



Cost and financing aspects of community renewable energy projects

VOLUME II: DANISH CASE STUDY



March 2016

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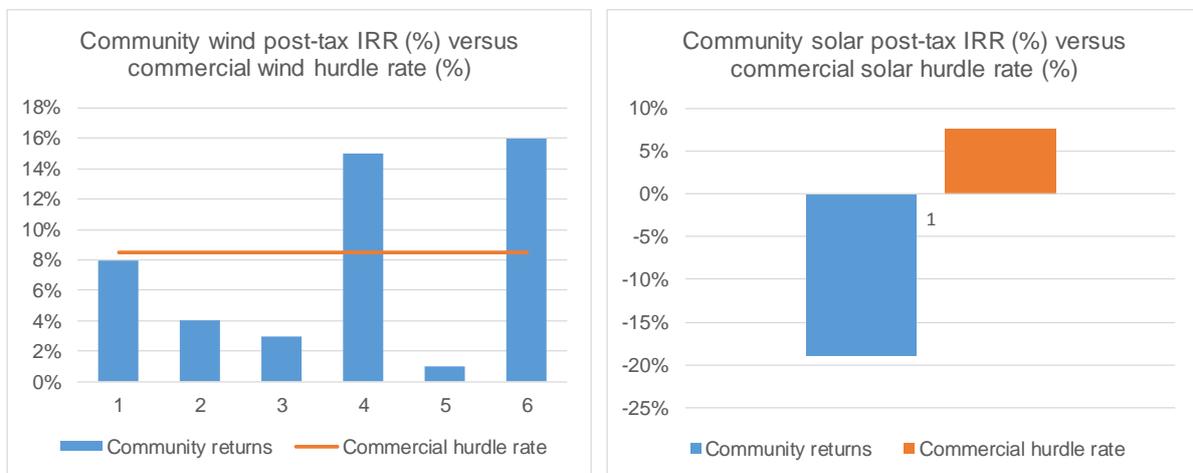
Executive summary

This Danish Case Study report presents the results of data collection and analysis of community and commercial wind and solar PV installations in Denmark. It has been based on information available as at the end of September 2015 and does not refer to any policy changes that may occur after this date.

Results of the interviews and the literature research show that there were major changes in the ownership structure of renewable energy resource (RES) projects in the past 25 years mainly based on the changes in the support scheme and the general legal framework for RES projects and community led projects in particular.

Cost Data Comparison

Through direct interviews with communities we have data for seven community projects, six wind and one solar PV. We chose to collect data on completed projects – so that the cost data represented actual, rather than predicted, costs. Using the data on costs, electricity prices and other forms of government support we have calculated the post-tax pre-financing Internal Rate of Return (IRR) for each of the seven community projects, shown below:



This shows that only two wind projects are projected to meet the hurdle rates of return commercial investors seek. This puts into question why so many of the Danish community projects (5 of 7 interviewed) appear to be predicting returns lower than commercial developers, for the evidence is that community projects pay similar project costs (development and construction costs) and similar operating costs to similarly sized commercial developments. It could be because the projects tend to be located in sites that are sub-optimal (e.g. lower wind speeds or lower levels of insolation), it could be because volatile and low electricity prices mean even commercially led projects are suffering, or it could be because larger commercial projects are able to benefit from economies of scale when buying wind turbines and arranging maintenance agreements, that smaller developers (whether they are community or commercial) cannot secure.

Conclusions

Denmark is a very interesting case study, given its pioneering role in community RES projects in the 1980s and 1990s, and now the move to fewer RES projects. This is partly because public opinion seems to be hardening towards wind power in Denmark, particularly on-shore wind power. What also seems to be happening is that the sense of community involvement has shifted. For now there seem to be very few new wholly owned community RES projects where the community conceptualises, plans, builds, finances and operates RES assets, but a number of cases where individuals close to new commercial wind farms are offered the opportunity to invest up to 20% in the commercial venture. Because the shared ownership projects are commercially led, the tentative conclusions are that local investors are becoming more financially minded, wanting to secure high returns with less consideration of delivering community dividends (also called community benefit) in the form of charitable assistance.

Where community RES projects are still happening, there is evidence that the new fixed price premium system, with a need to negotiate wholesale electricity contracts, is complex to understand for new

entrants. This makes it harder to secure financing. Nevertheless it seems that wind power cooperatives as well as individual owners of wind turbine shares have mitigated exposure to market risks through joint cooperative actions, such as the foundation of the independent trading cooperative Vindenergi DK, and cooperating with financially strong partners.

However, interview partners mentioned a possibility to reduce risk could be to move to a sliding premium, similar to that done on offshore wind projects. In this case, the support mechanism would guarantee a minimum payment and reduce market risk exposure. This is especially relevant in an energy market with increasing amounts of RES and thus more volatile wholesale prices.

With respect to the rising land rental costs interview partners mentioned the possibility to set an upper limit or to make the State responsible for buying and preparing sites for wind power exploitation and then installing a bidding procedure for the wind power project investors (as is already done for offshore wind power projects).

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1 Introduction

This Danish case study is structured into four main areas:

- Firstly a short overview of the Danish renewable energy sources (RES) market is given focusing on community based RES activities. To do this a definition of community led RES projects is proposed;
- Secondly the costs faced by community based and commercial¹ RES projects are described and analysed. The information on costs for community projects was collected via interviews with RES communities, and the information on commercial projects has relied on a literature review and internet sources. The numbers were then transferred into a financial model that shows how 'profitable' different projects are. This enables a comparison of the profitability of community versus commercial projects;
- Thirdly the responses to the seven project research questions are provided that draw on the outcomes from the interviews with communities and RES sector specialists, and from research;
- The case study then provides overall conclusions targeted at policy makers.

As there are only few empirical studies on the characteristics of recently formed energy cooperatives in Denmark² this case study has focussed on older literature and for more recent evidence results of research activities mostly in the form of PowerPoint presentations.

This Case Study has been based on information available as at the end of September 2015 and does not refer to any policy changes that may occur after this date.

2 Background: The Danish RES market

Denmark has a tradition of financial participation of communities and individuals in renewable energy, which stems from the environmental movement in the 1970s and 1980s and the relatively stable feed in tariff (FIT) regime in the late 1980s until 1999. These conditions allowed for financial and organisational participation of local citizens and community energy projects. However, from 1999 on the introduction of a new support mechanism (fixed premium tariff) and the abandonment of ownership regulations worsened the framework conditions for RES investors in general and community energy in particular. Furthermore, turbine sizes increased, spatial planning procedures became more complex and competition for available sites intensified with more commercial actors entering the market³. From 2003 to 2008 new investments into renewable energy, especially wind power came to a halt, except for some repowering investments. The stagnation of the expansion of renewable energy ended in 2009 with a strong revival of political support and a reform of the Promotion of Renewable Energy Act (Lov om fremme af vedvarende energi). Since 2013, however, the number of new wind power projects seems to be reducing again. This might be due to the decreasing public acceptance towards onshore wind and the lower levels of returns that developers and communities can secure on new projects.

Nevertheless, wind power still dominates RES in Denmark, but increasingly many RES community projects have biogas or solar plants beside their wind turbines. Due to the fact that wind is the most important renewable source in Denmark, this report especially focusses on wind energy.

2.1 Definition of community led projects

Riipens states that community led projects consist of a group of people who participate in the energy transition by cooperating in the field of renewable energy⁴. These projects are initiated, developed, and operated primarily by the local community and often run in the form of "general partnerships"⁵. However,

¹ The use of the term "commercial" lies in the necessity of making a distinction between the different types of RES projects, well knowing that community led projects are also "commercial" depending very much on the definition of the term.

² Bohnert, J.C. *Energy cooperatives in Denmark, Germany and Sweden – a transaction cost approach*. 2015. p. 4.

³ Gotchev, B. *Market integration and the development of wind power cooperatives in Denmark. Lessons learned for Germany*. 2015.

⁴ Riipens et al. *Report on REScoop Business Models*. 2013. p. 4.

⁵ Bolinger, M. *Community wind power ownership schemes in Europe and their relevance to the United States*. 2011. p. 44.

the nature of local ownership has changed significantly over the last six years with new projects exclusively owned by local citizens becoming the exception rather than the norm⁶. An increasing role of large commercial investors has made community participation the more usual case, being enforced by the Promotion of Renewable Energy Act of 2009, which forces the investor to offer at least 20% of its shares to local residents (for more details see section 2.4).

2.2 Possible legal forms for RES community based projects

The legal framework in Denmark provides different business models enabling citizens to participate in the financing of RES projects. The most common form is called “wind partnership”⁷, a type of general partnership. However, there are other legal structures as explained below.

2.2.1 General Partnership

In Denmark, energy cooperatives generally are organised in the legal form of general partnerships (*interessentskab – I/S*). This is because interest on loans for wind turbines is tax deductible from the private income of the individuals in a partnership. This is not possible with cooperatives⁸.

General partnerships are used for all sizes of projects, from single turbines to large projects, such as Middelgrunden Wind Cooperative with more than 8,000 members that own a number of turbines within a larger 40 MW wind farm⁹.

General partnerships have a democratic organisation, with each partner having one vote, regardless of the number of shares owned¹⁰. Unlike other countries (e.g. Germany or the UK), shares are connected to a specific amount of electricity generation, e.g. 1,000 kWh per year. Thus, installed capacity and the projected electricity generation determines the number of shares for each project¹¹.

The general partnership is not a taxable entity, rather taxes are levied on each member who is taxed at their marginal income tax rate. However, as long as cooperative members own less than about 10 to 20 shares and production revenue is less than 7,000 DKK/per year (approximately €940) no income tax is due¹².

All partners are held jointly and severally liable for any debts incurred by the partnership, thus this extends the level of individual’s investment and includes a certain risk¹³. In practice, this is mostly minimised in the bylaws of the partnership, which maintain that the partnership cannot contract debt. Therefore if debt is required this is secured by the members, not by the partnership. Furthermore the bylaws usually claim that the turbines must be adequately insured¹⁴.

Electricity is either sold to the local utility¹⁵ or to the cooperative Vindenergi DK which trades electricity on the partnerships’ behalf (see section 2.3.2).

With the increasing size of wind turbines cooperatives often partner with financially stronger partners to realise projects, such as with municipalities, utilities or private funds to overcome financial barriers in planning and siting, as well as dealing with regulatory complexities. After the project is implemented, the investors typically split ownership of the turbines so that their operation is legally and financially separated, e.g. the wind partnership may own five turbines and a commercial developer 15 turbines¹⁶.

