Sitra Studies 58

# Financing Carbon Neutral Districts

## Study on business and financing models for carbon neutral energy supply in Finland

**Aleksi Lumijärvi ja Juha Ollikainen,**
**GreenStream Network Plc.**

SITRA

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# Foreword

Sitra has been developing a Low2No concept which aims to sustainable and carbon neutral urban construction. In practical level this requires new approaches in technology, policy, business and finance. One of the questions that the Low2No project has brought up is how to finance the investments which are necessary in order to reach low or even no carbon levels at a district level. In many cases, the biggest challenge relates to financing local carbon neutral energy supply investments, e.g. photovoltaic, solar collectors, small wind turbines, small scale biomass CHP or heat pumps. This study focuses on financing and business models for carbon neutral energy procurement in Finland, in the context of carbon neutral districts.

As the energy market in Finland is open and competitive, there are several business and financing models that apply in this context. The main challenge is that many carbon neutral solutions are new both from technology and business model perspective, and in addition they are often small scale and distributed. Therefore, their deployment is still to a large extent dependent on risk capital, meaning largely different types of private equity.

The current private equity market is rather weak in Finland in general. Many traditional fund managers have exited the market recently, and new funds have not been raised to the extent covering this decrease. On the other hand, some new funds have been raised in the cleantech sector. The available funds specializing in cleantech concentrate mainly in technology driven venture capital in rather early stage businesses.

In order to ensure a balanced supply of risk capital in carbon neutral energy supply solutions, more and also more diversified private equity is needed. This could include investments in (1) service and non-IPR businesses in addition to technologies, (2) generation assets, (3) new business models and (4) later stage companies. Once new, small and unproven businesses have been developed to a more mature stage, successful cases could be increasingly adopted by larger established companies, such as energy companies, industrial companies and institutional investors.

The study has been carried out by GreenStream Network Plc. We want to thank the authors Mr Aleksi Lumijärvi and Mr Juha Ollikainen on bringing up interesting viewpoints. These create a good platform for further discussions on the role of financing in the development of carbon neutral districts and more sustainable urban construction.

Helsinki, June 2011

**Jukka Noponen**
Director
Energy Programme
Sitra

**Sami Tuhkanen**
Senior Lead
Energy Programme
Sitra

# Executive Summary

## Carbon Neutral Districts, the Concept

Carbon Neutral District refers to an area, where buildings do not cause net greenhouse gas (GHG) emissions. During a certain period, the district may be a net GHG emitter, but during another period it can be a net supplier of carbon neutral energy, thus being net carbon neutral e.g. within a timeframe of one year. Carbon neutrality can be achieved by enhancing energy efficiency of the buildings as well as purchasing the remaining energy need from carbon neutral sources. Energy supply can be arranged in many ways in Finland as the energy market is in principle an open and competitive market. It is possible to secure carbon neutral energy procurement onsite through building integrated solutions, or stand alone systems located onsite. On the other hand, it is also possible to purchase carbon neutral energy from offsite facilities. A district can be supplied with bioenergy based distrcit heating, delivered by an energy company. Electricity can be purchased from a renewable energy based power plant outside the area, or the owners or users of the buildings can even invest in renewable power generation facilities in another geographical area. Therefore, a carbon neutral district can be achieved through several different operative, ownership and financing models, and the approach should not be restricted to onsite generation only. Also GHG emission offsetting is an alternative, but this alternative is not included in this study.

## Need for Carbon Neutral Districts

Buildings and built environment in general are a central source of energy consumption and GHG emissions. Therefore city planning, construction and operation as well as maintenance of buildings and districts are key areas of improvement, when reducing GHG emissions. There is a large potential to be exploited in the fields of energy efficiency and carbon neutral energy supply. Also the regulations are becoming increasingly stricter in the European Union, aiming at close to zero carbon buildings by 2020.

In this study current and potential business models and subsequentely ownership and financing models are presented to describe the context within which the carbon neutrality of distrcts can be developed. The study concentrates especially in the carbon neutral energy supply business and financing models.

## Bottlenecks in Financing Carbon Neutral Districs

It is obvious that financial barriers exist, slowing down the deployment of carbon neutral energy supply businesses in Finland. Energy companies could be seen as the primary investors in such businesses. However, the business models, organisational structures, and risk profiles of energy companies may not match perfectly with new unproven technologies and business models often involving distributed and small scale installations and businesses. On the other hand, building integrated solutions could also be financed by the property owners, where institutional investors play a major role. However, in addition to the same barriers as energy companies institutional investors tend to face additional barries, such as lack of information and institutional barriers in finacing such solutions. Therefore other ownership and financing solutions are needed in order to bring carbon neutral energy solutions to market, and to develop the technologies and business model to a more mature stage.

It is a remarkable feature in the Finnish venture capital and private equity market that there are specialised cleantech investors in technology or IPR driven growth businesses, but considerably less specialised investors targeting (1) services and non-IPR businesses, (2) later stage companies, (3) new business model innovations, and (4) carbon neutral energy supply asset financing. This financing gap clearly limits the dissemination of new carbon neutral solutions.

At the same time institutional investors' attitude towards venture capital / private equity funds is increasingly critical. Private equity market in general is not working very well in Finland at the moment.

## Conclusions and recommendations

In order to speed up the dissemination of new carbon neutral solutions, new private equity is needed both in terms of volume and scope. New sources of funds could come from institutional investors, but also from households, wealthy individuals, or other smaller sources. The latter ones have been crucial in many other countries when new investments in new energy technologies have been promoted, such as in case of wind power capacity in Denmark and Germany.

Feed-in tariffs, which were implemented in Finland in March 2011, are an important incentive, but may not be sufficient to increase new flows of financing, and are also targeted towards more industrial scale investments rather than small scale distributed solutions. The investment decisions are not only based on financial calculations but also on perceived risk and investors' defined focus sectors. The latter challenges require also measures that reduce the information asymmetry between investors and investment targets, increase liquidity, etc.

Therefore, in order to mobilise new sources of private equity, following additional measures could be considered:

- Specialised funds should be designed targeting also other renewable energy businesses in additon to IPR driven technology companies
- New market places for new businesses providing more liquidity could be established and promoted
- Targeted policy support for certain desired investor types, such as
    - tax incentives for individuals
    - technical assistance and awareness raising activities
- Additional and strengthened policy measures promoting also smaller scale, distributed carbon neutral energy solutions, where investment subsidsies could be a well functioning and already existing measure.

# 1 Introduction

## 1.1 Background

Sitra has developed a "Low2No" concept, a model of design and construction which delivers sustainable built environment, and lays a foundation for ecological urban living. Low2No signifies a continuous development project striving for a gradual transition "from low carbon to no carbon" urban construction. The construction of a building block in Jätkäsaari in Helsinki is the pilot project for developing and defining the Low2No model in practice. Sitra is planning the block together with SRV and VVO, and the target of the project is to implement a "nearly carbon free block" by minimising the energy need of the buildings and to cover the remaining energy use through carbon neutral energy supply.

To this end, Sitra assigned GreenStream to carry out a broad study on the existing business and financing models used (or at least discussed) in Finland in relation to carbon neutral energy supply and purchase. As part of the study several interviews were carried out. The interviewees included Seppo Hyppönen (YIT), Mika Kallio and Harri Kemppi (One1), Marko Huovinen (Oilon), Marko Riipinen (Helsingin Energia), Antti Muilu (Eläke-Fennia), Timo Ahonen (SEB),and Timo Määttä (Motiva). In addition, the study has greatly benefited from discussions with different persons at Sitra as well as with Frank Hovorka, Head of Sustainable Investing at Caisse Des Dépôts. At GreenStream Network, Aleksi Lumijärvi has been the project manager and Juha Ollikainen the project expert of the assignment. The contents of this report reflect only the views of the project team, and not necessarily those of the interviewed persons and companies, or Sitra.

## 1.2 Objective and scope of the study

The objective of the study is to present, on a rather broad and general level, the existing business and financing models for carbon neutral energy supply and purchase in Finland. Based on the authors' experience and the interviews carried out during the study, several models have been identified. The aim of the study is to provide decision makers a broad overview of the current alternatives, their suitability in different cases, as well as their challenges and potential solutions.

The scope includes in principle all relevant business and financing models used to finance carbon neutral districts in Finland, including the basic structures both on small and large scale, and in onsite (or distributed) and offsite (or centralised) contexts. However, it has to be kept in mind that there can be virtually an indefinite number of business and financing models and therefore the ones presented here are not an exhaustive list but rather a representative sample of the structures having received attention in Finland.

## 1.3 Structure of the report

The Chapter 2 of the report describes on a general level the practical and technological alternatives available in Finland to generate carbon free (or nearly carbon free) energy. Chapter 3 aims at describing the basic business models applied in Finland to generate and purchase carbon neutral energy. The models start from basic options of an energy company investing in generating facilities and selling energy to end users, and owners of buildings (such as households) investing in building integrated solutions and thus owning the facilities. It is then described how these "basic models" may not work in some cases, especially when it comes to new technologies and business models. Therefore a set of business models involving an "external" owner or investor are described. These are models that have already been applied in practice in Finland. Chapter 4 turns the perspective to the financing models resulting from the business models identified in Chapter 3.

It is first described, what are the identified financial and other barriers in the "basic models", i.e. energy company or end user ownership models, and potential solutions to mitigate these barriers. The Chapter then presents the other ownership and financing models, and discusses their potential and limitations in financing carbon neutral energy solutions. In Chapter 5 a brief evaluation is made in relation to Sitra's Jätkäsaari project. The Chapter identifies potentially suitable carbon free energy solutions and their financing models specifically in the context of Jätkäsaari. Chapter 6 summarises the main findings and concluding remarks of the study, and presents some business and policy level recommendations.

# 2 Electricity and heat & cooling purchase options for carbon neutral districts and buildings

## 2.1 Heat Supply

Heating techologies used in Finland cover a combination of district heating and various household level solutions. District heating is available practically in all towns (some 125 000 district heating customers in 175 covered towns), and over 90 % of apartment buildings. Most of public and commercial buildings are covered by district heating. Among households district heating is the most common heating method with some 50% share. Electricity based heating and light fuel oil based heating have shares of some 15% of households of each. Also wood based heating and heat pumps are rather common with shares of 12 % and 7 %. Of district heating, 70-75%, is produced in combined heat and power plants. In 2009, the most used energy sources of district heating were natural gas (34 %), coal (24 %), peat (16 %) and wood-based fuels (15 %).

The Finnish National Renewable Energy Action Plan (2009) projects the contribution of various technologies or fuels to the Finnish renewable energy target as presented in Table 1. In total, renewable based heating and cooling is projected to increase by 20 TWh as a result of increased use of biomass and heat pumps. Biomass use is expected to increase especially within district heating, whereas in household level solutions, the absolute amount of biomass use is expected to remain roughly at the current level (although the relative share is expected to increase). The use of pellets is projected to increase to 2 TWh (0.7 TWh in 2008) and the use of heat pumps to multiply to 7.7 TWh.

