XPRESS

# The engagement of small and medium sized enterprises in the green transition

**Danish Association for Sustainable Cities and Buildings**
August 2022

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## ABBREVIATIONS

GPP – Green Public Procurement
PA – Public Authorities
PP – Public Procurement
RES – Renewable Energy Sources
SME – Small and Medium Enterprises

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# Introduction

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## Transition to Renewables

**The war in Ukraine and rising energy prices have made it abundantly clear that the transition to more renewable energy can only go too slowly.**

A major EU project, XPRESS, has worked with both physical and organizational frameworks to promote the use of renewable energy in municipalities and housing organizations by means of integrating more Small and Medium sized Enterprises in the work. The purpose of the project has been to look at where renewable energy can be promoted in the municipalities and how to use the opportunities in public procurement to activate innovative small and medium-sized enterprises in this process. This is described in more detail in the articles on renewable energy in district heating and the wastewater treatment plants on Samsø and on Bornholm, two islands in Denmark.

As another consequence of the current energy and security crisis, district heating should be extended – e.g. in Denmark to an additional 400.00 homes in Denmark. An opportunity to promote the development is the so called “district heating island”, which is being tested in Avedøre Village, Denmark. Financing is a challenge, but in Avedøre it has shown that through the establishment of energy communities, it is possible to engage the local community and expand renewable energy with both municipal and private investments.

For that reason, energy communities are an ideal format for implementing renewable energy in a local way. Such locally inspired projects can be a perfect avenue for SMEs and municipal planners to actively participate in the green transition.

**Enjoy the reading!**

**The editors**

# XPRESS

01

**By project leaders Paola Zerilli, University of York, UK and Riccardo Colletta, APRE, Italy**

**XPRESS stands for:**

XP = GPP Green Public Procurement
XRES = Renewables and Regions
XS = SMEs and Strategic

**Abbreviations in the articles:**

RES = Renewable Energy Sources
SME = Small and Medium Enterprises
PA = Public Authorities
PP = Public Procurement
GPP = Green Public Procurement

The XPRESS project has the purpose to demonstrate the positive impact of innovative Green Public Procurements on cities and municipalities and SMEs in terms of renewable energy and lower carbon emissions. Transition to more sustainable production requires innovation, adoption and to some extend also risky investments, which are unlikely to be raised exclusively by the private sector on its own. Innovative SMEs can pave the way for using sustainable technologies, which add values for the society. Green Public Procurement (GPP) reduces the investment risks and creates niches for the use of sustainable technologies.

fig 1. XPRESS Final conference

## XPRESS has been looking at case studies from 10 countries in Europe to analyze the challenges and possibilities for GPP, and in the following, we discuss:

- How municipalities /regions are applying innovative green public procurement to achieve RESrelated objectives
- To what extent SMEs are engaged in green public procurement
- What are the drivers and barriers to green public procurement as perceived by both suppliers and purchasers
- What are the critical success factors and barriers perceived by local authorities and SMEs on involving SME in public procurement.

## Municipalities' /regions' innovative green public procurement to achieve RES related objectives

**The findings show that most municipalities are planning to achieve RES related objectives and some of them have performed green public procurement.** However, many SMEs experience that they have not been well-informed, and they are not aware of the possible support provided by the municipalities. In most cases, this support is not easily accessible and is not adequate. There is a clear mismatch between the objectives of the municipalities and the perception of the SMEs.

For most PAs, minimizing the price of the contracts resulting from GPP is still the key criterion, or in some cases the only criterion. In some municipalities, such as in the interviewed municipalities e.g. in Norway and Sweden, performing green purchases with an emphasis on environmental criteria in their procurements is already common practice. In terms of the pre-tender dialogue with the potential suppliers, some municipalities have already included this aspect in their procurement (Denmark, Norway, Slovakia), while some municipalities are aware of the benefits of pre-tender dialogue and have plan to practice it. But other municipalities are not planning to conduct any dialogue because of the legal barriers.

## SMEs engagement in green public procurement

**SMEs bring both economic and social benefits to society, and they play an important role in stimulating the development and introduction of RES.** They can deliver a wide range of innovative products and service to the procuring organizations. However, sometimes these benefits are not well translated into the authorities' policy incentives.

Based on our interviews, we find that a large number of PAs have SMEs as their suppliers, regardless of any specific strategy for SME involvement. The PAs do not favor either SMEs or larger firms, but they conduct their procurements on the basis of their evaluation criteria.

**SMEs could win more public tenders, if they provided better offers than larger firms.**
In some cases, SMEs have more opportunities, if the PAs favor the local suppliers. This is for example the case for Denmark, where municipalities have been organized in procurement districts. SMEs can only bid in one district to ensure that more companies can have the opportunity to work for the municipalities. A similar approach can be found in Slovakia.