2.2.2 Municipal Ownership

A municipality can participate in limited liability companies if activities involve the production, transport, trade or supply of electricity¹⁷. Often, utilities establish separate enterprises, organized as a private or

⁶ Gotchev, B. *Market integration and the development of wind power cooperatives in Denmark. Lessons learned for Germany*. 2015. p. 3.

⁷ Bolinger, M. *Community wind power ownership schemes in Europe and their relevance to the United States*. 2011. p. 12.

⁸ Skotte, H. *Cooperatives – local and democratic ownership on wind turbines*. 2010.

⁹ Gotchev, B. *Market integration and the development of wind power cooperatives in Denmark. Lessons learned for Germany*. 2015.

¹⁰ Roberts et al. *Community power: Model legal frameworks for citizen-owned renewable energy*. 2014.

¹¹ Bohnert, J.C. *Energy cooperatives in Denmark, Germany and Sweden – a transaction cost approach*. 2015. p. 43

¹² Soerensen, H.C. *Danmarks Vindmølleforening. Copenhagen Solar Cooperative. Experiences and Lessons Learned as of October 2013*. PowerPoint presentation. 2014.

¹³ Bolinger, M. *Community wind power ownership schemes in Europe and their relevance to the United States*. 2011; Skotte, H. *Cooperatives – local and democratic ownership on wind turbines*. 2010.

¹⁴ Skotte, H. *Cooperatives – local and democratic ownership on wind turbines*. 2010.

¹⁵ Gotchev, B. *Market integration and the development of wind power cooperatives in Denmark. Lessons learned for Germany*. 2015. p. 2.

¹⁶ An example for this procedure is the Hvidovre Wind Farm. Ownership was split after commissioning and each party, DONG Energy and a local cooperative, operated one turbine.

¹⁷ Nordic Folkecenter for Renewable Energy. *Wind energy as a lever for local development in peripheral regions*. 2013. p. 11f.

public joint stock company (*aktieselskab* – A/S) or a public or private Limited Liability Company (*anpartsselskab* – ApS)¹⁸.

- In Samsø the municipality created Samsø Energy Company ApS in order to take ownership of five turbines. Five additional turbines are directly owned by citizens through the cooperative Samsø Vindenergi.
- The Middelgrunden Wind Farm consists of 20 turbines. 50% ownership is held by the local utility, owned by the City of Copenhagen. The remaining 50% is owned by Middelgrunden Vindmøllelaug I/S.

2.2.3 Community foundation

A community foundation (also named industrial foundation, in Danish: *erhvervsdrivende fond*) is usually established by local associations and businesses¹⁹. In the community foundation model the profits from electricity production are legally intended to support local purposes (e.g. employment, culture and infrastructure) – very much akin to the concept of community dividends (also called community benefit) in countries such as the UK. To form a community foundation needs at least DKK 300,000 (approximately €40,000). The foundation is its own legal person and the entities establishing the foundation do not hold ownership rights, but establish the objectives and conditions for how profits are used for community purposes²⁰. There is no restriction in the Industrial Foundation Act on who can be co-founder of a foundation. The objectives of the fund and the distribution of surplus depend on who the co-founders are, for example local associations might have the purpose to support sports associations, whilst other associations may support other RES projects²¹.

Usually, the community foundation model is combined with another private ownership model, such as a partnership (*interessentskab*, I/S) or combined with municipal ownership²².

Holmsland Dunes Tourism Association together with local unions, industry and utilities established a community foundation to build three offshore wind turbines of 3 MW each. 80% of the project is owned by the foundation, the remaining 20% is owned by Hvide Sande Nordhavn Møllelaug I/S, a partnership as required by law.

2.2.4 Shared or co-ownership

The legal obligation of the Promotion of Renewable Energy Act of 2009 requires developers to offer at least 20% of the shares of a wind turbine to local residents (for more details see section 2.4). However, in practice most investors develop several wind turbines or projects at once and then sell one (or a number) of their turbines to a community organisation after commissioning – aiming of realising one 100% community ownership installation. This is therefore a split ownership model as described in the **Section 2.1.2 of the Main Report**.

2.3 RES development in Denmark

In the following, a short historic overview is given to better understand the current situation and the different development of stages of community-led projects and RES development in Denmark.

2.3.1 Historic overview

Originally, electricity consumers could only set up wind turbines on their own land, and sell the generated surplus electricity to the grid. From the early 1980s, electricity consumers were allowed to install wind turbines and sell shares to people who lived within three kilometres of the wind turbine. Since then, the distance within which investors must be located has expanded to by 2000 covering the whole of the EU²³. Each consumer was allowed to own shares not exceeding his/ her electricity consumption; thus maintaining the principle that owners were offsetting their electricity with the wind power production. The government took these steps to ensure that only those bearing the costs or

¹⁸ Roberts et al. *Community power: Model legal frameworks for citizen-owned renewable energy*. 2014. p. 26.

¹⁹ Nordic Folkecenter for Renewable Energy. *Wind energy as a lever for local development in peripheral regions*. 2013. p. 5.

²⁰ Roberts et al. *Community power: Model legal frameworks for citizen-owned renewable energy*. 2014. p. 21f.

²¹ Nordic Folkecenter for Renewable Energy. *Wind energy as a lever for local development in peripheral regions*. 2013. p. 8.

²² Roberts et al. *Community power: Model legal frameworks for citizen-owned renewable energy*. 2014. p. 21f.

²³ Bolinger, M. *Community wind power ownership schemes in Europe and their relevance to the United States*. 2011. p. 13.

negative effects (namely noise and visual intrusion) received the financial benefits of the government subsidies. The intention was to create broad public involvement and local ownership of Danish wind energy and projects led to many small clusters of wind turbines.

From 1984 until 1999, private wind turbine owners as well as owners of biomass-/ biogas-installations received a fixed rate of 85% of the electricity price householders paid (DKK/kWh), excluding charges and deductions for administrative costs²⁴. Through the early 1990s, this payment was limited to cooperatives and owners of single wind turbines under 150 kW. For owners of larger turbines, and for cooperative members living outside the district where the cooperative's turbines were installed, payment was limited to 70% of the retail rate. The size limit for individually owned turbines was eventually raised from 150 kW to 250 kW and then eliminated in the mid-1990s²⁵. In 1993 this system was strengthened by setting up a fixed feed-in tariff for "green energies" of 84% of the utility's production and distribution costs.

Furthermore, wind energy projects benefitted from a refund on the Danish carbon tax and a partial refund on the energy tax²⁶. This led to an increasing amount of cooperatives. By 1996, around 2,100 cooperatives existed in Denmark, mostly supporting wind energy projects²⁷. By 2001 more than 80% of the 6,300 wind turbines in Denmark were owned by wind energy cooperatives, or individual farmers, with over 150,000 Danish families owning own wind turbines or shares in wind cooperatives²⁸.

In 1999 the FIT was gradually phased out, and a renewable portfolio standard (RPS) was introduced with a system of tradable green certificates to support the renewable energy sector further²⁹. The trading of RES certificates was originally planned to start in January 2000, but due to a number of operational problems with the system the Danish government postponed the starting date. In addition to the electricity reform a national wind power planning directive (WPPD) was issued in 1999. It followed from the provisions in the directive that areas for wind power development could only be laid down in municipal and local plans if the areas were already designated for wind farms in the regional planning guidelines³⁰.

In 2003 the RPS was stopped and a fixed-market premium with direct marketing of electricity introduced. Therefore, RES developers were offered a fixed price (DKK/kWh) minus the average wholesale electricity spot prices for the period. This forced RES developers to negotiate Power Purchase Agreements (PPAs). Between 2003 and 2008 no new cooperatives were founded³¹. The main reason for this was that the premium was too low to be attractive. At the same time, the repowering of old turbines was supported with more attractive incentives, such as a higher payment cap than for new installations. As repowering very complex, many cooperatives were sold off to commercial actors³². The trends in the Danish wind sector over this time are shown in Figure 1.

²⁴ Basse, E. M. *Environmental Law Denmark*. 2004.

²⁵ Gipe, P. *Wind energy comes of age*. 1995. p. 60.

²⁶ Bolinger, M. *Community wind power ownership schemes in Europe and their relevance to the United States*. 2011. p.11.

²⁷ IRENA. *30 years of policies for wind energy. Lessons from 12 wind energy markets*. 2012. p. 56.

²⁸ Krohn, S. *Danish wind turbines: An industrial Success Story*. 2002.

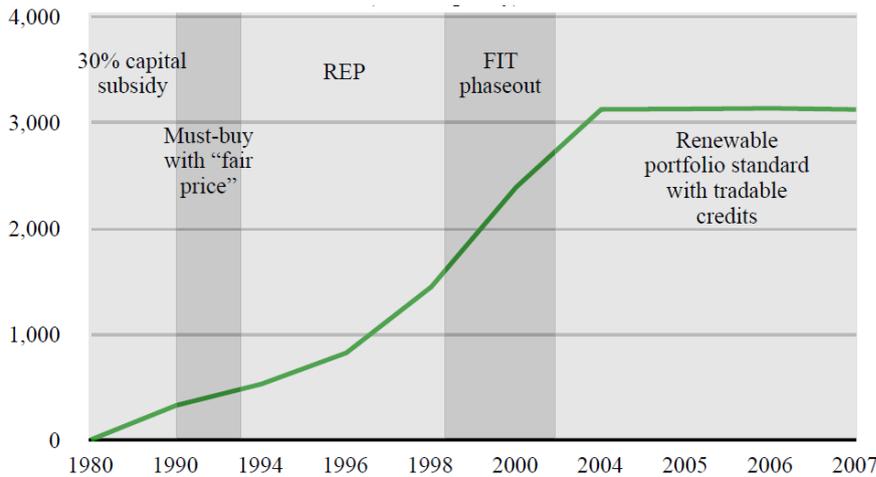
²⁹ Act on Electricity Supply 1999, §§ 60-63. For more details see Lucha, C. *Optimization of the share of renewable energies in electricity systems in the European Union. Cornerstones of an alternative political and institutional scenario*. 2006; Bolinger, M. *Community wind power ownership schemes in Europe and their relevance to the United States*. 2011. p. 11.

³⁰ For more details see Lucha, C. *Optimization of the share of renewable energies in electricity systems in the European Union. Cornerstones of an alternative political and institutional scenario*. 2006. p. 30-31.

³¹ Gotchev, B. *Civic participation in the Energiewende: What Germany can learn from Denmark*. 2015.

³² Gotchev, B. *Market integration and the development of wind power cooperatives in Denmark. Lessons learned for Germany*. 2015.