**Table 1.** Targeted development of renewable energy based heating and cooling in Finland (Projections from the Finnish National Renewable Energy Action Plan (2009).

| TWh | 2005 | 2010* | 2020 |
|---|---|---|---|
| Biomass | 63.8 | 58.0 | 76.9 |
| -solid | 63.4 | 31.5 | 45.8 |
| -biogas | 0.5 | 0.3 | 0.7 |
| -fuels | | 26.1 | 30.4 |
| Heat pumps | 0.5 | 2.7 | 7.7 |
| **Total** | **64.3** | **60.6** | **84.6** |
| - district heating | 9.7 | 5.9 | 14.7 |
| -use of biomass in households | 12.9 | 11.7 | 12.8 |

* 2010 value is a forecast

The planned measures for facilitating the use of wooden fuels include subsidies for harvesting small wood, feed-in tariffs for wood chip based electricity and small CHP, and hourly electricity metering incentivising wood use during electricity price peaks. The measures for pellet based systems and heat pumps are under consideration. The larger solar heating systems may apply a subsidy via the current energy subsidy system (case by case considered investment subsidy) and the household level ones are subsidised via the household tax deduction scheme.

Several carbon neutral or nearly carbon neutral heat purchase options are already available and common in the Finnish market. The use of these options is increasing continuously, and new companies and business models are emerging all the time. Solely the small scale use of wood corresponded approximately 4% of the total energy consumption in Finland in 2008. Most of the building level wood use is the use of logs and other larger particles in household level boilers and fire places. Pellet systems are not yet that common. However, some 13 000 Finnish single family houses, some larger buildings and industrial facilities use pellets already. Heat pump sales have been increasing rapidly witin the last year. In 2009, the amount of sales was some 60 000 units (50 000 air heat pumps, 7 500 ground heat pumps).

Besides building level solutions, district heating can provide nearly carbon neutral heating. This is already true in the networks, where the baseload is produced by wood fired boilers. Currently this is, however, an exception as bulk of the district heating is produced from fossil fuels and a combination of peat and wood. However, district heating companies may be interested to start offering carbon neutral heating products, where the supplied heat is traceable to carbon neutral fuels.

Wood-based fuels and heat pumps are reasonable cost alternatives for carbon neutral heat supply as such in many onsite (or "near-site") solutions. Their investment costs are typically higher than those of electricity and oil based heating systems (Table 2), which potentially causes investment barriers. However, in the long run, total costs of energy are in many cases competitive, due to lower operation costs. Also solar based heating could be among possible alternatives as a supplementary building level heating method.

**Table 2.** Indicative costs of various heating systems for detached houses (Motiva 2009).

| | Investment cost | Indicative "fuel" cost per produced energy unit |
|---|---|---|
| | EUR | EUR/MWh |
| Ground source heat pump | 15 000-20 000 | 30 |
| Pellet | 10 000-20 000 | 55 |
| Air-water heat pump | 10 000-15 000 | 30 |
| District heating | 10 000-15 000 | 55 |
| Light fuel oil | 10 000-15 000 | 60 |
| Electricity | 5 000-12 500 | 100 |

## 2.2 Electricity supply

In 2010, households (including farms) account for about fourth of the Finnish 87 TWh electricity consumption. The largest generation methods are CHP 31 %, nuclear 28 %, hydro 15 %, condensing power 11 % and wind 0,4 % (2009 figures). Renewable energy sources account for some 25–30 % of the total electricity consumption.

On the power generation side, Finland's target is to meet the EU's renewable energy targets by increasing especially wind power and biomass based generation (Table 3). This objective is mainly targeted via feed-in tariffs.

**Table 3.** Targeted development of renewable energy based power generation in Finland, GWh (projections from the Finnish National Renewable Energy Action Plan (2009).

| GWh | 2005 | 2010* | 2020 |
|---|---|---|---|
| Hydropower | 13.9 | 14.2 | 14.4 |
| Wind power | 0.2 | 0.4 | 6.1 |
| Biomass | 10.0 | 8.1 | 12.9 |

* 2010 value is a forecast

On-site technological options for carbon neutral power supply include technologies such as small wind power, biomass/biogas fired mini/micro CHP and solar PV. However, these technologies are still far from cost-competitive as such (see Table 4), and the policy instruments are designed to promote rather MW-scale electricity generation investments. There are not that many companies active in development of small scale renewable electricity solutions to the Finnish market.

**Table 4.** Indicative cost of various building level and larger scale renewable electricity generation alternatives.

| | Production cost, order of magnitude |
|---|---|
| **kW-scale / onsite** | |
| PV | 300-400 €/MWh |
| Wind <1MW | 100-150 €/MWh* |
| **MW-scale / offsite** | |
| Wind | 50-100 €/MWh** |
| CHP | 50-100 €/MWh** |
| PV | 300-400 €/MWh |
| Biogas CHP | 50-100 €/MWh** |

* Wind > 500 kW may be eligible for feed-in tariff

** Assuming high quality project & feed-in tariff (or investment subsidy)

# 3 Alternative business models for heat and electricity supply and purchase

This Chapter summarises the main business models existing in Finland for supplying and purchasing renewable energy heat and electricity, especially from the perspective of buildings. The identified models are not an exhaustive list of all possible business models, but a list of models that exist or have existed in Finland with regard to supplying and purchasing carbon neutral energy.

The models are presented in a simplified way to describe the main differences from the ownership and financing perspective. The simple point is that in order to supply and use a carbon neutral energy system someone needs to supply it, someone has to own it, someone has to operate it, and someone has to use the energy. The most reasonable ownership and financing model depends on several points including, but not limited to, the following:

- Whether the investment is large or small compared with the balance sheet of the customer
- Whether the investment is a stand-alone or a building integrated energy system
- Whether the investment has a long or short lifetime
- Whether the customer (or the investment project) has high borrowing capacity
- Whether the construction and installation of the system is easy or complicated
- Whether or not active operation and maintenance services are needed.

The different business models described in this section are categorised according to their ownership arrangements. The following main rolesneed to be distinguished in order to describe the business and ownership models:

- **Customers and end users:** These include e.g. single households, housing companies, businesses and municipalities who are the end consumers of energy. These also include the large property investors who own building spaces but do not use them by themselves.These are very different customer types from the energy investments and financing perspective.

- **Technology and system providers:** In this study these companies can broadly include technology and systems providers, EPC contractors and specialised service companies providing turnkey energy projects and solutions for customers. The common feature for these in this description is that they have the contractual relationship with the end customer, for example as the supplier of energy system, lessor of it, or as the heat supplier.

- **Energy companies**: These include municipal, regional, national and international energy companies owning considerable generation assets, participating in the wholesale market, and having retail customers in electricity and/or district heating supply. In Finland these are often owned by municipalities, but also for example state and energy intensive industry.

- **Construction companies**: For the sake of simplicity, in addition to construction companies, this refers to any entity controlling and financing the development and construction phase of a building or a district.

- **O&M companies**: These companies provide operation and maintenance services, and can be of many types. There are independent O&M companies focusing on services only, but also technology and system providers as well as energy companies provide O&M services.

- **Leasing companies**: These include financial sector companies, especially banks. Practically all banks in Finland provide leasing of cars, equipment and machines. Also large scale assets such as power plant equipment, ships and aircrafts can be leased. Also for example technology companies and energy companies can be leasing companies in this context.

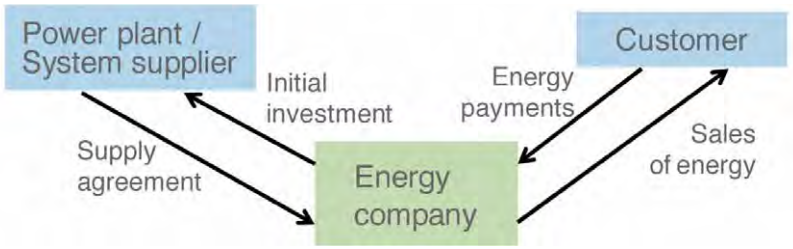
- **Special purpose vehicles**: An investment entity established specifically to own energy assets. These may be for example private equity funds pooling institutional investors' money and investing it in these assets.

It is important to notice that in some business models the previous roles overlap, for example an energy company may be a supplier, leasing company, and/or an O&M service provider.

In the following simplified business model diagram the green box denotes the entity which in the model will own and thus be responsible for financing the energy system. The business models start from the two basic forms of ownership:
(1) Energy company ownership especially in the case of centralised solutions and (2) property owner or end user ownership especially in the case of decentralised (onsite or building integrated) solutions. As these "natural owners" of energy assets may not always be capable or willing to invest in the energy solutions, alternative business models involving external investors have been developed and applied, and the most important ones will be subsequently described.

## 3.1 Energy company ownership models

### 3.1.1 Balance sheet financing by energy companies




The basic model and a starting point of supplying and purchasing energy, including zero carbon energy, is based on generation and distribution assets owned and operated by municipal and state energy companies. The energy products are sold to end users who pay for consumed energy (electricity, heat, and/or cool). Energy companies play a central role in the sector largely defining when, where and what kind of capacity will be constructed. Municipal and state owned companies play a major role in the energy business, even if it is largely privatized and opened for competition in Finland. Due to the dominating role of the traditional energy companies, any considerable change in the energy generation mix will include involvement by the municipal and state (and industry's) energy companies.

On the other hand, both Finnish and international experiences indicate that the energy companies are not typical early adopters of new technologies and business models. Often technology companies, new business models and private equity are required to initiate and finance the market penetration of a new technology.

#### Carbon neutral electricity

Several energy companies in Finland provide so called green electricity products today. Many companies who own for example wind and biomass based electricity generation have branded these as green electricity products, and any Finnish end user is free to purchase them. The price is formed on the market, based on consumers' willingness to pay. Green products are usually priced close to "grey" electricity, and sometimes they are even cheaper alternatives.

When an energy company has customers purchasing the green product, it has to monitor and ensure that the actual generation meets the consumption of green electricity. Although as a whole the supply and demand in the electricity market must meet continuously, the green electricity is usually balanced on annual level, i.e. the supply of green electricity does not have to meet the demand continuously but on annual level only. Thus, in practice other forms of generation are needed to balance the supply and demand of green power. Green electricity products usually include an independent third party verification of generation.

