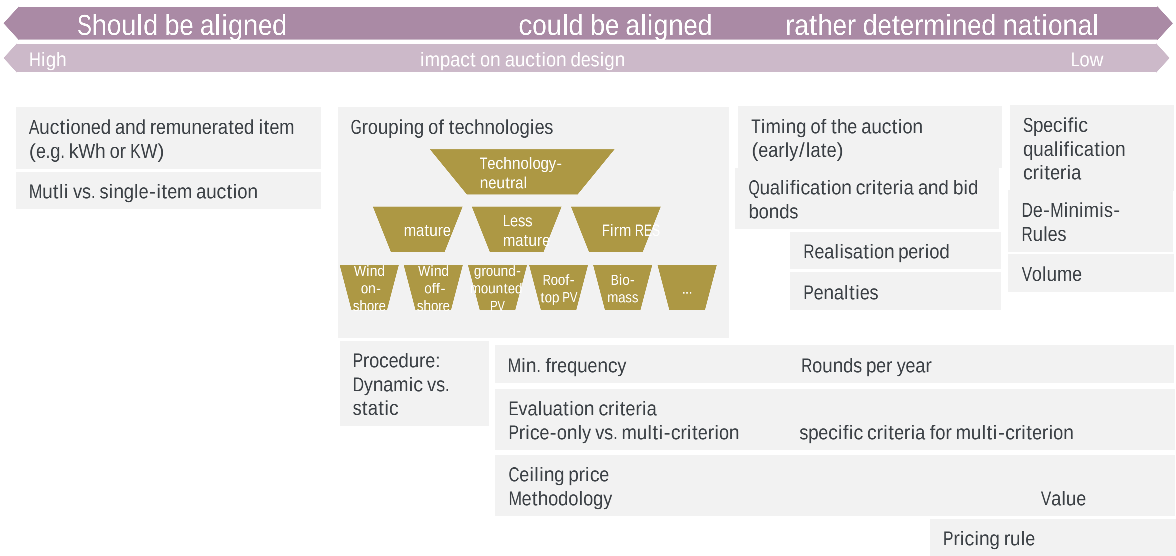


The aligned pathway framework includes a system of control stations every third year in order to be able to adjust for design faults. Over time, eligible technologies might – based on a number of transparent criteria – shift from one class to another, e.g. from less mature to mature. However, since the framework is defined in a treaty between the four countries, it provides not only transparency and ease-of-use across the Nordic countries, but also stability and predictability for investors and policy makers alike.

Country-specific parameters include the long-term build-out targets for the three baskets, targeted auctioned volumes/capacity and the definition of a long-term build-out corridor. Ceiling prices per technology, the number of bidding rounds over time, de minimis rules (for small-scale generation) and who pays for the grid connection might differ between the Nordic countries to account for resource and cost differences.

Auctions in basket 1 and 3 will have to be held rather regularly, depending on country, but at least held once a year. Auctions for basket 2 will likely be more seldom. The auctions for basket 1 would be *non-site specific multi-item auctions*, aiming at low complexity, in order to keep barriers of entry and administration costs for developers low. Auctions for basket 2 and 3 would be more complex, depending on technology and project size.

Figure 28: Auction design parameters and the opportunities for alignment



Progressing towards alignment, policy preparation should begin rather soon, detailing common denominators between the Nordic countries and already creating a de facto Nordic RES-E framework. Introducing the changes on a national level by 2020, each country would then have sufficient time to gain experience with the schemes, discussing them during Control station 1, before finally aligning on a Nordic level. One aligned, control stations continue to take place very third year.

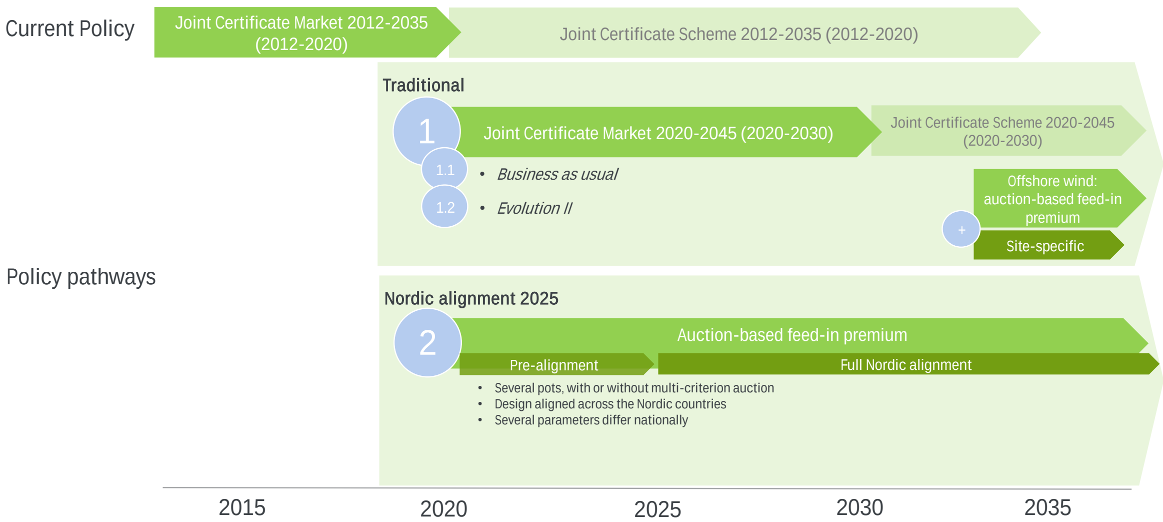
The Nordic RES-E alignment approach requires a long-term transparent target-setting in terms of volumes or installed capacity and improves grid planning. The advantage with this is a slightly more controlled build-out rate compared to e.g. the Certificate market. The long-term targets should preferably be defined in 10-year time steps and technology-specific. This should enable both a better grid planning and planning of the power system as a whole. Between the 10-year time steps, a desired build-out corridor should be defined, providing developers with the certainty of auctioned volumes/capacities.

5.1.4 Country-specific options

Although there are many similarities between the Nordic countries, many factors affecting RES support do differ, such as resource conditions, the state of the power system, power plant age, market integration, RES-fulfilment and political ambitions. Thus, recommendations must be adapted to each country. In the section below, we outline recommendations on a country level, which reflect the priorities of each country as mentioned within this project: a strong market orientation for Norway, cost efficiency for Finland, focus on compatibility with State Aid guidelines and technology neutrality for Denmark and the option of offshore wind for Sweden and Finland.

Norway has several options beyond 2020. There is only a very limited number of plants expected to phase-out in mid-term. Norway has more than 100% in RES-E already as measured for the target fulfilment and total volumes are expected to increase towards 2020 as part of the current certificate scheme. The need for a continuation of the current certificate scheme or a new main RES-support scheme to trigger major volumes after 2020 is lower than for Sweden and not obvious from a strictly national point of view.

Figure 29: Primary RES-E support policy options for Norway



Let the electricity market trigger investments? Norway is arguably the only country that might – from a strictly national point of view and with regards to RES fulfilment – be able to afford not explicitly supporting RES-E for a period. The competitiveness of RES has increased over time with the price reductions. For example, onshore wind is in many cases competitive vis-à-vis other new investments. Using the electricity market alone, which after the reform of the EU ETS might provide sufficient investment signals towards 2030, might be a good option for Norway. After 2021, RES-E investments would likely come to a halt for a few years. From a broader European point of view however this might not be the most preferable option.

Option 1.1 for Norway: continue with the Certificate Market and reform it carefully. Norway could continue with a slightly reformed certificate scheme and new targets for 2030 (option 1.1., see Figure 29), together with Sweden. Reforms to the current market should better reflect both fast technical development and the challenges for investors entering the market substantially before 2020 as well as provide improved transparency in the market, which can be done in different ways. For example, new investments could be allocated fewer certificates per MWh and potentially with a gradual reduction of certificate allocation depending on commissioning year after 2020. The system would be somewhat more complicated, since the allocation of certificates would have to take the commissioning year into account.

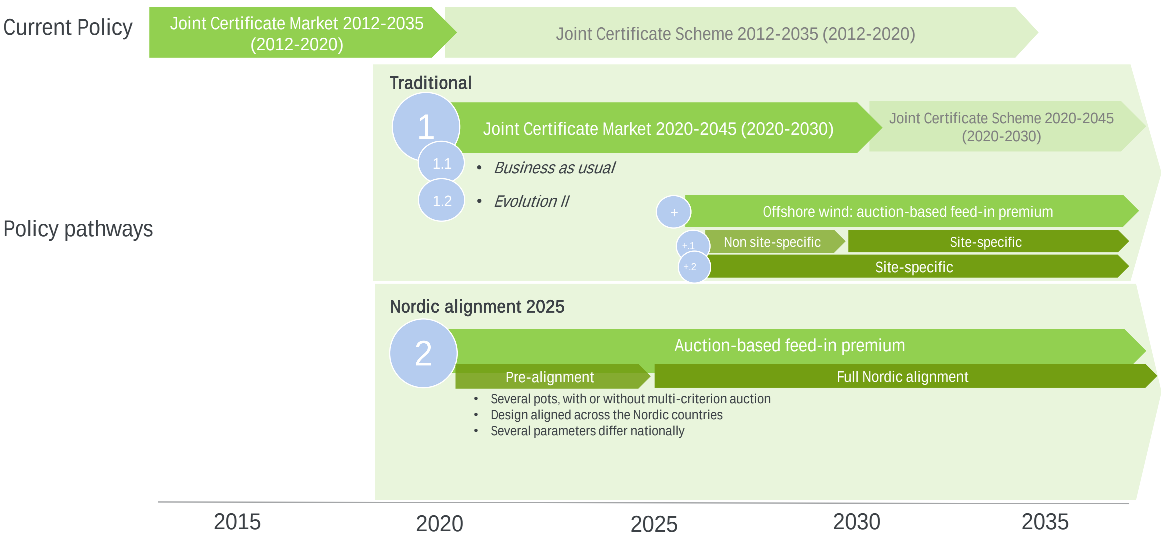
Option 1.2 for Norway: continue with a Certificate Market, but a *new one*. This scheme would have a separate certificate price ("*Evolution II*") in order to better account for fast technical development and avoid undermining the financial viability of the existing investments (assuming lower costs for new investments), here called option 1.2. The drawback of a separation would however be that the liquidity in the new scheme may be low, if it is not initially administratively equipped with a surplus. Otherwise there could also be situations with short term scarcity, particular in the beginning.

Part of Option 1 for Norway: auction-based feed-in premium for offshore wind. Whichever the form of certificate market, offshore wind would not be competitive with other technologies in the certificate market. If the diverse RES portfolio is desired to include offshore wind, there should be separate auction-based feed-in premiums, likely with site-specific auctions to guide capacity into specific areas.

Option 2 for Norway: an auction-based premium scheme aligned across the Nordics. This option would be designed as a national scheme, but with an aligned Nordic framework, leaving enough room for tailoring to national needs and resources.

Sweden's options in the traditional pathway are similar to Norway's, even if the option of letting only the electricity market work does not seem to be a politically accepted option. However, the Swedish goal of going towards 100% renewables would likely require a more diverse RES portfolio, and other less mature technologies may still need support. An extension of the current certificate market beyond 2020 is clearly an option, but must be thoroughly evaluated.

Figure 30: Primary RES-E support policy options for Sweden



Option 1.1 for Sweden: continue with the Certificate Market and reform it carefully. As for Norway, Sweden could continue with a slightly reformed certificate scheme and new targets for 2030 with or without Norway. These changes should focus on better reflecting technical development and increasing investor confidence. As discussed earlier, key changes could be the introduction of different certificate prices for new investments within this extended market, and decreasing certificate allocation depending on commissioning year after 2020. Integrating other Nordic countries in this existing, only slightly reformed, scheme would be challenging.

Option 1.2 for Sweden: continue with a Certificate Market, but a *new one*. As described for Norway, this scheme would have a separate certificate price ("*Evolution II*") in order to better account for fast technical development and avoid undermining the financial viability of the existing investments. This market could, however, have a low liquidity (especially if no other country participates) and would increase the market complexity for new investors, with two certificate prices.

We also recommend exploratory discussions with Finland and Denmark on a joint scheme. Neighbouring countries could have more similar technology costs and increasing market liquidity would be beneficial whichever the pathway chosen for the development of the certificate market.

Part of option 1 for Sweden: auction-based feed-in premium for offshore wind. While the continuation of the joint certificate market provides a cost-efficient supply of mature technologies and a politically rather stable system, less mature technologies such as offshore wind will still not be viable within this market until 2030. Furthermore, there is limited influence on the technologies to be invested in. If, for example, Sweden wanted to focus on more firm RES-E for reasons of system stability, the certificate market doesn't provide the answer.

A specific Swedish support scheme for offshore wind should clearly be handled outside of the certificate scheme, and preferably draw on the Danish experience and best practice – providing operating aid with tendered support levels. Furthermore, the Swedish Energy Agency has highlighted the use of inland sea technology as supportable. However, assuming that after 2020 the six remaining Swedish nuclear plants will continue to produce during a lifetime of approximately 60 years, there is no urgency to install large new RES-E volumes in Sweden beyond the existing path. On the other hand, there are good wind conditions, less turbulence, lower waves and less salt content in the Baltic Sea together with a significant cost reduction potential to support the development of offshore wind in the long-term.

A pre-condition for successful *non-site specific* multiple-item auctions as proposed by the Swedish Energy Agency are that the pre-developed sites are comparable and that there are enough developers involved to ensure sufficient competition in the auction. While this auction may be the quickest to realise, market participants have expressed doubts about the competitiveness aspect, expecting only 2 to 4 participants in each round during the mid-2020s.[162]

A site-specific auction option would clearly be preferable from a grid planning point of view. A compromise between site- and non-site specific options could be stopping further permits and realising the first auctions with already permitted projects *non site-specific*. Once these auctions are realised, the auction design could be transformed into a *site-specific* auction for state-developed sites. These auctions should be capacity related. The long-term potential for Nordic harmonisation in grid connection for offshore projects should also be analysed.

For offshore, site-specific auctions should be the long-term aim. As discussed in earlier sections, site-specific auctions have several advantages and are our main recommendation; the situation of offshore wind in Sweden is however particular in that several parks have been pre-developed. Due to this, there are two clear options for the site-specific nature of the auctions:

- Non-site-specific multiple-item auctions followed later in time by site-specific single-item auctions
- Site-specific single-item auctions alone.

Sweden already has seven pre-developed projects with permits, totalling more than 8 TWh, with permits likely running out before the projects can be realised. There are also two more parks that have applied for environmental permits with an additional 4.9 TWh, according to the Swedish Energy Agency.[163] Assuming that the existing permits can be extended,[164] the options are *non-site specific* multiple-item auctions, but also buying out the developers and *site-specific* (single item) auctioning. Since these Swedish projects have been developed for years, this option would mean buying out existing developers first; and developers have invested in pre-development to different degrees. The Swedish Energy Agency has earlier stated that buying out these parks would be costly. While pre-development costs are sunk costs and the permits are practically worthless without a support scheme, there would likely be legal challenges to such a buy-out. Since our preferred long-term option for offshore wind in Sweden would be site-specific tenders, we propose to analyse the buy-out option in detail both from a legal and an economic point of view.

A third option would be a *non-site specific* multi-criteria auction that includes criteria other than price. This would allow qualified selection of bids in case of limited competition.

We recommend that bidding should be per kWh. With hindsight to the limited recent experience with offshore projects in Sweden and referring to the good Danish experience, a sliding premium may reduce investor risk and thus be preferable over a fixed premium if investor risk is in focus, which is also the recommendation of the Swedish Energy Agency.

The Swedish solar PV strategy will be developed during 2016, followed by a policy design discussion. We recommend to focus on investment aid primarily and to aim at phasing out the additional tax reductions for micro-generation solar over time.

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[162] Discussion with market participants, December 2015

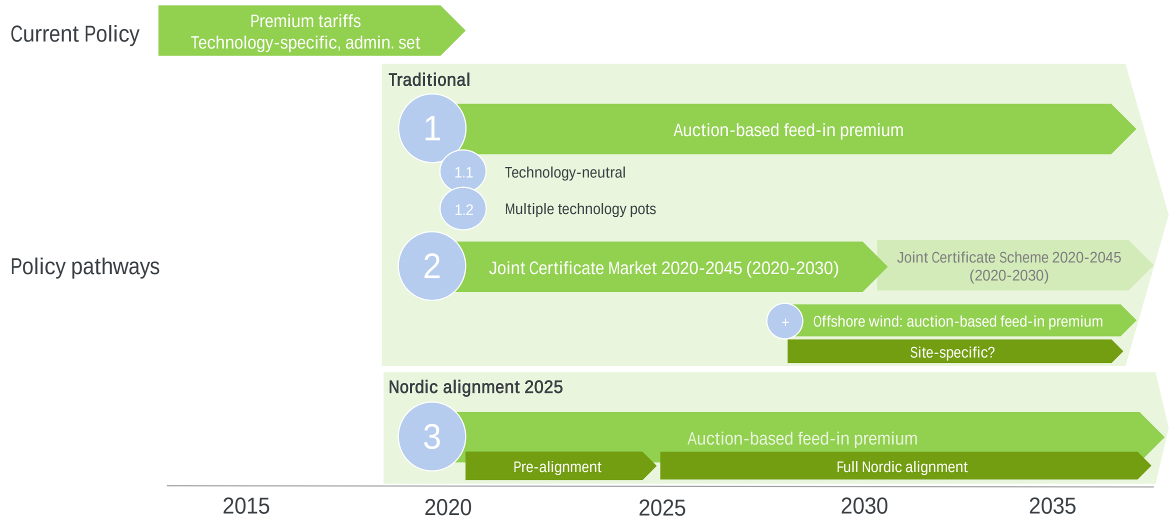
[163] "Havsbaserad vindkraft", Regeringsuppdrag 2015, ER 2015:12, Swedish Energy Agency 2015

[164] Maximum permit extension is 10 years in total; Kriegers Flak (Vattenfall) has already been extended with 4 years until 2018, while Stora Middelgrund (Universal Offshore) has been extended with 6 years until 2020.

Option 2: an auction-based premium scheme aligned across the Nordics. This option would be designed as a national scheme, but with an aligned Nordic framework, leaving enough room for tailoring to national needs and resources. This alignment approach could further improve the external view of the Nordics as an organised and politically stable market with a common electricity market, strong and increasing physical interconnection and now even an aligned RES-E support framework.

One of Finland's top priorities is cost efficiency of the new support schemes. In addition, an offshore tender system is considered. With the traditional policy development approach, Finland could opt for an auction-based premium feed-in with different technology baskets/classes or for joining the Certificate market with Sweden and adding a separate offshore wind support scheme, see Figure 31.

Figure 31: Primary RES-E support policy options for Finland



As mentioned in section 5.1.1.1, in designing for cost efficiency, knowledge of generation costs and their development is very important. For Finland, as for the Nordics as a whole, we recommend a complete and independent in-depth cost analysis of all recent RES-E projects and projects in the pipeline including projections of their future cost development. This analysis – the *RES-E Cost Monitor* - should be based on the specific Finnish conditions for the respective technologies and ideally be made for all Nordic countries with the same methodology in order to assure comparability. Such analysis should preferably be updated regularly e.g. once a year, with input parameters reviewed by market participants - in order to create a broad base for comparison.

Strategically, in order to achieve increased RES-E cost efficiency, we recommend focusing on the most mature and lowest cost technologies for the bulk of the volume in Finland for the next decade, such as onshore wind and bio-fuelled plants. Higher cost technologies such as solar and, most likely, offshore wind should be down-prioritised at least in higher volumes. The introduction of new offshore wind generation could be postponed to closer to 2030, in order to profit from technology cost development. Since volumes for less mature technologies would anyway be low and these technologies are broadly deployed in other countries, the loss in dynamic efficiency for these would only be in the local supply chain and loss of experiences in the Nordic climate, rather than the technology itself.

We discuss two main policy options within the traditional pathway for Finland, based on cost-efficiency of the support schemes being a top priority: *auction-based premium tariffs* or the *certificate market*.

Option 1 for Finland: auction-based premium tariffs. In the *technology-neutral* option 1.1 an auctioning body determines a base price. All projects willing to realise at this price are awarded a contract. If the pre-determined budget is exceeded, the annual auction stops. If the budget is not exceeded, the price is increased and bidders are allowed to submit new applications. This type of scheme would ensure that the lowest cost projects are realised, within a pre-determined budget; however, it does not ensure that a defined RES volume is realised. Realising RES target volumes can be easier assured with option 1.2: *auctioning multiple technology baskets* with, for example, mature technologies (e.g. hydro and onshore wind), less mature technologies (e.g. offshore wind) and firm RES-E capacity (e.g. bio-power CHP) with annual auction target volumes and ceiling prices per technology. This would allow budget control via ceiling prices and auction volumes. Provided that a long-term target is set and annually auctioned volumes are within a corridor, this would also provide sufficient certainty to investors. The second option is described more in detail as the alignment option. For either of the above options, we recommend to include a review of support duration, which could be increased to 15 years to be in line with other Nordic countries.

Option 2 for Finland: explore a national and a joint certificate market with Sweden and possibly Norway. Exploratory talks with Sweden and Norway to evaluate a joint certificate market from 2020 or some years thereafter are therefore recommended. While there are considerable differences in the various resources between the two countries and thus in LCOE, it remains to be see whether mutual gains can be achieved. A joint market would have a clear volume target and lead to a more liquid and better functioning market than a purely national market, especially if Norway should decide to not extend their system.

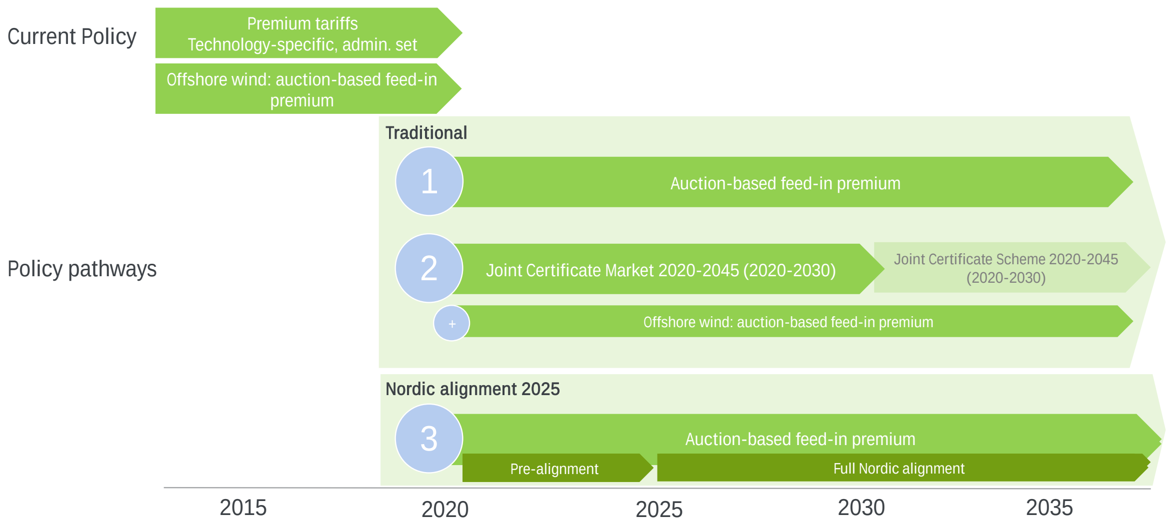
Part of Option 1 for Finland: Cost-efficient offshore wind tenders. While the most cost-efficient option for Finland would be to push back the introduction of offshore wind from a purely technology-cost and policy cost point of view, we cannot evaluate the potential welfare-economic effects within this study. Pre-qualification criteria, support duration (or rather the orientation to volumes) and burden sharing of the scheme should be similar to those recommended for Sweden. We prefer bid bonds in order to assure the realisation of the winning project and recommend penalties for delays by reducing eligible production (duration support) rather than reduced support levels.