Figure 1: Danish Wind Power Flat lines with FIT Expiration (MW Capacity)

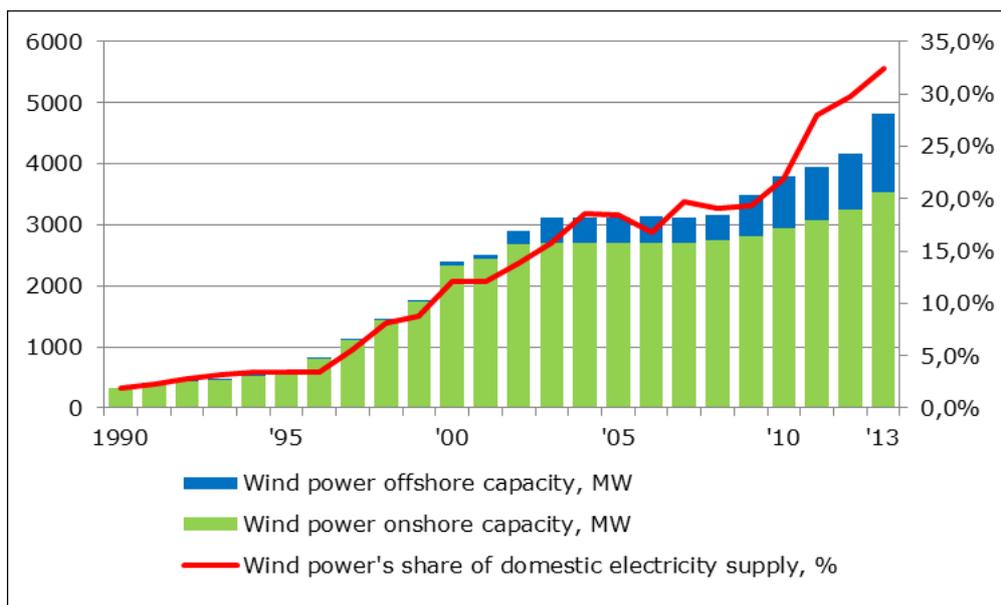


Source: Farrell, J. *Feed-in tariffs in America. Driving the economy with renewable energy policy that works*, 2009, p. 8.

The stagnation of the expansion of wind turbines ended in 2009 (see Figure 2) with a strong revival of political support for wind energy and a reform of the Promotion of Renewable Energy Act (for more details see section 2.4).

In 2013 wind turbines accounted for 30% of the electricity demand, and in the mid of 2014, there were more than 5,000 wind turbines with an installed capacity of 4,855 MW³³. As technology has improved there has been a movement from the typical 500 kW turbines built in the 1990s to 2 MW+ turbines.

Figure 2: Wind power capacity and wind power’s share of domestic electricity supply in MW

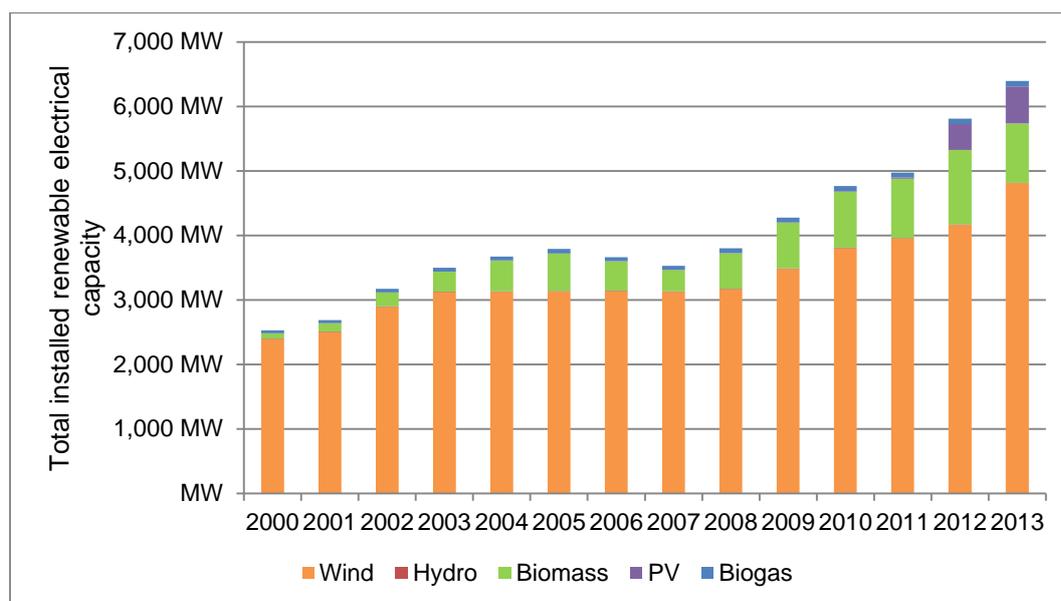


Source: Danish Energy Agency, *Energy Statistics 2013*, p. 9.

2.3.2 Current situation

As Figure 3 shows the majority of RES electricity capacity is installed in wind power plants. However, since the early 2000s biomass installations have increased in share and since 2012 solar PV has started to capture market share.

³³ Danish Energy Agency. *Renewable Energy*. 2015.

Figure 3: RES electricity: Development of installed capacity in Denmark by technologies


Source: Eurostat [nrg_113a]

With respect to wind energy the picture is mixed. According to recent findings public opinion is hardening against wind power in Denmark, particularly on-shore wind power³⁴. One interview partner made the connection between this decrease in acceptance and the declining levels of Government support for wind projects. Further, with the introduction of the Promotion of Renewable Energy Act of 2009 and its obligations for wind farm developers to offer at least 20% of ownership shares to local residents, the interview partner said that local people might be inclined to associate RES projects with something damaging that they need to be reimbursed for, but then be disappointed by the small returns that can be made.

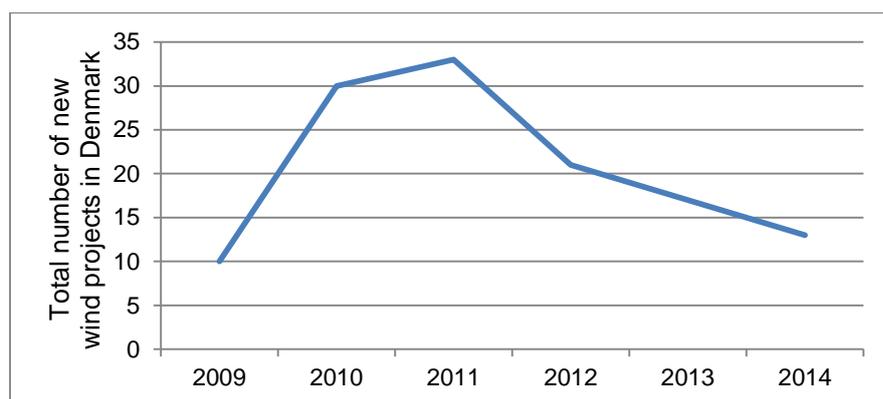
Another interview partner reported that it has been difficult for wind power developers/ investors during the recent years to sell ownership shares to citizens and especially to community organisations³⁵. Nevertheless, another interview partner reported that interest in buying shares of wind power turbines of citizens is high. Therefore, clearly interest and support depends on the specific local characteristics and demographics of localities, but drawing on the point above about local investors in shared ownership projects, it seems that local investors are now expecting much higher rates of return than in the 1990s when most wind projects were 100% community owned. In these shared ownership projects it can also be contended that there may be less interest in wider community benefits.

Since 2012 a still ongoing research project dealing shows that new wind power projects is decreasing again, as shown in Figure 4³⁶.

³⁴ DTU et al. *Public acceptance of wind farm development: Developer practices and review of scientific literature*. Wind2050 WP3 Deliverable 1. April 2015. See also Roberts et al. *Community power: Model legal frameworks for citizen-owned renewable energy*. 2014. p. 30.

³⁵ Gotchev, B. *Market integration and the development of wind power cooperatives in Denmark. Lessons learned for Germany*. 2015. p. 3.

³⁶ DTU et al. *Wind2050 - Multidisciplinary study on local acceptance and development of wind power projects*. Financed by Danish Strategic Research Council. 2014-2017. Project web site: www.wind2050.dk

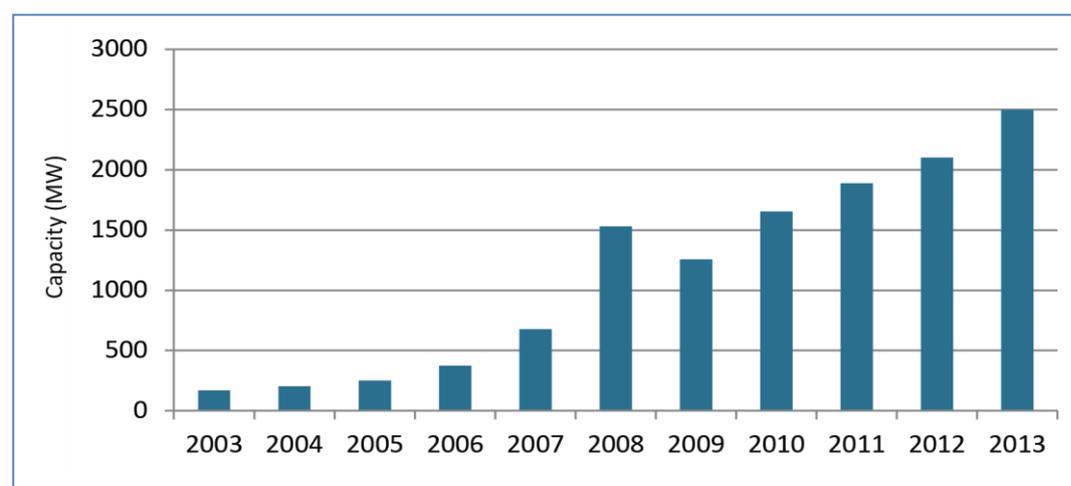
Figure 4: New wind projects in Denmark 2009-2014


Source: Justesen, Henrik Kamp (Energinet.dk). *Promotion of Renewable Energy act*. PowerPoint presentation. Wind2050 project meeting. 2015.

Statistics on ownership of RES installations ended in 2001 and no new official data could be found. According to the Danish Energy Agency in 2009 around 2,000 of the 5,200 wind turbines were still owned by local wind turbine owners' associations, although it does not clearly define what is meant by this term, but adding that "... *these are mostly older, smaller wind turbines because the majority of wind turbines erected since 1995 are owned by individuals, energy companies and other commercial wind power companies*"³⁷. Thus, empirical studies on the characteristics of recently formed energy cooperatives are missing.