One considerable issue in the case of purchasing green electricity is the problem of additionality. Sometimes this means that the purchased renewable electricity should not be based on existing capacity, but should lead to construction of new renewable energy capacity. However, the division between existing and new capacity is irrelevant from the additionality point of view. To put it exactly, additional generation is generation that would not have occurred in the absence of the specific demand. For example, if an end user were to purchase electricity from a wind farm that will be constructed in future, it does not mean that the wind farm would not be constructed without the specific "green demand" by the end user. In fact, the wind farm is probably built because it is expected that, due to support mechanisms, the investment will be profitable even if sold as "grey" electricity. Further, if an end user wants to strengthen the additonality argument, one might even consider investing in a wind farm to ensure that the activity will lead to construction of new capacity. Even in this case the generation may not be additional. This is because the wind project might have been constructed anyway. If the end user did not invest in renewable energy based generation, someone else might have done it. Again, the additionality argument would be weak.

To sum up, the problem of additionality boils down to the problem of contrafactual argumentation: it is impossible by definition. Therefore, buying existing renewable energy based generation may be as additional as buying from new generation capacity or investing in it. Finally, the target should be that the aggregate demand of renewable energy based electricity generation exceeds its aggregate supply, whereafter someone has to invest in the additional capacity. In this case the additional demand for green electricity results in additional generation of it. At the moment the demand of renewable (or zero carbon) electricity in Finland does not exceed the demand.

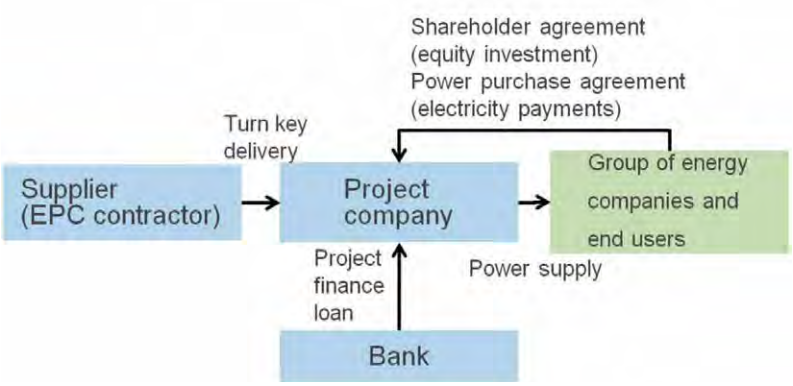
## Carbon neutral district heating and cooling

District heating (and cooling) is a traditional and efficient way of supplying and purchasing heat in Finland. However, from the carbon neutrality perspective, in this sector carbon neutral energy products have not been launched so far, although in some district heating networks for example biomass is used as fuel. Therefore at the moment, it is difficult to purchase carbon neutral heat as a district heating customer. At the same time, installing building integrated heating systems within the district heating network may have adverse impacts on carbon dioxide emissons in the larger energy system, especially if the district heat is to a large extent supplied by efficient CHP plants.

During the last years, however, the discussion on carbon neutrality of district heating has increased, and the district heat consumers pay increasing attention to this issue. As a result, some interesting signs can be seen among district heating companies. Currently some of these are designing for example carbon offsetting schemes or renewable energy based district heat products.

The problem of additionality is obviously an issue also in district heating, as it is in electricity generation. If a district heating customer wants to buy "additional" zero carbon heat, the baseline needs to be established, i.e. how much carbon neutral energy would have been used by the district heating company in the absence of green demand. Obviously, the answer would be to some extent ambiguous.

### 3.1.2 Mankala company




Whereas balance sheet financing of energy investments is the base case for energy companies, the so called "Mankala principle" is also a traditional way of financing generation assets and a very specific Finnish application of the project finance method in the energy sector. In this report it can be seen as a sub category under the traditional energy company ownership models, but also large end users such as industrial and retail groups participate in these structures as owners, thus the "Mankala principle" could be also categorized as end user ownership model.

In a Mankala arrangement the shareholders establish a limited liability project company (a "Mankala company"), the purpose of which is to operate like a zero-profit cooperative to supply electricity to shareholders at cost price. The owners of a Mankala company are therefore committed to the company also as electricity off-takers. Typically they have the right to get a share of the electricity corresponding to their share of ownership, and at the same time they commit to cover also their pro-rata share of the actual costs of the Mankala company. By this way the Mankala company is not exposed to market risks, as these are taken by the end users. The lenders do not have recourse to the shareholders' balance sheet, although in the case the Mankala company goes bankrupt the shareholders typically commit to take over the its debt. The structure is therefore attractive for banks, as several creditworthy owners or end users will ensure the long term cash flow, and as a result the project company can be heavily leveraged. The structure is heavy, entails extensive legal and financial arrangements and documentation, and therefore high transaction costs.

In practice the use of the Mankala structure is restricted to larger investments and most of the investors participating in the structures are large companies. On the other hand, gathering a large amount of companies may enable small or mid-sized companies to participate in the Mankala structure. However, as the structure is suitable for larger investments only, even a large number of very small investors may not be able to collectively secure the cash flows and debt service by the project company from the banks' perspective. So far the Mankala principle has been applied in several energy investments in Finland, including for example wind, hydro and nuclear power.

In the wind sector one of the first utility scale wind power project companies "Hyötytuuli", is established and operated as a Mankala company. The installed capacity has been gradually increasing, and the first eight 1 MW turbines installed by Hyötytuuli were the first MW class wind turbine generators installed in Finland. Currently Hyötytuuli has 21.5 MW generation capacity at two sites, and eight shareholders, all municipal energy companies.

The Mankala principle has been an important structure also in Finnish nuclear power projects. As an example Fennovoima, one of the two currently active nuclear project developers in Finland with an estimated investment cost of 4–6 billion euro, has as many as 70 shareholders. Many of them are smaller municipal energy companies or smaller industrial companies, including shareholders with turnover of less than 10 million euro. This shows that also smaller companies have the possibility to utilise the Mankala principle.

It is noteworthy that two Finnish MEPs have appealed to the European Commission arguing that the Mankala principle violates the Finnish companies act. The Commission has asked Finland to provide a clarification on the structure.

As Mankala companies have both energy companies and end users as owners, it could be considered both an energy company and an end user ownership model.

### 3.1.3 "Heat entrepreneurship" and other new energy supply business models

"Heat entrepreneurship" refers to a business model which is to some extent similar to traditional energy companies' district heating business, as described above, but in small scale. In the business model a smaller company, often even an individual entrepreneur, provides a full heating service solution locally to a larger customer or a group of customers. The basic model is a so called "BOOT" business model (Build, Own, Operate, Transfer). In this business model the heat entrepreneur develops, designs, constructs and invests in the heat generation and distribution system. Long term heat sales and purchase agreement(s) with the local end-customer(s) is signed, and the heat entrepreneur takes full responsibility of fuel supply, operation and maintenance of the system. The customer pays for consumed energy in the similar way as in the case of district heating. At the expiry of the heat supply contract the energy system may be transferred to the customer, or the ownership may be retained by the heat entrepreneur and the heat supply contract may be renewed. In the basic model the heat entrepreneur owns and finances the investment. From the technology perspective, heat entrepreneurship refers to biomass (almost always wood chips) based generation, but similar business models are being implemented also using other technologies.

The concept may involve different ownership structures according to case specific circumstances. For example, if the customer is a municipal organisation (school or other larger space, or group of municipality owned apartment houses), it may be easier for the municipality to own the heating system, although it is designed, provided as turnkey solution and operated by the heat entrepreneur. So far the most typical customer group has been municipalities.

It has to be noted that this business model may overlap with other models presented in this report. For example, also some municipal energy companies have used the heat entrepreneurship model for owning and operating heating systems for buildings outside the disctrict heating network.

During the last decade a clear increase in small scale heating businesses can be seen. In the end of 2009 there were more than 450 heating systems based on this business model in Finland, and the amount of heat entrepreneurs is more than 200. The installations are small in average, about 0.5 MW, but the average size has increased, and in 2009 the average size of new installations was around 0.7 MW. (Karjalainen & Korhonen 2010) The annual market has been some 35–40 new installations, and 20–25 MW new boiler capacity per year.

**Table 5**. Heat entrepreneur projects in Finland, end of 2009 (Solmio&Alanen 2010).

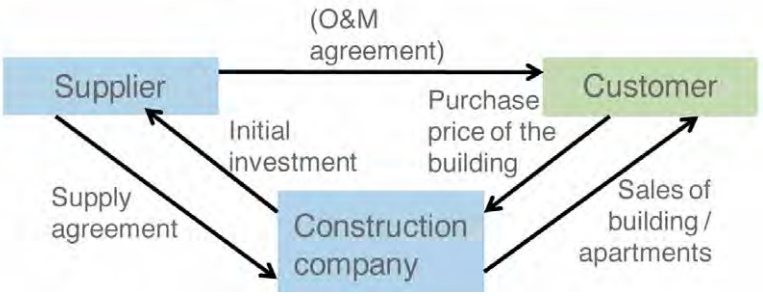
| Company form | Heating boilers | | Cumulative generating capacity, % | Average boiler size, MW |
|---|---|---|---|---|
| | Number | % | | |
| Entrepreneur | 163 | 36 | 26 | 0.40 |
| Group of entrepreneurs | 40 | 9 | 5 | 0.28 |
| Cooperative | 93 | 20 | 25 | 0.68 |
| Limited liability company | 151 | 33 | 42 | 0.69 |
| Other | 8 | 2 | 2 | 0.74 |
| **TOTAL** | **455** | **100** | **100** | **0.55** |

One of the main challenges in the business model is obviously financing, as the companies providing heat supply are often not capable to finance large amounts of investments. As the companies are small, and each of them have typically only one or a few (two on average) installations, both the financial strength and operational credibility are considerable investment barriers for the customers. If the supplier does not have many references, strong balance sheet, broad personnel base and long operational history, the risks in investing in the plant supplied and operated by the heat entrepreneur may be perceived as high.

Recently some companies have started to develop the heat entrepreneurship model further. For example Biowin Oy, which operates as a traditional heat entrepreneurship company, is building a portfolio using the franchising model. Another example is a startup company called One1 which has developed a concept that is close to heat entrepreneurship. One1 does not restrict the energy solutions to biomass only, but takes a broader view on the energy supply of an area, and applies technologies case by case. The company also adds IT services to the energy service, providing added value for the operation and maintenance of the system, as well as for use of the system by end users.

## 3.2 End user ownership models

### 3.2.1 Construction company driven installation in new buildings




In this model the supplier of the energy system sells the equipment to a construction company. In addition to construction companies these may thus include for example end users or property investors in such cases where these are responsible for the development and planning of the property. In the model the energy system is sold and installed as part of the building project, and sold further to the owner(s) of the building(s). Therefore, the energy system becomes part of the real estate asset.

