Green Solar Cities

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THEME Solar and biomass for low-energy building

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Towards EU "near zero" standard

Peder Vejsig Pedersen, Cenergia, chairman Association of Sustainable Cities & Building.

A basis for a completely new way to build has been created by the recast of the EU Energy Performance for Buildings Directive from 2010, which demands that new buildings should achieve a nearly zero energy standard based on local renewable energy sources already from year 2018 for new public buildings and from year 2020 for all new buildings, at the same time as the EU member states shall develop incentives to ensure a similar development for existing buildings.

In Denmark we are well ahead towards meeting these goals due to recent improved energy saving demands in the building regulations including a new protected low energy class 2015 standard which will soon be coupled also with a low energy class 2020 standard.

But when it comes to which energy supply solutions you should utilise there is a lot of discussions.

In Denmark we have at present the highest utilisation in the world of district heating, often in combination with combined heat and power and waste incineration, covering more than 50% of all heating demand, and due to this it seems like an obvious choise to rely on these technologies also for the low energy buildings of the future.

At the same time we see electricity based heatpumps being quite frequently used for new low energy building projects, but unfortunately still with not so convincing results with respect to actual yearly coefficient of performance (COP value) in practice, (this is the relation between heat supply and electricity use), since the aim is to reach a COP value of at least 3.0. A demand to document the COP value in practice could perhaps help here.

This could be part of a general performance verification procedure, which will be necessary to implement so there can be created a realiable link between the realised energy quality in building projects and the demanded certification of building energy quality.

It is also possible to introduce new interesting combinations of district heating and heatpumps, f.ex by letting very small heatpumps boost domestic hot water which has been preheated by very low temperature district heating at only 30-40 °C. In this way substaintial heat distribution losses can be saved in practice.

In general it is important to challenge the district heating business to be able to deliver adapted energy optimised solutions for low energy buildings of the future, so it is possible for municipalities to utilise this in new urban development. This should also include a policy for use of solar heating as a renewable energy source, which will have the best economy when you use large centralised solar heating systems.

And in connection to this it is also very important to work on ideas of how the zero energy building of the future look like, including a view to how far you need to reduce the energy use before you may use photovoltaics or thermal solar to ensure that the zero energy standard can be met by help of local renewable energy sources.

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Concerto Project in Salzburg – in urban district Lehen

Inge Strassl, SIR Salzburg Institute for Residential Planning and Housing.

The Concerto Area in Salzburg is located within the city district of Lehen, a central district with high population density and a relatively large stock of buildings existing since the 1950s – 1970s.

Numerous building projects of the last few years are supposed to be coordinated by Concerto in order to sustainably renew the district and reshape its image. Especially the topics renewable energies (focal point solar energy), energy efficiency and social sustainability are in the centre of attention of both the city of Salzburg and also all participating project partners.

At the beginning of the project (in December 2005) a first quality agreement has been formulated and signed by all parties concerned so that the main points and goals of the process could be fixed. After the architectural competitions had been decided and the projects as such had been set, the quality agreement had to be adjusted and defined more in detail. These quality goals have further been evaluated within the process of planning as well as before the start of construction. Involved are not only characteristic values (concerning energy and technique) but also a clear definition of roles, responsibilities and procedures as well as a schedule.

Status of the individual Building Projects in Spring 2011

Stadtwerk area (Public Utilities Area)

This area with its 43.000 m² was in former times a location for factory and office buildings, and in short time there will be 293 apartments, a kindergarten and a student hostel in the northern part of the area. In the southern part the Competence Park SALZBURG will be in construction from summer 2011 onwards. The project Competence Park SALZBURG includes companies and institutions from the sectors of "Creative Industries" and "Life Science" as well as additional educational institutions and service companies, which are going to be sited in this area.

In the implementation of the new district, the focus is laid on an innovative and comprehensive energy concept. The biggest thermal solar system of Salzburg, with its 2.000 m² solar thermal collectors and a 200.000 liters buffer tank, is in construction. A micro-network distributes the produced solar energy to the new and some older, redeveloped buildings in the area. Further, there will be approximately 500 m² PV installed.

The start of construction for the residential building, the kindergarten and the student hostel took place in October 2009. At the moment, the interior construction and installation work is in process. The residential units will be completed and

handed over to owners in November 2011, the handing over of the student hostel will already happen in June 2011.