An important part in the Danish RES market is played by the Vindenergi DK cooperative. In 1999, the Danish Wind Turbine Owners Association founded this independent, non-profit trading cooperative. Since 2003 Vindenergi DK purchases and trades electricity on behalf of private producers and wind power cooperatives. Members receive a yearly dividend. Ownership, control and voting rights are held democratically. As shown in Figure 5, in 2013, more than 50% of total installed wind capacity (around 2,500 MW) was traded by Vindenergi DK with many cooperative and private generators using them.

The success of the model is that Vindenergi DK mitigates risks and transaction costs for its member cooperatives by selling the electricity for them (overcoming some of the challenges of direct marketing by selling electricity to suppliers), reducing market risk exposure and facilitating the establishment of new cooperatives³⁸.

Figure 5: Installed capacity traded by Vindenergi DK in MW


Source: IASS Potsdam, based on data retrieved from www.vindenergi.dk

³⁷Danish Energy Agency. *Wind turbines in Denmark*. November 2009.

³⁸ Gotchev, B. *Market integration and the development of wind power cooperatives in Denmark. Lessons learned for Germany*. 2015. p. 3.

2.4 Policy support schemes for RES

A broad energy agreement reached in March 2012, included the decision to build 3,300 MW of new wind power capacity (1,800 MW onshore, 500 MW near-shore and 1,000 MW offshore) to reach the goal of 50% of electricity production in 2020 from wind energy³⁹.

Four policy measures were introduced by the **Promotion of Renewable Energy Act 2009** that were specifically aimed to reach the targets and enhance local acceptance of wind turbine projects, notably:

- A compensation scheme to neighbours;
- A co-ownership scheme;
- A community benefit scheme (green scheme);
- A guarantee fund for local ownership initiatives.

The compensation scheme and the co-ownership scheme were subject to adjustments in 2013⁴⁰.

The **compensation scheme to neighbours** states that property owners living very near turbines are to be compensated by wind farm developers for any loss of property value of dwellings greater than 1%. The scheme applies to onshore turbines more than 25 meters in height. Since 15 June 2013 it also applies to nearshore turbines and offshore turbines that are not subject to a tender (see below). The compensation to neighbours may either be settled by an agreement between the developer and the neighbour or (in case of no agreement) by the Valuation Authority⁴¹.

The **co-ownership scheme** was introduced by a statutory obligation that any person/ entity that erects one or more onshore (or offshore if not subject to tender) wind turbine higher than 25 metres shall, prior to commencement of erection, offer at least 20% of the ownership shares to residents in the municipality or living within 4.5 kilometres from the planned turbine(s). Ownership under the 20% ownership scheme (or more commonly one or two wholly owned community turbines under a split ownership deal with the private developer) is often legally constituted as a wind turbine guild (I/S or *vindmøllelaug*). Combinations with other community ownership models, such as a community foundation or with a municipal partner are possible⁴². Energinet.dk has established a website with information on co-ownership tenders⁴³.

The **community benefit scheme** or green scheme has the purpose to enhance local acceptance of onshore wind turbine projects. The main idea of the green scheme is to grant subsidies to initiatives enhancing local landscape and recreational values in communities that establish onshore wind turbines. The amount of subsidies granted to projects has ranged from approximately 20,000 to 4 million DKK (€2,700 to €536,000)⁴⁴. However, only few municipalities have utilized the full amount of funding available to the municipality. For instance, by the end of January 2015 an amount of 76.2 million DKK (€10.3 million) was available, while only 24.8 million DKK (€3.3 million) had been used under the scheme.

Local ownership initiatives can receive a **loan guarantee** for the construction of wind-energy plants for feasibility studies by Energinet.dk. The maximum guarantee is 500,000 DKK (€67,000) per project⁴⁵. If the project is implemented, the guarantee works as a low-interest loan. If the project is not implemented, the amount does not have to be paid back⁴⁶.

However, the main support system is a **premium tariff**. There are three premium support systems:

- Most offshore wind projects are tendered with the eventual premium for each site depending on the site characteristics and tender negotiation;

³⁹ IRENA. *30 years of policies for wind energy. Lessons from 12 wind energy markets*. 2012. p. 58 f; Nordic Folkecenter for Renewable Energy. *Wind energy as a lever for local development in peripheral regions*. 2013. p. 2.

⁴⁰ For more details see Anker, H. T. & Jørgensen, M. L. *Mapping of the legal framework for siting of wind turbines – Denmark*. IFRO Report 239. June 2015. p. 24f.

⁴¹ The Valuation Authority has been established with the specific purpose to deal with compensation claims from neighbours to wind turbines. The valuation authority is composed of one chairman (lawyer qualified as judge) and one expert (real estate agent) – regional branches have been established. Energinet.dk functions as secretariat for the valuation authority, see <http://taksationsmyndigheden.dk>

⁴² Roberts et al. *Community power: Model legal frameworks for citizen-owned renewable energy*. 2014. p. 21f.

⁴³ Energinet.dk. *Windmill Project Overview*. 2015. Available at: <http://www.energinet.dk/DA/EI/Vindmoeller/De-fire-VE-ordninger/Sider/Vindmølleprojektoversigt.aspx?udbud=kommende+aktuelle#>

⁴⁴ Energinet.dk. *Annual Report on the Green Scheme 2012-13*.

⁴⁵ RES legal. *Promotion in Denmark*. 2014.

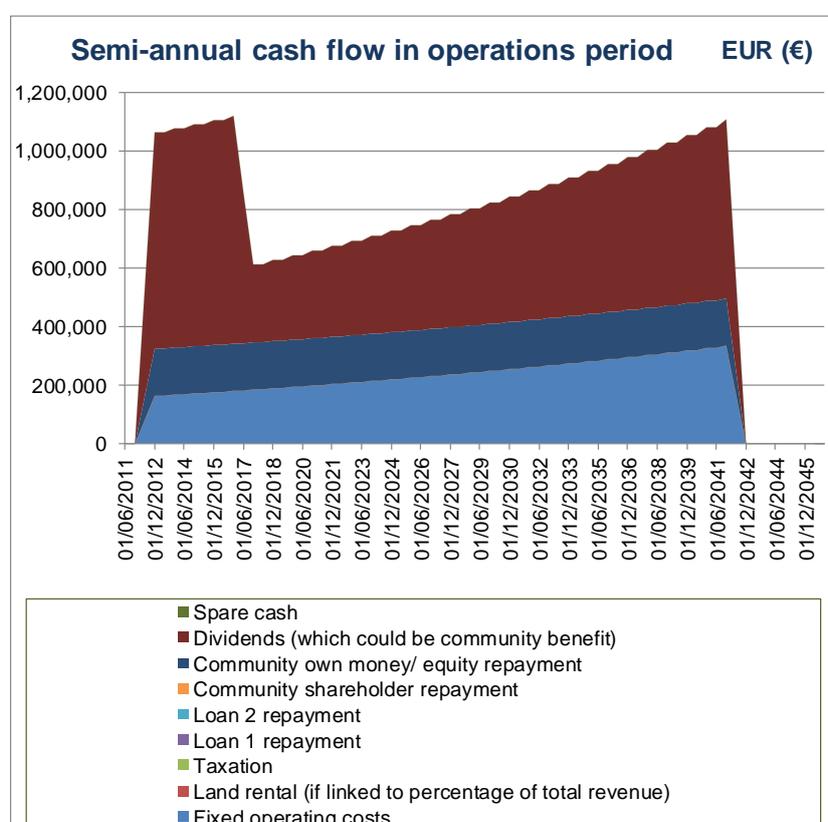
⁴⁶ Gotchev, B. *Market integration and the development of wind power cooperatives in Denmark. Lessons learned for Germany*. 2015.

- For some other technologies (onshore wind, hydro and offshore wind that is not tendered) there are fixed premiums that differ by technology and size;
- For solar and biomass there is a sliding premium which covers the difference between the wholesale support price and the statutory support level⁴⁷.

Fixed premiums are added to the market price. The prices paid under the fixed premium are capped to contain costs. For onshore wind power projects and offshore wind turbines not subject to tender the guaranteed price premium of DKK 0.25/kWh (€0.034/kWh) was only paid for the first 22,000 full-load hours. For wind turbines connected to the grid after 1 January 2014 the calculation model is different, but equivalent to approximately the first 25,000 peak load hours of the turbine. Additionally, DKK 0.0237/kWh (€0.0032/kWh) is received during the entire lifetime of the turbine to compensate for the cost of balancing. Since the end of the year 2013 the power production eligible for the premium is not only dependent on the rated capacity of the wind turbine but also on the rotor swept area⁴⁸.

An example of how the full-load hours is modelled is shown in Figure 6, which is Wind Project 4 shown in Appendix 2.

Figure 6: Effect of capped fixed premiums on cash flows



As can be seen, in this pre 2014 project it is anticipated that it will only take about 5¼ years to reach the 22,000 load hours cap, as each year about 4,250 load hours will be generated. As there are only 8,760 hours in a year, this equates to an extremely high capacity factor of 48.5% (most wind projects have capacity factors from 28% - 35%) as the site is located on the North Sea coast.

Some other specific wind turbine cases are explained in Box 1.

⁴⁷ RES legal. *Promotion in Denmark*. 2014.

⁴⁸ This is due to the fact that the support scheme worked in favour of wind turbines that were less attractive from a system perspective. For more details see Agora Energiewende. *The Danish Experience with integrating variable renewable energy*. September 2015. p. 34.

Box 1: Specific support for particular types of wind project

Wind turbines financed by utility companies receive a maximum subsidy (premium plus market price) of DKK 0.33/kWh (€0.04/kWh), applicable for 10 years from the date of connection of the system, plus a guaranteed bonus (unlimited term) of DKK 0.10/kWh (€0.01/kWh)⁴⁹.

Small turbines with a maximum capacity of 25 kW installed for consumption by the owner benefit from a maximum price (feed-in premium and market price) of DKK 0.10/kWh (€0.01/kWh) regardless of their grid-connection date.

Additional economic costs resulting from the support of RES are paid by all electricity consumers through the Public Service Obligation (PSO), depending on the consumers' electricity consumption⁵⁰. The **net-metering** regulation allows certain plant operators exemptions from paying the PSO. The exemptions depend on the installed capacity and renewable technology⁵¹.