Construction companies are very central players in Finland, and have significant control of the construction of residential and office space in particular. Therefore they have significant control over the choice of energy solutions that will be used in new buildings. The initial investment cost is an important issue for construction companies when choosing the solutions. Construction companies want to get as high a margin as possible, which in the past years has led to high share of direct electricity heating (if not in the district heating area), just because this has ensured the lowest investment cost, even if the energy costs were higher compared to some other solutions. Nowadays for example heat pumps are increasingly installed in new buildings, and in 2008 ground source heat pumps had almost a 30 % market share in single family houses' heating solutions, compared to 10 % in year 2000. At the same time the popularity of direct electricity heating has decreased: in the early 2000s direct electricity heating was installed in more than 60 % of new single family houses, whereas by 2008 the market share had fallen below 40 %. (Motiva 2009) This indicates that the lifecycle cost perspective is increasingly adopted by households, and that the incremental cost e.g. on household level is limited enough (compared to overall cost of houses).

At the same time also the market share of oil-based heating has decreased, but on the other hand the market share of wood fuels (including pellets) has remained almost constant (Motiva 2009). The constant share of wood fuels may indicate perceived operational uncertainties related to wood fuels; especially the price and security of fuel supply.

For example the construction company Hartela is building a single family house area in Espoo, where tens of houses are being built. Ground source heat pumps will be the sole heat generation solution in the area, and the houses will not be connected to the district heating network even if it is available close to the site. Instead, Hartela has established a drilling area for centralised the heat pump system serving all the houses in the area.

The clear increase in the market share of ground source heat pumps indicates that construction companies believe in the heat pump technology and its profitability, and that the awareness of customers has increased in relation to the lifecycle costs and environmental aspects of energy generation.Therefore the willingness to pay a higher initial price has increased. However, the incremental cost in these houses is probably in the magnitude of 3 % of the price of the houses (compared with direct electricity heating). It has to be kept in mind that on household level installations the willingness to pay is probably drastically reduced after about 10 000 euro. First, the heat energy cost savings in an average single family house in Finland cannot be much more than 1 000 euro per year. Therefore already a 10 000 euro investment has easily a direct payback time of 10 years or more. In addition, on household level the sizes of mortgage loans are high on average in Finland, compared with many other countries. In some cases this may leave limited financial capacity to invest much more in advanced energy systems – even if they provided cost savings in the long term.

### 3.2.2 Direct sales of system from the supplier to the customer

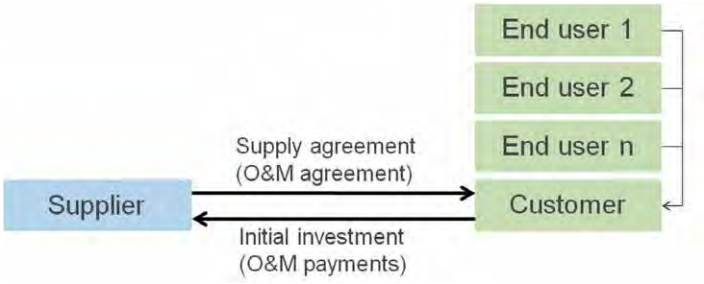

The basic model in delivering energy systems to owners and users of existing buildings is a simple business model, where the system provider sells the system or equipment to the customer (or end user). This is in principle the same model as the previous one, but whereas the previous model applies to new buildings, this model applies to existing buildings. The context of direct sales, however, may vary a lot. On a smaller scale this model is retail business, where the customers are households and the solutions are household level off-the-shelf applications. Typically in these cases the supplier (or retailer) may arrange for example loan financing or hire purchase for the customer. On the other hand, the customer may also be a larger end user, nowadays often a municipality and increasingly companies, and the investment can be for example a megawatt scale biomass heating system. In many cases these customers can finance the investment by themselves and no specific ownership and financing structures are needed. Finally, the customer may be for example a large institutional property investor, and the deal could in principle include a large number of smaller installations. Also in these cases the availability of financing is usually not an issue.

The application of new carbon neutral energy solutions by smaller end users and owners in existing buildings inludes certain barriers. First, the willingness to invest decreases if the size of the initial investment is large compared to the end- user's balance sheet or wealth, and its payback time is long (investment barrier). Second, direct sales to end users are more complicated in cases where the operational requirements of the system are high (operational barrier).

The major property investors such as pension insurance companies, banks, property investment companies and funds can be a potentially large customer group, but so far less active.The application of new energy systems includes barriers also from their perspective, although the barriers are partly different compared to the previous ones. First, institutional investors may be conservative in adopting energy supply solutions based on new technologies, new companies and new business models. For the financial sector references (related to both technology, companies and business models) are an important factor in decision making. Second, there may also be lack of information, and when the institutional investor is considering alternatives to replace an outdated energy system, the new alternatives may not be fully recognised. Third, institutional investors also pay high attention to any new potential liabilities new technologies or business models may bring to the operations. Fourth, in the case of institutional investors the owner and the user of the property are different. If this also includes that the energy investment should be made by the owner but the energy bills are paid by the user of the building, the fair sharing of the costs, risks and benefits may become too complicated and lead to rejecting the investment. On the other hand, institutional investors are able to finance the replacement investments with their own assets by themselves, in contrast to some other owner segments.

Direct sales of energy systems to end users have been a suitable way of installing e.g. heat pumps. They typically have some reasonable direct payback time, although financially the calculation period needs to be extensive in order to generate return on the investment. On the other hand, wood based solutions may be more difficult to sell even if they are profitable, because of continuous operational requirements and related uncertainties such as fuel supply. This may be an explanation for the low market share of wood based heating solutions in single family houses on the other hand, and the high market share of heat pumps on the other. End users may be used to purchasing oil from established oil retailers, but at the moment there is no similar logistics system available for wood chips for example. In direct sales of energy systems requiring continuous operation activity, it is therefore important that the supplier provides also credible O&M services either by itself, by a separate O&M provider, or for example by its retail network.

### 3.2.3 Community ownership




In the model a group of end users (a "community") form an entity to invest in a carbon neutral energy generation asset. The supplier sells and delivers the system to the entity, and the single end users get their energy from the generation asset for example pro rata to their relative investments. This model both enables and requires larger single investments compared to a situation where each end user invests in its own energy system. If necessary, the system provider or a separate O&M company can make an O&M agreement with the entity owned by the end users. There are two principal reasons for end users to form such communities. Firstly, the individual end users may be located in the same area. The area may possess attractive energy resouces, for example wind or biomass, and the group of end users decide to cooperate in order to exploit this locally available energy source. This kind of cooperation can be called a "community of locality". Advantages of local ownership include also the acceptance by the neighbourhood if they are, or have been provided with an opportunity to become, participants in the project, and if it can be anticipated that due to local ownership a large part of the revenues will come to the benefit of the community. There are also studies showing that locally owned projects bring more local benefits in the construction stage as relatively more sub-contracting and services are purchased locally, compared to projects developed by larger players often having no local presence. (Bolinger 2001)

On the other hand, single end users not necessarily located close to each other may want to cooperate on an energy project in order to get access to economically and environmentally attractive energy generation, which may not be available locally. This can naturally relate to electricity (or fuels) only, and not heating or cooling. For example, several individuals and businesses around a country may prefer to invest in wind, but on the other hand a feasible investment size is too high to them, and on the other hand there may not be feasible sites available locally. In such cases the end users may cooperate to develop a site that may be located anywhere in the country. In this case the cooperation could be called "community of interest". Communities of interest may be powerful in mobilising investment flows in cases where the mainstream financing sector is not interested because of the small and early stage of a business or technology (Bolinger 2001).

There are several practical examples both of communities of locality and communities of interest. In Finland Kempeleen ekokortteli ("Kempele Eco-block") is a good example of a community of locality, where a single block is covering all their energy needs by a locally available small scale CHP plant and a small scale wind generator.

Examples of communities of interest in the renewable energy sector in Finland are wind power companies Lumituuli and Sumituuli. The former has alread been put in operation and the latter is in the project development and capital raising stage. Both projects are megawatt size wind power projects collecting individual people as investors around Finland. The owners of these projects are allowed to purchase a certain amount of wind electricity, based on the amount and type of shares owned in the company.

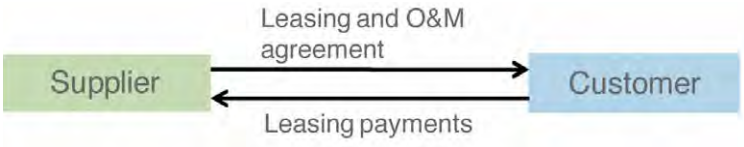
Internationally, for example in Denmark and Germany which are the two early movers in wind power, a large part of the wind capacity was initially invested by individuals. It is often cited that feed-in tariffs have been the crucial factor for rapid growth of wind power generation in these countries. In addition to this, a considerable issue was the advantageous tax treatment of individuals' investments in wind power. In Denmark households were allowed to offset their wind power investments from their energy taxation, whereas in Germany individuals were able to offset the investments from their income taxation. As the tax deduction base in Germany was wider, it also led to a situation where the typical investors were wealthy individuals and the average project sizes larger. These countries represent examples that end user or individual ownership models may be able to mobilise large amounts of financing for adoption of new energy technologies, in case mainstream energy companies or institutional investors do not yet want to participate.

## 3.3 Models based on leasing arrangements

Leasing has some relevance both in large and small scale energy investments, although it has also its obvious limitations and challenges. Leasing has been used, or at least considered, as a tool to scale up the sales of energy systems especially in smaller, building integrated solutions. In a leasing arrangement the leasing company ("lessor") owns the equipment and makes an agreement with the customer ("lessee") on the use of the equipment. The latter pays a monthly fee to the former for the right to use the equipment. As part of the agreement the lessor or a third party may provide operation and maintenance services, if needed. In the end of the leasing period the lessee has the option to purchase the equipment. A typical leasing period in Finland is 3–5 years, and the average value of leasing contracts is roughly 20 000 euro.

In this study three forms of leasing arrangements were identified through interviews: (1) equipment or system supplier, (2) energy company and (3) a mainstream leasing company as the lessor. These will be further elaborated in this Chapter. Leasing has been used also in a larger scale in municipal energy investments, where considerable amounts of balance sheet financing has been replaced by leasing arrangements. Large utility scale leasing arrangements will not be studied in more detail in this report.

### 3.3.1 Supplier as lessor

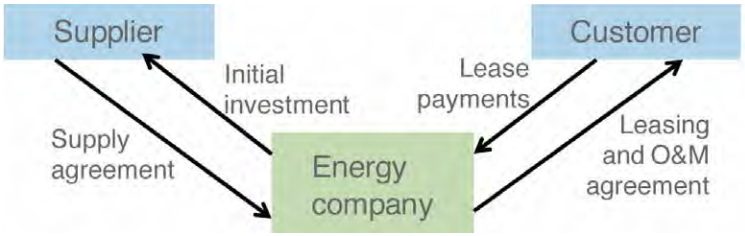



Some technology providers have chosen to act as lessors towards their clients, thus promoting the sales of the equipment. This model has been used for example in ESCO business. In the model the technology supplier retains the ownership of the equipment during the leasing period. Supplier or vendor finance has been typical in energy sector especially for new technologies. As the market matures, the business typically becomes more demand driven, meaning for example more active role and ownership by traditional energy companies, institutional investors and end users.