In contrast to Sweden, Finland is in the position of not having too many pre-developed offshore wind projects, which allows in theory for bringing in a *site-specific single item auction* of state-developed sites comparable to Denmark, which is cited by many market participants as a very well-functioning scheme. Careful assessment would be needed to identify the right sites and provide the right pre-development to bidders. We do however understand that there are major obstacles in the Finnish law for such a site-specific solution, developed by the state.

Option 3 for Finland: an auction-based premium scheme aligned across the Nordics. Designed as a national scheme, but with an aligned Nordic framework, leaving enough room for tailoring to national needs and resources. This alignment approach could further improve the external view of the Nordics as an organised and politically stable market with a common electricity market, strong and increasing physical interconnection and now even an aligned RES-E support framework.

Within the study, Denmark has highlighted the importance of cost efficiency and technology neutrality. Even in the *traditional pathway*, designing for technology neutrality would imply a major change for the Danish support system. For a technology-neutral system, it is important to understand if and for which technologies possible risks for overcompensations occur. In this way, also Denmark would profit from a complete project-specific Danish, but preferably even Nordic RES-E, cost analysis in order to evaluate the options, the *Nordic RES-E Cost Monitor*. It is also noted, however, the state aid guidelines are not particularly strict about technology neutrality; technology-specific systems are still possible, provided they have a detailed motivation.

Figure 32: Primary RES-E support policy options for Denmark



Option 1 for Denmark: auction-based premium tariffs. We propose considering an auction-based feed-in premium scheme to balance requirements for auction-based systems and technology-neutrality and it is described in more detail under the Nordic harmonisation 2025 section.

Option 2 for Denmark: explore a national and a joint certificate market with Sweden and possibly Norway. Alternatively, also Denmark might explore an own national certificate scheme or joint certificate market with Sweden. We do however think that a joint market between countries with too different resources and national priorities (e.g. self-sufficiency) is difficult to realise in a joint certificate market.

Option 3 for Denmark: an auction-based premium scheme aligned across the Nordics. Again designed as a national scheme, but with an aligned Nordic framework, leaving enough room for tailoring to national needs and resources. This alignment approach could further improve the external view of the Nordics as an organised and politically stable market with a common electricity market, strong and increasing physical interconnection and now even an aligned RES-E support framework.

5.2 Recommendations for alternative fuels and transport

This section presents the recommendations for the use of policy mechanisms to support biofuels and electric vehicles. The first part provides an overview of the different policy options, which is followed by the recommendations. Finally the future development of the policy support mechanisms and the possible benefit ("Nordisk nytte") of the recommended pathway are discussed.

5.2.1 Background

The biofuel markets in the Nordic countries are unique both in terms of relative size and diversity of renewable transport fuels as well as in terms of a relatively large share of high-blend fuels. Furthermore, the Nordic countries have more far-reaching goals than most other EU countries.

Given the increasing awareness of the ILUC effects, the further growth of the use of first-generation biofuels based on food or feed crops will be limited. Advanced biofuels produced from waste or lignocellulosic biofuels should be prioritised in the future development of the transport sector according to the Renewables Directive. This was added in the recent updates of the Directive (see chapter 2), but ILUC effects are currently not included in the sustainability criteria and standards for calculations of life-cycle greenhouse gas emissions that is defined in the Renewables Directive. The reason for this is that there are difficulties in quantifying ILUC effects, as it is a complex international mechanism that may be difficult to separate from other events in the global economy.

In the Nordics, there is a large potential for producing advanced biofuels with low life-cycle greenhouse gas emissions and limited ILUC effects. However, the costs are usually higher for such biofuels than for first-generation biofuels. Moreover, there are several different types of feedstock and energy carriers with varying cost structures for the production facilities, such as the ratio between investment costs and variable costs. For some of the fuels, large-scale production facilities are likely needed to achieve reasonable production costs, and investments in such facilities require a long-term support schemes that can reduce the investment risks. Some of these biofuels will in addition require adapted fuelling infrastructure and vehicles, which can increase the total cost of ownership.

Most biofuels can be stored and transported over long distances, which enables international trade. The Nordic countries import and export large volumes of biofuel which means that there is an interaction with the support mechanisms in other countries, both in the other member states but also in other parts of the world. For instance, market-based support systems in the Nordic countries will not necessarily support domestic production facilities, and investment/operation support to production facilities may not lead to policy goals of increased use of renewable energy. It is, therefore, difficult to delimit the effects of support systems to the Nordics or to a specific country, and the development of support mechanisms in other member states will influence the Nordic biofuel markets. An alignment of the support mechanisms in the member states is therefore needed, and it should be evaluated which member states that are open for this and what the benefits could be.

There is therefore a need to further investigate the extent of subsidy shopping in the EU and the possibilities to reduce this by alignment of the support mechanisms between the Nordic Countries and also with the other EU member states.

Altogether, this makes it challenging to find a long-term support system, especially while also considering the EU regulations regarding state aid and energy taxation. It is therefore necessary to combine a general support scheme (quota system or tax exemptions) with more specific measures.

5.2.2 Policy instrument options for alternative fuels and transport

A range of policy options have been presented through this report and an overview of them is presented below. They have been divided into two groups based on their connection to the value chain: "production and distribution" and "vehicles".

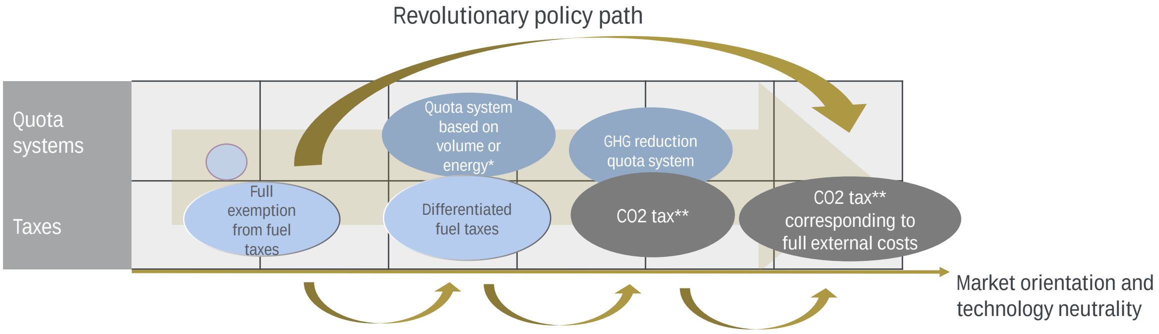
Production and distribution

- Blending standards for low blend fuels (based on volume or energy content)
- Mandatory fuel quotas based on volume or energy content.
- GHG reduction quotas for fuels
- Mandatory fuel quotas combined with certificates
- Exemptions from or reductions of fuel taxes
- Carbon dioxide tax
- Investment support to production facilities or distribution infrastructure (for example to charging infrastructure and infrastructure for gaseous fuels)
- Loans to production facilities or distribution infrastructure
- Support to R&D and demonstration

In the Nordics, the main general support mechanisms for biofuels today are quota systems and/or differentiated taxes. A quota system can be based on volume, energy content or on greenhouse gas reduction. Furthermore, specific fuels can be double-counted in the quota to give them extra priority. A quota obligation can also be related to only low-blend fuels while for example tax-exemptions are used to support biofuels and high-blend fuels. The support through differentiated tax levels have in some cases been general exemptions from fuel taxes but also by specific taxes directed at GHG/CO_2 emissions.

A mapping of the current general support mechanisms and the possible evolution of them are presented in Figure 33. The suggested development is further discussed in the following chapter, but mainly in section 5.2.5. The initial use of exemptions from general fuel taxes and volume or energy based blending mandates or quotas are suggested to be replaced by GHG/CO_2-based taxes and quotas. This would increase the market orientation as these systems would relate less to specific technologies and more to the actual GHG emissions. Furthermore, for the same reason, such mechanisms would steer more clearly towards the climate goals.

Figure 33: Policy instrument options for biofuels



* Could include double counting in the quota fulfilment
** Gradually increasing tax based on a simplified model for net lifecycle GHG emissions.

In the Nordics, several policy instruments are currently supporting the introduction of alternatively fueled vehicles. The suggested policy pathway for such support measures are similar as that suggested for general support mechanisms for biofuels; a system that more accurately and clearly steers towards the goal of reduced

GHG emissions in a technology neutral and market oriented way. This requires a more systematic approach that can align the different policy mechanisms directed at vehicles and give incentives based on the actual lifecycle GHG emissions of the different technologies.

Vehicles

- Tax exemptions and reductions from registration tax, vehicle tax or value added tax
- Clean car premiums
- Reduced fringe benefit tax
- Local support mechanisms such as free parking, removed congestion fees or road tolls, free ferries, access to public
- Emission standards for vehicles
- Public procurement

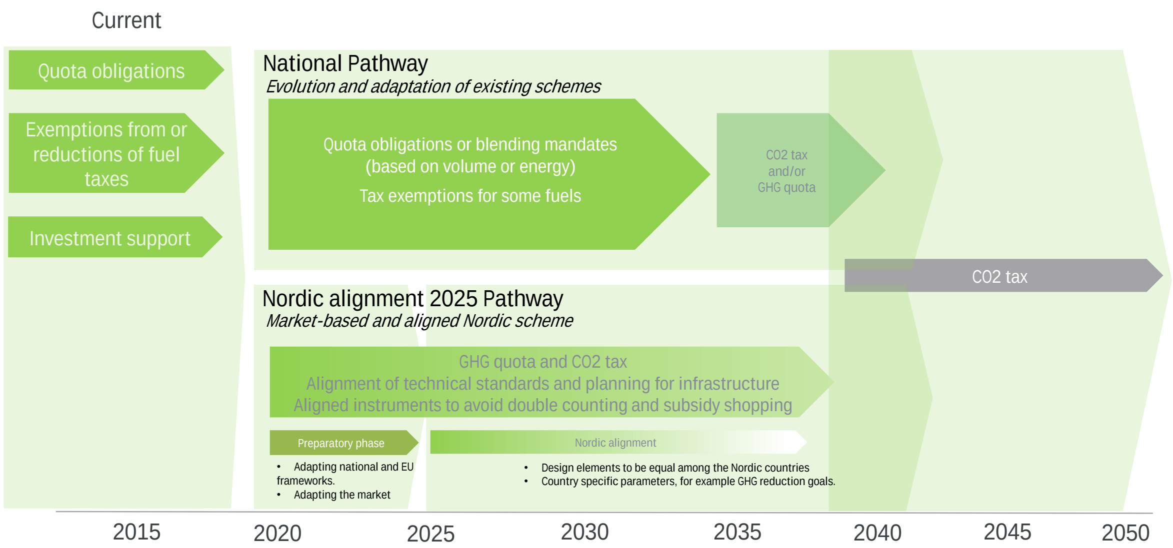
5.2.3 Possible pathways for biofuels

The suggested alignment of the Nordic support mechanisms are illustrated in Figure 34. In the national pathway each country evolves their available support schemes independently and relatively slowly. Whereas, in the Nordic alignment pathway, the current support mechanisms are adapted to achieve an effective and aligned support system. The alignment of the support mechanisms would need a preparatory phase to enable design of the policy mechanisms and a gradual adaptation of the current market towards the suggested system. In the aligned system, the main policy mechanisms would be the same in all Nordic countries, but parameters such as the increase rate of the quota could vary.

The main benefits of the Nordic alignment are that similar regulations and support mechanisms in the whole region will diminish the possibilities for subsidy shopping and also simplify the administrative processes for producers and resellers of biofuel. Moreover, the alignment of technical standards and planning for infrastructure could benefit the end users as well as the effectiveness of the implementation process.

Eventually, the national pathway may also be developed towards the GHG reduction quota and CO2 tax, at least in some of the countries, and finally both pathways are suggested to lead to a CO2 tax based on the external costs for the emissions.

Figure 34: Pathways for transport and alternative fuels



5.2.4 Possibilities to transfer available policy mechanisms to the Nordic countries

Of the various possibilities, in the next part of this chapter follows a discussion of the potential for application in the Nordics of the below mechanisms:

- Quota obligation with double counting and tax exemptions
- GHG quota obligation
- Quota obligation with certificates
- Quota obligation for low-blend fuels and tax exemptions for other fuels

5.2.4.1 Application of Finnish biofuel policy to other Nordic countries

As discussed previously, the use of a quota obligation can give less support to biofuels in the early stage of development, rather favouring more mature fuels. One such renewable biofuel in an early stage of development is that based on lignocellulosic biomass; countries such as Finland and Sweden, with significant forestry industries have considerable potential for such a biofuel.

The application of a quota obligation, "double counting" and carbon dioxide tax roughly based on life cycle GHG emissions, as well as investment support to energy technologies, could provide effective support to different types of biofuels and possibly to large-scale production facilities for fuels in an early stage of development. This is the approach that Finland has taken with their act to support biofuels in transport. Based on the lessons learned from support mechanisms from biofuels, the combination of quota system with a tax differentiation is an effective support mechanism. Furthermore, this combination gives a high incentive for introducing fuels with low GHG emissions, as they are supported by both mechanisms, and as the quota system creates a predictable and increasing market.

There is however a risk that the market could be distorted by this combination and not seen as technology neutral. The relatively high subsidies to fuels that are eligible for double counting and have zero percent carbon dioxide tax, in combination with the lower subsidies that are given to other fuels may distort the market. If the Finnish system would be used in Sweden, there would likely be concern that it is not technology-neutral in the sense that specific fuels are singled out and given significantly more support than other fuels. According to the estimated production costs for fuels in Sweden, there could be a risk that the Finnish support system would not give sufficient support to ethanol from food crops, and in particular not to high-blend ethanol.

5.2.4.2 Application of Germany GHG quota obligation to Nordic countries

Germany introduced their GHG reduction quota for the transport sector in 2015, and could provide an interesting example for the Nordic region.

A system based more clearly on greenhouse gas reductions would be more technology neutral, compared to for example the Finnish system with double counting, and clearly steers towards the goal of reduced GHG emissions. By having clear goals, such a system could give stability and predictability for actors. The fuels that can give the highest reductions in greenhouse gas emissions in relation to the cost will be prioritized. This means that the system can provide technology neutral support to the biofuel market.

It should however be noted that a sudden switch to this quota obligation would change the market pre-requisites for many of the available fuels and this could mean that some fuels lose their cost competitiveness. Among the currently available fuels, this system would increase the demand for fuels with high greenhouse gas reductions such as certain types of HVO (renewable diesel) and other second-generation biofuels based on waste or lignocellulosic biomass, while the demand for ethanol from food-crops and FAME (biodiesel) would be reduced.

As for all quota obligation systems, additional support systems are likely needed to support low-carbon technologies that are not yet commercial. As mentioned earlier, the size of this issue could be reduced with the design feature of a fast increase in the quota obligation. This would that create a high demand for biofuels which would lead to fuel distributors paying an increased quota premium; this would give a higher incentive to producers of renewable fuel and an even higher demand for fuels emit less GHG than conventional fuels.

Despite its clarity and intentions, such a scheme would support biofuels indirectly and could therefore increase uncertainty in the biofuel market, most greatly impacting early-stage technologies with high investment costs. A general issue for quota obligation schemes is that the indirect economic support provided for producers via the quota system is more uncertain than direct support such as tax exemptions. Additionally here, as GHG reductions can also be achieved by means other than biofuels, it adds another source of uncertainty to the indirect support. This can increase the risks of investing in all types of biofuel production, in particular for large-scale biofuel production based on lignocellulosic biomass, significantly raising the barrier to entry of this technology due to its high investment costs. Such investment decisions depend on long-term certainty of future support levels, which cannot be provided by the quota obligation or the short-term tax exemptions that has been used up until now in Sweden.

5.2.4.3 Application of UK quota obligation with certificates

A certificate system connected to a quota obligation provides a more transparent and direct economic support to biofuel producers. In the UK, in addition to the existence of a quota obligation, a biofuel producer receives a renewable transport certificate for each litre of biofuel produced and two certificates if the fuel is based on certain materials. This certificate system is an interesting solution for the Nordic countries, as it can provide a more transparent economic support to the biofuel producers compared to a quota obligation by itself.

The certificate system could make it possible to provide support to fuels, for example gaseous fuels (methane and hydrogen) or electricity that, in many cases, are not distributed by the conventional resellers of transport fuel. The support to such fuels are one of the main challenges in a quota system. If there is a significantly high or fast increasing quota, the conventional resellers would have to buy certificates from distributors of high-blend or pure biofuels. Nevertheless, other pre-requisites such as support to infrastructure and vehicles are also needed to increase the markets for these fuels and make it possible to include them in a quota/certificate scheme.

The certificate system can also be designed to give extra support specific fuels and overall goals. It is possible to support specific fuels with "double counting" of certificates. This could be fuels with specific environmental benefits or high-blend fuels. The certificates could also be directly related to greenhouse gas savings. Despite its benefits, a scheme of a quota obligation with certificates would struggle to be well-functioning in the Nordics. As there are a small number of actors in the fossil fuels markets in the Nordic countries it could be difficult to achieve a well-functioning market for certificates as there would be limited competition. It may be possible to design a well-functioning certificate system for the Nordics, but with the current market structure in the transport sector it seems challenging.

The certificate system can in principle be designed to not be defined as state aid, as it is a trading system between the actors in the market. But, if certain design elements are included, this may change.

5.2.4.4 Application of Czech Republic quota obligation and tax exemptions

A quota system specifically for low blend fuels, and tax exemptions for biofuels and high blend fuels could be an interesting combination for the Nordic region. Tax exemptions for biofuels have already been an important part of the support schemes in the Nordic countries. If first-generation biofuels can be supported with a quota system, then this could reduce the need for tax exemptions to them. This would allow for a possibility to maintain all parts of the current biofuel market while providing a strong support to high-blend and advanced fuels.

There are however several uncertainties regarding the effects of combining two systems in this way and it may not be a preferable solution in the longer term.

5.2.5 Overall recommendations for Biofuels

The policy mechanisms related to greenhouse gas emissions, such as carbon dioxide tax or greenhouse gas quota obligation, appear to be the best options in the long term for providing market-based support in a policy-effective, technology-neutral and cost-efficient way. A combination of these two policy mechanisms are therefore recommended. Quota obligations and tax differentiations have been effective in the introduction of biofuels so far and the GHG based versions of them are technology neutral in the sense that they only support the emission reductions and not specific technologies. This could possibly also provide a dynamic efficiency as it provides an incentive to develop more advanced technologies with larger GHG emission reductions, but this has not yet been proven for the GHG quota obligation. Furthermore, both policy mechanisms have the potential to be cost efficient, although this depends on the design and implementation of them.

There are still no experiences from a quota system with a significantly high quota for renewable fuels to exceed the volumes that can be fulfilled by low-blend fuels or from a GHG quota system. Moreover there are no or limited experiences of successfully supporting gaseous fuels (e.g. biogas and hydrogen) or electric vehicles in a quota system. Therefore several challenges remain for implementing such a system:

- How to design and implement a quota for a share of renewable fuels that is significantly higher than the currently implemented quota systems.
- Support to fuels that are not distributed in the conventional infrastructure for fossil fuels and/or used in conventional vehicles, i.e. gaseous fuels or electricity.
- How to achieve more predictable price levels on the quota market that can be used evaluate investments in second-generation fuels produced from lignocellulosic biomass.
- A transition from the current support mechanisms to a GHG reduction quota without disturbing the current biofuel market.

Support to gaseous fuels, electricity and second generation biofuels could be addressed by double counting in the quota fulfilment or other specific support measures like investment support and tax exemptions. This can give extra support to fuels that currently are not mature and therefore have higher costs. Furthermore, such mechanisms can be used to support specific fuels during the transition from the current support mechanisms to a GHG quota in order to avoid disturbing the current market for biofuels by rapid changes. Nevertheless, market support to the fuel is not sufficient for the fuels mentioned in point two, but they should likely be left outside the quota system for now until the markets for them and the quota system are more mature.

These also fuels require a support system for vehicles that can give economic support in relation to the environmental benefits of the vehicles that applies both to electric vehicles and to vehicles adapted for ethanol, biogas or other renewable fuels. Furthermore, the infrastructure for alternative fuels needs to be developed to at least provide a basic access. This can be achieved by implementing a long term market support for fuels and vehicles, but also via strategic cooperation between authorities and the industry to achieve this. The quota system could be combined with a gradually increasing carbon dioxide tax that applies to the net life cycle GHG emissions for all fuels, including renewable fuels. The combination of tax differentiation and quota obligations have proven to be very effective for supporting biofuels, and this specific design of the system would give extra incentives to advanced fuels with large GHG reductions. Fees and taxes connected to carbon dioxide has already been used in the Nordic countries, and it is a pathway that can provide market stability and clearly steer towards the long term goals of reduced GHG emissions. Furthermore it is a mechanism that can give support to the diverse Nordic market of renewable fuels, including the parts that are not connected to the distributors of fossil fuel.

Such a tax would require an accurate and relatively simple system for classifying the diversity of fuels according to their average lifecycle GHG emissions. Currently there are detailed regulations on the need for specifying the exact GHG emissions for each biofuel producer or on the classification of the origin of the fuel, for example, if the material is first classified as waste it may be given extra support. There is a need to improve this system in order to simplify the process for producers and distributors but also to enable support systems based on actual GHG emissions. Furthermore, it is a necessity for accurately steering towards the climate goals. The long-term use of a carbon dioxide tax that could be combined with the quota system could to some extent require an adaption of EU tax regulations, EU state aid regulations or a specific design of the carbon dioxide tax. Within this study, no state aid cases have been found that involves such a tax. It is beyond the scope of the study to investigate the details of the classification of such a tax as an environmental tax that does not constitute state aid. Nevertheless, we recommend the Nordic Ministries to make a joint effort to propose a design for such a tax and to propose adjustments of the EU frameworks that enables a combination of a CO_2-tax and a quota system.

One of the goals with the EU's guidelines for stated-aid is to keep the inner market homogenous, with similar conditions for the market actors. However, as described throughout this report, several different initiatives are taking place in order to develop EU nations' support schemes according to the current guidelines. As seen, several different support schemes has been adopted within EU, resulting in rather different market conditions for biofuels in the EU's internal market. Difference in support schemes have led to tax influenced long distance trade, resulting in unnecessary transports of fuels (e.g. fuels from residues is well compensated in Finland, while fuels with high reduction of GHG emissions are exported to Germany). A broad consensus on what policy instruments that is used in the Nordics can potentially minimize the amount of tax-driven trade in biofuels. If all Nordic countries implemented a greenhouse gas quota obligation in combination with a carbon dioxide tax, this could be achieved. However, it is even more important for the Nordic countries to follow and influence the development in the whole EU.

5.2.6 Recommendations for Electric vehicles

If one answers the strategic question 'Do we want to support EV in a larger scale?' positively, many lessons for quick EV deployment can be taken from the Norwegian example. There are several conditions within Norway (such as a considerable vehicle registration fee) that mean that the Norwegian model cannot be directly replicated. Their example does however present several key aspects that can be considered when developing policy to support the introduction of EVs. Also, while the Norwegian support provided not only significant support to the vehicle owner, its policy costs are rather high. Key recommendations from the experiences in Norway and other European countries are:

Reduce the total cost of ownership of EVs via exemption from registration tax and/or a subsidy on vehicle purchase. The high initial cost is the greatest barrier to many potential EV owners, bringing the cost closer to that of a conventional vehicle will decrease this. Reducing the personal income tax for company cars is another way in which this cost can be decreased. Schemes should have clear goals and caps, with sufficient budget allocated in the case of subsidies.

Increase infrastructure of charging stations via subsidies. Infrastructure needs to be available in urban areas and residential buildings so that users do not experience too great an inconvenience in recharging their vehicles. Charging infrastructure for EVs must be supported and developed, which is obvious from the lessons learned from the Nordics and other regions. The importance of this development is also emphasized in the Directive 2014/94/EU on the deployment of alternative fuels infrastructure. The development of charging infrastructure would benefit from an aligned Nordic strategy for technical standards and for the planning of the infrastructure. The Nordic experiences from electric vehicles could be used as a starting point for this work and the coordinated infrastructure would benefit the end customer and speed up the market development for EVs.