Besides the support schemes described above, no special guides to reduce development costs, free technical support or standardised agreements exist in Denmark. However, Energinet.dk provides **subsidies** for small-scale RES electricity installations and for technologies deemed of strategic importance by the responsible ministry. Covered are certain PV installations, wave power plants, and certain installations using biogas and biomass as electricity source. The budget for subsidies of Energinet.dk amounts to 25 million DKK (approximately €3.35 million) per year until the end of 2015⁵².

⁴⁹ For more details see the translation of the Promotion of Renewable Energy Act available under: <http://www.ens.dk/sites/ens.dk/files/supply/renewable-energy/wind-power/onshore-wind-power/Promotion%20of%20Renewable%20Energy%20Act%20-%20extract.pdf>

⁵⁰ Held et al. *Design features of support schemes for renewable electricity*. 2014. p. 17.

⁵¹ For more details see RES legal. *Promotion in Denmark*. 2014.

⁵² RES legal. *Promotion in Denmark*. 2014.

3 Costs faced by RES projects

The costs faced by RES projects were collected on the basis of the interviews (for community led projects) and by using publicly available data bases (for commercial projects).

3.1 Commercial RES projects

Figure 7 (for wind) and Figure 8 (for solar) replicate the data included in **Appendix 6 of the Main Report**.



Figure 7: Danish data: Wind

	International Danish data (USD \$)	International Denmark data in Euros at €1 = USD \$1.15 exchange rate	Additional : Danish data in Euros (€)
Development costs (Currency/MW)	N/A	N/A	€120,000 [≈]
Construction costs (\$/MW)	N/A	N/A	€1,080,000 [≈]
Operational costs (Currency/MW/ year)	\$46,085 [^]	€40,075 [^]	€29,784 [*]
Typical debt: equity ratio	80:20 ^a	80:20 ^a	N/A [≈]
Cost of debt (%)	5% ^a	5% ^a	N/A [≈]
Length of loan (years)	13 ^a	13 ^a	N/A [≈]
Cost of equity (%)	11% ^a	11% ^a	N/A [≈]
Tax rates (2015)	23.5% [°]	23.5% [°]	23.5% [°]
Post-tax weighted average cost of capital	5.3% [≡]	5.3% [≡]	8.5% [™]

Sources:

[^] IRENA. *Renewable Power Generation Costs in 2014*. January 2015. Table 4.4 has the operations and maintenance (O&M) costs for Denmark which are on a USD/kWh basis and are \$0.0152/kWh – \$0.019/kWh. With an average full load hours of 2,695 (source: IEA Wind. IEA Wind Task 26: Multinational Case Study of the Financial Cost of Wind Energy. March 2011. Table 1.2) this equates to \$40,964/MW - \$51,205/MW or \$46,085/MW on average.

^a IEA Wind. *IEA Wind Task 26: Multinational Case Study of the Financial Cost of Wind Energy*. March 2011. Table 1.3.

[≡] Post-tax weighted average cost of capital is given by the formula:

$$[\text{gearing} \times \text{cost of debt} \times (1 - \text{tax rate})] + [\text{equity return} \times (1 - \text{gearing})] = [80\% \times 5\% \times (1 - 23.5\%)] + [20\% \times 11\%] = 5.3\%$$

[≈] Danish Energy Agency and Energinet.dk. *Technology Data for Energy Plants. Generation of Electricity and District Heating, Energy Storage and Energy Carrier Generation and Conversion*. May 2012, updated in March 2015, p. 87. The capital cost (presumably including the development cost) for a 3 MW wind turbine is reported at €1,200,000/MW. IRENA. *Renewable Power Generation Costs in 2014*. January 2015. Figure 4.2 shows that development costs are typically 9%-13% of total project cost. An assumption of 10% is made, equating to €120,000/MW for development costs and €1,080,000/MW for the actual construction costs.

^{*} Danish Energy Agency and Energinet.dk. *Technology Data for Energy Plants. Generation of Electricity and District Heating, Energy Storage and Energy Carrier Generation and Conversion*. May 2012, updated in March 2015, p. 87 reports operational costs of €10/MWh. This report provides an average capacity factor of 34%, so every 1 MW of installed capacity will have a cost of (34% x 8,760 x €10) €29,784/MW.

[°] 2015 corporate tax rates are sourced from KPMG's Corporate Tax Rate Tables available at <http://www.kpmg.com/Global/en/services/Tax/tax-tools-and-resources/Pages/corporate-tax-rates-table.aspx>

[™] NERA Economic Consulting. *Changes in Hurdle Rates for Low Carbon Generation Technologies due to the Shift from the UK Renewables Obligation to a Contracts for Difference Regime*. Department of Energy and Climate Change. 9 December 2013, p.115 provides a Danish nominal post tax return ranging from 7% -10%, so an average of 8.5% is reported.

Figure 8: Danish data: Solar

	International Danish data for solar <1 MW (USD \$)	Denmark data in Euros at €1 = USD \$1.15 exchange rate	Additional : Danish data in Euros (€)
Development costs (Currency/MW)	\$90,000 ~ ^a	€78,250 ~ ^a	N/A
Construction costs (Currency/MW)	\$1,710,000 ~ ^a	€1,487,000 ~ ^a	N/A
Operational costs (Currency/MW/year)	\$36,000 ~ [*]	\$31,300 ~ [*]	N/A
Typical debt: equity ratio	N/A	N/A	N/A
Cost of debt (%)	N/A	N/A	N/A
Length of loan (years)	N/A	N/A	N/A
Cost of equity (%)	N/A	N/A	N/A
Tax rates (2015)	23.5% [°]	23.5% [°]	23.5% [°]
Post-tax weighted average cost of capital	Not available	N/A	7.5% [™]

Sources:

~ IEA. *Technology Roadmap. Solar Photovoltaic Energy. 2014 edition.* September 2014. Total cost of installation by Country are sourced from Table 2 and an assumption was made that Danish costs are the same German costs. Page 10 of the IEA. *Technology Roadmap. Solar photovoltaic energy.* October 2010, p.10 defines commercial scale solar as up to 1 MW and utility based solar as greater than 1 MW.

^a Based on Ricardo-AEA studies, development costs make up approximately 5% of total cost of installation. This covers feasibility work, planning permission and other related development costs.

^{*} The international operating costs were sourced from a UK report by DECC. *Electricity Generation Costs 2013.* July 2013, p. 66. The DECC report states operation and maintenance costs are approximately 2% (per year) of total cost of installation for large scale solar PV installations. Operation and maintenance costs include inverter replacements (approximately every 7-10 years), ongoing installation project management, insurance, cleaning and basic repairs.

[°] 2015 corporate tax rates are sourced from KPMG's Corporate Tax Rate Tables available at <http://www.kpmg.com/Global/en/services/Tax/tax-tools-and-resources/Pages/corporate-tax-rates-table.aspx>

[™] NERA Economic Consulting. *Changes in Hurdle Rates for Low Carbon Generation Technologies due to the Shift from the UK Renewables Obligation to a Contracts for Difference Regime.* Department of Energy and Climate Change. 9 December 2013, p.115 provides a Danish nominal post tax return for wind ranging from 7% -10%, so an average of 8.5% is reported. The author has assumed that the post-tax weighted average cost of capital for solar projects is approximately 1% less than the wind returns, given the lower risks.

3.2 Community based RES projects

Cost data for community based RES projects were gathered via stakeholder interviews in Denmark.

3.2.1 Interview process and initial results

We used our own contacts and got valuable contacts from the Folkecenter for Renewable Energy (Nordisk Folkecenter for Vedvarende Energi) to set up a list of community energy organisations. We then focused on contacting the community organisations with wind and solar PV projects. In total we contacted 22 community energy organisations or project developers, three associations and municipalities and two representatives from science.

We were successful in speaking to six (community) organisations and one RES association who provided data for a community-owned wind turbine who kindly gave us the numbers and information required.

We had particular problems contacting communities with PV systems, as until recently PV installations have been quite rare, with many of these installations being used to convert electricity to heat. One of the three community organisations operating PV installations we contacted was willing to participate. Whereas some surveys can result in bias (i.e. interviewees giving numbers to make their profit appear lower) we have no reason to doubt the values given. Therefore, despite the small size of the dataset the results are still very valid.

Figure 9 provides more details about the six wind projects and the one solar project.

Figure 9: Summary kW capacity of the seven community projects

	Project Scale (kW)	Number of projects
Wind Offshore – 2	4,600	1
	20,000	1
Wind Onshore – 4	200	1
	2,000	1
	3,300	1
	7,200	1
Solar Roof – 1	40	1

The projects were commissioned at different points in time, with the split of the seven projects being shown in Figure 10.

Figure 10: Commissioning dates of the projects

	1988	2001	2003	2006	2012	2013	2015
Wind Offshore	0	1	1	0	0	0	0
Wind Onshore	1	0	0	0	1	1	1
Solar	0	0	0	1	0	0	0

It proved very difficult to obtain information from recent community owned RES installations and even more difficult from recent installations with a shared ownership structure. However, we were able to obtain numbers for three wind installations commissioned in 2012, 2013 and 2015. Reasons for the difficulties might be:

- There are not many community wind installations after the year 2011 as the community system still needs to recover from the many changes in the support schemes for RES in Denmark;
- More recent RES projects are no longer planned and developed as community-led projects from the beginning. In general commercial project developers approach individual local residents living near a planned wind turbine and ask them if they want to buy shares, or even buy outright one or two turbines under a split ownership structure. This will be to comply with the co-ownership obligation (see section 2.4). Therefore the owners of the wind turbine are no longer organised in a cohesive community or a cooperative as they were with 100% community owned projects they planned, developed and built;
- Individuals who buy shares in commercially led projects may no longer associate themselves as part of a RES community organisation, so getting data for community-led projects is difficult;
- On these co-ownership deals commercial investors are reluctant to disclose detailed cost data of their projects.