The specific challenge in the supplier leasing model is that technology suppliers or system providers seldom want to be involved in the ownership of the energy generation assets, if not specifically required. Leasing of the equipment (instead of sales) ties capital extensively, and it easily becomes a financial burden for the supplier. In general technology companies want to use their balance sheet for developing and manufacturing their products, and expanding the business. The challenge of supplier leasing is exaggerated if the supplier is for example a venture capital backed growth company, in which case the financing of the leasing is very expensive for the technology supplier. Leasing may also be very risky for the supplier, and also for this reason some technology suppliers have withdrawn from leasing arrangements.

Close to this model, many technology companies provide other kind of financing for their customers to promote their deals. Other types of financing alternatives include for example hard equity or sweat equity (the latter meaning that the technology supplier provides for example project development services and receives shares of the project in return) and mezzanine finance (such as equity loans and subordinated loans). These will be discussed in more detail in Chapter 4.3.

### 3.3.2 Energy company as lessor




In Finland for example heat pumps have been sold "though" energy companies by using the latter ones as lessors. In this model the the equipment supplier sells the technology to an energy company which makes long term lease agreements, and if needed, O&M agreements with end users. The leasing periods have typically been for example 10 years, i.e. rather long compared to typical leasing agreements done by mainstream leasing companies. In the end of the leasing period the equipment is typically transferred to the customer with minimal or no residual value.

An energy company as the lessor may be more feasible than supplier, both financially and strategically. Firstly, many energy companies have strong balance sheets providing financial capacity to own assets. Secondly, owning energy assets and having good end user contacts is strategically desirable for energy companies, and therefore this model, or other similar models, may be not only possible but also strategically interesting for energy companies. Further, if the technology requires active operation and maintenance services (for example biomass and biogas technologies), the role of energy companies may be even more natural.

### 3.3.3 Leasing company as lessor


The leasing finance in Finland is dominated by the leasing companies of banks. In practice all banks have their leasing companies to serve their corporate customers. Here a "leasing company" refers primarily to these mainstream leasing companies.

In this model the technology supplier makes an equipment supply agreement with the customer, who in turn makes a leasing agreement with a "mainstream" leasing company and, if needed, an O&M agreement with the supplier (or a separate O&M company). In the same way as in the above alternatives, also in this model the equipment is typically transferred to the customer with minimal or no residual value in the end of leasing period.

In principle the leasing companies could be a suitable way of financing energy equipment. Many small scale energy systems fall roughly within the average value of leasing contracts in Finland, being in the magnitude of 20 000 euro.

Due to regulatory issues this is the dominating form of ESCO business in Finland (energy service companies providing energy saving projects): a leasing arrangement is required in order for the project to be eligible for public support. However, for different reasons an ESCO project is not an ideal leasing finance object, and without the regulatory requirement it is unlikely that ESCO projects would be financed by leasing companies.

## 3.4 Special purpose vehicles

Special purpose vehicle (SPV) refers in this report to any legal entity established to enable or provide a specific financial arrangement or instrument for a specific business need. Sometimes SPV is defined more narrowly as a project finance company isolating a specific investment project and its risks from the owner's balance sheet.

A typical example of a special purpose vehicle in the context of this study is a fund. Generally funds are established to collect investors' money to be invested in specific businesses according to a specific investment strategy of the fund. A fund is typically managed by a specialised fund manager being an expert in the target business and therefore believed to be able to make profitable investments.

A typical fund investing in energy assets is for example a private equity fund. Such fund would make equity investments in renewable energy generation assets. Private equity funds typically have a pre-defined lifetime consisting of investment period (during which the investments in energy generation assets are made), and the exit period (during which the fund sells its shares in the project companies at positive returns).

The fund itself is usually a limited partnership (kommandiittiyhtiö). The limited partnership is managed by a general partner which acts as the fund manager. The general partner is typically a limited liability company (osakeyhtiö). Investors of the fund join the legal structure as limited partners. The limited partnership is created by a partnership agreement between the general partner (fund manager) and limited partners (investors). In addition to partnership (and fund management) agreement investors control the activites of the fund manager by representation in the investment committee of the fund, which for example approves or rejects investment proposals made by the fund manager.

There are a few cleantech funds operating in Finland. These are typically venture capital funds investing equity and mezzanine finance in commercialisation and growth stages of technology companies. Unlike globally, there are no real clean energy asset finance funds currently operating in Finland.

# 4 Financing alternatives for carbon neutral energy solutions

In this Chapter different financing alternatives for different ownership arrangements will be described, and their relevance, potential, strengths and challenges evaluated. There is theoretically an indefinite amount of potential financing structures and solutions, and the examples presented in this Chapter aim at being just a representative sample of potential structures that have been used or considered in Finland, and which might have potential in the context of carbon neutral districts. The financing structures may have numerous variations, and as will be seen, they are in many ways overlapping.

It could be argued that in the first place the obvious investors to carbon neutral energy systems should be property owners (in case of building integrated energy systems) and energy companies and large energy consumers (in case of stand alone energy investments). However, it can be seen that these companies have certain barriers to promote new carbon neutral technologies and business models. Therefore alternative financing models are needed in order to facilitate the earlier stage of commercialisation of these technologies.

This Chapter starts with describing these "mainstream" investors' perspective to financing new carbon neutral energy solutions, including the barriers they face. Then the Chapter goes on to offer alternative financing solutions which could overcome the identified investment barriers.

## 4.1 Property owners and end users

### 4.1.1 Institutional investors, property investment companies and funds

Pension funds, life insurance companies, banks and property investment companies and funds are the main players in the Finnish property market (KTI 2011). Therefore, especially regarding the existing building stock, it would be reasonable to increase these companies' ability to invest in decentralised, building integrated carbon neutralenergy systems on building, block and even on smaller area level.

Among these investors availability of financing is not a barrier, but there are other organisational and institutional barriers preventing these companies from financing new carbon neutral energy solutions in their building stock. New technologies and business models maybe seen more as a risk factor than an opportunity, if technologies are new and/or companies offering solutions do not have a long history, track record and strong balance sheet. New business models and long contract periods may bring liabilities and counterparty risks which the property investors are not used to nor willing to take. These issues, combined with the relatively small scale of such investments, will also add the transaction costs of adopting new technologies and business models.

The benefits of carbon free solutions may also be marginal or even difficult to estimate for two reasons. First, the savings may depend on several factors difficult to predict such as future energy prices, end user behaviour, weather conditions, technological issues etc. Second, the benefit does not necessarily materialise for the property owner, in case the energy bills are paid by the users of the property. This would require new contractual arrangements or even business models compared to traditional ones in the property market.

No specific new finacing models would probably be needed in order to facilitate the investment activity of major property investors to invest in carbon neutral energy solutions. Instead the barriers are more of institutional and organisational nature. Some potential ways to make it easier for these companies to invest in new carbon neutral solutions in the existing building stock include:

- Companies with new technologies and business models need to standardise their operative procedures and contract models to lower the transaction costs of large investors to evaluate and negotiate the adoption of these new solutions. Once the due diligence and negotiation is carried out for the first cases, it will be easier for large investors to negotiate further agreements if they are based on identical models and contracts as the previous ones.

- Companies with new technologies and business models need to establish cooperation and have back up from larger and established companies in order to gain credibility from the perspective of these large, to some extent conservative investors.

- Companies with new technologies and business models need to put specific efforts to maximise the reference value of their first projects. In addtion to above issues this may require specific documentation and monitoring arrangements in the first cases, which provide precise empirical evidence of the feasibility of the solution.

- Industrial and other associations as well as public sector need to put effort to developing labeling systems which both make visible and reward the adoption of new carbon free solutions. This will make it easier to incorporate energy efficiency and carbon neutrality in the appraisal process. This may also lead to positive impacts on the valuation of certified property. For example the LEED certification scheme has become increasingly popular in Finland.

### 4.1.2 Municipalities and state

Much of what is written above about the property investors' ability and barriers to finance new carbon free energy solutions apply to municipalities and the state as well. On the other hand, the latter ones have some specific features that deserve specific attention.

Public sector has also financial capability to invest in energy solutions, although several municipalities suffer form budget deficits. Municipalities and the state also explicitly promote energy efficient and carbon neutral solutions. For example Senaatti Kiinteistöt, which owns government's building stock, has explicit targets related to energy and carbon efficiency, and it participates actively in research and development in the sector, and also the Association of Finnish Local and Regional Authorities (Kuntaliitto) has an explicit strategy and active development work in the field. Therefore many of these owners as such are willing to acively look for carbon neutral solutions in their building stock. In this sense municipalities and the state can be seen as a "niche market" for carbon free energy system providers.

The municipal organisations have the same challenges related to combination of (1) small investments, (2) possibly new technologies and business models as well as (3) small system and service providers with limited track record.

In addition, municipalities have other challenges to adopt zero carbon energy technologies. According to a study (Karjalainen, T. & Korhonen S. 2010) there are several specific organisational and institutional barriers, and also financial barriers which the municipalities face when considering zero carbon energy investments, especially in the context of "heat entrepreneurship" and similar smaller scale investments and business models.

First, the public procurement processes by municipalities are seen as very burdensome. The initiative to consider new technologies and business models often comes from the system providers, and these have to put much effort to the project development and sales of the project. As the municipal customer in the end has to go for an open competition, the system provider may hesitate to put effort in the sales and development if there is a considerable risk of losing the case in the competitive tendering process. Second, the responsible persons in the municipalities often do not have specific incentives to consider such new technologies and business models, in which case the personal attitudes of these persons become a crucial factor. Third, if the system provider is a local small company or entrepreneur, the case may become to some extent a "political issue", whereby some people may not want to use taxpayers' money for the benefit of a single company or even an entrepreneur.

As can be seen, there are considerable non-financial barriers the municipalities may face when considering zero carbon energy solutions. On the other hand, the municipalities have often financial constraints and, unlike in case of property investors, there may still be added value from alternative financing models. Some alternative solutions will be presented in Chapters 4.3 – 4.6. In principle all these financing solutions can be relevant for municipalities, but they apply to very different types of investments, as will be described.

### 4.1.3 Households and other small end users

Households are typical investors in small scale carbon neutral energy solutions in the context of single family houses or housing companies. In Finland the ownership of homes by individuals and families is more common than in many other countries, and therefore this end user group may be a more relevant investor group in Finland than in some other countries.

Households may not have many of the organisational and institutional barriers the larger end users and property owners tend to have. For example, contractual or liability issues are often not problematic for households. They may also pay less attention to the credibility of the supplier, or the track record of the technology.