## Drivers and barriers to green public procurement as perceived by both suppliers and purchasers

**Many factors are identified as drivers and barriers to green public procurement.**

Based on interviews in the project, political will at both the national and local level can be a critical driver for GPP. Case studies in Denmark, Germany, Portugal, Slovakia, Spain, Sweden and UK show that public support, ambition to achieve sustainability, political support, and intention to apply green criteria in public procurement are drivers for GPP. GPP requires commitment, expertise, and political and financial support. However, the lack of a specific strategy or policy for the procurement of RES is a major barrier for GPP. As mentioned by one of the respondents, "When there is no awareness that procurement could be an instrument to promote sustainable development, it will not be used".

**The interaction among different actors can facilitate the cooperation between the procurers and suppliers.**

The pretender dialogue among PAs and suppliers is an effective platform for exchanging information and knowledge. PAs learn about possible innovative solutions, offered by suppliers, and the suppliers can access information about upcoming tenders. However, in some cases, the level of supplier engagement is very low because of the legal restrictions in the country.

Some small municipalities have limited purchase power and capacity, and they rely on the central purchasing contracts organized by the central procurement department. Therefore, they are less motivated to implement GPP.

Only some PAs know that GPP could be an effective instrument to promote sustainable development.

In general, PAs are very sensitive to price and for many municipalities the financial constraints are a major barrier to GPP, because many of the green solutions are expensive. From the supply side, the limited number of suppliers of green solutions make it difficult for PAs to choose green solutions. From a legal perspective, public procurement is limited by the procedures established by law and the main GPP criterion is often based on lowest price of the winning bid. A driver is first and foremost the pretender dialogue.

fig 2. XPRESS Final conference

## Critical success factors and barriers perceived by local authorities and SMEs on involving SMEs in public procurement

**Public procurement process can be frustrating for SMEs.** Confusing and complicated requirement, restrictive financial criteria, tenders published with short notice, and outdated requirement make SMEs reluctant to participate in public tenders. Because of the complexity of the procurement, some SMEs perceive PP as a black box. Therefore, it is a key issue to simplify the PP process and provide clear written information.

SME-friendly public procurement policies and strategies are essential for SMEs participation in public procurement. Many PAs are unaware of the benefits of SME engagement in PP, and there is a lack of public support for SMEs. **Public policies and strategies that are short-term oriented and lack long-term consistency are a major barrier for the SMEs** as they do not have enough resources and time to keep track of procurement policies. For example, some municipalities require that participants to public tenders have a certain amount of equity: this is a barrier against SME participation. Furthermore, requirements such as environmental certification from a third party can be a barrier for SMEs. Other barriers are digitalization (some SMEs do not have enough ICT knowledge to participate in online bids), lack of knowledge and expertise on PP, and their own management problems in a cooperatively owned company.

The visibility of SMEs and communication between SMEs and PAs are critical factors for SME engagement in PP. Market dialogue between SMEs and PAs can increase the visibility of SMEs, and increase their interest to participate. For SMEs, participating in teams and join a network or a cooperative to share information can be very beneficial.

# EU needs an energy transition from grassroots and NGOs

02

**By Hasse Holmberg,**
Danish Association for Sustainable Cities and Buildings / FBBB
and Green Island Group Aps, Denmark

**The current energy crisis shows all too clearly that Europe needs an accelerated implementation of renewable energy. Giant offshore wind farms and solar arrays has and will likely also in the future play a significant role in the transition. But what role is there for SMEs and local authorities in this big-player-game?**

Mega-projects undoubtedly supply large amounts of renewable energy – needed for the transition from fossil fuels. However, the enormous outputs from such assets also place huge demands on European power grids. Electricity generated from renewable energy sources are not just set to displace fossil fuels in the traditional power sector but is also expected to contribute to a large-scale electrification of the heating sector as well as transportation and power to X. And with mega-projects often being the preferred model for supplying the energy, we will see a lot of energy produced at the same time, meaning that when the wind blows and the sun shines, power grids are challenged and in risk of being flooded with too much electricity. Needless to say that they are also in risk of being drained, when the wind doesn't blow, and the sun doesn't shine.

**Renewable energy makes balancing production and consumption a difficult task.**

But it is one that requires solving. And this is where the smaller players enter the field. Local energy assets organized in Energy Communities can help accelerate the green transition as well as develop a more distributed power grid capable of balancing production and consumption both locally and on an aggregated regional level. In this way, the electric grid, does not have to be extended so much and consumers and citizens will spare the costs.

An example is local solar plants on roofs, PV covering parking places and smaller wind turbines in combination with batteries and EV Chargers.