Offer tangible benefits to owners of EVs, such as use of bus lanes, free parking, and free charging in urban areas. The ability to save time in urban areas during peak hours and increasing convenience for EV drivers are instrumental for encouraging the paradigm shift to EVs and increasing market growth.

5.2.7 Future development of support for alternative fuels and transport

The norm in the transport sector today is fossil fuels, diesel and gasoline, against which all alternative fuels are evaluated. Most quotas (the dominator) and tax systems are based on fossil fuels and their emissions. An upcoming question is how long the development of renewable options can proceed before the norm should be changed. There are already a number of alternative fuels that can't easily be compared to, or be included in the same quota systems as, fossil fuels (e.g. biogas and electricity).

Quota systems contribute, to a certain degree, to making biofuel producers dependent on distributors of fossil fuels in order to sell their green product. Hence, a biofuel fuel producer has to sell the fuel/certificates to an actor that distributes a fossil fuel, assuming that the biofuel producer is not interested in starting their own distribution of fossil fuels. Distributors of fossil fuels, on the other hand, have the possibility of either buying biofuels/certificates or starting their own production of biofuels.

In the long term, it is advantageous to develop policies that are independent of fossil fuels and not having fossil fuels as the default norm. When designing the system beyond 2020, this question must be considered in order to facilitate that the future fuels, such as hydrogen and electricity, can be phased into a common system.

One way of achieving a support system that is not related to fossil fuel distributors would be to connect the taxation and incentives more to the vehicles and their use of the road system (for example tax related to the driving distance) than to the fuel itself. This option could also enable more effective policy instruments for changing the transport sector.

5.3 Nordisk nytte

The potential for *nordisk nytte* for the Nordic countries in working together to reach RES targets naturally depends on the extent of cooperation and alignment; these provide benefits for policy makers and investors alike.

For the development of RES policy and policy learning, at the simplest level, there is a benefit from having a forum for information exchange of experiences and best practice from the various support schemes implemented in each country, such as provided within the working group for renewables, AGFE.

A further step already discussed within the report would be to create a Nordic RES-E supply curve for the coming years. This would serve as a cost monitor for Nordic RES-E, both enabling the tracking and forecasting of technology and project cost level development in the different countries. Regardless of policy instrument and pathway chosen, this would create a transparent base for cost efficient policy design in the Nordic countries.

Of the two main pathways described within the report, the *alignment* pathway holds immediate benefits for RES investors by further increasing the attractiveness of the Nordic region and reducing transaction costs, which could increase competition and thereby potentially reduce overall policy cost. Nordic alignment also provides a simpler market environment for investors that is easier to understand and enter.

The area of offshore wind auctions provides a potential area of focus for alignment and possible cooperation. As mentioned within the report, there are several aspects that would benefit from being aligned between the countries, such as aligned auction schedules which could increase participation and competition in tenders and thereby reduce costs.

As for alternative fuels and transport, there are several potential opportunities for *nordisk nytte* in aligning the Nordic support mechanisms for biofuels. A combination of a GHG quota and a carbon dioxide tax in all the Nordic countries would provide a larger and more stable market for developing second generation biofuels or any other type of renewable fuel. Such a market with common regulations and predictable development would enable long-term investment decisions. If the Nordic countries develop a common methodology for calculating the life cycle GHG emissions from different fuels as a basis for these support systems, then a common effort can be made to introduce this system into the EU framework.

Furthermore, an alignment would reduce the possibilities for subsidy shopping, where fuels are produced with investment support in one country and then sold in a country with market support. Another possible negative effect of unaligned support that could be reduced with alignment are for biofuels with large GHG reductions to be exported to countries that incentivise their use while other biofuels with smaller GHG reductions are imported. However, as biofuels can be traded on a global market, the Nordic alignment can only reduce the mentioned effects and not remove them entirely; to do so would require further alignment with other EU member states.

In addition, the alignment of technical standards and planning for charging infrastructure for zero emission vehicles could enable an effective development of the infrastructure and make the Nordics one of the leading markets for ZEVs.

6. Appendix Nordics

6.1 Nordic measures - state of play today

Here we describe the current setup of support schemes and measures by country. These include, where information was obtainable, the following parameters:

- Objectives and main features
- Intention and expected outcome
- How it is designed and implemented
- Eligible beneficiaries and funding source

Where we have found independent evaluations of measures with these have been used, but a thorough evaluation is not within the scope of the study.

6.2 Norway

Table 8: Measure - investment subsidy for use of renewable resources in electricity generation

Characteristic	Description
Supported	Electricity production from renewables
Name of support scheme	**Investment subsidy for use of renewable resources in electricity generation, under the category "New Energy and Climate Technologies"**
Objectives	Promotion of environmentally friendly production of energy
Main features	Subsidy to cover investment costs for extra investments compared to a conventional plant of the same installed capacity
Year of introduction	2002
Technology focus and differentiation	The scheme covers the following technologies: liquid biofuel, solar, wind, tidal, wave and hydro. There is no differentiation in support levels.
Budgetary expenditures per year	2012: 62 MNOK 2013: 13 MNOK 2014: 1 MNOK[165]
Duration of support	Investment aid
Qualification criteria and eligibility	Projects involving the production of electricity from the above mentioned energy sources.
Penalties	Not applicable
Who pays the bill?	The energy fund is financed via the state budget, a levy on the electricity grid tariffs and interest generated by the fund itself. Thus, both tax payer and electricity consumer pay the bill.

Table 9: Measure – investment subsidy for domestic renewable electricity production via the Enovatilskuddet

Characteristic	Description
Supported	Domestic renewable electricity production
Name of support scheme	**Enovatilskuddet**
Objectives	Support for energy measures in Norwegian households, among others renewable electricity generation
Main features	Investment support for among others renewable heating solutions and small scale renewable electricity generation.
Year of introduction	2015
Technology focus and differentiation	Technology neutral regarding production technology
Budgetary expenditures per year	Varies depending on availability of eligible projects

[165] Enova annual report 2014, p. 17.

Duration of support	Investment aid
Qualification criteria and eligibility	Residences in Norway.
Penalties	Not applicable
Who pays the bill?	The energy fund is financed via the state budget, a levy on the electricity grid tariffs and interest generated by the fund itself. Thus, both tax payer and electricity consumer pay the bill.

Table 10: Measure - investment subsidy for biogas

Characteristic	Description
Supported	Alternative fuel
Name of support scheme	**Investment subsidy for biogas**
Objectives	To develop a market for the production and sale of biogas on an industrial scale, and contribute to technological development for the production of biogas
Main features	
Year of introduction	2002
Technology focus and differentiation	Focus on biogas
Budgetary expenditures per year	Varies depending on availability of eligible projects
Duration of support	
Qualification criteria and eligibility	Plants that produce biogas from biological waste, energy crops or forest timber, with a production › 1 GWh.
Penalties	Not applicable
Who pays the bill?	The energy fund is financed via the state budget, a levy on the electricity grid tariffs and interest generated by the fund itself. Thus, both tax payer and electricity consumer pay the bill.

Table 11 Measure: Electric vehicle support as part of “Klimatforliket” (Climate Agreement)

Characteristic	Description
Supported	Electric vehicle end-use
Name of support scheme	**Electric vehicle support as part of “Klimatforliket” (Climate Agreement)**
Objectives	Increasing the number of zero emissions vehicles
Main features	Registration fee exemption VAT exemption Reduced annual motor vehicle tax[166] Public parking fee exemption

[166] http://www.toll.no/en/international/english/motor-vehicles/annual-motor-vehicle-tax/annual-motor-vehicle-tax-2015/

	Road toll exemption Free ferry transport Permission to use bus lanes[167]
Year of introduction	2012 (in part introduced 1991)
Technology focus and differentiation	Zero emission vehicles, especially battery electric vehicles
Budgetary expenditures per year	Loss of income due to MVA: 1,5- 2 bill. NOK/year, yearly fee: 160 mill NOK per year, loss of toll road income 206 mill NOK a year, loss of parking fees 120 mill NOK per year[168]
Duration of support	At least until the end of 2017, but not exceeding 50 000 vehicles. In 2015, the quantity of 50 000 vehicles was reached, and the Government has come to an agreement concerning the future of these incentives. Tax exemptions are kept until the end of 2017 . [169]
Qualification criteria and eligibility	Zero Emissions Cars (Battery electric cars, fuel cell cars, hydrogen cars with internal combustion engines)
Penalties	Not applicable
Who pays the bill?	Government (forfeit of tax income)

[167] Nordic Climate Policy – A Case Study on Efficient Policy Measures, TemaNord 2014:522

[168] https://www.regjeringen.no/no/dokumenter/prop.-19-s-20152016/id2462625/?ch=1&q=

[169] http://www.venstre.no/assets/BilavgiftsgjennomgangENIGHET_0605_2015.pdf

6.3 Sweden

Table 12: Measure - reduction of the real estate tax for wind power

Characteristic	Description
Supported	Electricity production from renewables (indirect)
Name of support scheme	Reduction of the real estate tax for wind power Act on the Federal Real Estate Tax (SFS 1984:1052)
Objectives	To increase wind power exploitation
Main features	The real estate tax is reduced from 0.5 percent to 0.2 percent of rateable value for wind mills.
Year of introduction	2007
Technology focus and differentiation	Wind power
Budgetary expenditures per year	N/A
Duration of support	2007 – no end date is set
Qualification criteria and eligibility	Every person subject to real estate tax shall be entitled, if he/she owns a piece of land on which a wind power plant is located.
Who pays the bill?	Government

Table 13: Measure - exemption from energy tax for non-commercial supply of electricity from wind energy

Characteristic	Description
Supported	Electricity production from wind power
Name of support scheme	Exemption from energy tax for non-commercial supply of electricity from wind energy (SFS 1994:1776)
Objectives	To encourage wind power production for non-commercial use
Main features	
Technology focus and differentiation	Wind power
Budgetary expenditures per year	Not quantified
Duration of support	Ends June 2016
Qualification criteria and eligibility	Every producer that supplies electricity on a non-commercial basis is eligible for tax exemption
Who pays the bill?	Government

Table 14: Measure - support for planning initiatives for wind power

Characteristic	Description

Supported	Electricity production from wind power (indirect)
Name of support scheme	Support for planning initiatives for wind power. Ordinance on support for planning initiatives for wind power (SFS 2007:160)
Objectives	To facilitate the planning of wind power and thereby indirectly contributes to increased wind power production.
Main features	Municipalities, county administrative board, regional autonomous bodies and municipal cooperative bodies have been able to apply for aid for planning initiatives for wind power.
Year of introduction	2007
Technology focus and differentiation	Wind power
Budgetary expenditures per year	Total 84 MSEK, 2007 - 2010
Duration of support	2007 – 2010
Qualification criteria and eligibility	Municipalities, county administrative board, regional autonomous bodies and municipal cooperative bodies
Who pays the bill?	Government

Table 15: Measure - market introduction of wind power

Characteristic	Description
Supported	Electricity production from wind power in an early phase; demonstration and research
Name of support scheme	Market introduction of wind power. Ordinance on grants for measures for efficient and environmentally friendly energy (2003:564).
Objectives	Reduce the costs of establishing new wind power plants and to increase knowledge of the effects of establishment in certain environments. Aid is being provided for technology development and market introduction in collaboration with trade and industry as well as for environmental impact studies in order to obtain generalisable answers to the impact on humans, the environment and nature.
Main features	Financial support for investment or technology procurement
Year of introduction	2003
Technology focus and differentiation	Wind power on shore and off shore During Stage 1 the primary focus was on offshore establishment and to a certain degree in mountain environments. During Stage 2 the focus will be on all of the areas in which the Swedish Energy Agency in assessing aid will focus the aid, primarily on woodland and mountain environments, where wind power will be primarily developed and the need for knowledge is greatest for future expansion. The studies within Vindval have also moved from an offshore and mountain focus to one on woodland environments and mountains. The grid development can be included as a cost eligible for aid.
Budgetary expenditures per year	Total 700 MSEK, year 2003 - 2012
Duration of support	First period: 2003 – 2007 Second period: 2008 – 2012
Qualification criteria and eligibility	Wind power projects that involve technology development

	Focus on large-scale wind power establishments.
Who pays the bill?	Government

Table 16: Assessment - Market introduction of wind power

Market introduction of wind power (Sweden)	
Indicator	Result
Policy Effectiveness	8 new wind parks were built. Total expected energy output: 1,560 GWh/year.
Static efficiency or cost efficiency	Most of the 8 new wind parks would not have been built without the state aid.
Dynamic efficiency	Since the demo projects have contributed with knowledge about wind power in cold climate, the market for that kind of wind projects has expanded.
Independent evaluation	Faugert & Co evaluation in 2013: "Evaluation of major demonstration projects in wind power"
Predictability, stability and flexibility of support instruments	Predictability, stability, and flexibility are important but potentially conflicting characteristics of support schemes. Whilst predictability and stability aim to provide a secure investment environment, flexibility is required to adapt to changing circumstances, such as reducing support levels to reflect decreasing generation costs. The support scheme was a temporary scheme with the aim to support demo projects.
Burden sharing	It is important that the financial burden of the support is well distributed and that industry is not losing its competitive advantage as result of this burden. There are the different approaches applied in Europe to reduce the burden for energy-intensive industries resulting from RES-support. It is important that countries implement clear and fair burden sharing rules.

Table 17: Measure - investment support for solar photovoltaic cells in Sweden

Characteristic	Description
Supported	Electricity production from solar PV
Name of support scheme	Government support for solar photovoltaic cells Regulation on State Subsidies for Solar Panels (2009:689)
Objectives	Target is that the number of operators will increase in Sweden that the system costs will be reduced and that electricity from solar photovoltaic cells will increase.
Main features	Grants amount to a percentage of the eligible costs. Eligible costs include labour costs, costs of materials and planning costs. Costs of the connection to an external electricity grid are excluded from the eligible costs. The regulation has been revised several times to reflect the fast technology cost development for PV. The level of funding has changed from 60 percent to 45 percent and then 35 percent of eligible costs as of 1 February 2013. For 2015 support levels became differentiated so that companies could maximum 30 percent and others maximum 20 percent. Grants awarded under this scheme cannot be received on top of other public grants, including those of the European Union or tax reduction for labour costs (§ 2 par. 1 Regulation No. 2009:689).
Year of introduction	2009
Technology focus and differentiation	Eligible are PV-installations connected to either internal (on the given property) or external grid. Installations generating both electricity and heat from solar energy (hybrid installations) are eligible only if the electricity generated amounts to at least 20 % of an installation's total annual production.
Budgetary expenditures per year	Between 2009- March2015: 361 MSEK total paid out of 467 MSEK granted
Duration of support	Year 2009 – 2016
Qualification criteria and eligibility	Eligible are private individuals, municipalities and enterprises
Who pays the bill?	Government

Table 18: Measure - tax reduction for micro-generation of electricity from renewable sources in Sweden

Characteristic	Description
Supported	Micro-generation
Name of support scheme	Tax reduction for micro-generation of electricity from renewable sources
Objectives	Promote micro-generation of electricity from renewable sources
Main features	Reduced tax by 0.6 SEK per kWh. Maximum 18 000 SEK per year. The maximum tax reduction is limited to the number of kWh that has been used at the connection point.
Year of introduction	2015
Technology focus and differentiation	Micro-production from photovoltaic systems, small-scale wind power, micro-turbines
Budgetary expenditures per year	30 MSEK
Duration of support	2015 – no end date is set
Qualification criteria and eligibility	Eligible are both physical and juridical persons. Fuse size no larger than 100 A.
Who pays the bill?	Government

Table 19: Measure - investment support for biogas and other renewable gases

Characteristic	Description
Supported	Micro-generation
Name of support scheme	Investment support for R&D into biogas and other renewable gases Ordinance concerning government support for measures for the production, distribution and use of biogas and other renewable gases (2009:938)
Objectives	Promote energy technology which is beneficial from a climate perspective but not yet commercially competitive, through support that contributes to efficient and increased generation, distribution and use of biogas and other renewable gases
Main features	Funding for projects which are commercially non-viable and have a technical potential for further evolvement and competitiveness to contribute to increased generation, distribution and use of biogas and other renewable gases
Year of introduction	2009
Technology focus and differentiation	Production, distribution and use of biogas and other renewable gases
Budgetary expenditures per year	There is a common budget for solar PVCs and biogas. The expenditures are thus not reported separately.
Duration of support	2009 – no end date is set
Qualification criteria and eligibility	See "Main features" for qualification criteria. Which projects receive the support is decided by the Swedish Energy Agency based on which fulfils the objectives best
Who pays the bill?	Government

Table 20: Measure - exemption from energy tax and carbon dioxide tax for biogas used for engines or heating in Sweden

Characteristic	Description
Supported	Biogas use
Name of support scheme	Exemption from energy tax and carbon dioxide tax for biogas used for engines or heating. Act (1994:1776) on energy tax and act (1990:582) on carbon dioxide tax
Objectives	Promotes the use of biogas
Main features	Exemption from energy tax and carbon dioxide tax
Year of introduction	1991
Technology focus and differentiation	Biogas which is used for engines or heating
Budgetary expenditures per year	N.a.
Duration of support	1991-?
Qualification criteria and eligibility	
Who pays the bill?	Government

Table 21: Measure: Rural Development Programme – aid for farm-based biogas production

Characteristic	Description
Supported	Small-scale biogas production
Name of support scheme	Rural Development Programme
Objectives	
Main features	The contribution is at 30% (50% to northern Sweden) and applies to the entire biogas generation site, including materials and labour. Maximum 1.7 MSEK during three years.
Year of introduction	2009
Technology focus and differentiation	Farm-based biogas production. At least half of the substrate should be manure, and the production facility need to ensure tight storage of digestate.
Budgetary expenditures per year	Between 2009 and 2013 SEK 200 million has been allocated for investments linked to this type of biogas generation.
Duration of support	2009-2013
Qualification criteria and eligibility	Eligible are farmers and other agricultural entrepreneurs
Who pays the bill?	Government

Table 22 Measure: obligation to provide renewable fuel

Characteristic	Description
Supported	Use of renewable fuels in transport

Name of support scheme	The so-called "Pump Act", that is Act (2005:1248) on the obligation to provide renewable fuel
Objectives	Increasing the availability of renewable transport fuel at filling stations.
Main features	Regulation to force fuel distributors to provide renewable transport fuel.
Year of introduction	2006
Technology focus and differentiation	Filling stations for renewable fuels
Budgetary expenditures per year	
Duration of measure	2006-
Qualification criteria and eligibility	The obligation to provide at least one renewable fuel currently applies to filling stations that annually sell more than 1500 m^3 diesel or petrol. In the year of the introduction, the limit was 3000 m^3 and it was gradually lowered to 1000 m^3 (2010) and then adjusted again to the current level.
Who pays the bill?	Fuel distributors and end customers

Table 23 Measure: State support to measures for distribution of renewable fuels

Characteristic	Description
Supported	Use of renewable fuels in transport
Name of support scheme	Act (2006:1591) on state support to measures for distribution of renewable fuels.
Objectives	Increase the availability and variety of renewable transport fuel at filling stations.
Main features	Investment support was given for installing a fuel pump for renewable fuel other than ethanol at a filling station: 30% of the investment cost after deduction of the lowest alternative cost for fulfilling act (2005:1248), possible cost benefits or increased profits during the following five years, and other state support granted to the measure.
Year of introduction	2006
Technology focus and differentiation	Infrastructure for renewable transport fuels other than ethanol, in most cases compressed methane.
Budgetary expenditures per year	SEK 59 million in total
Duration of support	2006-2009
Qualification criteria and eligibility	It was granted to investments in measures connected to distribution of renewable transport fuel at filling stations for petrol, diesel or other renewable fuel. Support was not granted for measures that was forced by legislation, was considered regular maintenance, could be considered to be connected to the normal business, or was initiated before this act and can be considered profitable in the short term.
Who pays the bill?	Government

Table 24: Measure - exemption from energy and carbon dioxide tax for biofuels

Characteristic	Description
Supported	Use of renewable fuels in transport
Name of support scheme	Act (1994:1776) on energy tax

Objectives	Increase the use of renewable fuel.
Main features	Exemption from energy and carbon dioxide taxes
Year of introduction	1995
Technology focus and differentiation	Renewable transport fuels
Budgetary expenditures per year	
Duration of support	1995-
Qualification criteria and eligibility	Applies to all biofuels (eg. from biomass). Ethanol, FAME, HVO, synthetic biogasoline and biogas are the biofuels that are currently on the market, but the legislation allows for other types of biofuels as well. All biofuels get full exemption from carbon dioxide tax. The exemption from energy tax is differentiated to avoid over-compensation. The differentiation is made both between different kinds of biofuels, and between low blend and high blend fuels. For low blend fuels the energy tax exemption only applies up to 5 % biofuels in the fuel mix. The fuel supplier must have a sustainability decision from the Swedish Energy Agency to show that the biofuels fulfil the sustainability criteria for biofuels in Act (2010:598)
Who pays the bill?	Government

6.4 Denmark

Table 25 Assessment: Premium tariffs (Denmark)

<table>
<tr><th colspan="2">Premium tariffs (Denmark)</th></tr>
<tr><th>Indicator</th><th>Result</th></tr>
<tr><td>Policy Effectiveness</td><td>
Wind
Policy targets for 2020 (agreed upon in 2012):

1,500 MW new offshore capacity;
1,800 MW new onshore capacity.

The installed capacity (MW) of wind power plants has seen a steady growth since 2009.
<table>
<tr><td>2005</td><td>3,128</td></tr>
<tr><td>2006</td><td>3,136</td></tr>
<tr><td>2007</td><td>3,125</td></tr>
<tr><td>2008</td><td>3,163</td></tr>
<tr><td>2009</td><td>3,483</td></tr>
<tr><td>2010</td><td>3,802</td></tr>
<tr><td>2011</td><td>3,953</td></tr>
<tr><td>2012</td><td>4,163</td></tr>
<tr><td>2013</td><td>4,808</td></tr>
</table>
Source: Sweco wind database
An increase in installed capacity from 2009 onwards may be explained by change of premium from 2008 onwards: a rise in premium from 0.10 to 0.25 DKK/kWh. To what extent the premiums are effective in meeting the 2020 targets still needs to be seen.
High potential for wind generation in Denmark due to geographical and weather conditions. Diacore assesses the policy effectiveness for both onshore and offshore wind in Denmark as being high in 2013.
Solar
No specific targets for solar generation have been set. The installed capacity (MW) of solar power generation has seen a remarkable growth in the last couple of years:
<table>
<tr><td>2010</td><td>7</td></tr>
<tr><td>2011</td><td>17</td></tr>
<tr><td>2012</td><td>402</td></tr>
<tr><td>2013</td><td>571</td></tr>
</table>
Source: Energistatistik Danmark 2013, ens.dk
In 2012 a new support scheme was introduced leading to a higher premium, especially for small installations (‹ 400 kW).
</td></tr>
</table>

	During the 2010-2013 period the costs for solar panels decreased which may also be reason for the increase on installed capacity. Therefore, it is difficult to determine the effect of the premiums on solar. Biogas The use of biogas for electricity production in GWh has not seen a significant increase: 2005 282,5 2010 356,9 2011 345,8 2012 373,9 2013 388,9 Source: Energistatistik Danmark 2013, ens.dk We cannot however draw any conclusions based on these figures regarding the effectiveness of the tariffs. Is capacity fully exploited? The Danish Energy Authority foresees a doubling of biogas production before 2020.[170] However, the tariffs for biogas will terminate in 2020. Biomass Half of the 35% renewables target for Denmark is to be produced on the basis of biomass.[171] Use of biomass for electricity production in GWh has gone down slightly the last couple of years: 2010 4,236.7 2011 4,028.9 2012 4,068.3 2013 3,945.5 Source: Energistatistik Danmark 2013, ens.dk The effect of the premium tariff on the use of biomass to produce electricity is unclear. The price of biomass is also an important factor influencing its use.
Static efficiency or cost efficiency	The premium tariffs are financed via the PSO tariff (Public Service Obligation). The budget for premium tariffs amounted to: 2012: 3,834 MDKK 2013: 5,449 MDKK
Dynamic efficiency	Premium tariffs are inherently biased towards technologies which are closer to market, rather than technologies with extensive need for R&D and market entry investments.
Independent evaluation	None found

[170] Energistyrelsen, Biogas i Danmark – status, barrierer og perspektiver, 2014, p. 5.
[171] Energistyrelsen,"Analyse af bioenergi i Danmark", p. 5.