Households are also able to finance the purchase of smaller investments such as air source heat pumps by themselves. However, the purchase price of these and especially more costly applications combined with long payback periods constitute a clear financing barrier for household and housing company level applications. For overcoming this financing barrier different vendor finance alternatives could be a suitable solution. Vendor finance means a financing arrangement where the supplier of equipment provides the financing for the customer. This could be for example in form of a loan or a hire purchase. These will be discussed more in Chapter 4.3.

On the other hand, households and other smaller end users can participate also in larger carbon neutral investments by forming "communities of interest". There are some examples (such as wind power company Lumituuli) but the model has not really taken off in Finland. It has been seen in other countries that this financing model could mobilise large amounts of financing, but it requires tax or other incentives provided for the households. The recently introduced feed-in tariffs for wind, biomass and biogas based electricity could provide a similar incentive in Finland. Small end users could form entities to invest in these technologies, thus benefiting from the feed-in tariffs, i.e. becoming effectively electricity producers. If the investment is profitable, the end users could get benefit either in the form of a lower electricity price or alternatively in the form of dividends from the project company. Communities of interest require active and skilled persons or companies to promote the financing model and to develop and operate the projects on behalf of the other individual investors.

As a rough example, let's assume that a 3 MW wind power project has an investment cost of EUR 3.3 million, and that the project generates 7 000 MWh electricity per annum, and that 30 % of the investment is financed with equity and the rest with debt. In this case roughly EUR 1 million equity investment is needed. If 1 000 households around Finland form an investment entity, and each household invests 1 000 EUR, each would have a share of 7 MWh/a, which roughly corresponds to a single family house's annual electricity consumption (assuming other than electricity heating).

## 4.2 Energy companies

In the same way as property investors can be seen as the most natural investors in building integrated energy systems, energy company balance sheet financing can be considered the starting point financing option for stand alone energy investments. On the other hand, like large property investors, also large energy companies may have considerable investment barriers – also other than financial – to invest in new carbon neutral technologies and business models.

Traditionally these companies have preferred larger and more centralised investments, and the organisations, expertise and operative procedures may still be more tuned torwards these business models. In addition, the traditional energy companies face the same operational and institutional barriers as property investors. New technologies, new business models and new companies lack operational history, track record and are often financially weak. Therefore large energy companies have difficulties in making long term investments and entering into long term cooperation agreements with them.

On the other hand, when a technology or a certain business model becomes mature, energy companies have the needed capacity to adopt them quickly. Again, wind power development, earlier in other countries and currently in Finland, is a good example. Internationally wind power development was much pushed by turbine suppliers teaming up with project developers. When wind power had gained a track record, and when support schemes were strengthened to spur wind power investments, energy companies became active and the market dynamics changed quickly. Instead of turbine suppliers being the drivers in project development, energy companies took the active role in developing projects and cooperating with independent developers, creating market pull. The same seems to be happening in Finland, as well.

Also in the case of new business models, for example providing smaller scale heating or CHP solutions, smaller companies are currently developing business models and track record in Finland. It remains to be seen whether these small companies will find their position in the longer term, or whether they will be largely acquired by energy companies when they see the business mature enough to enter the market. Smaller businesses could also actively look for cooperation with energy companies, developing their businesses to take into account the interests of energy companies. As has been seen in some new business models and technologies, there may be benefits from technology and project providers and project developers to team up with energy companies. New businesses can benefit from energy companies' financial strength, customer base and general credibility of the traditional companies. Energy companies on the other hand get insights in emerging business opportunities, and can proactively offer new products and services for their customers.

The ways new businesses can engage in closer cooperation with energy companies are largely same as described in Chapter 4.1 with regard to property owners.

## 4.3 Vendor financing

Vendor finance typically means a loan given by a supplier to a customer for the purchase of goods. It is a traditional way of sales promotion, and in addition to loans or notes the vendor finance can take also the form of hire purchase or leasing. These all (expect for pure leasing arrangements) mean in practice that the supplier becomes the lender and the customer becomes the borrower in order to finance the purchase of the goods by the latter from the former.

However, vendor financing can be seen also in a wider sense meaning all types of financing provided by equipment and system providers to their customers. In addition to debt financing this can also take the form of equity or mezzanine financing.

In the Finnish biogas sector for example some biogas technology providers have participated in the equity financing of a project by participating in the project development, and instead of having been paid in cash they have been issued shares in the project company (so called sweat equity). Some technology providers have also invested hard equity in their customers' projects in order to speed up the construction of the project and thus the delivery of the technology.

In addition to equity and debt, technology suppliers can provide their customers with mezzanine finance, meaning financial instruments combining both equity and debt features. Equity loan is a typical example of a mezzanine instrument, and has been used for example in a recent biogas investment in Finland. Equity loan is loan in the sense that it has a predefined interest and repayment schedule. On the other hand, it is equity in the sense that it can only be paid out of the company's after-tax profits in the same way as dividends.

Vendor finance – here meaning all debt, equity and mezzanine types of financing – has its obvious limitations, however. The technology and project providers seldom want to invest in the projects. Financing of customers' investments ties extensive amounts of capital. In addition, the company may not have financial expertise and therefore has a risk of falling outside its core competence and core business. Especially newer and smaller companies face quickly financial limitations if providing vendor finance.

Also the liquidity risk is an obvious challenge when financing customers. The supplier may want to finance the customer as short time as possible. However, especially in the case of investing equity or mezzanine financing, the exit may be delayed if for example the customer is not able to purchase the shares from the supplier as agreed beforehand. This challenge is exaggerated by the typical high investment costs and long payback times of energy investments. It is difficult to contribute any considerable amount of financing with short repayment times.

Instead of using their own balance sheet, technology companies could also consider partnering with a bank, which would provide a loan for the technology supplier's customers. This financing model is typical in several retail businesses such as cars and home electronics. The challenges with new energy technologies are, however, that the lenders may not be familiar with the technology and in particular the potential loan portfolio may be too narrow to attract banks to get involved with the financing of the systems.

Vendor financing thus has its challenges in the context of carbon neutral energy technologies. Some solutions that have been used to a limited extent are based on a specialist type of external financiers involved with vendor financing:

In one case the equipment supplier sold the equipment to an energy company, which leased them further to households and other smaller energy consumers. Although it was rather a hire purchase than leasing, it was an example of a case where a company with a larger balance sheet and high expertise in energy business was able to take the financial burden and risks associated with vendor financing. The energy company may also have seen closer customer contact as an additional benefit from the arrangement.

In another case a specialist private equity provider invested in the technology company, which invested part of the money further in an investment project in order to get a technology supply contract with the project owner. In such an arrangement the financing should be as short term as possible in order to release it quickly for other purposes. Equity, especially venture capital, is the most expensive form of capital for companies. Therefore its use needs to be planned carefully in order to maximise its benefit for the target company. Project investments (or asset financing) seldom provide returns expected by venture capitalists.

It is a good question whether such special purpose vehicles could be established that would target primarily energy asset financing, in form of vendor financing, private equity fund, etc. Internationally many such examples exist, but in Finland private equity for asset financing is still very limited. This will be discussed in more detail in Chapter 4.5.

## 4.4 Leasing companies

Leasing has been much discussed in the context of financing the roll-out of new energy technologies. In Finland all major banks have their own leasing companies which in principle can provide lease financing for these investments. "Mainstream" leasing could be suitable for many building integrated carbon neutral solutions because of the following reasons:

- The average lease agreements are in tune of 20 000 euro, which is roughly same order of magnitude with many building integrated energy systems (heat pumps, pellet heating, solar heating, etc.)
- Leasing companies can provide leasing finance for many types of equipment and machines. Therefore also the physical asset could in principle be suitable for leasing.
- Households could be interested in avoiding the high initial investments and instead pay monthly instalments.
- Municipalities and companies may not want to have the investments in their balance sheets, and therefore would be willing to utilise off-balance sheet options such as leasing.
- A leasing arrangement could include also maintenance services, making the package more attractive to end users.

On the other hand leasing has important limitations in the context of building integrated energy technologies:

- The mobility of the equipment may be limited. As an extreme example, the drilling holes are not movable and therefore, in case of ground source heat pumps, leasing in principle could only involve the central unit. For example a car is much easier as a leasing object in this sense as it is fully movable.
- The liquidity of second hand energy systems may be limited. It may be possible to sell used heat pump units or pellet boilers but for example a used car is a far more liquid asset and thus easier for the leasing company.
- A typical leasing period in Finland today is approx. 3–5 years. This is a limited period compared withthe long payback times of these investments. If the monthly lease fee was close to the cost of an alternative energy solution (the opportunity cost), the system would have a relatively high residual value in the end of leasing period of 5 years for example.
- The technologies themselves may be too new for leasing companies, increasing their perceived risks.
- The market is limited, compared with cars as an example again. Leasing as any financing requires volumes to bring down transaction costs. As the technology is new for leasing companies and the leasing stock is likely to remain limited, the transaction costs for the leasing company would probably be high, making the leasing arrangement unreasonably expensive for the lessees.

It has to be kept in mind that the key assumptions in leasing include that the object must be a movable asset, and in the end of leasing period the lessee shall have an option not to continue the contract and not to purchase the equipment. The object must also have a residual value in the end of contract period. This means that in a real leasing arrangement the lessor has a real risk of owning a asset which is not fully depreciated after the leasing period. If these requirements are not met, the arrangement is closer to a hire purchase or a loan rather than leasing.

One solution could be a specialised renewable energy leasing company, having the expertise and other needed resources to do the business efficiently, and having different energy technologies included in the service it could achieve the needed scale of business. Although Finland may be too small market for such financing entity, there are several examples of this in larger markets, such as WB Financial and Renewable Energy Equipment Leasing LLC in the United States.

## 4.5 Private equity

Equity is the most risky form of capital and therefore the most expensive form of financing. In principle businesses should avoid using equity financing to the extent possible. Especially private equity is an expensive form of financing because of transaction costs, as well as liquidity and information constraints compared with listed companies' equity.

However, new businesses and technologies are often forced to use private equity as it is not possible for them to get other types of financing. If businesses have large growth opportunities the use of private equity can be justified. It may enable a much faster scale-up of the business. Without private equity the adoption of new technologies would happen slower. Therefore it may be beneficial for the owners to dilute their ownership in the company to some extent, if they can considerably increase the value of the company compared to the situation without equity injection.

There are a few cleantech venture capital funds in Finland. These are typically managed by specialist fund managers having experience in the target market, as well as good contacts in the sector. Using these assets the specialist fund manager is believed to be able to identify good investment opportunities in the sector, negotiate good investments, and increase the value of the target company by actively participating in the strategy work and business development of it. The funds get their returns through successful exits where the shares are sold at a considerably higher price compared with their purchase price.