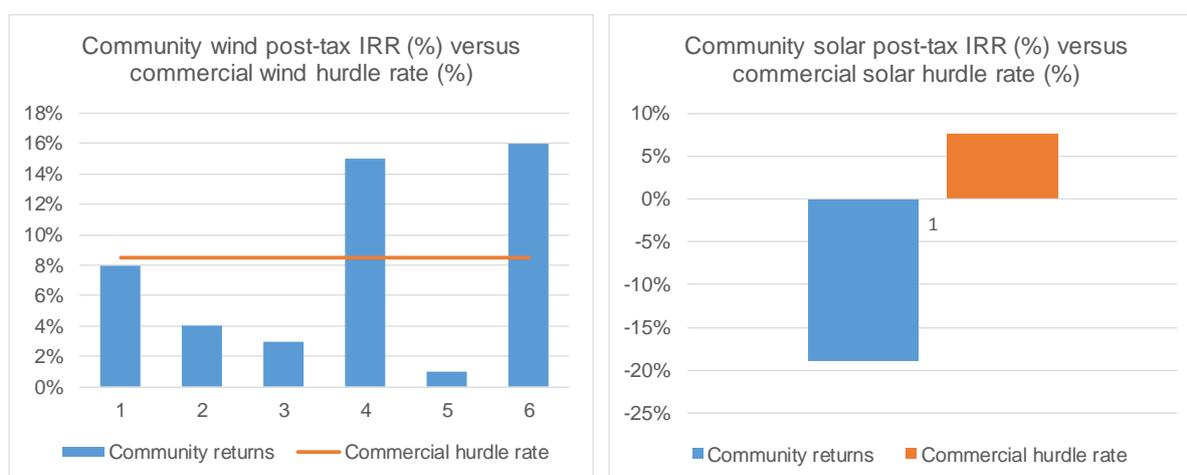
Telephone interviews were held with each of the community groups after they had received the questionnaire to ensure consistency across the data provided.

3.3 Results from financial modelling

As explained in **Section 2.2 of the Main Report**, the numerical values from the interviews were entered into the bespoke financial model to estimate the profitability of community projects. The profitability of community projects was then compared to the equivalent profitability of commercial projects. Section 2.2 explained that the most common legal form for community RES projects is the “wind partnership”, a form of a general partnership. Partnerships such as these do not pay corporation tax, rather the members of the cooperative are taxed on the proportion of the income they receive from the project, with certain exemptions allowed. Particularly on earlier projects, some of the profits were gifted tax free to a charity.

However, as some community projects pay corporation tax (especially shared ownership projects) the most appropriate comparison metric is the post-tax pre-finance Internal Rate of Return (IRR) — essentially the profits available to repay the various financiers (whether that be banks, community shareholders, equity investors or money for community benefit). Figure 11 presents the results, which are shown in Appendix 2.

Figure 11: Community wind post-tax IRR versus commercial post-tax IRR



It can be seen that two of the community wind projects would pass the commercial hurdle return. Interestingly both of these are more recent wind projects (2012 and 2015) where the market has matured. Each of the other four community wind projects do generate positive net cash flows, and based on the numbers provided should be able to distribute dividends back to the community investors.

The one solar project actually generates a negative IRR, i.e. the operating costs before any financing costs are actually greater than the revenues the project receives per year. This project is not seen as representative of the Danish community solar market.

3.4 Comparison of community energy and commercial cost data

3.4.1 Based on project data and literature review

Figure 12 and Figure 13 compare the cost information provided by the small sample of communities against the cost for commercial projects shown in Figure 7 and Figure 8. As explained in section 3.2.1, even though the sample size was quite small, and some of the community projects have differing commissioning dates, the results are still based on actual community costs, which we have no reason to believe are incorrect.

Figure 12: Comparison of costs (€/MW) for community projects and commercial projects - Wind

	Average for six community wind projects	IRENA (from Figure 7)	Danish specific commercial (from Figure 7)
Capacity (kW)	6,200	N/A	3,000
Development cost (€/MW)	41,100	N/A	120,000 ▲ 191%
Construction cost (€/MW)	1,368,200	N/A	1,080,000 ▼ 21%
Annual operational cost (€/MW)	35,600	40,075 ▲ 13%	29,784 ▼ 16%
Annual operational cost as percent of total project cost	2.5%	N/A	2.5%
Development cost as percent of total project costs	2.9%	N/A	10.0%

Figure 13: Comparison of costs (€/MW) for community projects and commercial projects - PV

	Community One community roof mounted project:	Commercial (from Figure 8)
Capacity (kW)	40	N/A
Development cost (€/MW)	3,337,500 combined	1,565,000
Construction cost (€/MW)		▼ 53% combined
Annual operational cost (€/MW)	47,000	31,300 ▼ 33%
Annual operational cost as percent of total project cost	1.4%	2%
Development cost as percent of total project costs	N/A	5%

Using the Danish specific commercial costs for wind projects, rather than the IRENA database (which had few Danish specific costs), it can be seen there are differences when compared to the six community wind projects. However the differences, especially in development costs could well be down to the way the costs are allocated. For the total project cost for the community wind projects is €1,409,300 /MW, compared to the €1,200,000 /MW for commercial, a number which is 14.5% lower.

For the operation costs, the differences of about 15% lower are not significant, especially as operating costs per year are only about 2.5% of the total commissioning cost. The differences in cost could be because the wind projects were built at different points in time and two of the community wind projects are offshore installations, which have higher costs than the onshore commercial figures shown in Figure 7 and Figure 12. Therefore, the differences are not believed to be material.

Larger differences are shown for the solar PV project, but the solar PV project was commissioned in 2006 and there have been large falls in PV costs since then. Because of the date and sample size of one, no conclusions can be made for solar costs. Interestingly, as shown in Figure 3, it is only since 2012 has solar PV started to ramp up.

3.4.2 Based on interviewees' assessment

In addition, we asked communities to estimate how different the costs would have been for an identical commercial project with the same kW capacity and exactly the same load factor (i.e. generating exactly the same MWh of electricity). The results from the seven interview partners who responded to this question are presented in Figure 14. The number of responses for each option is shown in red.

Figure 14: Community views of comparable costs for commercial projects

				No answer	Overall
The time from concept to commissioning would have been:	Quicker 0	Similar 4	Slower 1	2	Similar
Development costs would have been	Higher 3	Similar 2	Less 1	1	Higher
Capital costs would have been	Higher 2	Similar 2	Less 1	2	Indecisive
Installation/ construction costs would have been	Higher 1	Similar 5	Less 0	1	Similar
Substation/ BoP costs would have been	Higher 1	Similar 4	Less 0	2	Similar
Grid connection costs would have been	Higher 1	Similar 4	Less 0	2	Similar
Loans would have been	Cheaper 1	Similar 1	Dearer 1	4	Indecisive
Equity finance would have been	Cheaper 0	Similar 0	Dearer 3	4	Dearer
The amount of the loan would have be	More 2	Similar 2	Less 0	4	Indecisive

The main messages from the respondents are that most costs will be similar, which is evidence of the maturity of the Danish community energy sector. The only two areas where there are perceived to be differences are:

- Development costs for commercial projects would have been higher, possibly because many communities still benefit from free volunteer time;
- Equity finance for commercial projects would have been dearer. This is in line with the general consensus that communities will commonly have lower equity hurdle rates than the commercial of 8% plus. However, as already mentioned interview partners reported that citizens participating in wind power projects do expect increasingly high investment returns as the sector passes to larger commercial projects.

In the questionnaire we sent to communities we explicitly asked communities to estimate how many days of professional time were given freely. Communities responded to these questions, with estimates that ranged from 10 days to hundreds days. To these numbers we applied appropriate daily rates, which we valued at €150 a day, unless the community gave us other information. The results for the projects are shown in Figure 15.

Figure 15: Importance of ‘free’ professional time as a proportion of invoiced development costs

The following tables show:

- The value of free time, given by members of the community group,
- The value invoiced development costs (e.g. for legal advisers, wind studies, project management, etc).

	Wind					PV roof
Capacity (kW)	4,600	20,000	200	7,200	3,300	40
Free time (€)	45,000	75,000	-	-	-	4,500
Priced costs (€)	265,000	2,600,000	-	160,000	-	-
Free as percent of priced	17%	2,9%	-	-	-	-

3.4.3 Conclusions from analysis

Whilst the solar project needs to be discounted, given it was a single project, the main message seems to be that commercial wind project costs (both the initial project commissioning and operating costs) may be about 15% lower, so not significantly different. Some of the reasons for this could be that two of the projects are offshore wind farms, which have inherently different cost structures. Therefore, the overall message is that project and operating costs are probably quite similar for a community or commercial entity developing a wind project of a similar size.

4 Responses to research questions

4.1 Cost components for different ownership options (community-led, shared ownership and fully commercial)

As shown in Figure 16 all models of ownership (community-led, shared ownership and fully commercial) will have similar costs to commission projects, with the exception that:

- Community organisations often incur considerable costs with community engagement, which may be less for wholly commercial projects, but this may be offset by lower costs for planning applications;
- Some Danish community projects (e.g. the “wind partnership”) are corporation tax exempt, but other community structures pay corporation tax, and for this reason a question mark (?) is shown in Figure 16;
- The exact split between costs faced by communities and commercial developers in shared projects will depend on the actual project arrangements. However, indications are that whereas in other countries shared ownership options can generate community dividends (e.g. money to support local charities or encourage energy efficiency), in Denmark many of the recent shared ownership options are solely locals owning shares in commercial projects. Therefore the local shareholders will be brought into projects often at the point of construction commencement or even at commissioning, meaning they will not need to pay for most of the development costs (although clearly they do effectively pay for the development costs through their share purchase), as the development costs, plus any developer mark up, will be included in the valuation.

Figure 16: Different costs faced by different ownership models

	Community	Shared community involvement	Shared commercial involvement	Commercial
<i>Development costs</i>				
• <i>Initial feasibility</i>	✓*	✗	✓	✓
• <i>Planning permission preparation</i>	✓	✗	✓	✓
• <i>Project management costs</i>	✓	✗	✓	✓
• <i>Other advisory</i>	✓	✓	✓	✓
• <i>Community consultation</i>	✓	✓	✓	✓
<i>Construction costs</i>	✓	✓	✓	✓
<i>Operations costs</i>	✓	✓	✓	✓
<i>Taxation costs</i>	?	?	✓	✓

* Communities often benefit from ‘free’ volunteer time, so delving into the actual costs by accounting for the ‘free’ volunteer time will affect the total costs.

4.2 External factors that can affect the costs of community-led and shared ownership projects

Prior to 2000 most wind turbines were owned by cooperatives, but after this with commercial actors increasingly able to enter the market, rental costs for land started to rise as community and commercial developers compete for sites.

The intended increased market integration with the implementation of a premium system (fixed premium for onshore wind and the tendering for offshore wind) has created barriers for community-led projects because of the complexities involved. For example, communities often have a lack of experience in trading electricity on wholesale markets. This increases risks (unreliable and reduced revenues) as well as the perception of risks by citizen and banks.

Unlike other countries that have many grants for community projects, there are very few in Denmark. Nevertheless, local ownership initiatives can receive a loan guarantee for the construction of wind power plants for feasibility studies by Energinet.dk, the maximum guarantee being 500,000 DKK (€67,000) per project. There is also the **community benefit scheme** or green scheme which are grants towards enhancing local landscape and recreational values (see Section 2.4).