The EU strategy of boosting local participation in the green energy transition through both the RE Directive and the Electricity Market Directive makes it possible for local citizens, businesses, and municipalities to adopt a more active role by participating in local Energy Communities.

In reality, barriers remain to some extent within certain member states having taken a more restrictive approach to the implementation of EU directives – e.g. Denmark. Nevertheless, the opportunities are there, and determined municipalities across the EU can play a vital role in promoting the energy communities.

Municipalities can create fast-tracks for processing Energy Communities as well as make municipal land and rooftops available for locating PV and other assets. Also, municipal participation can act as leverage in negotiations with local grid operators in shaping plans for a better balancing of production and consumption.

Moreover, Energy Communities is an ideal avenue for SMEs to participate in the green energy transition. This is especially true in cases with active municipal involvement. Municipal administrations have a unique opportunity to support their local SME industry when procuring goods and services for building out Energy Communities. Likewise, SMEs should actively seek out citizen-led transition programs as a way of picking up local orders and show their local municipality that with a little support, local initiatives can lead the way to fossil freedom.

The EU directive combines consumers and producers locally. Implementation in the European member states needs a boost.

# District heating with **solar cells on Samsø**

03

fig 3. Stakeholder café on Samsø Energy Academy (XPRESS case study)

## Interview with Carsten Vejborg, Head of the Energy Service by Lotte Vind, EGC

**Heating plants reap both green and economic gains by installing solar cells on the buildings and supplementing with heat pumps. During summer, the plants can become self-sufficient in electricity and heat - shows a new report prepared by EnergiTjenesten and European Green Cities for Grøn Varme Samsø (Green Heat Samsø - GHS).**

Based on a survey from Tranebjerg heating plant, which belongs to GHS, EnergiTjenesten has set up three scenarios, where solar cells contribute to the supply of the plant's electricity consumption for operation, and in combination with heat pumps, they contribute to the heat supply. And the three scenarios show that the heating plant can become self-sufficient for a large part of the year and save money, which is particularly interesting in a market with rising electricity prices and general uncertainty.

Tranebjerg heating plant currently has three boiler plants, where a straw boiler supplies 99% of the heat and wood pellets and oil the rest. In the three scenarios, two solutions have been considered, 1) where the solar cell system and the heat pump cover all electricity and heat consumption and 2) where the solar cell system and the heat pump only cover parts of the consumption.

## **Scenario 1:** Solar cells on the plant's buildings provide surplus production

**In scenario 1, a photovoltaic system (500 kWp) has been placed on the plant's own buildings.** This means that the plant is self-supplying with electricity for operation for a part of the year. If the entire roof surface is used for solar cells, a surplus production of electricity is possible. Electricity can then be sold on the electricity grid / the electricity market.

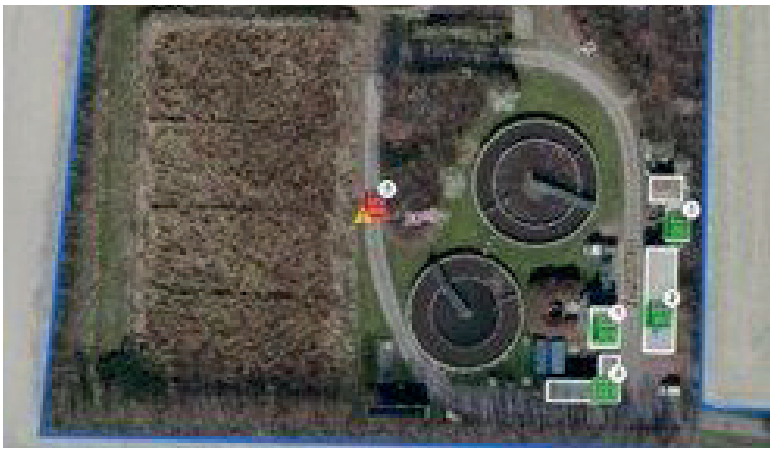

fig 4. Ballen – Wastewater Plant

## **Scenario 2:** Solar cells combined with a heat pump contribute to the heat supply

**In scenario 2, the PV has been supplemented with a heat pump (500 kW),** and instead of selling the excess power from the PV, it is used for the heat pump, so that the solar cells (500 kWp) cover electricity consumption for operation, and the heat pump contributes to the heat supply.

## **Scenario 3:** Upscaling of photovoltaic system and heat pump cover summer consumption

A solar cell system of 2,000 kWp and a heat pump of 2 MW are the prerequisite for scenario three.

A solar cell system of this size cannot be on Tranebjerg heating plant's own buildings but requires the purchase of an extra area for the solar cells. The large heat pump makes it possible to switch off the boilers during the summer. Whether it pays to let the boilers run a little more during the winter and turn off the heat pump depends on the production price of heat.