Venture capital has also its limitations when it comes to the adoption of new carbon neutral technologies and business models. The venture capitalists may add value to develop the target company, but these investments do not necessarily develop the market. A typical challenge for a technology company is that it has venture capital, but its customers are not able or willing to finance the projects or equipment purchase because of the uncertainties related to new technologies and businesses. The Finnish cleantech specific private equity currently means largely venture capital investments in technology companies possessing intellectual property rights. This leaves several investment opportunities outside of the investment strategy.

For example there are no clean energy asset financing private equity funds financing the projects or purchase of equipment provided by the technology companies in Finland. Also many interesting service companies or companies based on innovative business models do not hit the radar of venture capitalists, as they lack intellectual property rights and cannot promise returns clearly exceeding 25 % per annum. It could be argued that private equity investments in generation assets are also financially justified even if they provided returns of about 15 % on equity, because of considerably lower risks of these investments. The cash flows of generation assets are usually much more predictable compared with early stage technology companies.

Private equity invested in service companies in the sector as well as in new business models would also accelerate the off-take of new carbon neutral energy technologies and systems. These companies develop and rationalise the sector, are able to standardise and stabilise the structures, operations, etc., and thus alleviate the perceived risks of more conservative large investors, in this context especially energy companies and property investors (about the investment barriers of these companies see Chapters 4.1 and 4.2). When a technology and the whole sector becomes more mature, it will attract large mainstream investors, lead to more fundamental change and demand driven investments (technology pull) instead of supply driven investments (technology push) typical for early stage technologies or sectors.

To sum up, more diverse private equity in the Finnish cleantech sector could accelerate the dissemination and mainstreaming of carbon neutral energy systems by developing the markets and sectors as a whole.

## 4.6 Project financing

Project finance does not refer generally to financing of investment projects, but is a specific method of financing them. Project finance, or non-recourse (or limited recourse) financing, means an arrangement where the lender considers only the merits and borrowing capacity of the investment project itself, instead of the project owner's balance sheet. If an investment financed as project finance goes bankrupt, the bank will have no (or only limited) recourse to the project owner's balance sheet. In order for a bank to lend on a project finance basis the project has to be very robust. This does not include only the technical and economic feasibility, but also for example the agreements must be strong and signed by creditworthy counterparties, and the project development, construction and O&M companies have to be very professional with good track record. The investment (typically a power plant) must typically be supplied as a fixed price turnkey project, the fuel supply, power purchase and other key agreements must be long term and fixed-price agreements fixing the cash flows on the long term, at least until the loan has been repaid.

As described in Chapter 3, so called "Mankala companies" are a specific example of project financing, where the project company is secured by participation of large amount of creditworthy companies as shareholders and long term electricity off-takers at the same time.

Project finance arrangement involves strong engineering, financial, legal and other skills, and is applicable to large investments only, typically at least tens of millions of euros. In Finland the prerequisites for project finance have improved considerably after the introduction of the feed-in tariffs in March 2011. The feed-in tariff will enable the generator to fix its revenues from wind, biomass and biogas power plants for 12 years. Possibility for project financing will provide opportunities for more companies, not only for those having large balance sheets. Adoption of carbon neutral energy systems could therefore be accelerated also by strengthening capabilities of project developers to utilise project finance as a financing mechanism.

# 5 Case Jätkäsaari

Sitra is developing a city block in Jätkäsaari area. The city block will include among others Sitra's new office building, other office space, apartment houses, and some commercial space. The intention of Sitra is to develop a carbon neutral city block where the use of energy is minimised, renewable energy is generated onsite to the extent feasible, and the energy purchased from outside will be carbon neutral. To this end, in this Chapter different technological alternatives, business and financing models as identified in the previous sections will be briefly evaluated in the specific context of Jätkäsaari.

Jätkäsaari is located near the city centre of Helsinki, right on the shore. This sets certain limitations regarding the availability of land and types of energy generation that can be installed onsite. On the other hand, district heating and cooling networks are available. Logistically the site is to some extent challenging from the road transport perspective, but on the other hand it is easily accessible from the sea.

The block has been designed to meet the expected EU energy efficiency targets for 2020 already today. Compared to a typical building constructed in 2010 the planned building stock will use about 40 % less energy. An indicative remaining energy demand is approx. 1 800 MWh electrcity, 700 MWh heat, and 50–100 MWh cooling. (Arup / Campbell 2011)

## 5.1 General alternatives

On a general level the alternative carbon neutral solutions can be divided into following categories:

- onsite and offsite alternatives
- grid-connected and isolated alternatives
- carbon neutral energy supply and offsetting schemes.

Energy generation can be located either on the same site where the consumption is located, or at a separate site. Onsite generation can further be divided in building integrated and stand alone systems. In principle all heating, cooling and electricity systems can be both building integrated and stand alone. In the Jätkäsaari area the site does not allow large stand alone installations, and therefore it can be expected that the onsite solutions are building integrated or small stand alone installations.

Offsite alternatives are more mainstream solutions, where the most straightforward way of carbon neutral energy purchase is to make a purchase agreement on renewable energy by an established energy company, although investing in offsite generation is also an alternative. Regarding electricity there is plenty of suppliers of renewable energy products, and a customer in Finland is free to make an agreement with any of them. Currently it is possible to buy at least wind, biomass and hydro based electricity. Regarding offsite heating and cooling, the consumer is naturally restricted to the local supplier, and whether carbon neutral alternatives are available or not, depends on the local supplier.

In principle, a site can be isolated from the electricity grid, but this is usually relevant for rural sites only, and in the case of Jätkäsaari more of a theoretical idea. Connection to district heating and cooling grids is also particularly easy in the case of Jätkäsaari. On the other hand, the district heat and cool provided by the local supplier is currently approximately 97 % based on fossil fuels. In a normal year approximately 60 % is natural gas based, 35 % coal based, 2 % based on oil, and some 3 % generated by heat pumps. If the local supplier cannot supply carbon neutral heat, an isolated heating and cooling system might become relevant. Some new construction sites have recently chosen not to connect to district heating, and have chosen an onsite solution instead. In Jätkäsaari, the local district heating and cooling company Helsingin Energia is planning to introduce a carbon neutral district heating product. In practice, the company is currently evaluating different technological options to start using biomass in its coal-fired CHP plants, and increase the biomass content gradually so that the coal as a fuel would be fully replaced by biomass by 2050. The intention of Helsingin Energia is that it offers its customers an option to buy biomass based district heat which would add on the company's long term biomass target, and thus contribute to an accelerated replacement of coal by biomass.

Finally, it is possible to either purchase energy that is generated by carbon free energy sources, or purchase energy based on fossil fuels,and then utilise emissions trading to offset the carbon dioxide emissions of the purchased energy. A consumer may for example buy European emission allowances (EUAs) or "Kyoto compliant" Certified Emission Reductions (CERs) from the market, corresponding to the emissions of the consumed energy. As the result, there would be less emission allowances for the regulated companies available in these markets, and consequently the companies could emit less carbon dioxide than they would otherwise do. Offsetting is a very different alternative from the "physical" alternatives to use carbon neutral energy, and it will not be studied in detail in this study.

## 5.2 Business model perspective

### 5.2.1 Heating and cooling

If the local district heating and cooling company were able to provide a carbon neutral product satisfying the needs of Sitra and the carbon neutral block in Jätkäsaari, it would be a strong alternative to secure carbon neutral heat and cool to the site. In this case, the business model of carbon neutral heat and cool would be the traditional way of a consumer purchasing energy from a municipal energy company owning and operating the facilities, and selling and distributing the product. The consumer would be an ordinary end user of an energy product, paying for the energy use according to the pricing by the supplier. The heat product pricing formula should be defined though, as it cannot be the same as for "grey heat" because of different fuels used. The business model would, however, have first-of-its-kind value in Finland, being probably the first branded carbon neutral heating product based on renewable energy.

However, in addition to defining what the eligible product exactly is, and pricing it, there are two main issues that need to be solved: the baseline & additionality issue, and the monitoring and verification issue.

The problem of additionality needs to be solved in some reasonable way. The question is about setting a proper baseline against which the additional use of biomass is calculated. It can be argued that as Helsingin Energia will in any case replace coal by biomass by 2050, some biomass will be used irrespective of any specific demand for this. It is the intention of Helsingin Energia to establish such a baseline and sell only the biomass heat additional to this baseline as a carbon neutral product. Definition of a baseline is, however, a complicated issue, and finally there is no exact right answer to the question of baseline, but it must be established by a convention between the supplier and the customers. One reference related to establishing baselines is the Clean Development Mechanism under the Kyoto protocol, which enables developed countries to participate in emission reduction projects in developing countries. The baseline definition and emission reduction calculation rules and methodologies in CDM are very robust. It may not be advisable to apply the rules and methodologies as such, but CDM would provide good insight for the baseline and additionality issues.

Another issue to be designed if purchasing biomass based district heat is the monitoring and verification that required amounts of biomass really was used during a certain period. There are different regulatory auditing schemes which also apply to Helsingin Energia, which could be utilised in order to seek synergies between schemes and avoid unnecessary work. Two such schemes requiring auditing are for example the emission trading scheme (based on the emissions trading law) and the new biomass tariff scheme. The biomass use of Helsingin Energia would probably qualify to receive some form of tariff according to the tariff law. The law requires monitoring and verification of the generation between three months periods, although biomass based generation can have its generation verified only annually. Also the emission data, including the used fuels, is audited on annual level due to the emissions trading law. Both audits and/or verifications must be done by auditors officially recognised by these schemes, and as these are based on law, it can be assumed that the quality of these is sufficient. It is obvious that the carbon neutral heat product would benefit from combining the monitoring and verification requirements with these schemes. It is also probable that the requirements on auditing and verification do not need to be any stricter than those of the schemes based on laws.

In addition to district heating and cooling solutions, complementary onsite solutions such as heat pumps and solar heating systems, could also be considered. However, if doing so, the complex impacts of replacing CHP based heat generation on the carbon dioxide emissions of the whole energy system have to be taken into account. The issue cannot be analysed in detail in this study, but the use of onsite heat-only applications in a district heating system will reduce the heat load of the system, and thus the generation of the boilers and power plants connected to the heating grid. If the district heat is to a large extent generated by CHP, the reduction of the heat load will reduce the CHP generation and thus lead to a reduction of electricity generated by the plant as well. As it can be assumed that the electricity demand would not be affected by this, the corresponding amount of electricity should be generated by other forms of electricity generation, in Finland often coal-fired condensing plants. As the consensing power plant will require almost the same amount of coal to generate 1 MWh power as the CHP plant to generate 1 MWh power and in addition heat, the use of an onsite carbon neutral solution would in this example in fact lead to an increase of coal use in the electricity system roughly by the same amount as saved by replacing coal-fired heating.

It must also be noted that heat pumps consume electricity, and if they are considered a carbon neutral energy supply solution, it must be ensured that the electricity they use is derived from carbon neutral energy sources.