There are also income tax exemptions for members in general partnerships (the most widespread community organisation type in Denmark) owning less than about 10 to 20 shares and having a production revenue less than 7,000 DKK per year (approximately €940 per year).

4.3 Constraints and related cost/ financing implications that only apply to community-led and/ or shared ownership projects

As suggested there are no specific constraints with regard to the financing conditions that apply only to community-led RES projects. The great majority of the interviewed persons from community-led projects did not have difficulties to raise risk capital for the development, construction and operational phases. However, for shared ownership projects there is evidence of local investors looking for higher returns than the 100% community owned projects were and are able to secure. As explained in section 4.3, the premium system has disadvantaged smaller actors who only undertake one project, as is the case for many community projects.

4.4 Whether some of the cost components are invariably higher for community-led and/ or shared ownership projects

Community interviewees' believe construction and installation costs as well as grid connection costs should have been similar, and this has been drawn out in the conclusions in Section 3.4.3.

As explained in section 4.2, two interview partners indicated that costs for land rental were increasing in recent years. As securing planning permission for wind projects is getting harder, more investors are competing for additions to existing wind farms, or repowering sites when the assets that were installed in the 1990s need to be replaced. This is pushing up rentals. Where new sites are being sought one interview partner reported that there is often no early engagement with local people, and contracts between land owners and investors are commonly concluded even before the official municipal or regional plan is published.

In other Case Studies (e.g. UK and Canada) development costs are often higher for community projects. Whilst the Danish communities we interviewed believed that community projects can often have lower development costs (profiting from a lot of free working time from the project members) this point is unresolved.

4.5 Whether some of the cost components are invariably lower for community-led and/ or shared ownership projects

Apart from opportunities for community projects to be corporation tax exempt there are few other costs that are invariably lower for community projects given the limited availability of grants or specific support. Even if community owned projects are liable to corporate tax, part of this can be offset by giving some of the profit to a charity for community benefit. Whilst this does reduce the dividends local shareholders can receive it does allow the community dividends to support charitable aims.

In the past community investors were often prepared to accept lower returns than commercial investors would, but it has been noted that on many of the newer commercially led shared ownership or split ownership projects local investors are now seeking higher returns to more closely match those made by the commercial investor, and there may be less interest in wider community benefits.

4.6 Cost projections to 2020

The main costs for renewable energy projects are the construction phase costs. The IEA estimates that roof mounted solar project construction costs are forecast to decrease by 18.6% in real terms between 2015 and 2020⁵³. There is no available IEA data on operational solar expenditure costs, but they are likely to remain flat in real terms. Operational costs will include land rentals, insurance, cleaning and replacing inverters every 7-8 years. So whilst the costs of inverters will fall, it is likely that the other operating costs will remain similar, giving an overall similar operating cost profile.

For onshore wind projects, the IEA forecasts capital expenditure costs will drop at an annual nominal rate of 2.2%, due to a consistent reduction of wind turbine prices⁵⁴. A report by KIC InnoEnergy estimates that operational costs are expected to fall by about 6% between 2014 and 2025. Therefore, an assumption is made that between 2015 and 2020 annual operational costs will only fall by 3% in total. This small reduction in costs is due to advances in maintaining wind turbines, although other operational costs (e.g. insurance, rentals, etc.) are likely to remain flat or even rise slightly⁵⁵.

As there are fewer and fewer 100% community owned projects development costs for communities are no longer that relevant, as the community will often be buying into a commissioned wind project with a split ownership structure. Therefore, the bulk of the development costs will be incurred by the private developer, and these are projected to remain similar or slightly increase due to the increasing difficulties in securing planning permission for wind projects in Denmark.

4.7 Opportunities to reduce community-led and/ or shared ownership costs

Since interview partners did not mention facing higher or additional costs in comparison to commercial RES projects, most of them denied having considerable cost reduction opportunities. Some of them pointed out that they would expect the costs being even higher now as low interest development phase loans that were previously available are no longer on offer.

With respect to the (suspected) rising land rental costs one interview partner mentioned that a way to reduce these costs could be to set an upper limit. This – according to the interview partner – could be realised only if wind turbines were defined as common goods like other infrastructure such as transmission towers, roads or railways. Then the expropriation principle could be applied and land owners would get a reasonable payment for the use of their land for common good infrastructure.

Another interview partner pointed out that another solution may be for the State to buy and prepare the sites for wind power exploitation and then create bidding procedures for wind power project investors; like the process for tendering offshore wind power projects.

As communities tend to invest in smaller wind projects than commercial developers they, like any other small developer, are having to understand the fixed premium system. Interview partners mentioned a possibility to reduce risk could be to move to a sliding premium, similar to that done through the offshore wind tendering competitions. In this case, the support mechanism would guarantee a minimum payment to reduce market risk exposure. This is especially relevant in an energy market with increasing amounts of RES and thus more volatile wholesale prices. For instance, interview partners mentioned that the current low market prices of electricity in combination with an increasing importance of the rate of return for community shareholders are important reasons why community-led (as well as shared ownership-based) onshore wind installations are now quite difficult to realise in Denmark.

⁵³ IEA. *Technology Roadmap – Solar Photovoltaic Energy*. 2014, p. 23 (Figure 11). Retrieved from: https://www.iea.org/publications/freepublications/publication/TechnologyRoadmapSolarPhotovoltaicEnergy_2014edition.pdf

⁵⁴ IEA. *Technology Roadmap – Wind Energy*. 2013. Retrieved from: https://www.iea.org/publications/freepublications/publication/Wind_2013_Roadmap.pdf

⁵⁵ KIC InnoEnergy. *Future Renewable Energy Costs: Onshore Wind*. 2014. Retrieved from: http://www.kic-innoenergy.com/wp-content/uploads/2014/09/KIC_IE_OnshoreWind_anticipated_innovations_impact.pdf

5 Conclusions

Mindful that the conclusions need to be tempered by the fact that community wind costs were gathered for projects that were commissioned at different times between 1998 and 2015 and data was only obtained for one community solar project, the three top findings of this case study are as follows:

- 1) There is little evidence that community projects have higher project costs (development and construction costs combined) than commercial developers, although it is unclear whether development costs tend to be higher or lower – higher because of the extra effort involved in community consultation and the fact that many communities will be doing projects for the first time, offset by lower costs with the amount of ‘free’ professional assistance given and possibly easier planning application. Likewise there is little evidence of different operating costs.

This puts into question why so many of the Danish community projects (5 of 7 interviewed) appear to be predicting returns lower than commercial developers. It could be because the projects tend to be located in sites that are sub-optimal (e.g. lower wind speeds or lower levels of insolation), it could be because volatile and low electricity prices mean even commercially led projects are suffering, or it could be because larger commercial projects are able to benefit from economies of scale when buying wind turbines and arranging maintenance agreements that smaller developers (whether they are community or commercial) cannot secure;

- 2) The Danish history of community RES is that from the 1980s to 1999 the guaranteed FIT including purchase obligations, in combination with the strict rules about local ownership of the RES installations led to many community and cooperative projects, as well as farmer-led RES projects. This was combined with income tax incentives that ended in 1990.

In the period between 2003 and 2008 investment in new RES installations, especially by cooperatives, dropped to virtually zero, with the exception of some repowering and offshore installations. This can be explained by the premium within the newly installed RPS being too low to be attractive and by the (temporarily) abandonment of local ownership rules that had been beneficial for community based RES projects. Since 2009 the number of new RES installations increased again. There is some doubt, however, as to whether since 2012 the number of new wind farms is has started to fall again.

It is too early yet to draw up a definitive conclusion whether small and financially weak community or citizen led initiatives in Denmark have found a way to deal with the greater exposure to market signals via the premium system. However, it seems that especially wind power cooperatives have mitigated exposure to market risks through joint cooperative actions, such as the foundation of the independent trading cooperative Vindenergi DK, and by cooperating with financially strong partners;

- 3) The 2009 Promotion of Renewable Energy Act require wind developers to offer 20% of shares to local individuals. It now appears that local investors are expecting a much higher rate of return than back in the times when most wind turbines were conceptualised, planned, built financed and operated by communities. There is also evidence that on these shared ownership projects there is less consideration of wider community benefits than on some of the earlier wholly owned community projects.