Scenario three will generate an overproduction of electricity. Whether selling of electricity will be large or small depends on the electricity price versus the price of current fuels.

## Electricity prices determine how profitable the solutions are

**In scenario three, the economic calculations are based on the fact that the price of straw does not increase, as straw is expensive to move outside the island of Samsø's natural border.** If the scenario had been made somewhere else than Samsø, the straw price would have been pushed up, because it replaces natural gas. Scenario 3 will be more advantageous, if the prices of competing fuels increases.

- We do not know the development of the prices of electricity or fuels, and they are a crucial prerequisite. So, when you make these scenarios, you have to decide what you believe in. After we made the report, the war in Ukraine has changed the picture and the agenda. Now the natural gas must be phased out much faster than originally thought. This can cause the prices of electricity and other fuels to rise, says Carsten Vejborg.

**A payback period of 34 years is given in scenario 1, 20 years in scenario 2 and 33 years in scenario 3. However, the long payback times will be shorter with the higher electricity prices:**

- The payback times are too long in the economic scenarios, we have to reduce to 20 years or less, if it is to be interesting, but it is also realistic with the higher electricity prices, says Carsten Vejborg and adds: In scenario three, we have also calculated on the acquisition of an extra area for the solar cells. Not everyone has that option, but it is especially relevant, when the price of electricity is as high as it is now.

## Intelligent control

**The real breakthrough in the 3 scenarios is the control, because solar cell production and consumption must be adapted so that the heating plant has the greatest possible own consumption from the produced solar cell power and optimal utilization of the investment in the plant. Intelligent control is important.**

The innovation lies in the intelligent control system, which optimizes and balances battery operation and prices for electricity and fuels.

It is about managing when it can be profitable to store electricity and how much to save, as well as ensuring economic optimization in relation to stocks and forecasts of solar cell production in relation to hourly prices.

The scenarios describe two forms of storage: energy (heat and water) and electricity on battery. In scenario one, only batteries are included, because here there is no heat production. In scenarios two and three, we work with an accumulation tank, where heat production from solar cells via heat pump can store the energy from sunny days to days with less solar cell production. It is proposed that the entire system should be supplemented with an immersion heater that can also provide the necessary capacity for peak loads.

However, it is neither the battery bank, the accumulation tank nor the immersion heater that are the innovative innovations. It is the intelligent control that ensures the interaction and how to use it.

## Smaller tenders for SMEs

**The solutions in the three scenarios contain components that make it obvious to divide the tender so that small and medium-sized enterprises (SMEs) can also bid for parts of the project. EnergiTjenesten proposes a division into the following smaller tenders:**

- The photovoltaic system with panels, inverters, etc., including installation and connection
- Intelligent control
- Battery solution for accumulation of electricity
- Accumulation tank

Today, barriers such as equity requirements make it difficult for SMEs to bid on large tenders, and with a division into smaller tenders, municipalities and companies will share in the innovative power that SMEs offer for the benefit of both the provider and the the green transition.

## Fact Box

EnergiTjenesten is an independent player that offers tailored advice on energy savings and renewable energy to municipalities, companies and citizens.

European Green Cities is a non-profit network organisation, working for green cities in Europe in close collaboration with citizens and other stakeholders. European Green Cities is partner in a number of European projects and collaborate on innovative development within energy, energy efficiency, mobility, biodiversity – and disseminate information on results to the network and other stakeholders.

# **Solar cell systems contribute** significantly to the electricity consumption of sewage plants

04

fig 5. Tranbjerg Fjernvarme (Samsø Green Energy)

### Interview with Carsten Vejborg, Head of the Energy Service by Lotte Vind, EGC

**Sewage plants that use energy from solar cells in wastewater management lift both the green and the economic bottom line. A new report from the Energy Service and European Green Cities prepared for Samsø Spildevand documents that the South Island's sewage plant can cover most of the electricity consumption with energy from solar cells, and in the summer period it can produce more electricity than it consumes.**

Based on a survey of the current conditions at Sydøen's treatment plant under Samsø Spildevand sewage, including an analysis of electricity consumption on an hourly basis, the Energy Service has set up scenarios where solar cells contribute to the supply of the treatment plant's electricity consumption and other activities such as a pyrolysis plant. The processes in the treatment plant also carry an energy consumption in the form of electricity that is used for pump operation and aeration via large compressors.

## Intelligent control ensures that consumption and production play together

**In scenario 1, a medium-sized photovoltaic system (200 kWp) is proposed. As there are no localisation possibilities for solar cells in the plot of the sewage plant, neither on roof areas nor detached areas, it requires an acquisition of a nearby area. The report points to an area west of the sewage plant, which with its approx. 4,000 m2 will be able to provid space for a medium-sized photovoltaic system.**

The medium-sized photovoltaic system is estimated to cover 75% of consumption. But this can only be done with intelligent control.