### 5.2.2 Electricity

Electricity puchase in general gives more opportunities from the market and business model perspective than the heating and cooling in the Jätkäsaari project. On the other hand, distributed onsite electricity generation technologies have not been actively promoted in Finland, but the policy instruments have been targeted for more centralised larger scale investments.

The basic models for Jätkäsaari could be summarised as follows:

- Onsite, building integrated systems (such as photovoltaics)
- Green electricity purchase from energy companies
- Co-investing in an offsite carbon neutral electricity generation facility.

As mentioned, onsite systems suffer from high investment and generation costs. For example photovoltaics (PV) are currently so much more expensive than the electricity market price that it would entail excessive costs to cover all or even a major share of electricity consumption through PV installations, as long as there are no support schemes available. The investment cost of a PV system covering the whole electricity need of the block (initially estimated at 1 800 MWh/a), would require approximately 2 MW installed power, and be several million euros as an investment cost. Small wind generators could be closer to break even point, but would probably also entail costs above the market price. In addition, getting the necessary permits to install considerable amounts of wind power onsite would be unlikely in a densely populated area. Covering the whole electricity need by wind would require roughly 700–900 kW of installed wind power, being in tune of one million euros as an investment cost. To sum up, onsite renewable energy technologies can be applied in the context of Jätkäsaari project, but probably only to a limited extent, and it is reasonable to consider offsite solutions.

The purchase of "green electricity" from an energy company would be a straightforward way to secure carbon neutral electricity supply. However, it is often argued that this business model has serious weaknesses from the additionality point of view, as described in Chapter 3.1.1. Consequently, an alternative way of purchasing carbon neutral electricity in the Jätkäsaari context could be becoming an investor and owner of an offsite renewable energy generation facility (although this model can also suffer from a weak additionality argument in the same way as the "green electricity" purchase). If Sitra wants to take an active role in developing and promoting new business and financing models in this field, forming a "community of interest" around a wind, biomass or biogas plant, for example, could be a potential model. As the electricity requirement of the block is rather considerable, and as the organisation is well known, such an end user could be crucial in attracting smaller end users in the cooperation.

However, it has to be kept in mind that the electricity market is open for competition and the end users are free to choose their supplier. It is not common that in the context of new buildings the construction company would tie the future users of the buidling to a long term agreement with a single electricity supplier. Instead, Sitra should negotiate with the other property owners and users, and try to persuade them to join the carbon neutral purchase model. There have been discussions about a "facility management company" providing different support services on the city block level. If such an organisation were established, it could be natural to give the coordination in the electricity purchase to this company.

# 6 Conclusions and recommendations

## 6.1 Feasible small scale electricity solutions and business models are more scarce than those in the heating sector in Finland

In this report different business and financing models used in carbon neutral energy supply in Finland have been presented. It is noteworthy that in electricity generation the available solutions tend to be utility scale solutions, whereas small scale onsite solutions are far more scarce. Also the support schemes such as the feed-in tariff favours larger scale investments. From this perspective it is not a surprise that small scale renewable energy solutions have found it hard to survive in the Finnish context. In the heating business there is more activity also on smaller scale. For example biomass based heating solutions are in many places profitable alternatives in the current market and subsidy environment. There is also plenty of knowledge and development activity in this sector in Finland.

The scale-up of technologies and business models that are not economically feasible is unlikely, as it cannot be expected that large amount of energy consumers would be willing to pay considerably more for energy, which at the same time is increasingly heavily taxed.

It can also be argued that entering the electricity market with small scale electricity generation asset includes higher barriers than entering the small scale heating business. The former is typically technologically and commercially more sophisticated, more regulated, and has higher investment costs. Electricity generation is also more concentrated, more utility scale business. To this end it is understandable that in the heating sector more activity can currently be observed.

## 6.2 Financing does not turn bad businesses into good ones

Another general level conclusion is that financing is just a tool to implement feasible businesses. Financing does not turn bad business models into good ones. If the operative cash flows of a business are weak and volatile, there is little financing solutions can do to solve the problem. In the context of new businesses, "innovative financing solutions" are often called for. In practice financing is, however, often very conservative business, and the solutions may finally not be so innovative. Rather the investment cases are carefully designed to be "bankable", and a tailored financing solution may be designed to match with the needs of the business case. In other words, it is at least as much about hard work as about innovation, although both are needed.

## 6.3 Low perceived risks and transaction costs are as important as high profitability and growth

From the investors' point of view references, track record, uncertainties and volume are among the most crucial issues when considering new businesses and technologies. This is a valid point especially in the field of generation asset financing. In order to attract financing, businesses with limited track record need to do their utmost to maximise the value of their first references. This means for example explicit documentation and monitoring of the reference projects, related to both project delivery and operation stages. Further, from the investors' due diligence perspective, standardising and documenting business processes, model contracts, etc. is important. In addition to improved credibility, this also reduces the investor's transaction costs, which is important in small scale investments.

## 6.4 Private equity is needed in larger volumes and with a broader scope

Most importantly, specialised private equity is required in considerably larger volumes and with broader scope compared to the situation in Finland today. The private equity market in general is weak in Finland, and institutional investors are increasingly critical towards the asset class. In renewable energy sector, or more generally cleantech sector, there are a few specialist funds, all of which tend to concentrate in IPR driven venture capital. There is, however, many other investment opportunities within renewable energy sector in Finland which are currently not properly served by the private equity market. The sector has its specifics and therefore also specialist private equity investors are needed. When it comes to (1) later stage financing, (2) service businesses, (3) new business model innovations and (4) asset finance, specialist private equity investors are almost non-existent. Private sector should develop and launch investment vehicles serving these investments. Taking in account the general importance of this issue also the government should address the issue and consider ways to promote efforts to mobilise finance for such vehicles.

Private equity is needed to develop new businesses and bring them to more mature stage. Private equity can thus be seen as kind of a development vehicle required in earlier stage of businesses, before they are mature enough to be considered by strategic investors such as established energy and industrial companies, as well as financial institutions. If only IPR driven venture capital is provided, other businesses supporting the deployment of these technologies will remain underfinanced (such as EPC and service businesses), thus limiting the growth potential of the sector as a whole. Also, lack of later stage financing leaves potential businesses without financial resources to take further growth or internationalisation steps, or they have to be sold to foreign investors at a relatively early stage.

In addition to venture capital and buyout investments private equity has been used in large scale in generation asset financing globally. Large institutional investors have gradually built generation portfolios, initially a riskier asset including small amount of operative, cash generating assets, and a pipeline of projects in development stage. In later stages the portfolios have been financed increasingly by debt instruments as the amount of cash generating assets increases. In case of distributed solutions, the challenge compared to these existing examples is the small scale of a single investment, and the need of large amount of installations in order to create a portfolio that is interesting for institutional investors, and the resulting management challenges and transaction costs of such portfolio.

In addition to institutional investors also households and individuals can be a powerful source of private equity. It is often mentioned that the feed-in tariffs in Denmark and Germany have created a rapidly growing wind power capacity in these countries. The role of individuals and households in these cases is seldom mentioned. In fact, in both countries the capacity was originally constructed using households' and individuals' money, which was mobilised using different types of tax incentives. Also in Finland mobilising individual people's money could provide considerable volume for these investments. Feed-in tariffs alone are unlikely to do this.

Because of the lack of private equity in Finland, energy companies have been one natural source of financing so far, but it is not likely that the financing needs of carbon neutral energy solutions could be fully covered by existing energy companies. Therefore there is a need to mobilise specialised financiers, examples of which include:

- funds or other structures established by energy sector specialists (technical and business skills in the sector).
- funds established by "nearby sector" specialist fund managers.There could be interest towards the energy sector for example among real estate fund managers.
- funds established by institutional investors that are interested or already active in utility scale energy project financing, global examples including Allianz, Macquarie, etc.
- specialised market places for private equity investors lowering the threshold to make investments in these businesses, and increasing the liquidity of these investments.

## 6.5 Policy recommendations

Small scale solutions are to some extent under supported in Finland compared with utility scale investments. It would be interesting to study the correlation of policy support and the types of successful carbon neutral energy solutions in Finland. For example, there have been small wind turbine suppliers in Finland, but few of these seem to be successful in commercialising their technologies. One obvious reason (certainly not the only one) is that wind power installations below 500 kW are not eligible for any feed-in tariff.

Incentives for private persons can be a powerful tool to mobilise financing in cases where the typical investors (energy companies, financing sector, energy intensive industries etc.) hesitate to invest in new technologies or business models. Experiences in Germany and Denmark for example have shown that large amounts of capital can be mobilised by giving tax incentives to private persons. One possibility is to provide energy tax rebates against investments in carbon neutral solutions, like in Denmark. On the other hand, even larger amounts of households' funding could be mobilised by using a wider tax base. For example in Germany investments could be deducted from income tax, giving much stronger incentive for individual persons to invest in renewable energy generation. Community ownership is often seen as a small and negligible business and financing model, but it has to be kept in mind that both of these wind power pioneers created their leadership by incentivising community and/or private ownership of wind power. Incentives should be provided for individuals also to invest in potential growth businesses.

Asset financing private equity in the field of carbon neutral energy generation is almost non-existent in Finland. Currently the energy companies are willing to finance wind power investments. However, there seems to be room also in wind asset financing, but especially in other renewable energy asset financing sectors. There are profitable opportunities in biogas and biomass CHP investments, but these are overlooked by all current investors, and a clear lack of private equity can be seen. For energy companies and for the financing sector these investments may be too small. The project owners (such as municipalities, farmers, industrial companies, etc.) may not have the necessary financing available, or may be not familiar enough with these investment opportunities. Also the current specialist investors in "cleantech" sector typically concentrate in IPR based venture capital only, and consider asset financing being outside their investment scope. It might be reasonable to study further the supply and demand of asset financing in renewable energy in Finland, and see if promoting this type of financing would be justified. The investments are often small in size, have long payback periods, and require special understanding. These issues may lead to a situation where there is no "technology pull" in the market for many potential technologies and business models. Obviously feed-in tariffs are not the whole solution even if they make certain investments profitable on paper.

It has to be kept in mind that the situation with public spending is challenging. On the other hand, promoting more balanced supply of financing for carbon neutral energy businesses could increase the efficiency of these financing flows as a whole.

As a specific issue, the current subsidy available for households for major heating renovations should be amended to make leasing arrangements possible. In the investment subsidy law preceding the current feed-in tariff law the less or in leasing arrangements was also able to receive the investment subsidy (KTM 1994). In the current investment subsidy scheme for household level investments the less or is not eligible for receiving investment subsidy. Therefore it is not in line with the larger scale investment subsidy scheme. As leasing has been used also in household level investments, the legislation should be amended to take in account this specific financing structure also in these smaller investments.

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