Predictability, stability and flexibility of support instruments	Due to a stable renewables policy and that the premium tariffs have been in force for quite a while the scheme is in its entirety quite stable. On the other hand there have been a high number of changes to the scheme, allowing for the possibility to respond to changes in the market. The tariffs for biogas will be abolished by 2020 which compromises the stability for gas plant operators.
Burden sharing	Financing via the PSO tariff. Large consumers and installations that generate electricity for own consumption pay a reduced tariff or are exempted from paying the PSO tariff.

Table 26: Measure - funds for small renewable energy technologies in Denmark

Characteristic	Description
Name of support scheme	ForskVE-programme – Funds for small renewable energy technologies
Objectives	To promote the spread of power generation plants with a smaller capacity
Main features	Grant of funding to cover investment, preparation or installation costs for small scale generation.
Year of introduction	2008
Technology focus and differentiation	The scheme is focused on: •
Budgetary expenditures per year	25 million DKK
Duration of support	Not applicable.
Qualification criteria and eligibility	•
Penalties	Not applicable
Who pays the bill?	Consumers

Table 27: Measure - Loan guarantees in Denmark

Characteristic	Description
Name of support scheme	Loan guarantees
Objectives	Promotion of production of energy from renewable sources.
Main features	Grant of guarantees of maximum 500,000 DKK per project for loans to finance feasibility studies for wind turbines.
Year of introduction	2009
Technology focus and differentiation	The scheme is focused on wind power tubines.
Budgetary expenditures per year	10 million DKK
Duration of support	-
Qualification criteria and eligibility	Eligible turbines: The guarantee is awarded to a wind turbine committee or initiative group which fulfills the following requirements: -
Penalties	Guarantees need to be paid back if ownership of the project is transferred.
Who pays the bill?	Grid operators and consumers

Table 28: Measure - net-metering discount in Denmark

Characteristic	Description
Name of support scheme	Net-metering discount
Objectives	
Main features	Discount or exemption of the PSO
Year of introduction	2012
Technology focus and differentiation	All RES technologies, except for geothermal plants; differentiation according to installed capacity •
Budgetary expenditures per year	
Duration of support	
Qualification criteria and eligibility	production plant is required to connected to the public electricity grid and must be owned fully by the producer/consumer
Penalties	Not applicable
Who pays the bill?	Electricity consumers

Table 29 Measure: Price-based premium tariff for biogas

Characteristic	Description
Name of support scheme	Price-based premium tariff for biogas
Objectives	Further the use of biogas for transport or business purposes
Main features	Premium tariff plus bonus
Year of introduction	2013
Technology focus and differentiation	Biogas
Budgetary expenditures per year	
Duration of support	
Qualification criteria and eligibility	Sellers of biogas to end consumers for transport purposes. Owner of business using biogas for processing purposes
Penalties	
Who pays the bill?	Government

Table 30 Measure: Tax reduction for biofuels mixed with gas, petrol and diesel

Characteristic	Description
Name of support scheme	Tax reduction for biofuels mixed with gas, petrol and diesel
Objectives	Promotion of use of biofuels
Main features	The amount of tax is reduced for gas, diesel or petrol which is blended with biofuels
Year of introduction	2010

Technology focus and differentiation	Biofuels
Budgetary expenditures per year	
Duration of support	
Qualification criteria and eligibility	Biofuels must comply with the criteria of the Renewables Directive
Penalties	Not applicable
Who pays the bill?	Government

6.5 Finland

Table 31: Measure – operation aid via premium tariff in Finland

Characteristic	Description
Country	Finland
Supported	Electricity production from renewables
Name of support scheme	Operation aid: premium tariff/feed-in tariff
Objectives	To further production of electricity from renewable sources by giving a premium on top of the market price.
Main features	Variable premium, absolute amount administratively set
Year of introduction	2011
Technology focus and differentiation	The scheme is technology specific. It covers electricity production from: • Wind power plants; • Biogas power plants; • Forest chip power plants, and • Wood fuel power plants.
Budgetary expenditures per year	2012: 33.2 million EUR 2013: 54.9 million EUR
Duration of support	Max. 12 years.
Qualification criteria and eligibility	General and plant specific criteria apply. Power plants must fulfil operational and economic requirements. Eligible plants must: • not already received state support; • be new; • have a certain nominal effect. Wood fuel power plant must produce useable heat in addition to electricity (CHP).
Penalties	Not applicable
Who pays the bill?	Government

Table 32: Assessment: Premium tariffs for renewable electricity generation (Finland)

Premium tariffs (Finland)	
Indicator	**Result**
Policy Effectiveness	The scheme was introduced in 2011. In 2013 installed capacity of wind power plants had doubled compared to 2011. 2011 198 MW 2012 257 MW 2013 447 MW Source: Sweco wind database.

	Without the tariffs wind power would probably not have been built as building wind power plants in Finland is relatively expensive due to low wind and required higher heights for turbines. Since 2010 forest chip and other wood fuel have been used for production of electricity to the following amounts (in): 2010 15.812 GWh 2011 15.179 GWh 2012 13.487 GWh 2013 13.754 GWh 2014 13.707 GWh *Source: Statistics Finland* The figures above do not give any leads regarding the effects of the premium tariffs. The potential for electricity production from biofuels is limited by the market for district heating, as the plants in question must be CHP. In that sense the premium tariffs may not be that effective.
Static efficiency or cost efficiency	2012: 33.2 million EUR state budget for premium tariffs 2013: 54.9 million EUR state budget for premium tariffs Not the most efficient resource allocation.
Dynamic efficiency	Premium tariffs are inherently biased towards technologies which are closer to market, rather than technologies with extensive need for R&D and market entry investments.
Independent evaluation	None found
Predictability, stability and flexibility of support instruments	The scheme was introduced in 2011 via the Act on support to production of electricity from renewable resources. This Act has been changed a number of times over the last years. Since the parliamentary elections on 19th April 2015, the general view was that support for biomass in energy production will increase while subsidies to wind power will be reduced. The target will probably be mostly achieved (unless many plants already in the system cancel the project). After announcing the plans to reduce the accepted total generation capacity to the system, all the capacity and more was pre-booked. There are hence no plans to lower the tariff.
Burden sharing	This scheme is financed via energy taxation. Electricity intensive industry and data centres receive a discount on energy taxation.[172]

Premium tariff. In order to further production from renewable sources, a premium tariff scheme was introduced in Finland in March 2011. The scheme gives certain producers the right to a premium on top of the market price for the electricity produced.

The tariff system is specified in the Act on support for production of electricity from renewable energy sources ("Lag om stöd till produktion av el från förnybara energikällor"). The aim of this legislation is to promote production of electricity from renewable energy sources, improve the competitiveness of these energy sources, diversify electricity production and improve the self-sufficiency level for electricity.

The tariff scheme is applicable to electricity produced from wind, biogas and wood fuel. The following facilities can be eligible to receive the premium tariffs:

1. forest chip power plant;

[172] http://www.tulli.fi/sv/finska_tullen/publikationer/kundanvisningar/punktbeskattning/filer/021.pdf

2. wind power plant until the total nominal effect of the generators exceeds 2,500 MVA;
3. biogas power plant until the total nominal effect of the generators which mainly are used for biogas exceeds 19 MVA;
4. wood fuel power plant if the approved plants are more than 50 and if their generators have a total nominal effect which exceeds 150 MVA.[173]

Criteria differ from technology to technology. General and technology specific conditions apply for a plant to be approved for the tariff system. A wind power plant, biogas power plant, forest chip power plant of wood fuel power plant must be situated in Finland or in Finnish territorial waters and be connected to the Finnish electricity grid. In addition the power plants must fulfil operational and economic requirements for energy sources.[174]

The power plant specific requirements are as follows.

A *forest chip plant* is approved for the tariff system if:

- the total nominal effect of the generators is at least 100 kVA, and
- the plant is not already part of the system or in the past belonged to the system.

A forest chip plant can be eligible for a "gasification premium" on top of the premium tariff if the plant has a carburettor which gasifies forest chips to use as fuel for a powder combustion boiler.[175]

A *wind power plant* is approved for the tariff system if:

- it has not received state support (unless it is a pilot project);
- it is new and does not contain second hand parts, and
- the total nominal effect of the generators is at least 500 kVA.

A pilot project for an offshore wind power plant can be approved for the tariff system even though it has received state aid for the investment.[176]

A biogas power plant is approved for the tariff system if:

- it has not received state support;
- it is new and does not contain second hand parts;
- it has a total nominal effect of the generators is at least 100 kVA, and
- it uses as fuel biogas that is generated in a biogas facility that has not received state support and which is new and does not contain second hand parts.

A biogas power plant can in addition to the premium tariff be eligible for a heat bonus if:

- if it besides electricity produces usable heat, and
- the plant has a total efficiency rate of a minimum of 50 percent or of a minimum of 75 percent where generators have a total nominal effect of 1 MVA or more.[177]

A wood fuel power plant can be approved for the tariff system if:

- it has not received state support;
- it is new and does not contain second hand parts;
- the total nominal effect for the generators is be between 100 kVA and 8 MVA,
- if it besides electricity produces usable heat, and

[173] §6, Act on support for production of electricity from renewable energy sources.

[174] §7, Act on support for production of electricity from renewable energy sources.

[175] §8, Act on support for production of electricity from renewable energy sources.

[176] §9, Act on support for production of electricity from renewable energy sources.

[177] §10, Act on support for production of electricity from renewable energy sources.

- the plant has a total efficiency rate of a minimum of 50 percent or of a minimum of 75 percent where generators have a total nominal effect of 1 MVA or more.[178]

The **premium tariff** constitutes the difference between the target price and the average value of the market price for electricity for three months in the area in which the power plant is situated. If the average value of the market price for electricity for three months is under 30 EUR per MWh, the premium tariff is paid out on the basis of the target price reduced by 30 EUR per MWh.[179] The target price for electricity from wind power plant, biogas power plant or wood fuel plant is 83,50 EUR per MWh. Thus, for these plants a minimum premium tariff of 53,50 MWh applies.

Support for or a forest chip plant is paid out on the basis of a changing support so that forest chip as a fuel keeps its competitive position in relation to peat with simultaneous production of electricity and heat.[180]

The premium tariff is calculated as follows:

1. 35,65 – 1,824 x tax on peat – 1,358 x the average ETS price during a three months period, if the average ETS price is at least 10 EUR during a three months period;
2. 22,07 – 1,824 x tax on peat, if the average ETS price is below 10 EUR during a three months period.

The calculated premium tariff must be at least 1 EUR per MWh.[181] The market price is calculated on the basis of the day ahead market prices established on the Nordic market for the bidding area in which the plant is situated. An average of the hourly prices for the three month period is used.[182]

Limitations

Approval of the European Commission on the compatibility of the aid with the internal market needs to be obtained where it concerns:

1. gasification premium,
2. pilot project for an offshore wind power plant,
3. a power plant whose capacity for production of renewable electricity will, thanks to the production support, exceed the threshold for detailed state aid research.[183]

Electricity producers can receive the premium tariff for a maximum of 12 years from the date the right to the premium is established. In addition, the right to receive the premium is limited by:

- for electricity from wind power plants, biogas power plants or forest chip power plants: the total amount of production for which the premium is to be paid out exceeds the maximum amount that has been established in the approval decision of the Energy Authority.
- the premium tariff amounts to more than 750 000 EUR for four consecutive price periods[184] where it concerns electricity produced in a wood fuel power plant.[185]

There is currently a very high focus on cost efficiency in Finland.

Investment aid. The second scheme Finland has to promote the use of electricity from renewable sources are subsidies for investment and investigative projects in relation to the production and use of renewable energy.

Support can be awarded to climate and environmentally friendly investment or investigative projects which:

1. promote the production or use of renewable energy,

[178] §11, Act on support for production of electricity from renewable energy sources.

[179] §25, Act on support for production of electricity from renewable energy sources.

[180] §23, Act on support for production of electricity from renewable energy sources.

[181] §4, Regulation on support for production of electricity from renewable energy sources

[182] §3, Regulation on support for production of electricity from renewable energy sources.

[183] §15, Regulation on support for production of electricity from renewable energy sources.

[184] A price period is a period of three months (§16 Act on support for production of electricity from renewable energy sources). Thus, a calendar year has four price periods.

[185] §16, Act on support for production of electricity from renewable energy sources.

2. promote energy saving and efficiency of energy production or use of energy, or
3. reduce environmental damage of energy production or use of energy.[186]

An investment project should concern an investment in *"anläggningstillgångar"*, assets which are needed to implement one of these three aims. Investigative project are projects which relate to energy audits and energy analysis or other research which relate to the development of a new method or service.[187]

A project eligible for support must be financed by the party receiving aid for at least 25 percent with own finances (excluding from public support sources). This requirement does not apply to projects carried out by municipality or an association which is primarily owned by a municipality. Support can be awarded to companies, municipalities and other associations. It cannot be awarded to a housing company, residential property, a building project with a state share or farms or projects attached to farms.[188] Projects attached to any of the previously mentioned R&D projects are funded from different instruments.

Support can amount to a maximum of 30 percent for investment projects and for energy audits to 40 percent of the acceptable costs. Support for an investment project can be increased with 10 percent if the project includes a new technique.[189] In addition, the support for investigative projects can be increased with 10 percent if the support is granted to municipalities or to small to medium sized companies which are compatible with the Commission's recommendation concerning the definition of micro, small and medium sized enterprises (2003/361/EG).

Table 33: Measure –Investment support in Finland

Characteristic	Description
Country	Finland
Supported	Investment and R&D projects
Name of support scheme	Energy support
Objectives	To stimulate climate and environmentally friendly investment projects
Main features	Financial support for investment projects (max. 30% of acceptable costs) depending on selected technology project (max. 40% of acceptable costs).
Year of introduction	2013
Technology focus and differentiation	Differentiation on basis of sort of project and sort of party receiving support.
Budgetary expenditures per year	2012: 26 million EUR 2013: 18 million EUR
Duration of support	Not applicable
Qualification criteria and eligibility	Support can be awarded to climate and environmentally friendly investment or research projects which (1) promote the production or use of renewable energy, (2) promote energy saving and efficiency of energy production or use of energy, or (3) reduce environmental damage of energy production or use of energy. Awarded to companies, municipalities and other associations.
Penalties	Not applicable
Who pays the bill?	Government

[186] §5, Regulation on general conditions for the grant of energy support.
[187] §3, Regulation on general conditions for the grant of energy support.
[188] §6, Regulation on general conditions for the grant of energy support.
[189] §7, Regulation on general conditions for the grant of energy support.

Table 34: Measure: Tax reductions for biofuels

Characteristic	Description
Country	Finland
Supported	Promote the use of biofuels
Name of support scheme	Tax reductions for biofuels
Objectives	Increase the use of biofuels
Main features	Tax deduction
Year of introduction	1995
Technology focus and differentiation	Liquid biofuels for transports
Budgetary expenditures per year	
Duration of support	
Qualification criteria and eligibility	Eligible parties are the authorised warehouse keepers as well as registered consignees and temporary registered consignees
Penalties	Not applicable
Who pays the bill?	Government through waivered tax

7. Appendix – selected EU member state experience

This Appendix section includes descriptions of specific elements of the main renewable energy support schemes of five EU Member States outside the Nordics, in which we first characterise them before the schemes are assessed. We have focused on the following five support schemes:

Table 35: Other EU Support schemes characterised and assessed

Country	Name of support scheme	Type of support scheme
UK	Contracts for Difference (CfD)	Feed-in tariff with Contracts for Difference (CfD)
NL	Stimulering Duurzame Energie (SDE+)	Feed-in Premium based on auctions
DE	Erneuerbare-Energien-Gesetz (EEG)	Combined Feed-in Tariffs and Premiums (Pilot auction for PV)
FR	Décret n°2002-1434 du 4 décembre 2002 relatif à la procédure d'appel d'offres pour les installations de production d'électricité	Combination of Feed-in Tariffs and Auction
IT	There is no official name for the scheme, but it is referred to DM 06/07/12 (Ministerial Decree 6 July 2012) Incentives for electric renewable energy sources apart from PV).	Combination of Feed-in Tariff and Quotas (now auction)

7.1 Characterisation of the support schemes

7.1.1 United Kingdom (UK)

The 2008 Climate Change Act is the main legislation that defines the UK climate and energy policies. The Act sets legally binding targets to reduce emissions by at least 34% in 2020 and 80% in 2050 from 1990 levels. The Act also establishes a framework to develop an economically credible emissions reduction path by defining legally binding 'carbon budgets'. A carbon budget is a cap on the amount of greenhouse gases emitted in the UK over a five-year period. The first four carbon budgets have been put into legislation and run up to 2027.

In the past, the UK experimented with different support schemes for renewable energies including feed-in tariffs, quota systems, and tax regulation mechanisms. As one of the first countries, the UK started to introduce a competitive bidding process with exclusive technology bands to allocate support to renewables. The support was financed through a tax of 10% on electricity (Fossil Fuel Levy). After this tax was reduced to 1% the budget was too tight to continue the support for biomass and offshore wind, which led to the exclusion of these comparatively more expensive technologies and in 1998 to a new programme, the Renewable Purchase Obligation (draft: IRENA 2015).

With the Energy Act 2013, the UK introduced the Electricity Market Reform (EMR). One of its two major reforms is the Contract for Difference (CfD) for low carbon technologies, i.e. renewables and nuclear energy. By 2017, the CfD will have fully replaced the RPO and be the main policy that supports renewable energies. The following therefore introduces and analyses the CfD in greater detail.

Table 36: Characterization of UK Contracts for Difference (CfD)

Characteristic	Result

Name of support scheme	Contracts for Difference (CfD)
Objectives	The policy objective of the CfD scheme is to facilitate **meeting UK's decarbonisation targets at least cost to the electricity consumer** over the longer-term, while also facilitating the ability to stay within the spending limits imposed by the Levy Control Framework (LCF)[190].
Main features	A CfD is a private law contract between a low carbon electricity generator and the Low Carbon Contracts Company (LCCC), a government-owned company. CfDs are allocated in a competitive bidding process. The first auction round started in October 2014 and the first CfDs were allocated to successful bidders in January 2015. The CfD guarantees successful bidders a sliding feed-in tariff, whereas the level of the feed-in tariff corresponds to the clearing price of the auction. The generators will sell energy to energy suppliers at a price that can be above, below or the same as the strike price. If the selling price of energy to the suppliers is equal to the strike price, then there is no further action. If the selling price is below that price, it will trigger top up payments by the suppliers. If the sales by the generators are at a higher price, it will result in generators paying back the difference.
Year of introduction	The CfD was introduced in **January 2014**. It replaces the former Renewables Obligation (RO), a quota scheme. The transition phase from the RO scheme to CfD begun when CfDs were available (January 2014) and ends when the RO closes to new capacity on 31 March 2017. During this transition phase project developers can choose between ROs and CfDs. After 2017, no certificates of the RO will be provided to new plants and CfDs will be the only option for new installations. The certificate market will probably be kept functioning for existing plants until 2037. Presumably, the RO target will have to be increased more moderately than originally defined in the RO target trajectory and it has to be adapted to the newly installed capacities under either scheme to keep prices relatively stable. The consultation proposes to further manage the switch from one scheme to another through grand fathering: RO certificates will be bought for a fixed price from 2027 onwards until 2037, which is defined by the RO price in 2027 (+10%).191
Technology focus and differentiation	The CfD is subdivided into three technology groups (called 'pots') with respective budgets: **Pot 1 Established technologies:** onshore wind (>5 MW), solar photovoltaic (PV) (>5 MW), energy from Waste with CHP, Hydro (>5 MW and <50 MW), landfill gas, sewage gas **Pot 2 Less established technologies:** offshore wind, wave, tidal stream, advanced conversion technologies, anaerobic digestion, dedicated biomass with combined heat and power, geothermal, Scottish Island onshore wind projects (subject to state aid approval) **Pot 3 Biomass conversions:** A separate group is needed as the scale of these projects may distort competition in Groups 1 and 2. This technology group will be subject to immediate competition. Projects will be considered for a CfD against those projects and technology types within the same budgetary 'pot'.[192]
Budgetary expenditures per year	The overall CfD budget for the first allocation round is broken down by technology group and delivery year. CfDs will be allocated to the cheapest projects first, regardless their start date, as long as they fit under the budget profile. The budget caps are as follows: Delivery Year

[190] Note: the Levy Control Framework has been established in 2011 by DECC and HM Treasury with the aim of monitoring and controlling the cost of levy-funded schemes against annual caps. Cap limits are published until the year 2020/21. As of 2015, the LCF applies to all electricity policies in general. The cap to electricity policy levies is set to £ 4.3 billion for the year 2014/2015 and will rise to £ 7.6 billion by 2020/2021 For each of the policies covered by the LCF a spending envelope is defined by DECC on an annual basis. DECC (2013): Impact Assessment Contract for Difference. Available at: *https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249571/ia_cfd_secondary_legislation.pdf* (last accessed 22.04.15).

[191] DECC (2013): Impact Assessment Contract for Difference. Available at: *https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249571/ia_cfd_secondary_legislation.pdf* (last accessed 22.04.15).

[192] Norton Rose Fulbright (2015): Contracts for Difference: First Allocation Round. Available at: *http://www.nortonrosefulbright.com/knowledge/publications/119318/contracts-for-difference-first-allocation-round (last accessed: 22.04.15).*

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<tr><td></td><td>
<table>
<tr><td>£m (2011/12 prices)</td><td>15/16</td><td>16/17</td><td>17/18</td><td>18/19</td><td>19/20</td><td>20/21</td></tr>
<tr><td>Pot 1 (established technologies)</td><td>50</td><td>65</td><td>65</td><td>65</td><td>65</td><td>65</td></tr>
<tr><td>Pot 2 (less established technologies)</td><td>-</td><td>155</td><td>260</td><td>260</td><td>260</td><td>260</td></tr>
<tr><td>CFD Budget (2014 release)</td><td>50</td><td>220</td><td>325</td><td>325</td><td>325</td><td>325</td></tr>
</table>
Pot 3: no budget released in 2014. Decisions on budget for 2015 allocation round will be taken in late 2015.[193]
</td></tr>
<tr><td>Duration of support</td><td>15 years for renewable energy technologies (except biomass conversion).

The contract length for nuclear energy technologies is agreed on a case-by-case basis. E.g. the Hinkley Point C nuclear power station has agreed on a contract difference payment duration of 35 years.[194]</td></tr>
<tr><td>Qualification criteria and eligibility</td><td>To be able to participate in the allocation round RES-E generators have to meet the following qualification requirements:

Provide copies of the relevant planning consents, which enable (1) the relevant CfD unit to be established/altered and (2) electricity generated by the relevant CfD unit to be supplied to the national transmission/ distribution grid or a private grid[195].