- The control is the innovative element here. It ensures that electricity consumption can be moved to times, where the PV cells are productive, and power can be saved. The sewage plant has an overcapacity, which is due to the fact that it's dimensioned for a slaughterhouse that is no longer in operation. We can use that overcapacity to move some of the necessary electricity from at night to during the day, so that consumption and production play together, just as we can store electricity in a battery bank. And that means that you can cover a very large share of consumption, says Carsten Vejborg, head of the Energy Service.

The treatment plant's electricity consumption is largely used for aeration via large electric compressors.

**Approx. 70% of the electricity consumption is used to promote the turnover of wastewater, and this part of the electricity consumption will to a large extent possibly be shifted to the daytime**.

The remaining 30% is evenly distributed over the day. It's the control that puts the compressors down in consumption at night, just as it's the control that puts power on the battery.

## During the summer period, production is higher than consumption

**In addition to the overcapacity at South Island's sewage plant, another factor distinguishes this sewage plant from other plants. The amount of wastewater is not constant throughout the year, but is greater during the summer period, when there are tourists on the island:**

- If there had been a constant amount of wastewater, there would have been a more constant electricity consumption and thus a larger profit from solar cell production during the summer period.

But here we are lucky, because we have the largest electricity production from the solar cells in the summer period, where consumption is highest. And at this time of year, you will have a larger production than you have consumption.

## Financial gains

**The excess electricity can be sold to the grid / the electricity market, and the price of electricity is the critical point:**

- We do not know the development of electricity prices, and they are a crucial prerequisite. So when you make these scenarios, you have to decide what you believe in. After we made the report, the war in Ukraine has changed the picture and the agenda. Now the natural gas must be phased out much faster than had been thought. This can cause electricity prices to rise, says Carsten Vejborg, head of the Energy Service.

## 95% self-sufficiency and greater sales to the electricity grid

**In scenario 2, a larger photovoltaic system (750 kWp) is proposed** - larger than in scenario one, which - in addition to covering almost the entire current electricity consumption - can contribute to the supply of other activities in the local community, such as a pyrolysis plant, production of hydrogen, charging of cars or buses and the like.

There will also be more surplus electricity for sale in scenario 2. However, as sewage plants cannot have the production of energy as their main purpose, legal barriers must be overcome, if the energy production becomes too big.

### Smaller tenders for SMEs

The solutions in the two scenarios contain components that make it obvious to divide the tender so that small and medium-sized enterprises (SMEs) can also bid for parts of the project. EnergiTjenesten proposes a division into the following smaller tenders:

- The photovoltaic system with panels, inverters, etc. including mounting and connection
- Intelligent control
- Battery solution for accumulation of electricity

Today, barriers such as equity requirements make it difficult for SMEs to bid on large tenders, and with a division into smaller tenders, municipalities and companies will share in the innovative power that SMEs offer for the benefit of both the provider and the the green transition.

# Avedøre Village as **District Energy Island**

05

fig 6. The Avedøre VIllage

**Mikkel Lander Frank and Reto Michael Hummelhof,** COWI, Denmark

In the district heating areas of the future, several decentralized solutions will be included to produce heat for space heating and domestic hot water and utilize local renewable energy sources, either with decentralized co-production or as district heating islands, possibly prior to interconnection with larger district heating systems.

Local co-production sets capacity free to convert natural gas (n-gas) supplied areas to a greater extent. In connection with this, Hvidovre Municipality received permission from the regional District Heating Supply Company, VEKS to produce up to 15% of their total heat consumption with local energy sources.

The decentralized solutions must be of interest to the residents. In particular, the solution must be cheaper than the current supply from n-gas and oil-fired boilers. It should also be cheaper and more attractive than individual heat pumps. For Avedøre Village, it's very difficult to avoid noise nuisance from individual air / water heat pumps, as the houses are very close to each other. In the same way, the solution must be better in terms of economics and the use of primary energy.

## Avedøre Village

**Avedøre Village consists of a mixture of terraced houses and single-family houses. In total there are approx. 270 buildings in the area, which can be supplied with district heating.**

The area is today supplied from individual energy sources (n-gas, oil and wood pellets), and in the old village there is a mixture of different buildings, most of which have been renovated taking the original architecture into account.