Appendices

Appendix 1: Glossary

Appendix 2: Results from financial modelling

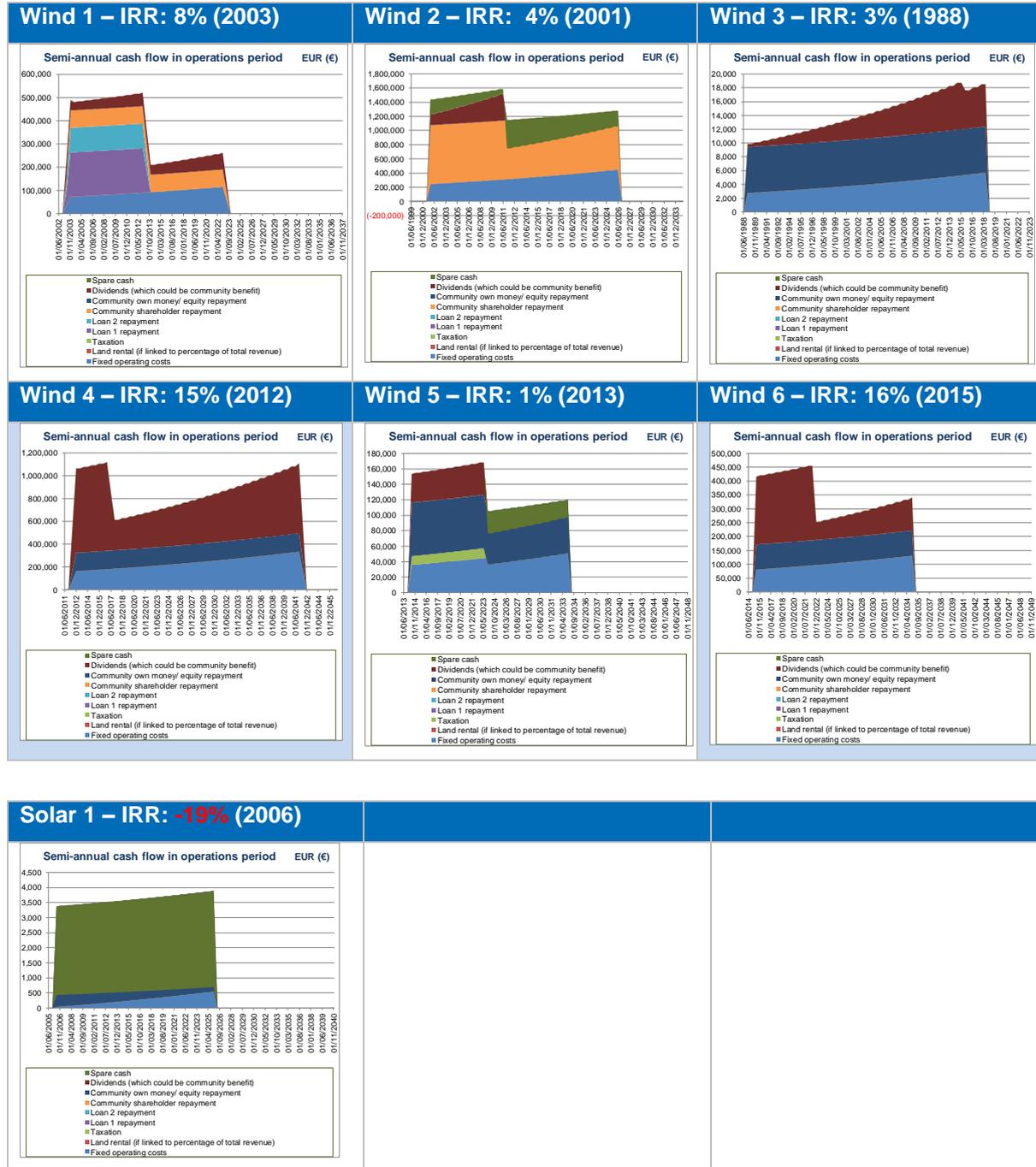
Appendix 3: Bibliography

Appendix 1 – Glossary

FIT	Feed-in Tariff
GW	Gigawatt
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
IRR	Internal Rate of Return
kW	Kilowatt
kWh	Kilowatt hours
MW	Megawatt
MWh	Megawatt hours
PPA	Power Purchase Agreement
PV	Photovoltaics
RES	Renewable Energy Sources
RPS	Renewable Portfolio Standard
WACC	Weighted Average Cost of Capital
WPPD	Wind Power Planning Directive

Appendix 2: Results from financial modelling

The following charts show the anticipated returns on the community wind and solar projects we obtained information on. Light blue cells (■) highlight the two projects that are projected to make higher returns than the commercial hurdle rate.



Appendix 3: Bibliography

- Anker, H. T. & Jørgensen, M. L. *Mapping of the legal framework for siting of wind turbines – Denmark*. IFRO Report 239. June 2015.
- Basse, E. M. *Environmental Law Denmark*. DJOF Publishing 2015. 2nd edition.
- Bohnerth, J.C. *Energy cooperatives in Denmark, Germany and Sweden – a transaction cost approach*. Department of Earth Sciences. Uppsala. 2015.
- Bolinger, M. *Community wind power ownership schemes in Europe and their relevance to the United States*. Lawrence Berkeley National Laboratory. 2011. Retrieved from: <https://escholarship.org/uc/item/78k755vv>
- Copenhagen Solar Cooperative. *Experiences and Lessons Learned as of October 2013*. PowerPoint presentation. 2013.
- Danish Energy Agency and Energinet.dk. *Technology Data for Energy Plants. Generation of Electricity and District Heating, Energy Storage and Energy Carrier Generation and Conversion*. May 2012, updated in March 2015
- Danish Energy Agency. *Renewable Energy*. 2015. Retrieved from: <http://www.ens.dk/en/supply/renewable-energy/wind-power/onshore-wind-power>
- Danish Energy Agency. *Graphs Renewable Energy*. 2013. Retrieved from: <http://www.ens.dk/en/info/facts-figures/energy-statistics-indicators-energy-efficiency/annual-energy-statistics>
- Danish Energy Agency. *Energy statistics 2013*. Retrieved from: <http://www.ens.dk/sites/ens.dk/files/info/tal-kort/statistik-noegletal/aarlig-energistatistik/energystatistics2013.pdf>
- Danish Energy Agency. *Wind turbines in Denmark*. 2009. Retrieved from: http://www.ens.dk/sites/ens.dk/files/dokumenter/publikationer/downloads/wind_turbines_in_denmark.pdf
- Danish Nature Agency. *Guidance regarding the planning procedures for onshore wind turbines (Vejledning om planlægning for og tilladelse til opstilling af vindmøller)*. 2015. Available at: http://naturstyrelsen.dk/media/131731/vejledning_06012015_web.pdf
- DECC. *Electricity Generation Costs 2013*. July 2013.
- DTU et al. *Wind2050 - Multidisciplinary study on local acceptance and development of wind power projects*. Financed by Danish Strategic Research Council. 2014-2017.
- DTU Wind Energy et al. *Public acceptance of wind farm development: Developer practices and review of scientific literature. Wind2050 WP3 Deliverable 1*. April 2015.
- Ea Energy Analyses. *The Danish experience with integrating variable renewable energy. Lessons learned and options for improvement*. Study on behalf of Agora Energiewende. September 2015.
- Energinet.dk. *Annual Report on the Green Scheme 2012-13*. Available at: <http://www.energinet.dk/SiteCollectionDocuments/Danske%20dokumenter/EI/Årsrapport%202012-2013%20Grøn%20Ordning.pdf>
- Farrell, J. *Feed-in tariffs in America. Driving the economy with renewable energy policy that works*. New Rules Project. Minneapolis. 2009.
- Nordic Folkecenter for Renewable Energy. *Wind energy as a lever for local development in peripheral regions*. 2013.
- Gipe, P. *Wind energy comes of age*. John Wiley & Sons, Inc., USA. April 1995.
- Gotchev, B. *Market integration and the development of wind power cooperatives in Denmark. Lessons learned for Germany*. IASS Potsdam, Plattform Energie. 2015.

- Gotchev, B. *Civic participation in the Energiewende: What Germany can learn from Denmark*. IASS Potsdam, Blog. 2015. Retrieved from: <http://blog.iass-potsdam.de/2015/02/energiewende-civic-participationde-what-germany-can-learn-from-denmark/>
- Held, A., Ragwitz, M., Gephart, M., de Visser, E. & Klessmann, C. *Design features of support schemes for renewable electricity*. Ecofys. 2014.
- IEA. *Technology Roadmap – Solar Photovoltaic Energy*. 2010. Retrieved from: https://www.iea.org/publications/freepublications/publication/pv_roadmap.pdf
- IEA. *Technology Roadmap – Solar Photovoltaic Energy*. 2014, p. 23 (Figure 11). Retrieved from: https://www.iea.org/publications/freepublications/publication/TechnologyRoadmapSolarPhotovoltaicEnergy_2014edition.pdf
- IEA. *Technology Roadmap – Wind Energy*. 2013. Retrieved from: https://www.iea.org/publications/freepublications/publication/Wind_2013_Roadmap.pdf
- IEA Wind. *IEA Wind Task 26: Multinational Case Study of the Financial Cost of Wind Energy*. March 2011.
- IRENA. *30 years of policies for wind energy. Lessons from 12 wind energy markets*. 2012.
- IRENA. *Renewable Power Generation Costs in 2014*. January 2015.
- Justesen, H. K (Energinet.dk). *Promotion of Renewable Energy act*. PowerPoint presentation. Wind2050 project meeting. 2015. Available at: <http://www.wind2050.dk/Events>
- KIC InnoEnergy. *Future Renewable Energy Costs: Onshore Wind*. 2014. Retrieved from: http://www.kic-innoenergy.com/wp-content/uploads/2014/09/KIC_IE_OnshoreWind_anticipated_innovations_impact.pdf
- Krohn, S. *Danish Wind Turbines: An Industrial Success Story*. 2002. Available at: http://www.ingdemurtas.it/eolico/normativa-danimarca/Danish_Wind_Turbine_Industry-an_industrial_succes_story.pdf
- Ladenburg, J. “Dynamic properties of the preferences for renewable energy sources – A wind power experience-based approach”. *Energy* 76:2014. p. 542-551
- Lucha, C. *Optimization of the share of renewable energies in electricity systems in the European Union. Cornerstones of an alternative political and institutional scenario*. Universität Koblenz-Landau. 2006.
- NERA Economic Consulting. *Changes in Hurdle Rates for Low Carbon Generation Technologies due to the Shift from the UK Renewables Obligation to a Contracts for Difference Regime*. DECC. December 2013.
- NERA Economic Consulting. *Changes in Hurdle Rates for Low Carbon Generation Technologies due to the Shift from the UK Renewables Obligation to a Contracts for Difference Regime*. Appendix F. International Benchmarking – Denmark. Department of Energy and Climate Change. December 2013.
- Promotion of Renewable Energy Act (Lov om fremme af vedvarende energy) 2009. Retrieved from: http://www.ens.dk/sites/ens.dk/files/supply/renewable-energy/Renewable%20Energy%20Act%20_VE%20loven.pdf
- Ragwitz, M., Winkler, J., Klessmann, C., Gephart, M., Resch, G. *Recent developments of feed-in systems in the EU – A research paper for the International Feed-In Cooperation*. Fraunhofer ISI, Ecofys, Energy Economics Group. A report commissioned by the BMU. 2012.
- RES legal. *Promotion in Denmark*. 2014. Retrieved from: <http://www.res-legal.eu/search-by-country/denmark/tools-list/c/denmark/s/res-e/t/promotion/sum/95/lpid/96/>
- Rijpens, J., Riutort, S. & Huybrechts, B. *Report on REScoop Business Models*. 2013.
- Roberts, J., Bodman, F. & Rybski, R. *Community power: Model legal frameworks for citizen-owned renewable energy*. Client Earth: London. 2014.
- Skotte, H. *Cooperatives - local and democratic ownership of wind turbines*. In: *Wind power to combat climate change*. 2010. Energinet.dk. Retrieved from:

<http://energinet.dk/SiteCollectionDocuments/Engelske%20dokumenter/Klimaogmiljo/Wind%20power%20magazine.pdf>

Soerensen, H. C. *The cooperative approach in Danish Wind energy ownership before and after the 2008 RE-law*. PowerPoint presentation. 2014.

Soerensen, H. C. *Danmarks Vindmølleforening*. PowerPoint presentation. 2014. Retrieved from: <http://www.wind2050.dk>

WPPD. *Cirkulære nr 100 af 10. juni 1999 om planlægning for og landzonetilladelse til opstilling af vindmøller. Vindmøllecirkulæret*. Danish Ministry for Energy and Transport. 1999.

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