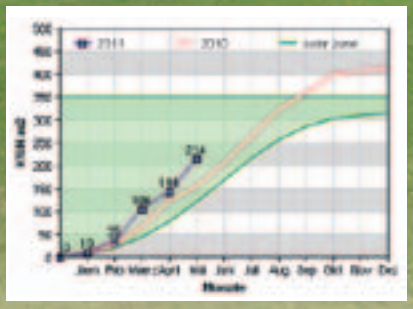
In the south-east corner of the area, an information point has been established, where residents and other interested citizens can get further information. For the southern commercial part, the planning phase is mostly completed and the necessary permits are obtained. Start of construction is planned for summer 2011.

Construction Site Residential Part „Stadtwerk Lehen", March 2011.

Zero-energy (passive) House Esshaverstraße.

The plans for the residential building with its 12 flats and condominiums include controlled living room ventilation and a 36cm thick thermal insulation for an optimized energy balance. The solar energy produced by 38m² solar thermal collectors is used for hot water and heating. For an additional heating there are hot water convectors installed over the living room doors (in special door frames) which pre-heat the absorbed fresh air.

The construction work of the residential building was finished in June 2008. At the moment, a detailed energy monitoring with an analysis of the user behaviour is in progress. The first two heating periods have already been evaluated. The results of the solar system are additionally documented and analyzed online on www.energiebuchhaltung.at .



Solar gain from 144 m2 - see explanation page 26.

Old Stadium
– Project "Neue Mitte Lehen"

The old soccer stadium in Lehen was torn down and a new complex of building has been constructed on this area. The city library, a day-centre for old people, a café, a bar and 48 subsidized rental flats are accommodated there. The green area in the centre has been preserved. 144m² solar thermal collectors produce solar energy which is used for hot water and heating.

Completion in winter 2008/2009, online monitoring of the solar system from the middle of July 2009 onwards.

Renovation of the existing residential buildings

Many of the buildings in the area neither have a thermal insulation nor a central heating at the moment. Renovation concepts and schedules for these old buildings are being elaborated in order to connect the existing buildings step by step to the local heating supply within the micro-net of solar energy. Overall a sustainable and energy-optimized approach is to be applied with regard to any renovation project.

Kuenburggasse

The building Kuenburggasse (with 45 flats) has been thermally renovated and connected to the district heating. In 2007 the first conceptions of renovation were done, the actual status of the building components was assessed and possibilities of renovation were discussed.

The building had very high running costs and was not optical attractive.

The building renovation started in March 2009 and was finished in February 2010. The outside insulation works were already finished in November 2009, so that in winter 2009/ 2010 a thermografic analyze could be made to see the thermal quality which showed to be very well in line with project design quality.

Strubergasse

Further, a framework plan for a sustainable and overall redevelopment of the 32 buildings in the area (property owner is the city of Salzburg) has been produced. (This includes energetic optimizing up to the standard of a zero-energy house, potentials for an increase in density, floor plan variations and open space qualities.) Currently, a planning competition for the overall renovation of the area (including partly demolition and reconstruction of buildings which are no longer suited for contemporary living) is in preparation. The first building is planned to be torn down and newly constructed by the end of 2011.

Kuenburggasse.

Strubergasse.

Centre for old people – Siebenstätterstraße

On this area, which was in former times an industrial site of the Mercedes plant, a new centre for old people, apartments for assisted living as well as subsidized rental flats are being constructed. The old people's home with 90 beds is part of the Concerto project. A low-energy-concept for the building shell, an approximately 200 m² large solar system and a controlled living area ventilation system with heat recovery guarantee an optimized energy performance of the building. Green roof vegetation will provide extra attractive open spaces.

Start of construction took place in March 2010; Now in Spring 2011 the building shell is nearly complete, the end of construction work is planned for spring 2012.

Train station in Valby - PV modules supply energy for the platform LED lightning.

Concerto project in Copenhagen - in urban district Valby

Jakob Klint, Kuben Management, Coordinator of the EU Concerto project: Green Solar Cities.

Valby has a vision of year 2025. The vision is that solar panels shall supply 15% of consumption of electricity in the district. The vision support the use of renewable energy, and deals with building integration of photovoltaics (PV) in existing urban areas. The plan fits very well to the goal of City of Copenhagen being carbon neutral in 2025.