## District heating island

**The idea behind the establishment of a "district heating island" with its own plant is to produce heat with renewable energy and supply consumers through a local low-temperature district heating network.** With a decentralized booster system, the required temperature in the district heating network can be lowered, and local requirements for higher temperatures can still be met. It provides less network losses and higher system efficiency ie. less consumption of electricity. At the same time, the need to change the radiator system in the homes is reduced.

fig 7. The Avedøre VIllage

The system can most simply consist of a central air-water heat pump, which - as an alternative - also can be a geothermal heating system with vertical geothermal heating hoses (which, however, requires a ground area of at least 4000 m²). In addition, a photovoltaic system can be installed to supply the heat pump with electricity during the day, while at the same time producing electricity for an energy community. (See also the article p. 18 on 'The Energy Community Avedøre'). In addition, a peak-load boiler based on RES is installed.

## Supply options

**In the following, we present assessments of new supply alternatives for Avedøre Village.**
**The different alternatives are:**

**The reference: Replacement of existing gas boilers with new gas boilers**

- Scenario 1: New district heating network by VEKS via a new transmission line from Avedøre Stationsby
- Scenario 2: New traditional district heating with central heat pump and local network
- Scenario 3: New low-temperature district heating with central heat pump and decentralized booster pumps

The various alternatives are simulated using the Polysun software, where plant models have been built up, and then one year's consumption has been simulated.

## Scenario 1

Establishment of a new local district heating network connected to the existing district heating network in the vicinity. Scenario 1 is also considered as a possible solution for phasing out individual fossil boilers in the project area.

| Scenario 1 | |
|---|---|
| Heatpump | - |
| Solar Cells | - |
| Flow temperature in District Heating network | 65°-70° |
| Return temperature in District Heating network | 40° C |

## Scenario 2

In this scenario, a central heat pump system is established with a local district heating network.
The plant consists of a central heat pump that covers most of the production and a peak load boiler for the cold periods. District heating units are installed in each home incl. hot water tank for domestic hot water.

| Scenario 2 | |
|---|---|
| Central heatpump | 1 MW |
| Peak load boiler | 1,3 MW |
| Solar Cells | - |
| Flow temperature in District Heating network | 65°-70° C |
| Return temperature in District Heating network | 40° C |

## Scenario 3

This scenario combines a central heat pump system with decentralized booster heat pumps in the homes connected to a new local district heating network. By combining central and decentralized heat production, the temperature in the district heating network can be lowered, so that heat loss in the network is reduced. The central system consists of an air-to-water heat pump with a peak-load boiler for the cold periods, while an innovative district heating unit with a built-in booster heat pump system is introduced to consumers as a pre-assembled unit (Flex-Booster). The district heating network can now be operated with ultra-low temperature most of the year, but the temperature is raised during the coldest periods when the peak load boiler enters. This increases the capacity of the district heating system when needed.

| Scenario 3 | |
|---|---|
| Central heatpump | 1 MW |
| Peak load boiler | 1,3 MW |
| Decentral heatpumps (in each house) | 4,5 kW* |
| Solar Cells | 5.000 m² |
| Flow temperature in District Heating network | 45°-50°C |
| Return temperature in District Heating network | 25°-30°C |

* Flex booster effect. In larger buildings, several units must be installed – or a larger fluid / water heatpump.

## Price

The heat prices are calculated as the total expenses for financing components, purchase of energy (gas, district heating and electricity) as well as income from the sale of electricity from solar cells, divided by the energy used by consumers for heat and domestic hot water. It's calculated without VAT and without taxes on fuel, including electricity. The value of electricity produced on solar cells and utilized is deducted from the annual expenses, also without VAT and taxes. The value of electricity sold is also deducted.

It appears that the cheapest scenario is scenario 3 with Flex-Booster district heating. Here, the resulting heat price is 74 øre / kWh (10 Cents). This will therefore be chosen to proceed with a project proposal. In the project proposal, the associated company finances will be calculated.

District heating from VEKS ends up at a price of 87 øre / kWh, which is related to investments in transmission lines, which is almost 30% of the investments.The same price can be calculated for individual air-to-water heat pumps.

## Socio-economic analysis

The result of an initial socio-economic analysis for scenario 3, which is the one that gives the lowest resulting heat price, is compared with the reference to be used in socio-economic analyzes, namely indivi-dual air-to-water heat pumps. It appears here that scenario 3 with Flex-Booster district heating gives a somewhat lower socio-economic price and is still the preferred solution. The socio-economic investment is higher with the Flex-Booster solution, but the energy costs are much lower, as the plant as a whole is more energy efficient.