Provide copies of connection agreements allowing connection to the grid where a direct/ partial connection applies or is to apply to the relevant CfD unit.[196] Where a direct/ partial connection does not apply or is not to apply to the relevant CfD unit, statement has to be provided by the applicant which states that (1) no such connection is, or is to be, applicable and (2) no agreement to allow such a connection has been obtained or is to be sought during the period in which a CfD may apply to the relevant CfD unit.[197]

Operators of projects of and beyond 300 MW must provide a copy of the Supply Chain Statement issued by the Secretary of State.[198]

Where a relevant CfD unit is or is to be a phased offshore wind CfD unit the applicant must demonstrate that (1) after all phases are completed, the capacity of the CfD unit will not exceed 1,500 MW, (2) the 1st phase will represent at least 25% of the total capacity of the CfD, and (3) the 1st phase is expected to be completed by 31 March 2019 latest and the last phase will be completed no later than 2 years after the completion of the 1st phase.[199]</td></tr>
<tr><td>Penalties</td><td>There are a number of key deadlines set out in the CfD Contract which all generators should be aware of:

A Milestone Delivery Date (MDD) – one year from contract signature. By the MDD, the generator must provide evidence either that they have spent 10% of all project pre-commissioning costs (specified by technology) or that they have instead fulfilled certain 'Project Commitments' which include, for example, signing contracts for material equipment thereby committing significant expenditure against the delivery of agreed capacity (the full list of general and technology specific Project Commitments is set out in the contract). If neither of these are met, the generator's CfD can be terminated by the LCCC.

Target Commissioning Window (TCW) – the generator will have specified their TCW time period in their CfD application. If they do not commission within this TCW, the 15 year subsidy support period is proportionately reduced by the length of this delay.

Longstop Date – this is a technology-specific length of time after the end of the project's TCW. If generation has not started by this date, the generator's CfD can be terminated by the LCCC.</td></tr>
</table>

[193] Secretary of State (2014): Explanatory Note to set out the wider context of the CfD Budget Notice. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/360278/Explanatory_Note_To_Set_Out_The_Wider_Context_Of_The_CFD_Budget_Notice_Alternative_Version.pdf (last accessed: 22.04.15).

[194] DECC (2014): Hinkley Point C. State aid. Available online: http://www.csvts.cz/cns//news14/140325b.pdf (last accessed: 22.04.15).

[195] Reg. 23 (2) (a) and (b) CfD Allocation Regulations 2014. Available at: http://www.res-legal.eu/search-by-country/united-kingdom/single/s/res-e/t/promotion/aid/contracts-for-difference-cfd-scheme/lastp/203/ (last accessed: 18.04.15).

[196] Reg. 25 (2) CfD Allocation Regulations 2014.

[197] Reg. 25 (3) (a) and (b) CfD Allocation Regulations 2014.

[198] Reg. 26 CfD Allocation Regulations 2014 in conjunction with Reg. 11 EMR General Regulations 2014.

[199] Rule 5 Final Allocation Framework 2014.

	Withdrawing from the process: Successful bidders who are sent a CfD for signature cannot (without suffering the consequences at least) change their mind if they do not like the strike price they have been awarded. DECC have a non-delivery disincentive policy to prevent such 'gaming' of the system, to incentivise successful CfD parties to deliver, and to minimise the risk of CfDs being awarded to projects that are not able to be delivered. Where a generator is awarded a CfD but does not sign it, it will not be able to reapply for a CfD for the same site for 13 months. There are only very limited exceptions to this. It is also worth noting that the same fate applies where the generator does sign the CfD but the project then does not meet its MDD.
Who pays the bill?	The cost of CfD scheme is met by consumers via a levy on electricity suppliers.

Table 37: Review of UK Contracts for Difference (CfD)

Characteristic	Result
Lead time before auction	The first auction round was announced in August 2014, with the planned starting date of October 2014, notice awards for successful applicants sent in November, bids submitted in December and contracts awarded in January 2015. However, the timetable was revised due to review requests from unsuccessful applicants. Sealed bids were finally invited for end of January and awards notified end of February.
Min./max. size of project	Renewable projects ≤5 MW are supported by a small scale feed-in tariff regime and are not part of auctions. The following are excluded applicants: • CCS and Nuclear • AD, Hydro, Onshore Wind, Solar ≤ 5MW • Applicants in receipt of funds from other Government support schemes – RO; CM; ssFIT (some exceptions apply, e.g. dual scheme facilities) • Non-Great Britain based projects
What is auctioned?	Tariff: the auction is used to set actual strike prices (administrative strike prices have already been set)
Frequency of auctions	Allocation rounds are currently expected on an annual basis until the budget is used up.
Volume of the tender	The volume of the tender is expressed in terms of the budget which equals total support payments given in a year.
Auction procedure	The CfD scheme operates as a sealed bid procedure, where the bidders have no information on other bids and thus cannot react on those. Key elements of the auction process (per pot): • All projects in each delivery year are listed in order of price; • Lowest bids are always considered first; • If the budget is not breached all bids are offered the administrative price; • The first project that breaches the budget in a delivery year is rejected; • The delivery year is then closed to all other bids; • The last accepted project sets the clearing price for that delivery year; • The administered strike price is the maximum clearing price for a technology; • When all years are closed, or when there are no more projects in the auction, the auction ends. The auction process is conduced as **pay as clear**, which means that all projects under the same 'pot' and delivery year, receive the same financial support.

Ceiling price	In the CfD ceiling prices are equal to the administrative strike prices set by DECC. Strike prices are adjusted on an annual basis to reflect technology learning and cost reductions. The strike prices in £/MWh (2012 prices)[200] for the first allocation round were:

	2014/15	2015/16	2016/17	2017/18	201
Advanced Conversion (with or without CHP)	155	155	150	140	140
Anaerobic Digestion (with or without CHP)	150	150	150	140	140
Dedicated Biomass (with CHP)	125	125	125	125	125
Energy from Waste (with CHP)	80	80	80	80	80
Geothermal (with or without CHP)	145	145	145	140	140
Hydro	100	100	100	100	100
Landfill Gas	55	55	55	55	55
Sewage Gas	75	75	75	75	75
Onshore Wind	95	95	95	90	90
Offshore Wind	155	155	150	140	140
Biomass Conversion	105	105	105	105	105
Wave	305	305	305	305	305
Tidal Stream	305	305	305	305	305
Large Solar PV	120	120	115	110	100
Scottish Islands Onshore				115	115

Pricing rules	Uniform pricing: the payment rule is pay-as-clear, where all projects are paid the relevant clearing price, which is different for each delivery year. Prices are capped at their Administrative Strike Price.

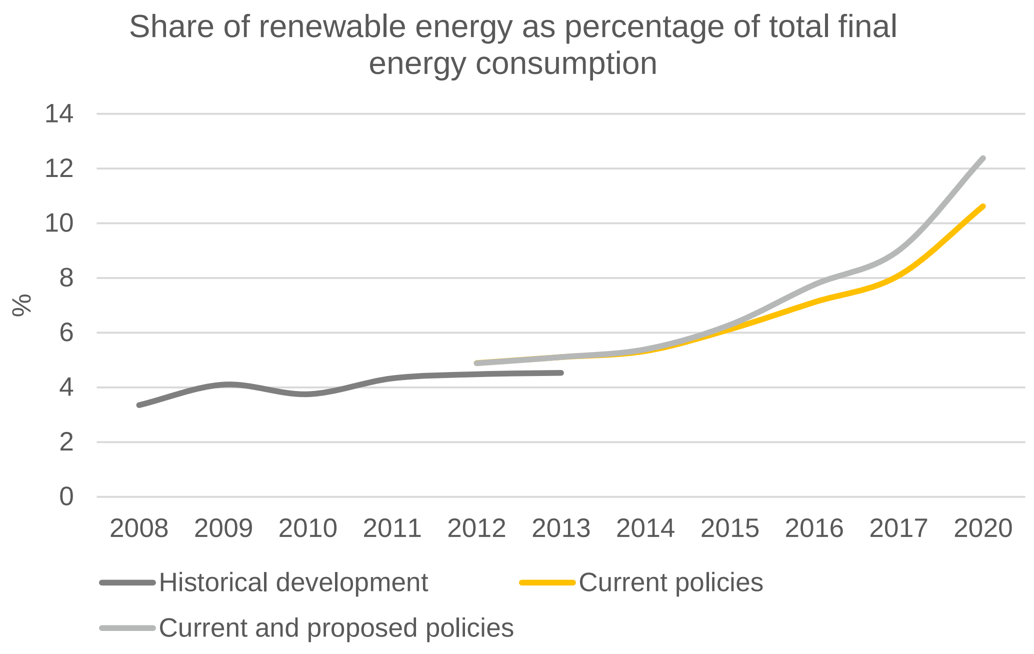
7.1.2 Netherlands

The Netherlands has a binding EU target for Renewable Energy of **14% in 2020. The current share** is 4.5%.

Although progress has been slow historically, deployment speed is picking up. This has been strengthened by an agreement in 2013 between all relevant stakeholders to meet the target and on the measures that are needed (Energy Agreement).

According to the latest prognoses the Netherlands will not meet its RES target with current and proposed measures and is expected to fall 2 – 4% short.

[200] DECC (2013): Investing in renewable technologies – CfD contract terms and strike prices. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/263937/Final_Document_-_Investing_in_renewable_technologies_-_CfD_contract_terms_and_strike_prices_UPDATED_6_DEC.pdf (last accessed: 22.04.15).



PJ (final energy), current Policies

Hydropower	0.4	0.2%
Wind onshore	51.0	22.2%
Wind offshore	12.7	5.5%
PV	15.6	6.8%
Solar thermal	1.4	0.6%
Heat Pumps, Heat and Cold Storage	16.4	7.1%
Geothermal	8.6	3.7%
Biomass energy	123.6	53.8%
Total	229.8	100%

Table 38: Characterisation of the SDE+ in the Netherlands

Characteristics	Description
Name of the support scheme	Stimulering Duurzame Energie (SDE+)
Objectives	The primary objective of the scheme is the realisation of the Dutch renewable energy target of 14% for 2020 as agreed in the EU RES Directive, most cost-efficiently.
Contracting authority	Rijksdienst voor Ondernemend Nederland (RvO), which is the executive agency of the Dutch Ministry of Economic Affairs.

<table>
<tr><td>Main features</td><td>In July 2011, the Dutch government replaced its existing feed-in premium scheme SDE (Subsidieregeling duurzame energieproductie) introduced in 2008 with SDE+, a sliding premium determined based on auctions. The SDE+ scheme aims to incentivise the deployment of renewable energy at the lowest possible cost.</td></tr>
<tr><td>Year of introduction</td><td>The auction scheme was introduced in 2011. Since, the scheme has been revised each year, adding additional competitive annual auction rounds or phases.</td></tr>
<tr><td>Technology focus and differentiation</td><td>The scheme covers RES-E, RES-H&C and biogas and the whole range of technologies that fall under these three broad categories. In theory, the SDE+ differentiates between technology categories. In each auction round the auctioning body sets a technology specific base price and determines the budget that should be allocated to this technology. All bidders that are willing to realise their projects of this technology for the base price are awarded with a contract. In practice, it is a technology-neutral scheme where all technologies compete against each other. The reason is that there is a “free category”. If a bidder is willing to realise a project of any technology for a lower price than the base price in the technology specific categories, the bidder gets a preferential treatment. This way, the free category gives bidders the opportunity to access the scheme sooner, at lower tariffs. All projects, independent of the technology, can apply for subsidy in this free category.</td></tr>
<tr><td>Budgetary expenditures per auction and per year</td><td>For 2015, the total budget of the auction is 3.5 bln. EUR for new projects that participate in the auctions that year. This is similar to the budget in 2014. The budget for the years after 2015 is not established yet and determined annually in the year preceding the auction. The budget depends on several developments, including whether the entire budget is consumed the previous year(s), the actual realisation of projects (the allocated budget for projects could be cycled back into the scheme) and changes in energy price scenarios.

The annual (expected) budgetary expenditures for the SDE+ are presented in the table below.

<table>
<tr><td>2012</td><td>2013</td><td>2014</td><td>2015</td><td>2016</td><td>2017</td><td>2020</td></tr>
<tr><td>100</td><td>200</td><td>320</td><td>494</td><td>878</td><td>1,624</td><td>2,455</td></tr>
</table>
Table 39: annual (expected) budgetary expenditures (mln. EUR)</td></tr>
<tr><td>Duration of support</td><td>12 years for biomass related projects, 15 years for the other categories.</td></tr>
<tr><td>Qualification criteria and eligibility</td><td>Qualification requirements

Completed application form

Required permits:

Environmental permit (Omgevingsvergunning);

Geothermal projects only: (mining) exploration permit (Opsporingsvergunning) and a completed geological survey.

Written permission of the owner of the location/land;

A (technical) description of the installation/project;

For projects with a budget claim >400 mln. EUR, a bank statement and a realisation contract (Uitvoerings-overeenkomst) is required.

A feasibility study (see below).

Grounds for disqualification

Non-conformity to legal requirements of the qualification;

Non-feasibility of projects or insufficiently realisic or non-viable projections;

Missing permits and official documents for prove;

No or insufficiently grounded permission from the owner of the location/land.</td></tr>
</table>

	Feasibility study Since 2014 it is required to submit a feasibility study for projects that are larger than 0.5 MW, 500 kWp resp. 50 Nm³/hr. The feasibility study should contain the following elements: Exploitation statement with: A specification of the investment costs per (main) component of the production installation A cost-benefit analysis of the installation A profit & loss statement with expected returns on investment Statement of the level of equity and financing: For projects with less than 20% equity: a letter of intent from a financing party stating capacity and willingness to finance the project Calculations and projections of the expected production from wind, hydro, biomass and waste sources (only these sources). For biogas projects: a statement from the responsible DSO of the costs for feeding into the gas network For renewable heat projects: an assessment of the heat demand (prove of sufficient demand/customers for the heat from the installations).
Who pays the bill?	The SDE+ is financed through a levy on the energy bills of consumers and industry. See further section 'Burden Sharing'.

Table 40: Support scheme specific characteristics of the Netherlands' SDE+

Characteristics	Description
Min./max. size of projects	There is no set minimum or maximum size of projects.
What is auctioned?	The scheme auctions premiums that remunerate the production from renewable energy sources.
Lead time before auction	Each year in March the conceptual design of the scheme for the year thereafter is published by ECN and DNV GL (i.e. in March 2014, for the auctions in 2015). This publication contains the ceiling prices for the different categories, including underlying assumptions and information, including the technical and financial parameters. From June to July market consultations take place. In the November the final publication becomes available. The usually adopted by the Ministry, though minor changes are sometimes made. The definitive details of the design of the auctions for that year are published in the government Gazette, usually in February (the auctions take place in April).
Budgetary expenditures per auction and per year	See table above
Frequency of auctions	Each year the auctions open in several rounds. In 2014 there were 6 rounds, in 2015 there will be 9 auction rounds. The rounds and their opening dates are presented in the table below. Auction rounds and opening dates in 2015 **Round** – Opening date **1** – 31/3 **2** – 20/4 **3** – 11/5 **4** – 1/6 **5** – 22/6 **6** – 31/7 **7** – 21/9 **8** – 12/10

	9 9/10
Volume of the tender	The volume of the tender corresponds to the annual budget ceiling. This is 3.5 bln. EUR in 2014 and 2015. The budgets for subsequent years are not published yet but will be equal or higher than preceding years.
Auction procedure	The SDE+ works with multiple bidding rounds or phases (6 in 2014, 9 in 2015). For each round, the auctioning body sets the base amount. Bidders that are willing to realise at this price will be awarded with a contract. If the predetermined budget is budget is exceeded by one round, the annual auction stops. If the budget is not exceeded, the auctioning body rises the base amount and bidders are allowed to submit new applications. After each round, only an aggregated overview is published, showing the technology (categories) and their budget claims. The individual bids (name developer, limited technical project details and budget claim) are published at the end of each year after the scheme has closed for new applications. In 2012, the budget was exhausted after the first round. There is also a "free category" in each bidding round, in which project developers have the opportunity to request a lower level of compensation than the one of the respective bidding round. The Dutch government is planning to organize separate tenders for offshore wind energy in 2015.
Ceiling price	In order to limit the cost of support, the SDE+ sets a ceiling price for each technology, above which projects are not considered. The ceilings for the different technologies are established and adjusted on an annual basis. The ceiling in the SDE+ corresponds to the so-called base prices. The base prices reflect the remuneration (i.e. premium) and (a projected) market price. The ceiling prices are disclosed and publicly accessible and established by a set of LCOE calculations done by the Energy Research Centre in the Netherlands, after extensive market consultations. Their recommendation for next year ceiling prices is usually communicated in November each year. They are usually adopted by the Ministry, though minor changes are sometimes made. The definitive prices are published in the government Gazette, usually in February (the auctions start in in April).
Pricing rules	The SDE+ is a pay-as-bid auction whereby the winning bidder receives the price of its bid. The auction results in the allocation of multiple units of the same product with different prices to more than one project developer.
Exemptions from requirements for small plants/developers?	The following exemptions are in place for small plants and developers: Projects with a budget claim <400 mln. EUR: a bank statement and a realisation contract[201] (uitvoeringsovereenkomst) is not required[202]; Projects smaller than 0.5 MW, or 500 kWp resp. 50 Nm³/hr are exempt from submitting a feasibility study (see section on qualification criteria).
Penalties	Since 2012, penalties are in place for the non-realisation of projects within the required period (usually 3 years). This is only relevant for projects that claim > 400 mln. EUR of the budget (over their lifetime).These projects have to sign a contract for realisation with the executive agency of the Ministry of Economic affairs (RVO) and have to present a bank statement. The fine is max. 2% of the budget claim of that project and decided by RVO (or in Court in case of a dispute). The bank statement has to guarantee payment of this 2%. No projects have claimed more than 400 million EUR in 2012. No information is available why such high limit was chosen. For all other projects: developers will lose their subsidy if the installation is not constructed and connected to the grid within the given years (usually 3) and/or when, within a year of the date of the decision, the

[201] The contract states that the project has to be realised within the given timeframe.

[202] BIJLAGE 7 BEHORENDE BIJ ARTIKEL 39 VAN DE REGELING AANWIJZING CATEGORIEËN DUURZAME ENERGIEPRODUCTIE 2011 Uitvoeringsovereenkomst tot zekerheid van het aanvangen van de activiteiten ter zake waarvan subsidie is verstrekt op basis van artikel 35, eerste lid, van de Regeling aanwijzing categorieën duurzame energieproductie 2011. https://zoek.officielebekendmakingen.nl/stcrt-2011-9424.html

	order for the construction of the installation is not given. They cannot re-apply for SDE+ support within the next 5 years for the same project. However, project developers could "redefine" their project (e.g. by making larger or bigger) and apply again. New measures have been introduced to limit the unnecessary budget claim of projects that are not realised. These measures include[203]: Since 2014: a feasibility study is an important qualification requirement (see section on qualification criteria). This is seen as a major contribution to improving the realisation rate. Project developers of projects that are not realised are excluded from SDE+ for five years, for the same project. Stricter check on feasibility y of projects and their economic viability on the basis of an assessment of the realisation and a financial plan that are submitted by applicants. Check of progress after one year by RVO. For projects with a budget claim >400 mln. EUR, a bank statement and a realisation contract (uitvoeringsovereenkomst) is required. The contract states that the project has to be realised within the given timeframe[204].
Different options regarding what is effectively tendered and what is asked for as bids	In the SDE+ bidders offer a price per kWh. Projects are selected that perform best on the price per kWh. The tender is closed when the annual budget cap is reached.
Transferability of support right	The support right is not transferable to other (legal) persons than those to whom the support is granted[205].

7.1.3 Germany

In the 2010 Energy Concept, the German government has set energy and climate change policy targets up to 2050. Compared to 1990 levels, GHG emissions shall be reduced as follows:

- 40% by 2020
- 55% by 2030
- 70% by 2040
- 80-95% by 2050.

To achieve these GHG emission reduction goals, a strong increase in the deployment of renewable energies is planned. Renewables shall cover 18% of the gross final energy consumption by 2020. By 2050, this share is projected to be 60%. The share of renewable energies in the electricity sector plays a key role. The Renewable Energy Sources Act 2014 (EEG 2014) aims to reach the following minimum shares in the electricity consumption (compared to 25.5% in 2014):

- 40% - 45% by 2025
- 55% - 60% by 2035
- minimum 80% by 2050.

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[203] http://wetten.overheid.nl/BWBR0022735/geldigheidsdatum_03-04-2013#i6

1.1 **204** bijlage 7 behorende bij artikel 39 van de regeling aanwijzing categorieën duurzame energieproductie 2011 Uitvoeringsovereenkomst tot zekerheid van het aanvangen van de activiteiten ter zake waarvan subsidie is verstrekt op basis van artikel 35, eerste lid, van de Regeling aanwijzing categorieën duurzame energieproductie 2011. https://zoek.officielebekendmakingen.nl/stcrt-2011-9424.html

[205] Article 61, second paragraph, Besluit Stimulering Duurzame Energieproductie.

Parallel to the increasing deployment of renewables, the German government decided to completely withdraw from nuclear power by 2022. The remaining nine nuclear power plants that are still operating will have to phase out gradually in the coming years.

The determined targets will change the geographical distribution of power generation facilities. Power plants and wind turbines are expected to concentrate in Northern and Eastern Germany, while load centres are in Western and Southern Germany. The government plans to install large direct current "electricity highways" from Northern Germany to Southern Germany to ensure adequacy of supply. This might increase network costs on transmission grid level. Additionally, distributed electricity generation in PV installations and wind turbines increase network constraints on distribution grid level. Tariffs for network fees are therefore expected to increase.

The Renewable Energy Sources Act (EEG) is key to the achievement of said energy and climate change policy goals. Through various policy instruments, it regulates the financial incentives (mainly feed-in-premiums) for renewables support, the surcharge to finance the support, as well as the exemptions for energy intensive industries. Furthermore, the EEG 2014 stipulates the extension targets of wind onshore by 2,500 MW per year (net extension i.e. excluding repowering measures) and PV by 2,500 MW per year (gross extension). In the EEG 2014, the expansion goal of wind offshore was reduced to 6,500 MW by 2020 (the original goals was 10,000 MW) and 15,000 MW by 2030. Targets for biomass were reduced to 100 MW per year (gross extension). The policy costs of the EEG are substantial. For 2015, German TSOs estimate support payments of €26.9 billion.

In 2014, the renewable energy share in gross electricity production was 27.8%.[206]

Table 41: Characterisation of Germany's EEG (2014)

Characteristics	Description
Name of the support scheme	§55 Renewable Energy Sources Act (EEG 2014)
Objectives	The aim of the tender process is to determine the required level of support for renewable energies in a competitive manner. At the same time, the tender process should allow keeping the present diversity of market players and meeting the government's expansion targets. The pilot scheme is being tested for ground-mounted PV plants before similar but technology-specific schemes will potentially become effective for wind onshore, wind offshore, roof-top PV, and biomass by 2017.
Contracting authority	Bundesnetzagentur (Federal Network Agency)
Main features	Annually, three tender rounds for ground-mounted PV plants will take place. Details of each tender round will be published on the Bundesnetzagentur's website about eight weeks in advance together with the strict requirements for the tender documents. Each tender had to include information and documents on the land to be developed for the plant and had to specify an incentive rate (in cents per kilowatt hour) for the electricity to be generated and the farm's capacity in kilowatts. Contracts are awarded from the bottom up to the tenders with the lowest rates until the total volume put out for tender has been reached. In the first round, investors had until 15 April to submit their bids to the Bundesnetzagentur. In this round, a total of 150 MW had being put out for tender, with the maximum rate set at 11.29 cents per kilowatt hour.
Year of introduction	April 2015
Technology focus and differentiation	PV as pilot project, tenders for other technologies are planned from 2017 onwards, tender schemes are expected to be technology-specific
Budgetary expenditures per auction and per year	No overall budget is set for the auctions.

[206] BMWi (2015): Erneuerbare Energien im Jahr 2014. Erste Daten zur Entwicklung der erneuerbaren Energien in Deutschland auf Grundlage der Angaben der Arbeitsgruppe Erneuerbare Energien-Statik. Available at: https://www.bmwi.de/BMWi/Redaktion/PDF/Publikationen/erneuerbare-energien-im-jahr-2014,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf (last accessed: 22.04.15).