Since the plan's formulation in 2000, electricity consumption in Valby presumably has followed the general trend in Danish society. This means that it has been slightly increasing until 2008, and then fallen due to the financial crisis. In Valby it is particularly homes that use electricity, and electricity consumption in homes without electric heating have been fairly stable throughout the period. New A-rated products with lower energy consumption and an increased use of energy saving light bulbs have presumably been balanced by more electrical appliances in information technology etc. In the homes there has been a growing number of flat panel displays, computers, networks and game consoles, and associated small black power utility boxes, which many hours of the day consume power.

Simultaneously, in the period was put up almost 2,000 m^2 photovoltaics in the district. So development in the last 10 years has to some extent stimulated the vision of Valby, but there is still a long way to the 15% supply from solar energy.

The future is bright

However, the future looks bright in a broad sense. Better management and better technology may result in decrease of the electricity consumption, and the production of electricity develops generally towards carbon neutral sources.

In the past 4 years, solar vision for Valby have been supported by the EU Concerto project "Green Solar Cities", and the results of project is now starting to become visible several places in the district. The EU project has supported numerous projects in which PV is integrated into roofs and facades. The project as well support a number of innovative energy efficient solutions for both building renovation as new construction.

In the beginning the results were few due to the financial crisis that put an abrupt "slow-down" to the development. Urban sites such as FL Smith area, Carlsberg, Valby Stadium, Grønttorvet (vegetables marketplace) which were ready to be transformed into new office and residential areas were stopped and very little has happened here during the last 4 years.

First realizations

The project just managed to support the first 36 dwellings in Karensminde of the ambitious program of 5.000 "affordable dwellings" (low cost and low rent) in Copenhagen. Production facilities for the building of energy efficient low cost family housing were ready, but few were built when the market collapsed due to the financial crises and thus large supply of vacant apartments in Copenhagen.

For the Karensminde apartments is used the technology of prefabricated room-sized modules. They are produced in Estonia and sailed to Copenhagen and transported on lorries to the site. The construction fulfills the low energy class 2 of the Danish building code and is heated by district heating. Subsequent measurements have shown that the building meets the energy class, and the dwellings have in the spring of 2010 been equipped with 30 kW photovoltaics.

Lightweight prefabricated housing is a relatively new technology in Denmark. The background of using this construction technology was an overheated market for concrete wall, floor and roof units, and a desire to reduce construction costs. Simultaneously, there were energy benefits. Experiences from the other Nordic countries showed that it was relatively easy to achieve a good insulation, where thermal bridges were minimized and high air tightness obtained.

Full size prefabricated modules are as well used in the construction of a 400 m² kindergarten, Ellepilen, and by the two upper floors of Langgadehus which is also supported by Concerto project.

20 small scale PV installations

Citizens in Valby are very interested in utilizing solar energy – and the campaign from Green Valby (local environmental centre in Valby district) has resulted in now 20 small scale installations with a total of 40 kW PV.

See local projects on www.solivalby.dk (click "sun" symbols).

Karensminde.

Langgadehus is built as a traditional block with a courtyard in the middle. The use of the building consists of dwellings for elderly people and families. The two first floors are built in concrete for the elderly (dwellings and service centre facilities) and followed by two floors family housing made by prefabricated elements like Karensminde. The building is constructed in two different energy classes (1 and 2) with the prefabricated dwellings in the best standard. In addition, the building is supplied with a thermal solar system.

Space for reflection

The financial crisis and the subsequent construction crisis has allowed space for reflection and reeducation, and over the past 4 years the Danish construction and building sector has completed a huge transformation. Today, we are able to build low energy buildings. New products hit the market such as energy efficient windows and better ventilation solutions. Architects and engineers have got new skills and contractors have developed their construction solutions. This development has been stimulated by the new Danish building code and an increasing focus for local authorities to promote energy efficient construction and climate-friendly solutions.

On the former Henkel site of Carl Jacobsen Vej in Valby, the local building code prescribe that new buildings have to fulfill the best energy performances, and to integrated PV on facades and roofs. Similarly it prescribes green roofs.