In addition, preliminary calculations show that the Flex-Booster solutions provide the least $CO_2$ emissions and also achieve the highest system COP values, ie. lowest primary energy consumption. Flex-Booster thus provides the best environmental solution for the money invested. And then noise from the alternative with the outside part of individual heat pumps is avoided.

fig 8. Avedøre Village – Energy supply area

## Conclusion

**The project shows that the combination of a central heat pump, ultra-low temperature district heating and Flex-Booster heat pumps in the houses is an interesting solution that can supply heat produced with renewable energy and low primary energy consumption at a price, lower than natural gas, but also lower than individual air / water heat pumps in the houses.**

06

# The Energy Community Avedøre

**By Stephan C. Krabsen,** European Green Cities (EGC)

**An Energy Community is a form of organization that brings together the parties behind the Energy Community into a legal and economic entity that en-ables them to buy, produce, consume, store and sell energy (the RE Directive, Art.16 and the Electricity Market Directive, Art.15 ).**

Energy communities can represent different forms of collaboration. They can focus on establishing a renewable energy-based production of electricity and gather a number of distributed activities, such as charging stations for electric cars, storage in batteries and let all of its acitivites be included in the delivery of flexibility.

EGC help developing projects dealing with energy production, storage, consumption, and financing. EGC have developed `Energy Community Avedøre' to be Denmark's first energy community in collaboration with the Municipality of Hvidovre, EBO Consult, local citizens and other local stakeholders.

fig 9. Charging the first electrical car at the new charging station

## The energy community is

- catalyst for green energy (solar cell systems and wind farms) and mobility (eg charging station systems, sharing scheme for electric charge bikes and electric cars) and contributes to $CO_2$ reduction under the auspices of DK2020 (national initiative for municipalities in DK to develop environmental plans).

**Under the auspices of `Energy Community Avedøre´, the partners and local stakeholders have established a solar cell-covered charging station system, and the possibility of collectively establishing solar cells on numerous buildings in its area of operation is currently being investigated - a system that is aimed to cover a large part of the total energy needs in the district.**

## Different forms of cooperation

**Partners in an energy community can be citizens, municipalities, housing associations, public institutions and small businesses, including shops. They are characterized by being energy consumers who choose to join a community to gain benefits through this. Who can actually be partners in an energy community is determined by the chosen company form and the provisions on participation, which are laid down in the articles of association. The partners of the energy community can individually contribute with their energy installations, and they can invest in and operate energy installations under the auspices of the joint venture.**

According to EU directives, an energy community is not bound to be built solely around a spatially
coherent, local organization of energy activities, but can for example be a group of distributed energy consumers who together own and operate a production of electricity in a wind turbine or solar park located in nearby.

In Denmark, there are many different types of company law structure of energy companies, which can be used as inspiration in the choice of the company law form that is suitable for handling the tasks and decisions that must be handled by an energy community.

The Energy Community Avedøre is established as a non-profit Limitied Liability Company and the surplus is either re-invested in new facilities or used to lower the cost of the energy that is being internally sold in the energy community.Municipalities can also participate. This is concretely supported in EU directives, where municipalities are both listed as possible partners in an energy community, and where it is also possible for municipalities and public authorities, for example, to make suitable roof surfaces available for solar cells if electricity contributions are utilized in the local area.

## The EU Electricity Market Directive 2019 package of Clean Energy for all Europeans

**With the two new energy directives, the EU is for the first time giving citizens who organize them-selves in communities a regulated access to the energy market in all EU countries, both as producers, distributors and consumers. In order to promote the citizen's influence on the transition and to ensure the development of renewable energy, the EU actively enters into the future regulation of the energy field with provisions that define the right of consumers (customers) to produce, store, consume and sell energy both in terms of renewable energy and generally in the
field of electricity.**

The Electricity Market Directive (EU) 2019/944 introduced citizens' energy communities as a legal entity that can directly form a platform to involve and engage consumers in promoting flexibility in the electricity system. The Electricity Market Directive states that each member state must establish a favorable set of rules for citizens' energy communities.

This has formed the basis for the implementation of the directive in Danish legislation and for the aspects in Market Model 3.0 that are aimed at the citizen energy communities. (Danish Energy Agency - BEK no. 1069 of 30/05/2021).

## The day to day operation

Energy communities can choose to build their own expertise for the day-to-day operation, but just as it is obvious to buy advice on projects outside the community, it is obvious to consider purchasing service from outside to handle data, manage the ongoing optimization of energy systems and the management of the ongoing operation of the total energy plants. The energy community Avedøre has chosen to enter into a contract with EBO Consult A/S regarding the operation.

## Experiences

**Numerous experiences are gained from EGC working with the Energy Community in Avedøre:**

- It is associated with high complexity with many parties involved - in the Energy Community Avedøre, for example, there are challenges with Social Housing Organizations, which do not have the opportunity to participate due to their company size that succeeds that of an SME. In Denmark there is currently a discussion going on whether a social housing association at all should be consideres as an entreprise;
- It requires new business models - cf. above, where Energifællesskabet Avedøre has chosen the ideal company law form that opens up the possibility for the community to invest in purposes that benefit the local community;
- It requires insight into the energy market and legislation in relation to data processing and balance responsibility - therefore the experience is that you must have professional help for the operation;
- Most important is, though, the democratic influence and the involvement of local stakeholder and the financing possibilities that energy communities open.