Duration of support	The tariff payment period is usually 20 years plus the year in which the system or plant was put into operation (§ 22 EEG 2014).
Qualification criteria and eligibility	In principle, everyone can participate in the auction. The bids must be made for an installed capacity (DC) of an ground-mounted PV plant of at least 100 kW and a maximum of 10 MW. Electricity produced may not be used for self-consumption during the entire funding period. This also applies once the owner of the PV plant changes. Awarded contracts are provider-specific. , which means that a successful bidder may transfer the support rights from the winning project to another project within its own portfolio at the expense of a small penalty, but is not allowed to sell the support rights. The possibility to sell an entire plant remains untouched. In 2015, bids are only eligible if they are made for areas that: • have been sealed at the time of the decision; • are a conversion area of economic, transport, architectural or military activities; • are along highways and railways at a distance up to 110 meters, measured from the outer edge of the paved road; • Are owned by the Federal Government or the Federal Agency for Real Estate; • are farmland in a disadvantaged area. Additionally, bid bonds of 4€/kWh have to be paid as a security which comes effective in case the bidder withdraws a successful bid i.e. does not hand in the additional security for the penalty.
Penalties	Successful bidders who do not apply for a certificate of support (which they can only successfully do if the plant has been commissioned) within a period of 24 months have to pay a penalty. The amount depends on the state of planning the PV power plant was in when the bid was made. It can amount to up to EUR 50/kW.
Who pays the bill?	End user via levy on electricity bill

Table 42: Support scheme specific characteristics of Germany's EEG (2014)[207]

Characteristic	Result
Lead time before auction	The legal statute (Freiflächenverordnung) was passed in January 2015 by the cabinet. The first auction round started in April.
Min./max. size of project	Bids must amount to at least 100 kW and be no higher than 10 MW.
What is auctioned?	In each auction financial support for power generated in ground-mounted PV plants with a total capacity of 200 MW is auctioned.
Frequency of auctions	Three auctions are planned (1 April, 1 August, 1 December) for each calendar year.
Volume of the tender	A total capacity of 600 MW per year for ground-mounted PV plants will be auctioned per year. [208]
Auction procedure	The auction follows a so-called static procedure. First, bidders submit a sealed offer to the Bundesnetzagentur (BNetzA, the agency responsible for implementing the tendering process). Second, the BNetzA checks compliance with the prequalification criteria and excludes offers that exceed the price ceiling. Third, the BNetzA ranks bids

[207] Information is taken from; Verordnung zur Ausschreibung der finanziellen Förderung für Freiflächenanlagen. Available at *http://www.gesetze-im-internet.de/ffav/BJNR010810015.html* (last accessed: 22.04.15) and Bundesnetzagentur (2015): PV-Ausschreibungen. Avialable at: *http://www.bundesnetzagentur.de/cln_1421/SharedDocs/Pressemitteilungen/DE/2015/150421_Erste_PV-Ausschreibung.html* (last accessed: 22.04.15).

[208] *http://www.germanenergyblog.de/?p=17391* (last accessed: 22.04.15).

	according to the offered price and determines which bids will be awarded to meet the fill the volume. Fourth, the BNetzA notifies successful bidders. Fifth, successful bidders have to hand in a security for the penalty. If successful bidders do not submit this penalty, the awarded support rights are withdrawn and the volume may be awarded to the next-ranked, previously unsuccessful bidder.
Ceiling price	A ceiling price which bids may not exceed is set for each tender round. The ceiling price equals the current support level for roof-mounted PV plants pursuant to Sections 51 §2 no. 3 and 31 § 1 to 5 EEG 2014.
Pricing rules	Bids are awarded on a pay-as-bid basis, with the exception of two rounds in 2015 which apply uniform pricing (all bidders receive the same financial support that corresponds to the highest successful offer). Using both methods shall help gain more experience.

7.1.4 France

France has committed to a 40% share of renewable electricity in supply by 2030 and 27% by 2020. In detail, the targets for 2020 are: 5.4 GW photovoltaic, 19 GW Onshore wind, 6 GW Offshore wind, 2.3 GW Biomass. Additionally, France's nuclear share in electricity production will decrease from 75% in 2014 to 50% by 2025.

In France electricity from renewable sources is promoted through feed-in tariffs and tax benefits. Additionally, France has a tender system for offshore wind and solar PV. Renewable heat generation is subsidised by various systems and tax regulation mechanisms, as well as through a zero interest loan. The main support scheme for renewable energy sources used in transport is a quota system. Furthermore, biofuels are supported through fiscal regulation.

The French electricity generation market is still dominated by the historical incumbent, EDF, which owns all of the country's nuclear power plants, the nuclear fleet alone accounts for 73% of total generation. In 2013, total installed capacity was 128 GW and total electricity generation was 550 TWh. Electricity generation was 1.7% higher in 2013 than in 2012. France has a target of 27% renewable power by 2020. The recently passed energy transition bill provides for a cap on nuclear capacity at its present level. In 2013, spot prices were €43.2/MWh on average over the year, down by €3.70 compared to 2012. In 2013, the French regulator (CRE) forecasted significant price increases by 2017 in regulated tariffs for all types of customers. Transmission and distribution are unbundled from generation. However, the transmission operator, RTE, and the largest distribution operator, ERdF, are 100% owned by EDF.

Table 43: Characterisation Solar-PV auctions in France

Characteristic	Description
Name of support scheme	The legal basis for the auctions is set with the Decree n°2002-1434 of 4 December 2002 on the procedures of calls for offers for electricity producing installations (FR: Décret n°2002-1434 du 4 décembre 2002 relatif à la procédure d'appel d'offres pour les installations de production d'électricité) and the Decree n°2004-90 on compensation for the additional costs arising from public electricity services. Two different auction systems for solar PV exist: one for solar PV between 100 and 250 kW and one for solar PV >250 kW . This analysis focuses on tenders for solar PV that are between 100 and 250 kW (As of 2014, only two auction round were held for the larger segment which has many different categories. In each category only very few projects participated)
Objectives	•
Main features	France conducts **standardised pay-as-bid online-auctions**. No prequalification stage exist (however the bidder has to meet certain criteria (see pricing rules)). Bids can be submitted during the 3-month auctioning phase. In **France**, 20% of the tariff is indexed annually with income levels in the energy industry and an industry-specific price index.[210]

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[209] Cruciani, M. (2015): A short analysis of the French public policy (2000-2014): Franco-German Renewable Energy Office.

[210] Held, A., Ragwitz, M., Gephart, M., de Visser, E., Klessmann, C. (2014): Design features of support schemes for renewable electricity. A report compiled within the European project "Cooperation between EU MS under the Renewable Energy Directive and interaction with support

Year of introduction	Since **2011**, France has conducted standardised pay-as-bid online-auctions for rooftop PV installations between 100-250kW.
Technology focus and differentiation	France conducts technology specific (solar) pay-as-bid auctions.
Duration of support	Tariffs are guaranteed for 20 years.
Qualification criteria and eligibility	In France, for small scale PV, parties are required to meet the following criteria: •
Who pays the bill?	End user financed via the "Contribution au Service Public de l'Electricité" (CSPE).

Table 44: Support scheme specific characteristics of France's solar PV auctions

Characteristic	Description
Min./max. size of projects	Only 100kW-250kW systems are eligible. The reasons for choosing the thresholds of 100 kW and 250 kW for PV tenders are explained by the French Commission for Energy Regulation (Commission de régulation de l'énergie) as follows: (iii)
What is auctioned?	Capacity is auctioned. The evaluation of the bids takes the price (required feed-in tariff in €/kWh) and the CO_2 balance into account (by 33%). Network connection charges are covered by the project developer and have to be considered in the bid.
Lead time before auction	The lead time before the auction is around 6 months. The tenders are announced in the official gazette of the European Union as well as on the homepage of the French Regulatory Energy Commission. The auction phase usually lasts for 3 months. Afterwards an 18 months deadline exists for construction and commission (after the announcement of the winner of the auction).[213]
Frequency of auctions	The auction time-table aims for regularly auctions. 5 auctions were scheduled for 2011-2013 for a total of 300 MW, however the last two rounds have been cancelled to improve the auction design. For 2013-2014 3 auctions took place for a total of 120 MW.[214] The ministry responsible for energy invites tenders at irregular intervals to reach the target production of electricity from renewable sources, which is specified in the multi-annual investment plan (Programmation Pluriannuelle des Investissements PPI), (art. 8 Loi n°2000-108).[215]
Volume of the tender	Tender volumes vary. Several auctions are taking place per year with an average volume of 40 MW.[216]

schemes". Available at: https://ec.europa.eu/energy/sites/ener/files/documents/2014_design_features_of_support_schemes.pdf (last accessed: 22.04.15).

[211] Franco-German Renewable Energy Office: http://enr-ee.com/de/veranstaltungen/vergangene-veranstaltungen/messen-und-fachvortraege/ (last accessed: 22.04.15).

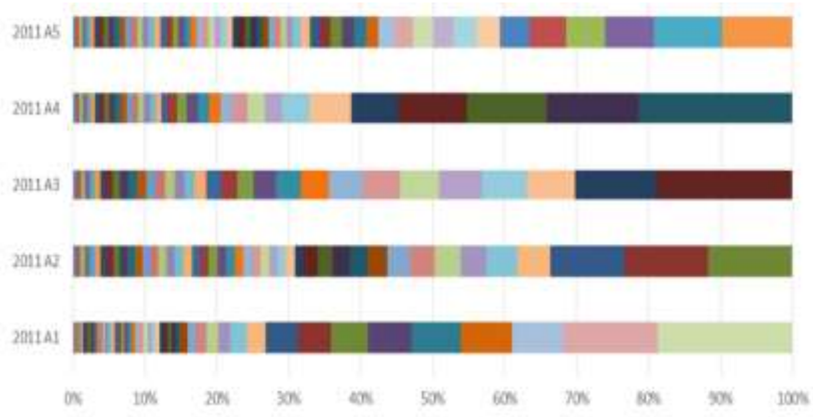
[212] •Grau (2014): Comparison of Feed-in Tariffs and Tenders to Remunerate Solar Power Generation. Available at: http://www.diw.de/documents/publikationen/73/diw_01.c.437464.de/dp1363.pdf (last accessed: 22.04.15).

[213] •Regulatory Commission of Energy: http://www.cre.fr/documents/appels-d-offres (last accessed: 22.04.15).

[214] Franco-German Renewable Energy Office (2014): Das Ausschreibungsmodell für erneuerbare Energien. Erfahrungen aus Frankreich.

[215] http://www.res-legal.eu/search-by-country/france/single/s/res-e/t/promotion/aid/tenders-appels-doffres/lastp/131/ (last accessed: 22.04.15).

[216] Fraunhofer ISI, Consentec GmbH, TU Wien (2014): Ausschreibungen für Erneuerbare Energien. Available at: http://www.agora-energiewende.de/themen/die-energiewende/detailansicht/article/ausschreibungen-sorgfaeltig-testen/ (last accessed: 22.04.15).

Competition and type of participants	The design of the auction in France is kept simple (no prequalification stage etc.) to not impose obstacles for small agents.  **Figure 35: Proportions of individual bidders at the contracted power PV tender in 2011 (plants smaller than 250 kW). Colours represent the different market actors** The different colours reflect the different actors and the share of the total capacity auctioned in 2011. No data is available for other years.[217]
Auction procedure	The auction process itself is organised as static auctions (so called "sealed bid"). In this option, bidders have no information on other bids and thus cannot react to those.
Ceiling price	No ceiling price exists in France.
Pricing rules	All bids are made online. Pricing rules changed in 2013. Previously they were based 100% on price. From 2013 onwards selection was based on two criterion, with a total mark of 30 points. •
Exemptions from requirements for small plants/developers?	The tender is only inviting bids for small-scale PV installations.
Penalties	In France, penalties are foreseen for small-scale photovoltaic facilities, however the amount it not settled and so far penalties have not been used. The installation has to be up and connected 18 months after publication of the auction results (extendable by 2 months, if the delay is caused by the DSO). In case of delays, the duration of support can be reduced by the delay, multiplied by two. [219]
Different options regarding what is effectively tendered and what is asked for as bids	Capacity (tendered) / Price per kWh (offered/supported): In this case capacity is tendered. However, bidders offer a price per kWh. Projects are selected that perform best on the price per kWh and other selection criteria. The tender is closed when the defined capacity is reached.
Transferability of support right	Transferability is not allowed, the bidder has to be the owner of the building/installation. However, change of operator is possible afterwards, but has to be approved by the Ministry.

[217] •Franco-German Renewable Energy Office (2014): Das Ausschreibungsmodell für erneuerbare Energien. Erfahrungen aus Frankreich.

[218] Winkler et al. (2014): Sammlung der Beiträge der Zukunftswerkstatt Erneuerbare Energien. Available at : *http://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/Berichte/2014-08-07-reader-zukunftswerkstatt.pdf?__blob=publicationFile&v=7* (last accessed: 22.04.15).

[219] Fraunhofer ISI, Consentec GmbH, TU Wien (2014): Ausschreibungen für Erneuerbare Energien. Available at: *http://www.agora-energiewende.de/themen/die-energiewende/detailansicht/article/ausschreibungen-sorgfaeltig-testen/* (last accessed: 22.04.15).

7.1.5 Italy

Italy is required to source 17% of its final energy consumption from renewable energy sources by 2020. According to Italy's National Renewable Energy Action Plan, the country is targeting 26.4% of electricity from renewable sources by 2020.

According to the latest projections and the 2013 National Energy Strategy (NES), Italy is going to reach its target of 17% of final energy consumption covered by RES.

Table 45: Characterisation of RES-E auctions in Italy

Characteristic	Description
Market characteristics	The public spending on RES-E support have been EUR 6.5 billion in the past. Under the new scheme the total annual budget available for incentivizing RES-E (except solar-PV) is set to EUR 5.8 billion since 2013 (Personal Communication, 2014)[220].
Name of auction scheme	There is no official name for the scheme, but it is referred to as DM 06/07/12 (Ministerial Decree 6 July 2012); Incentives for electric renewable energy sources apart from PV.
Objectives	The main objective of the tenders is to set feed-in-tariffs.
Contracting authority	Gestore dei Servizi Energetici (GSE)
Main features	The Italian auction scheme can be best characterized as a reverse auction. The "base tariff" is actually a maximum tariff. Contracts are awarded and the final price issued is based on bids in a tendering process. Bids qualify if they fall within an acceptable window: more than 2% reduction relative to the base tariff, and less than a 30% reduction of the base tariff.[221]
Year of introduction	The auction scheme for other renewables was introduced on January 1st, 2013. The scheme replaces the quota obligation scheme with Tradable Green Certificates (*Certificati Verdi*). New plants other than PV plants, with a capacity higher than 1 kW and commissioned after 31 December 2012 are eligible for funding under this new incentive scheme.
Technology focus and differentiation	Bidders bid for the volume allocated to the respective technology. An onshore wind project has to compete with other onshore wind projects and not with other technologies. New plants and hybrid plants for all RES-E sources apart from PV are eligible (Art. 3, c. 1, Art. DM 06/07/12).[222] Technology — Eligible capacity Wind energy — > 5 MW Geothermal energy — > 20 MW Biogas — > 5 MW Hydro-power — > 10 MW Biomass — > 5 MW
Lead time before auction	30 days before opening of the tender GSE publishes a notification
Min./max. size of project	Auctions only apply to RES plants > 5 MW, except hydro > 10 MW and geo > 20 MW. RES plants ≤ 5 MW get their incentive from a so-called registry.
What is auctioned?	Premium tariff
Support duration	Incentives are granted for different periods of time, depending on the source (Annex 1 DM 06/07/2012)

[220] Personal Communication, Erika de Visser and Niccolo Cusumano

[221] Gipe, Paul (2012): Italy Abandons RPS, Adopts System of Feed-in Tariffs. Available online at: http://www.renewableenergyworld.com/rea/news/article/2012/12/italy-abandons-rps-adopts-system-of-feed-in-tariffs?page=2 (last accessed: 29.04.15).

[222] RES Legal (2014).

	• Wind, Onshore: 20 years • Wind, Offshore: 25 years • Geothermal: 25 years • Biogas: 20 years • Hydro, Conventional: 30 years • Hydro, Run of river: 30 years • Hydro, Wave and tidal: 20 years • Biomass: 20 years
Qualification criteria and eligibility	Participating RES investors need to have a production license, a connection offer from the grid operator as well as a proof of their capacity to finance the project. Relating to this third requirement, participants have to show that they are 'financially and economically sufficiently solid to undertake the activities for which they are requesting incentives'. Hereto, bidders have to contribute financing bonds (5% of the project cost) by depositing part of the project volume as a security. The bid bond guarantee is increased to 10% if the project is retained at the end of the tender.[223]
Budgetary expenditures per auction and per year	The Decree sets a cap on the indicative cumulative cost of all the incentives granted to renewable energy installations, other than PV, which cannot exceed the total value of € 5.8 billion per year. The Decree also introduces annual quotas of supported installed capacity for each year from 2013 to 2015, divided by type of source and plant and broken down according to manner of access to the incentives (auctions; Registers for constructions, complete reconstruction, reactivation, upgrading and hybrid systems; Registers for renovations)[224].
Frequency of auctions	Once a year. Fixed time table: each year before March 31 GSE publishes a notice for the coming tender 30 days before the opening. Time table of the tendering process: t(0) GSE publishes a notice for the coming tender 30 days from t(0) = opening of the tender From 30 to 90 days from t(0) = tendering process From 90 days to 150 days from t(0) = evaluation process At 150 days from t(0) = publication of ranking From 150 days to 165 days from t(0) = GSE returns surety deposit
Volume of the tender	The available capacity of the tender is set by GSE. Total volumes are defined at: 1710 MW for 2013 (1st procedure), 1494 MW for 2014 (2nd procedure) and 1349 MW for 205 (3rd procedure).
Who pays the bill?	Financial resources for incentives come from a component ("A3") of the electricity bill (public funding is highly affected by changes in budget policies and does not offer a good stability).

Table 46: Support scheme specific characteristics of Italy's RES-E auctions

Characteristic	Description

[223] Fraunhofer ISI, Consentec and TU Vienna (2014): Auctions for Renewable Energy in the European Union. Published by Agora Energiewende. Available online at: *http://www.agora-energiewende.de/fileadmin/downloads/publikationen/Hintergrund/Ausschreibungsmodelle/Agora_Auctions-Paper_056_web.pdf* (last accessed: 29.04.15).

[224] Italy's Second Progress Report under Directive 2009/28/EC

Competition and type of participants	Participants are mainly large electricity companies, with a limited number of small and medium sized energy companies during the 2nd procedure.
Auction procedure	Auctions are conducted as reverse auctions where operators bid on the amount of the incentive to be paid to the plant, starting from the pre-defined base amount.
Ceiling price	In order to prevent projects from either under- or over-bidding in the reverse auctions, Italy has prescribed floor (89€/MWh) and ceiling premium values (124€/MWh) that cannot be exceeded in each auction.[225]
Pricing rules	The auction is designed as a pay-as-bid auction, which means that winning bidders receive the price of their bid.
Penalties	Investors have 28 months (onshore wind, bioliquids) or 40 months (all other RES) for the construction and commissioning of their RES project after publication of the tender results. If they fail to meet this deadline, the FIT will be reduced by 0.5% for each month of delay. After 24 months of delay, the FIT guarantee is withdrawn and the final guarantee is withheld.

7.2 Assessment of the support schemes

The aim of this section is to give an assessment and understanding of the best practice elements for support schemes, especially focusing on recent changes in the support schemes to comply with the EU State Aid guidelines. The detailed assessment will focus on the following key elements:

- Policy effectiveness
- Static efficiency or cost effectiveness
- Dynamic efficiency
- Competiveness
- Distributional effects
- Predictability and stability
- Compatibility with market principles

These key elements were outlined in the recommendations section of the main document, and here follows a detailed analysis of each of the selected EU support schemes.

7.2.1 United Kingdom

The first CfDs were allocated in February 2014. Most of the successful bids were wind projects. Only a small amount of solar (72 MW) was successful [226]. Out of the 15 awarded wind onshore projects (770 MW in total), the largest will be the Dorenell wind project developed Infinergy in Scotland. Two offshore projects won CfDs totalling over 1.1GW. The average price awarded for onshore wind that participated in pot 1 was £80.57/MWh (€110/MWh) while offshore projects that participated in pot 2 averaged £117.14/MWh (€160/MWh) [227].

The technologies have different delivery periods, which leads to lead times of up to 5 years. The graph below summaries the results of the first round with regard to the expected delivery date of the technologies. Two solar projects were meant to be realised in 2015-2016. As their price was particularly low (£50/MWh), the successful

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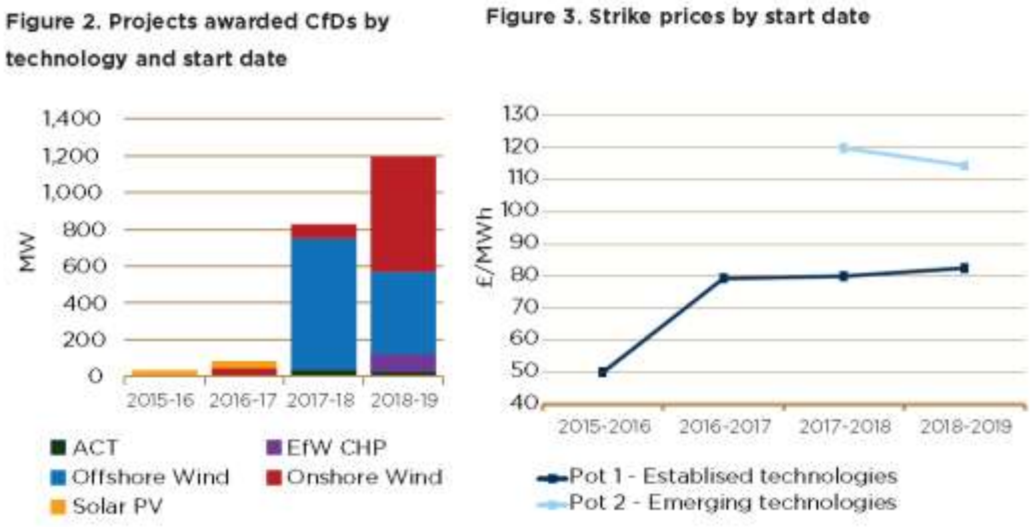
[225] Fraunhofer ISI, Consentec and TU Vienna (2014): Auctions for Renewable Energy in the European Union. Published by Agora Energiewende. Available online at: http://www.agora-energiewende.de/fileadmin/downloads/publikationen/Hintergrund/Ausschreibungsmodelle/Agora_Auctions-Paper_056_web.pdf (last accessed: 29.04.15).

[226] Frontier Economics and LCP (2015): What next for UK auctions of renewable Contracts for Difference. Available at: http://www.frontier-economics.com/documents/2015/03/lcp-frontier-economics-next-uk-auctions-renewable-contracts-difference.pdf (last accessed: 22.04.15).

[227] http://www.windpowermonthly.com/article/1335815/uk-awards-first-cfd-round

companies decided not to sign the CfD. As a consequence no project from the first auction round will be realised within the fiscal year 2015-2016.

Figure 36: CfD projects awarded and strike price by start date



Source: http://www.frontier-economics.com/documents/2015/03/lcp-frontier-economics-next-uk-auctions-renewable-contracts-difference.pdf

At the time of writing the report, the first allocation round of the CfD has only recently been completed. Therefore, no overall conclusion may be drawn and the following represents a preliminary assessment at this time. There is however an ongoing evaluation and if this is completed within the timeframe of the assignment the results will be taken into account in the forward analysis.

Policy effectiveness

The preliminary assessment of the policy effectiveness is mixed. On the one hand, enough established technologies (pot 1) have successfully participated in the auction to fulfil the UK renewable energy targets. On the other hand, some successful solar projects will not be realised, which reduces the policy effectiveness. As there are no technology specific targets within pot 1 and solar only represents a minor share of the successful bids anyways, the overall policy effectiveness might be in danger if large or several wind projects will not be realised.

The two solar projects that failed to sign a CfD after being successful in the auction, were widely accused of speculative bidding. As a consequence some members of the UK Renewable Energy Association spoke up in favour of rising entry criteria and/or introducing bid bods. The REA therefore urged DECC to investigate how speculative projects could be prevented from entering the auction228. The UK Solar Trade Association (STA) announced that the results of the first auction round show that auction schemes are not an adequate mechanism to support solar in the UK229.

Interestingly, the very same problem of low realisation rates had already been the reason why the Non Fossil Fuels Obligation (NFFO) auctions that took place in the1990s were discontinued. According to an analysis by the IRENA (2013), the low realisation rates were caused by an absence of penalties in case a project will not be realised, high incentives to submit low bids because of a high level of competition, and very low qualification criteria. Against the background, it is unclear why DECC decided against higher entry criteria and penalties in the form of bid bonds.

Static efficiency or cost effectiveness

According to publicly available information, competition in the first pot was relatively high. As a consequence the clearing prices per technology was below the administratively set strike prices (see Table 47). The savings of 17-18% in the wind industry mean that the target of generating at least 30% of the UK's electricity from renewable

[228] http://www.r-e-a.net/upload/150329_uk_solar_response_to_cfd_policy_review_final.pdf

[229] http://www.rechargenews.com/solar/1396433/uk-solar-support-shut-out-this-year-as-projects-fail-to-sign-cfds

sources by 2020 may be realised at lower cost. The extremely low clearing price for solar projects only indicates a general conflict between cost and policy effectiveness, as the successful projects will not be realised.

Table 47: Auction Results in the UK

Technology	Admin Strike Price	Lowest Clearing Price	Maximum % Saving on Admin Strike Price
	(£/MWh)	(£/MWh)	
Solar PV	120	(50)	(58%)[230]
Onshore Wind	95	79.23	17%
EfW CHP	80	80	0%
Offshore Wind	140	114.39	18%
ACT	140	114.39	18%

Dynamic efficiency

The CfD auction round is divided into two major pots, established and emerging technologies. This division is meant to shield the less mature technologies (especially wind offshore) from direct competition with established technologies. As a result of the strong demand for pot 2 (less mature technologies), DECC announced an increase to the budget for the less established technologies of £25m, which means a total of £260m is made available for projects commissioning from 2017/2018 onwards[231]. This shows the intention of the policy maker to realise dynamic efficiency gains in the longer term.

According to the Renewable Energy Association, however, the low frequency of the auction leads to high uncertainty in the market, which hampers investments and therefore makes dynamic efficiency gains difficult[232]. This argument is especially valid for the solar industry, which may face a rupture as no solar projects will be realised in the next fiscal year.

Competitiveness

Competition in the first auction of the CfD was strong, with only 27% of applicants receiving a contract (based on projected support costs in 2018/2019).

Distributional effects

Costs of the CfD are passed on to consumers via the electricity bill and are subject to changes in wholesale electricity prices. However, costs are controlled within the Levy Control Framework which sets a cap on overall costs. This effectively means that the amount of low-carbon capacity that the UK Government is capable to support changes, which passes on the risk from the consumer to future developers.

Two-thirds of the UK onshore wind projects awarded in the first auction round will be constructed in Scotland. The remaining three solar projects will be constructed in the south of the UK.

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[230] Will most probably not be realised.

[231] https://www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference

[232] http://www.renewableenergyfocus.com/view/41523/decc-releases-results-of-uk-s-first-auction-for-contracts-for-difference/

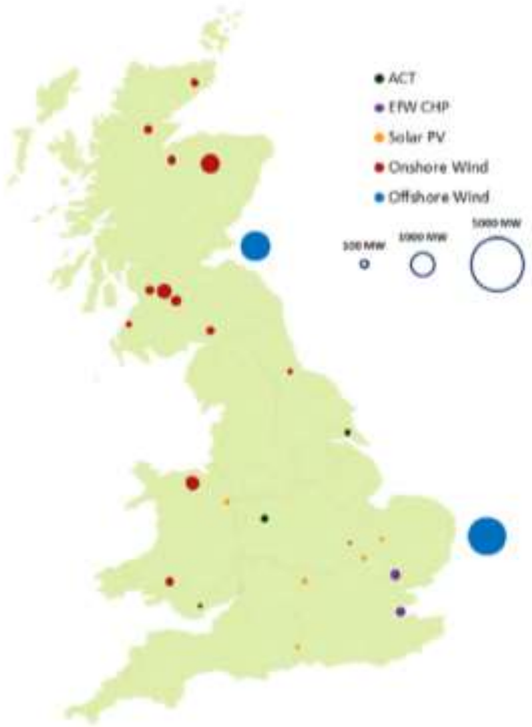


Figure 37: Projects awarded CfDs in the UK 2015 allocation

Source: http://www.frontier-economics.com/documents/2015/03/lcp-frontier-economics-next-uk-auctions-renewable-contracts-difference.pdf

Predictability and stability

The low (annual) frequency of rounds leads to relatively high insecurity for developers.

Given the longevity of the CfD, the UK Government has included an "independent expert" role within the CfD framework. Their task is to consider arrangements for adjusting reference prices and other CfD parameters in response to changes in trading arrangements, market liquidity or the trading platforms, which in turn influence the reference price.

Compatibility with market principles

CfDs represent a sliding feed-in tariff scheme, which means that the generators will sell energy to energy suppliers at a price that can be above, below or the same as the strike price. If the selling price of energy to the suppliers is equal to the strike price, then there is no further action. If the selling price is below that price, it will trigger top up payments by the suppliers. If the sales by the generators are at a higher price, it will result in generators paying back the difference. Therefore, the CfD is expected to be **compatibility with market principles**.

Main findings:

- The UK experience shows that auctions may be effective in meeting generic renewable energy targets. If the auction scheme does not prevent speculative bidding, however, some of the successful projects may not be realised. Hence, an auction scheme should define project specific qualification criteria and/or penalties for non-realisation in the form of bid bonds.
- The auction let to cost savings with regard to the administratively set clearing price. As less mature technologies (wind offshore) are shielded from competition there may be some dynamic efficiency gains in the future. That some successful projects will not be realised indicate a conflict between policy and cost effectiveness.
- A low (annual) frequency leads to insecurity among market players.
- The UK decided to introduce a "technology neutral" auction schemes that officially divides technologies according to their maturity, not according to the type of technology. This effectively leads to one technology-specific round for wind offshore and one where solar and wind onshore compete against each other. This division seams to create problems for realising solar PV and has heavily been criticised

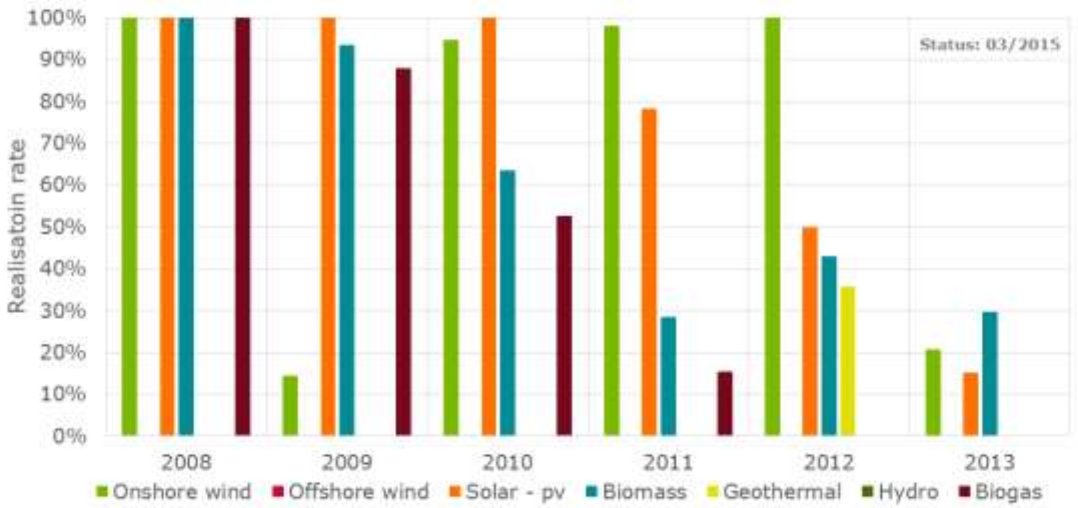
by associations like the UK Renewable Energy Association and the UK Solar Trade Association for being arbitrary, opaque and unfair.

7.2.2 Netherlands

Policy effectiveness

Realisation rates are a proxy for effectiveness. In the graph below the realisation rate of projects under the SDE and SDE+ scheme are presented. The SDE+ was introduced in 2011.

Figure 38: SDE and SDE+ project realisation rate



2008	2009	2010	2011	2012	2013
	SDE			SDE+	
100%	17% (36%)*	88%	43% (86%)**	54%	19%

* This figure is relatively low due to the fact that a large chunk of the total subsidy went to offshore wind projects that have not yet been taken into operation and are currently still under construction. Also a large share of the onshore wind projects have not been realized as of to date. The obligation to realize projects within three years after granting, was not effective until 2011.
** Without biogas

Source: Ecofys 2015, on the basis of information from RVO

The above figure shows that from the projects that were awarded SDE+ in 2011, 68% has been realised, from projects in 2012 54% has been realised and 11% from projects awarded SDE+ in 2013.

Projects have to be realised within 4 years after the subsidy is granted (3 for solar-PV). This means that projects from 2011 (first SDE+ year), will have to be realised by the end of 2014/early 2015. As a consequence, budgets are currently underutilised. The most recent data is from mid-2014. This means that the realisation rate for 2011 (and subsequent year) will further increase.

Since 2012, penalties are in place for non-realisation within 4 years (3 years for PV). The penalty is maximum 2% of total budget that was applied for (so over the total lifetime of a project). However, this only applies to projects with budget claim > 400 M€. This is large for a single project. There are hardly any projects that have reached this amount so one could argue that the limit is set too high.

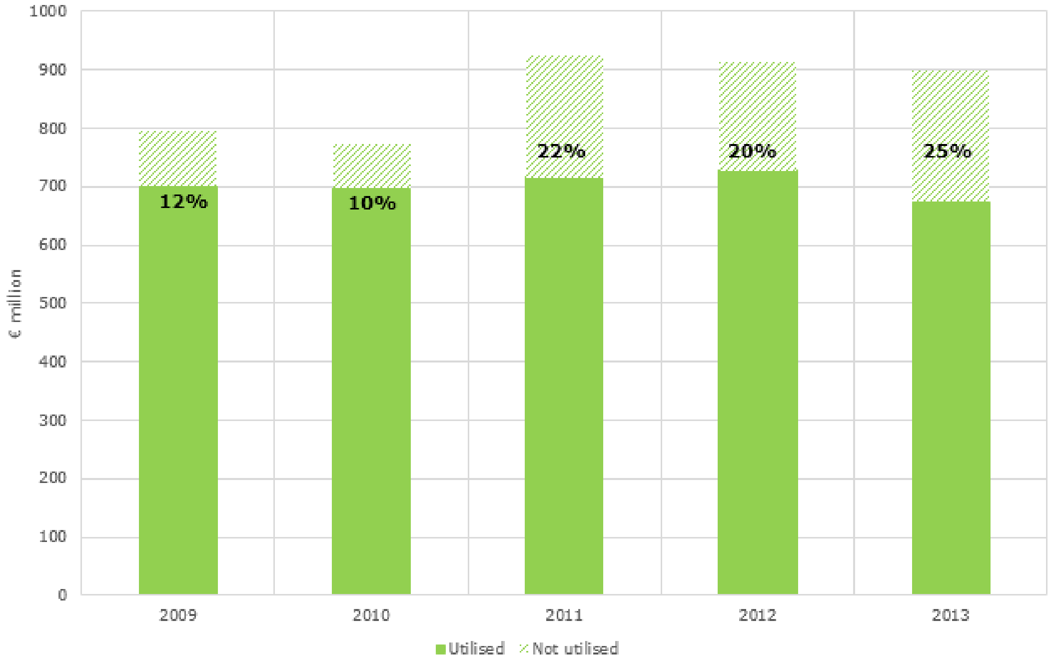
Other measures have been introduced to limit the unnecessary budget claim of projects that are not realised. These measures include:

- Since 2014: a feasibility study is an important qualification requirement (see section on qualification criteria). This is seen as a major contribution to improving the realisation rate.
- Project developers of projects that are not realised are excluded from SDE+ for five years, for the same project.
- Stricter check on the realisability of projects and their economic viability on the basis of an assessment of the realisation and a financial plan that are submitted by applicants.
- Check of progress after one year by RVO.

For projects with a budget claim >400 MEUR, a bank statement and a realisation contract (uitvoeringsovereenkomst) is required. No projects have claimed more than 400 million EUR in 2012. No information is available why such high limit was chosen. The contract states that the project has to be realised within the given timeframe (4 years, 3 years for solar-PV).

Besides realisation rates, the utilisation of budgets is another useful proxy for effectiveness. In the case of the Dutch scheme, budgets are structurally underutilised (see graph below). This means that from the budgets that are reserved each year and granted to the projects, not all of this budget will actually be used. This is due to the fact that the SDE+ assumes theoretical production, which in practice turns out to be much lower (i.e. (so less MWh's/GJ's need support). Underutilisation forms a serious risk for target achievement as more projects could have been awarded support.

Figure 39: SDE and SDE+ budget utilisation



Source: Ecofys, Algemene Rekenkamer 2015

In 2011, 22% of the budget will not be utilised, in 2012 this is 20% and 25% in 2013. This is roughly twice as high as the previous SDE scheme.[233]

Static efficiency and dynamic efficiency

The demand is structurally higher than budget available (see graph below), which leads to a relatively high level of competition.

[233] Algemene Rekenkamer (2015) Stimulering van duurzame energieproductie (SDE+). Haalbaarheid en betaalbaarheid van de beleidsdoelen

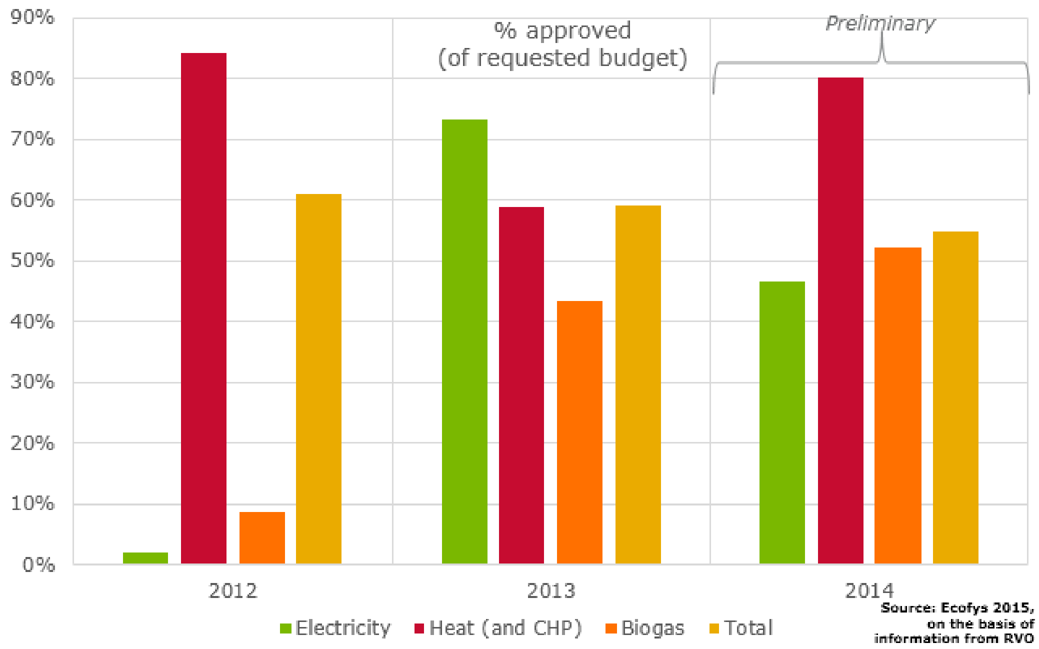


Figure 40: SDE+ budget approval by technology

The base amount for each round is calculated yearly by ECN on the basis of market consultations and levelised cost of energy (LCOE) calculations. The procedures are transparent and an extensive report is published each year that contains detailed calculations and their input parameters. The report is complemented by Excel spread sheets that contain these calculations and parameters and allows project developers to get a good indication of their potential business case. Much experience has been gained with this for over 6 years and support levels are considered sufficient, yet challenging, by the market.

Each year, support levels (strike prices) are revaluated and adjusted to market circumstances and technology developments. There are no assessments on how successful the SDE+ managed to drive down costs (dynamic efficiency).

Predictability and stability

The SDE+ has been a fairly stable and predictable scheme. The same fundamentals of the scheme have remained the same since its start in 2011. Changes to the scheme have been made (esp. adding new phases each year), but changes have so far been announced quite far in advance and always around the same date.

Compatibility with market principles

The SDE+ is an auction scheme with a competitive price building mechanism (sliding feed-in premium) that reflects market principles. This has positive effect in avoiding negative prices. The SDE+ scheme fosters demand oriented generation since RES plants are fully subject to price signals in the market.

Balancing responsibility: RES generators need to comply with scheduled production as all other plants. RES plants operators are responsible for delivering the predicted electricity production.

Electricity from renewable sources is however granted priority in times of grid congestion, over electricity from energy sources other than renewable.

Competition and type of participants

The large majority of parties that apply for SDE+ are (small) SME's (>80%), followed by non-profit organisations (municipalities, sport associations, water boards, schools etc.). A small percentage of applicants may be grouped as larger (multi-national) companies and utilities. In the table below the shares of participant types are presented.

Table 48: Shares of participant types in the SDE+ rounds in 2011 – 2013

	SME	Large/multi-national	Utility	Non-profit, public authority, municipality etc.
2011	79%	1%	0%	20%

2012	85%	0%	2%	14%
2013	81%	2%	1%	15%
2014[234]	n/a	n/a	n/a	n/a
Overall	81%	1%	2%	16%

Source: Ecofys 2015 (status 01/2015) on the basis of RVO.nl[235].

The level of competition may be typified as healthy, with different participants each year. The accessibility of the scheme for smaller companies and non-profits is good. A recent survey performed by the Netherlands Court of Audit confirmed this picture. The survey also shows that the administrative burden/complication of scheme was not mentioned as an issue for market actors to participate.

Burden sharing

The average household contribution will increase significantly: from €25,- in 2015 to €120,- to €240,- in 2020 and between €250 and €310 towards 2030.

The SDE+ is paid from a surcharge (per kWh and m3) on the electricity and gas bills of consumers and companies. Consumers cover 50% of the total annual budget, the other half is covered by companies. The more you consume, the less you pay in surcharges (relative). In the tables below the annual surcharges are provided. The surcharge is depending on the amount of electricity/gas consumed. The surcharge is established annually and is set on the basis of an estimate of the expected SDE+ expenditures for that year (the table below).

Table 49: SDE+ consumer surcharge for electricity and gas

Electricity	From	To	2013	2014	2015	2016
1	0 kWh	10,000 kWh	0.0011	0.0023	0.0036	0.0056
2	10,000 kWh	50,000 kWh	0.0014	0.0027	0.0046	0.0070
3	50,001 kWh	10 million kWh	0.0004	0.0007	0.0012	0.0019
Gas	From	To	2013	2014	2015	2016
1	0 m3	170,000 m3	0.0023	0.0046	0.0074	00113
2	170,.000 m3	1 million. m3	0.0009	0.0017	0.0028	0.0042
3	1 million. m3	10 million. m3	0.0003	0.0005	0.0008	0.0013
4	10 million. m3	-	0.0002	0.0004	0.0006	0.0009

Main findings:

- The main focus of the SDE+ is on efficiency, i.e. on bringing down costs of the support scheme. This is achieved by allowing competition between all technologies that fall under the categories of RES-E, RES-H&C and biogas.
- For market participants, the technology neutrality creates a relatively high level of insecurity. To decide whether to participate or not a bidder has to quantify the risk of not being successful in the auction. To do so, however, they would need to estimate how the budget will be allocated, which requires information on all three markets (RES-E, RES-H&C and biogas) in detail.
- For the auctioning body, determining the base prices that define the lowest possible support level remains challenging and involves relatively high transaction cost. The base prices are currently set by

[234] Not available at the time of writing (01/2015)

[235] On the basis of publicly available overviews. C.f. *http://www.rvo.nl/sites/default/files/2014/07/SDE%2B%202014%20Positieve%20beschikkingen.pdf*

experts from ECN after extensive consultations and are adjusted each year according to market and technology (price) developments.

- The SDE+ is more effective than precursor schemes but budgets are structurally underutilized and realisation rates are low. The current policy does not take this underutilization sufficiently into account.
- The effectiveness of scheme may increase over time. To improve the scheme, regular evaluations and subsequent improvements were done over the past six years, which e.g. led to the introduction of a feasibility study as a qualification criteria and the introduction of bid bonds to increase the effectiveness.
- To cope with the low realisation rate and the underutilisation of budgets, an alternative to higher qualification criteria and/or bid bods would be to allow more projects than the theoretical amount that is needed to achieve the envisaged production. As this would require more flexible budgets, this option is currently not on the table.
- Other factors like the availability of (private) capital, permitting and spatial planning, public acceptance and the political will, as well as a stable policy framework for 2030 influence the efficiency and effectiveness of the scheme. These factors are external and may only partially be addressed by the design of an auction scheme.

7.2.3 Germany

The first auction round for ground-mounted PV plants in Germany finished on April 15th, 2015. This section analyses, to the extent possible, the experiences made during the first auction round. A conclusive analyse will only be possible after the realisation period ends in April 2017.

Policy effectiveness

The target for renewable energy deployment from solar energy is set by the EEG 2014. According to evaluations by the auctioning body, the Bundesnetzagentur[236], 170 bids with a total of 715 MW were received in the first round. While 37 bidders had to be excluded for formal reasons, the auction volume of 150 MW was still exceeded four times. To meet the target set by the EEG 2014, a sufficient number of projects participated in the auction. Therefore, the policy has the potential to be effective.

The consecutive question concerns the realisation rate of the successful bids. The sum of the annually tendered volume per round slightly exceeds the targeted annual volume, as it is expected that some projects that were successful will not be realised. To be effective, the realisation rate should therefore be in line with the assumed non-realisation. On April 29th, 2015, the Bundesnetzagentur announced the results and notified the winner. Winners had ten working days to accept the bid by handing in a second financial security, which all of the successful bidders did. Thereby successful bidders proved their willingness to realise the project, which is an important indicator for a policy’s effectiveness.

Regarding the actual realisation and its timing, however, significant uncertainties persist. Some bids will receive a support level which is below the current EEG support level (see below). It is very likely that these projects will only be realised at the end of the realisation period as they speculate on decreasing module prices in the coming month. In case the price does not decrease, there is a chance that these projects will not be realised at all, which would decreased the policy effectiveness.

Static efficiency or cost effectiveness

The static efficiency measures if the target can be fulfilled at the lowest possible overall costs. The produced electricity from winning projects will be remunerated with, on average, 9.17 cent/kWh (min: 8.48 cent/kWh, max: 9.43 cent/kWh) which is significantly below the ceiling price of 11.29cent/kWh but exceeds the administratively set support level of the EEG 2014 of 9.02 cent/kWh.