# Great potential for Renewable **Energy Projects for local SMEs**

07

fig 10. Renewable energy implementation

### Bornholm Energi Og Forsyning (BEOF) - interview with Torben Jørgensen, BEOF by EGC

At an XPRESS webinar, arranged between European Green Cities and the Danish Island of Bornholm's Energy & Supply Company (BEOF), Torben Jørgensen from BEOF presented their actual situation and potentials for the use of renewable energy at their district heating and sewage plants.

## Strategy and Planning

**Torben Jørgensen informed about the municipality's ownership strategy. Basically, the goal is to be fossil-free in electricity and heat production during normal operation in 2025. The plan is to phase in more electric-based heat and waste heat in the district heating system. In 2025, BEOF will lay out a plan to reduce the use of biomasses wood chips and straw for both heat an electricity production.**

The water sector and the Danish Minister of Environment have agreed that the water sector must be climate and energy neutral in 2030.

To meet the goals, BEOF Strategy is, in 2025 to have a long-term plan for biomass reduction and for phasing in of new technology. Concerning the water, the goal is to have a CO2 free water production in 2030, and concerning wastewater, BEOF works towards climate neutrality at the treatment plants.

The public companies - for District Heating and Sewage plants together - own 71 plots where the plants, boreholes, pumping stations, etc. are located. Small wind turbines can be placed on several of the plots.

The municipal plans for the areas states that they must be placed in connection with buildings (eg the district heating plants). Solar heating can also be established on several of the plots. The municipality states that there are no immediate restrictions in the open country, however, it requires a land zone permit and a building permit.

## Actions / decisions

**At BEOF, Torben Jørgensen states that the following actions / decisions needs to be considered, before the next steps can be taken:**

- Effect / fuse size of electrical connection should be mapped
- Detailed mapping and proposals for RE for the individual plots
- Should the capacity of RE systems (kW) be adapted to the electricity consumption or to the fuse size (possibly larger fuse)?
- Should also batteries be considered - and according to which criteria

## Water Supply Plants

The public company for water supply owns plots where waterworks, boreholes, elevation vessels, and pressure boosters are located – 33 plots / properties in total (some consist of several plots, and on a few there is no "activity" anymore). The plots cover areas from 75 - 31,440 m². Solar cells could be placed on potentially all plots, either on roofs and / or on racks. Small wind turbines can be placed on several plots – the municipality states that they must be placed in connection with buildings. Solar parks can help reduce the cost of groundwater protection.

## Sewage Plants

The public company for Wastewater treatment owns land where treatment plants, basins, and pumping stations, etc. are located - 28 plots / properties in total. The plot areas are from 50 - 21,117 $m^2$. Solar cells can be placed on virtually all plots, either on roofs and / or on racks. Small wind turbines can be placed on several plots (especially treatment plants). Water turbines will be able to be installed at the outlet from Rønne and Tejn treatment plants.

## District Heating Plants

The public company for heating owns plots, where heating plants, and pumping stations etc. is located - 10 plots / properties in total. The plot areas are from 5,419 –23,806 $m^2$. Solar cells can be placed on potentially all plots, either on roofs and / or on racks. Small wind turbines can be placed on several plots – there must not be be too much shelter from nearby forest. Solar heating systems can be placed on several plots: They can e.g. cover summer loads so that the heating plant can lie still during the summer period – e.g.

- Traditional plane solar collectors
- Parabolic solar collectors or “lenses” that concentrate solar energy in a receiver
- Combination of solar collector / solar cell in the same panel can be an option

## Conclusions

**The possibiliities are enormous. For Bornholm’s Region, it is essential to develop local renewable energy projects to reduce CO2, and to form the tenders so that local SMEs have the possibility to participate.** The experience from XPRESS is to split the tenders e.g. as follows:

- Solar cells
- Battery storage
- Accumulation tank
- Controls

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# XPRESS, RES and SMEs

- The EU could double the renewable share in its energy mix, cost effectively, from 17% in 2015 to 34% in 2030;
- All EU countries have cost-effective potential to use more renewables;
- Renewables are vital for long-term decarbonisation of the EU energy system;
- The European electricity sector can accommodate large shares of solar PV and wind power generation;
- Heating and cooling solutions account for more than one third of the EU’s untapped renewable energy potential;
- All renewable transport options are needed to realise long-term EU decarbonisation objectives.

XPRESS

## Consortium Partners

APRE – Agency for the Promotion of European Research
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