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236 Bundesnetzagentur 2015 Hintergründe zu den vorläufigen Ergebnissen der 1. Ausschreibungsrunde _http://www.bundesnetzagentur.de/cln_1411/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/ErneuerbareEnergien/PV-Freiflaechenanlagen/Gebotstermin_15_04_2015/Gebotstermin_15_04_2015_node.html#doc528638bodyText1_

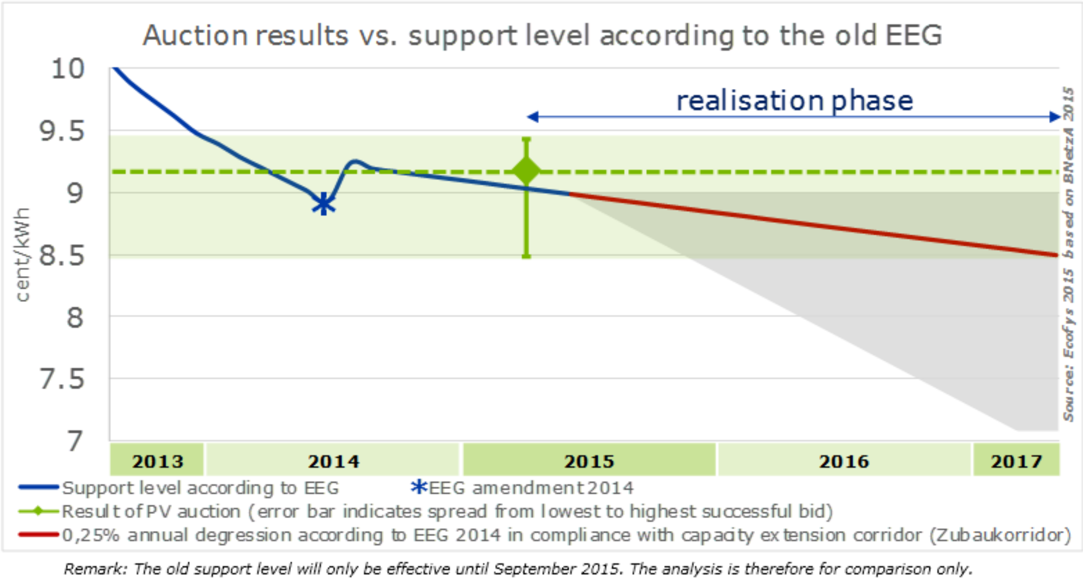

Figure 41: Comparison between support level as set by the EEG and the result of the auction[237]

Even though the average support price exceeds the administratively set price, the auction may have led to cost efficient results. A comparison between Figure 41 and Figure 42 shows that the annual capacity additions rapidly declined after the administratively set support level was reduced in 2012. It may be argued that the current support level is insufficient to cover the LCOE of ground-mounted solar plants and are therefore currently insufficient to incentivise capacity additions that are in line with the overall target. Hence, the result of the auction may be in line with the *lowest possible* overall costs.

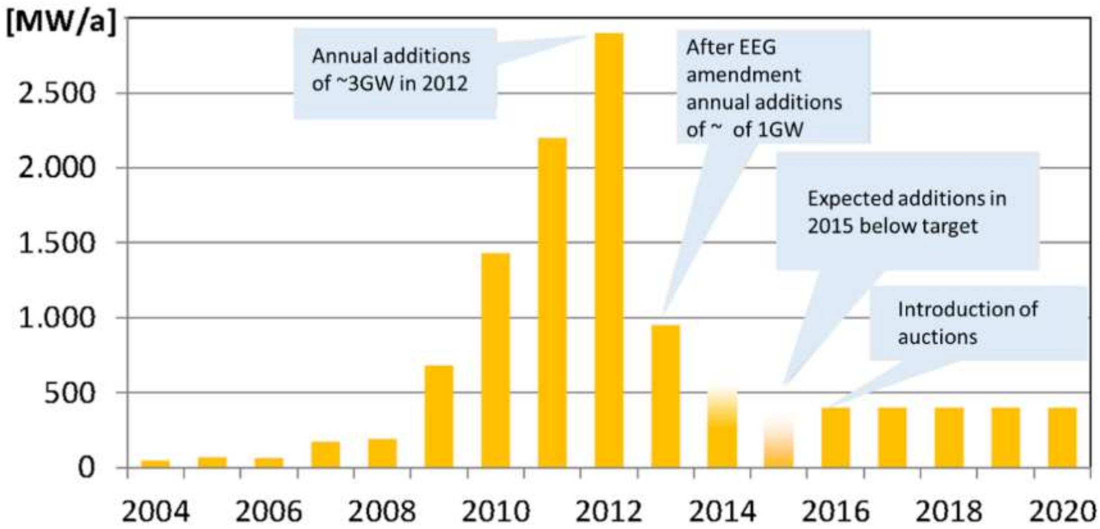

Figure 42: Annual capacity additions of ground-mounted solar plants (Source: Kehl et al. 2014)[238]

Dynamic efficiency

The auction is a technology-specific auction for ground-mounted solar plants. Innovative technologies may in principle participate in the auction but will not receive preferential treatment. Innovative and less mature technologies in the form of pilot projects will more likely be supported by a different policy that is to be designed.

As the projects may be realised within the next two years, a successful bidder has quite substantial investment security over the next two years. As projects are allowed to participate in an early stage of the project planning, a successful bidder will try to realise the project at the lowest possible cost, which incentives (small) investments

[237] Achieving a price which is as low as 8.48cent/kWh does not necessarily stand for efficiency gains, as the projects are unlikely to be realised soon and the administratively set support price would have decreased in the coming month (see figure 2)

[238] Kelm, T.; Dasenbrock, J.; Günnewig, D. et al. (2014), Vorbereitung und Begleitung der Erstel-lung des Erfahrungsberichts 2014 gemäß § 65 EEG, Vorhaben IIc, Stromerzeugung aus Solarer Strahlungsenergie, gemeinsamer Zwischenbericht von ZSW, Fraunhofer IWES, Bosch & Partner, Feb-ruar 2014

in increasing the efficiency of the project and could therefore lead to dynamic efficiency gains on a small scale. On a large scale, however, this mechanism could actually decrease the dynamic efficiency. If all successful bidders speculate on falling prices (e.g. module prices), no project will be realised in the short run. As a consequence, deployment rates would suffer and innovation is de-incentivised as the market stagnates (in the short run).

Competiveness

The pilot scheme is a technology-specific auction, which, according to the European Commission, reduces competition. As mentioned above, however, the level of competition in the first round was high.

The following analyses to what extent the design was open and transparent. An indicator for the openness of the auction is the variety of participating actors. As shown in Figure 43, 170 bids were received out of which over 2/3 came from professional actors (Limited Commercial Partnerships (GmbH & Co.KG) and Private Limited Companies (GmbH)). Neither cooperatives nor individuals were among the 25 winners. 37 bids had to be excluded for formal reasons.

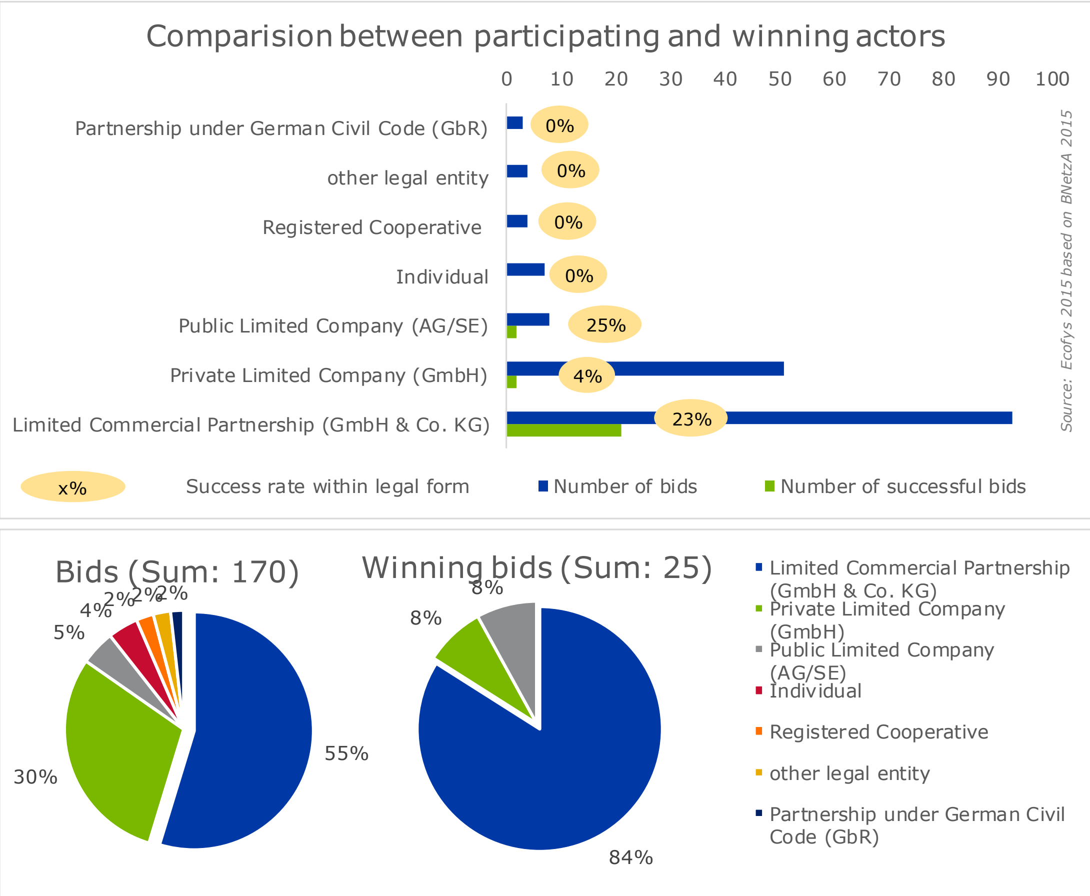

Figure 43: Comparison between participating actors (own graph based on data provided by BNetzA 2015)

Some successful bidders are part of the same group. As a consequence, three groups account for 45% of the successful bids and could secure 61% of the tendered volume. Given that participants in a survey by the German Solar Association perceived the auction procedure as rather transparent and accessible, the results strengthen the concern that an auction does not per se excludes smaller players but that smaller player have a very low likelihood to be successful and may therefore abstain in the long run[239]. Conclusive answers, however, cannot be obtained from the results of the first action round alone. The same survey came to the conclusion that the auctions leads to additional cost for staff and juridical advice. Furthermore, if the same actors continue to be successful, there is a risk of market consolidation and subsequently lower levels of competition in the future. In the future, the variety of actors could be further reduced as actors refrain from participation given the high level of completion and consequentially low likelihood of success.

[239] BSE 2015 http://www.energieverein.org/docs/201504/02_BSW_Koernig_Pilotausschreibungen_PV-Freiflaechen.pdf

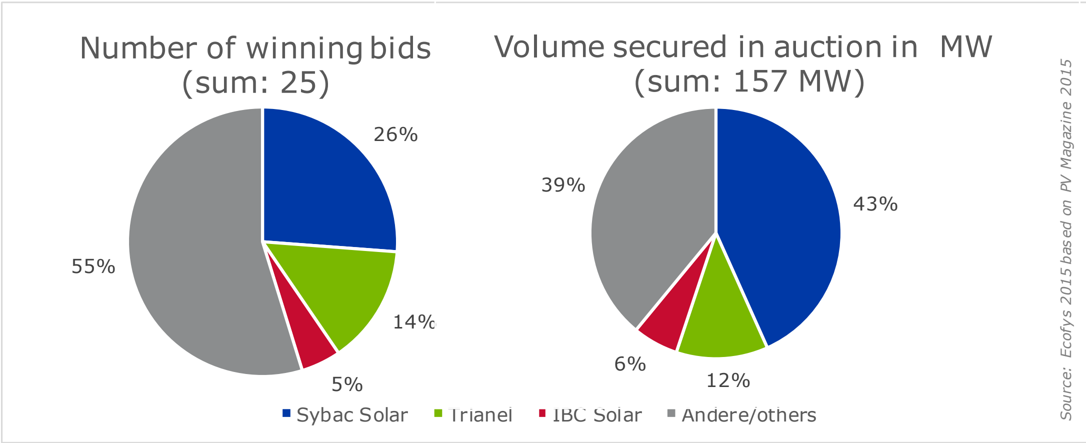

Figure 44: Comparison between number of winning bids and volumes secured

Distributional effects

The auction scheme should aim to allocate support only to those projects that could not otherwise be realised and thereby aim to avoid windfall profits for renewable power plant operators. As mentioned above, the realisation rate under current EEG for ground-mounted solar plants was low which justifies the higher price. As projects will likely be realised with some delay, there is a small risk that the price might exceed the required support level once prices for solar panels come down.

Regarding the distribution of benefits, the auction let to a concentration of winning bids in Brandenburg and Saxony-Anhalt (see Figure 11), which is, according to the Bundesnetzagentur, in accordance with previous installations of ground-mounted solar plants but might lead to a political debate on a fair distribution in the future. Compared to the EEG 2014, the distribution of cost does not change and will still be covered for by an electricity bill levy.

Figure 45: Regional distribution of winning bids in Germany

Predictability and stability

The current policy is only a pilot scheme and adjustments are likely. Even under the current policy, the auctioning body has the right to adjust the tendered volume in accordance with the results of previous rounds and only has to announce the tendered volume eight weeks in advance, which decreases the predictability. Regarding the policy design process, adjustments were made late in the design process, which was not well perceived by the industry, the above-cited survey by the German Solar Association finds[240]. As changes in the support of successful projects are very unlikely and the level of support is known at an early planning stage, the policy leads to a reliable support for successful projects.

Compatibility with market principles

The auction procedure was implemented to comply with European State Aid Guidelines. The policy is not yet open to other countries. The auction is solely a mechanism to determine the level of support in a competitive manner and does not address additional questions of system or market integration of renewables.

Main findings

- The number of received bids far exceeded the tendered volume, which indicates that market participants see the auction scheme as an opportunity rather than a treat.
- A high level of competition may be realised in technology-specific auctions as it seems to depend more on sector specific characteristics (e.g. previous level of support).
- All successful bidders handed in a second security which shows their willingness to realise the project. That suggests that the realisation rate and thereby the policy effectiveness will be high.
- The relatively long realisation period gives successful participants the opportunity to delay the realisation. This makes a timely evaluation of the effectiveness of the scheme difficult. If prices for solar PV continue to fall, the current support level might be too high, which would lead to windfall profits.
- An auction scheme can allocate support in an efficient manner. Efficiency does not automatically mean, however, that the overall support level decreases. In Germany, the previous, administratively set support level may have been too low. That would also explain why the support level is above the previous level despite having a high level of competition.
- Auctions with a relatively long realisation period may incentives investments that could lead to short-term dynamic efficiency gains.
- It remains to be seen if the scheme is open for different actors or if the transaction costs are prohibitively high for smaller actors.

7.2.4 France

Policy effectiveness

The easy-to-use online platform for auctions has attracted a high number of bids, which indicates that the auction scheme is accepted. The offered capacity exceeds the required capacity to be in line with the targets of the French government, which indicates that the auction scheme has the potential to be effective. However, of those bids at most 60% were eligible. This is seemingly due to unclear and/or inadequate documentation requirements (for instance regarding the CO_2 assessment). The volume that was offered by the still eligible bids was above the auction volume which means that the policy is still effective. However, the level of competition was significantly reduced, which led to higher prices (see below).

France has penalties in place for delays in constructing the PV plants, which helps to keep realisation rates high[241]. There does not seem to be a problem with the realisation rate yet no reliable information could be found.

Static efficiency or cost-effectiveness

As mentioned above, many bids were excluded for formal reasons. As a consequence, the level of competition in the auction decreased and projects that offered relatively high prices could be successful. In detail, auction results were ranging from 194€/MWh to 231.5€/MWh in 2012 and 165€/MWh to 168€/MWh in 2014 (see Table 50). Compared to the previous feed-in-tariff scheme, cost savings could still be realised but in general, the efficiency was low due to a low level of competition.

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[240] BSE 2015 http://www.energieverein.org/docs/201504/02_BSW_Koernig_Pilotausschreibungen_PV-Freiflaechen.pdf

[241] Grau (2014)

Moreover, bidders are allowed to submit bids. The transaction costs to meet the qualification criteria are high and economies of scale may only be realised if one submits several bids[242]. As a consequence, smaller, non-professional actors refrained from participating in the auction and in the fourth auction in 2012 the 143 bids were submitted by only 35 bidders. Due to this fact, auctions for 2013 have been cancelled to improve the auction rules. The effects are still to be seen.

Table 50: Auction results in France

Round	Auctioned amount	Results
2012 / 1	120 MW	• Bids: 345 (68 MW) • Eligible/selected bids: 218 (45 MW) • Average price: 229 € / MWh
2012 / 2	30 MW	• Bids: 227 (47 MW) • Eligible bids: 138 (27 MW) • Selected bids: 109 (20.9 MW) • Average price: 231.5 € / MWh
2012 / 3	30 MW	• Bids: 262 (53 MW) • Eligible bids: 148 (30,2 MW) • Selected bids: 88 (18.5 MW) • Average price: 231 € / MWh
2012 / 4	30 MW	• Bids: 388 (81 MW) • Eligible/selected bids: 143 (30,9 MW) • Average price: 194 € / MWh
2014/1	40 MW	• Bids: 594 (123.9 MW) • Selected bids: 177 (40.3 MW) • Average price: 168 € / MWh
2014/2	40 MW	• Bids: 594 (123.9 MW) • Selected bids: 193 (40.7 MW) • Average price:165 € / MWh
2014/3	40 MW	• Bids: 217 (189 MW) • Selected bids: 189 (41 MW) • Average price: 153 €/ MWh

Dynamic efficiency

Tenders in France are not simply price-based, but consider the carbon footprint of the panel as well. Therefore technologies that are more climate friendly may have a better chance to compete in the auction which in turn creates an incentive to invest into such kind of improvements.

Compared to the auction scheme for 100-250kW PV plants, the auction scheme for larger plants takes a range of different criteria into account. They range from the level of R&D to the local acceptance of a specific project and therefore explicitly provide for technology innovation. The here discussed auction schemes for PV plants between 100-250 kW however, does not explicitly provides for dynamic efficiency gains other than the arguably relatively low incentive to invest into more climate friendly panels.

Competitiveness

[242] IZES 2014

The auction design in France is kept simple to attract a high number of participants. However, some bidders submitted several bids and as a result, in the fourth auction in 2012 the 143 eligible bids were submitted by only 35 bidders, which meant a low level of competitiveness during the auctions (see above). Additionally, only a small number of bids were eligible, which reduced competitiveness even further. Therefore auctions for 2013 were cancelled to improve auction rules.

Distributional effects

The "Contribution au Service Public de l'Electricité" (CSPE) has to be paid by all consumers per consumed kWh quarterly via their electricity bill (levied). The differential costs for bridging the "Price Delta" are determined annually on the basis of calculations of the current regulatory authority of the Ministry of the Environment, with the exception of auto-production of Industry (consumption to 240 million kWh). This ensures that system costs are evenly distributed among electricity consumers while competitiveness of the industry is maintained.

Predictability and stability

The total support duration is 20 years. While the support level is mainly based on the outcome of the auction (80%), 20% of the tariff is indexed annually with income levels in the energy industry and an industry-specific price index. Moreover, support is limited to 1,580 full load hours per year in France (mainland) and to 1,800 full load hours per year in Corsica and overseas. Once this limit has been reached, support is reduced to 5 €ct/kWh. As support conditions are long-term and provide a stable investment framework, the support level is fairly predictable and stable once a project has been successful in the auction.

Compatibility with market principles

Compatibility with market principles is not relevant for this tender system as it only applies to small-scale PV plants.

Main findings

- The French online auction scheme for PV plants between 100 and 250 kW is a technology-specific auction, which illustrates that auctions for small-scale technologies are possible and may attract a high level of bidders.
- If the qualification criteria are unclear and/or prohibitively high, a high number of bids will be excluded. As a consequence, the level of competition and therefore the efficiency of the scheme is reduced.
- The qualification criteria have to be designed adequately to ensure a high share of eligible bids. The documentation (requirements) should be kept clear, simple and straight forward.
- Auctions do not per se exclude smaller players but the scheme has to reflect the reduced capacity and capability of smaller players of baring transaction costs. Particularly one should avoid requirements (e.g. CO_2 assessment) that cannot be realised by smaller, inexperienced bidders/project developers.

7.2.5 Italy

Policy effectiveness

In Italy, projects gain access to the feed-in tariff by successfully participating in the descending clock auction. As the table below shows for three auction rounds, wind onshore is the only technology were the number of bids exceeded the offered capacity. For wind-offshore, waste, biomass and hydro, the available capacity (set as governmental targets) was not met due to a lack of bids. Hence, the auction mechanism is only effective in meeting the pre-set wind onshore target whereas the overall effectiveness remains low.

Table 51: Results of 1st, 2nd and 3rd auction rounds, source: (Benedetti, 2014) [243]

	1st procedure (2013 cap)	2nd procedure (2014 cap)	3rd procedure (2015 cap)

[243] Benedetti, L. (2014) Italian experience in deploying renewable energy, presentation given at RES4MED DAYS "A step change in the deployment of RE and EE solutions in the Mediterranean", 16th September 2014, Rabat

	Available capacity	Bidding capacity	Available capacity	Bidding capacity	Available capacity	Bidding capacity
	MW	MW	MW	MW	MW	MW
Wind on-shore	500	442	400	1086	356	1261
Wind offshore	600	30	620	0	650	0
Hydro	50	0	50	0	50	0
Geothermal	40	40	0	0		
Biomass	120	13	107	0	64	17
Waste	350	33	317	34	249	18

Static efficiency or cost effectiveness

Competition is a prerequisite for static efficiency. There was no competition for any of the technologies except wind on-shore, which means that the necessary condition for having an efficient auction scheme was not met. As for offshore wind, the offered capacity increased from 88.4% to 354% of the available power capacity. This in turn led to increasing tariff bid reductions:

- from 2.5% to 24.4% for the 1st procedure
- from 9.5% to 19.0% for the 2nd procedure
- from 26.4% to 30.0% for the 3rd procedure.

These tariff reductions mean that only projects that are located in an area with a very good wind resource will be able to gain support. As these projects are in general the less costly projects, the auction for wind on-shore leads to efficiency gains.

Dynamic efficiency

The auction scheme differentiates according to technologies which would shields less mature technologies from the competition against other more advanced technologies. In principle, this could lead to investments into dynamic efficiency gains. The low number of participating actors in the auction could either indicate that the base price was too low or that auctions are, in general, not an adequate mechanism to support the technologies mentioned in the table above (other than onshore wind). Further analysis would be required to come to investigate this point further.

Competitiveness

Participants are mainly large electricity companies and only a limited number of small and medium sized enterprises. The strong prequalification criteria hinder market access for small and medium-sized enterprises and therewith reduce the level of competition in the auction. A further analysis is required to investigate if the qualification criteria were prohibitively high and therefore let to a low effectiveness of the scheme.

Distributional effects

Costs of the auctions are passed on to the consumer via the A3 component of the electricity bill. Additionally, plant operators must pay EUR 0.05 per kWh which receives financial support to cover the administrative costs. Therewith a distribution of costs is taking place. Furthermore, an overall cap of EUR 5.8 billion per year is set to control costs.

Predictability and stability

As auctions are invited on an annual basis and support duration for the technologies is 20 years and above, predictability and stability are given.

Main findings:

- The Italian auction scheme is technology-specific in the sense that technologies of a different type to not have to compete against each other.
- The results of three rounds show that the auction is only well functioning for onshore wind.

- The auction scheme let to support level cost reductions for wind onshore energy only.
- For hydro, wind offshore, biomass and geothermal, the number of submitted bids is below the targeted volume which decreases the effectiveness of the overall auction.
- The reasons for the low participation should be investigated further. One potential reason might be that the auction scheme (price rule, qualification criteria etc.) were appropriate for wind onshore but not for the other technologies. This argument, if true, would support a case against a one-technology-fits-all approach.