EU Concerto project supports several projects in this part of Valby and contributes, among other things, to low energy ventilation solutions, integration of PV installations and solar thermal as well as monitoring. Monitoring is crucial to assess whether the building meets the required energy standards. Yet there is no such requirements in the Danish building code. Additionally the results and the ongoing monitoring is used to guide residents and

Langgadehus.

users in direction of a more environmentally and energy efficient behavior.

The coming new buildings on Carl Jacobsen Vej use the technology of concrete wall units. The wall units are sandwich constructions where the insulation material is integrated. The visible part of the facade will be bricks to get the same outer expression as the existing buildings in the area.

Status of low energy buildings

Experience with low-energy buildings in Valby, and in Denmark in general, shows that it has been possible to switch over to low energy buildings without raising the construction costs significantly. Certainly there are many new low-energy buildings that don't fulfill the expected energy requirements, and some of the technical solutions have not been satisfactory. For example, the use of ventilation heat pumps has caused problems in many places, since the theoretical efficiency has been to optimistic. Especially the last two relatively cold winters have caused problems with achieving the necessary heating – and resulted in high power consumption. Lack of air tightness is another common problem and overheating in summer time is a widespread problem.

The ongoing more and more strictly energy demands in the Danish Building Code with 5-year intervals, makes it necessary for the building sector to keep up and constantly focus on improving their skills. It demands better products and better solutions, and lead to ability to construct buildings with very low energy consumption.

Consumption of electricity, and possibilities to reduce consumption, will probably remain a major challenge - both in relation to shift to renewable energies and in relation to reducing consumption. Photovoltaics may be an important part of the solution.

PV below windows - student college "Solbakken".

Existing buildings – a great challenge

Besides the power consumption it is a great challenge to reduce energy consumption from existing buildings. It requires substantial investment and technical solutions are much more difficult than for new construction.

The EU Concerto project support several projects to reduce energy consumption of existing buildings, and particularly the renovation of Hornemanns Vænge will be a significant project in Valby.

Hornemanns Vænge is a public housing development from the 1960s and managed by a social housing association PAB. It consists of 6 blocks of four storeys with a total of 288 dwellings. The residences will be renovated as a result of rundown technical installations, concrete damage, the need for new windows etc. The actual construction work will begin in autumn 2011.

The work is mainly funded by The National Building Fund. A foundation all social housing residents pay for to provide the necessary capital for renovation and modernization of the social housing stock.

The support from the EU Concerto project has enabled a number of energy measures. These are ventilation with heat recovery, use of photovoltaics, the use of solar thermal collectors and a comprehensive measurement program. There will be 100 m² photovoltaic and 100 m² thermal solar on each building block when the flat roofs are renovated into pitched roofs.

There have been two major challenges with the introduction of these new elements. The first was to design a solution for the installation of ventilation with heat recovery in a building. So far the building had only exhaust ventilation. The consultant has in cooperation with the housing organization conducted a pilot study where they have installed a prototype system in one dwelling. In a dialogue with the residents they have succeeded to get their acceptance of the solution, where part of the hallway ceiling is lowered to make room for necessary ventilation ducts.

The second challenge has been to show that it is sound economy to install ventilation with heat recovery, photovoltaics and thermal solar heating – financed by the obtained energy savings in the long run. Also, this part has been a success, and it is now possible to make the renovation with the extra energy improvements that will reduce building energy consumption significantly.

Showing good economy for completion of energy-efficient renovations and energy conservation is the key to ensure the dissemination of these solutions to buildings and building owners in general. In recent years, the price of PV has declined substantially and everything looks like rising energy prices, so the EU Concerto project may be the effort that really makes solar energy a part of energy supply in Copenhagen. Pursuing the sun is probably one of the best solutions in the world to reach nearly zero energy buildings.

Hornemanns Vænge.

Skive Municipality is boosting solar power

Claus Christensen, Energy Service Denmark.

In order to implement the many solar cell systems which today decorate the roofs on a number of the municipal buildings in municipality Skive, Denmark, it has been necessary to work at full speed. Day-care centres, schools and even the town hall today obtain their green power from the sun. One of the most recent systems is a thin-film solar cell system, which is integrated on the roof of one of the 24 newly build homes for elderly people.

In 2010 the largest system in the town, on Skivehus primary school, delivered the first environmentally friendly power. No fewer than 2000 square meters of solar panels have replaced the red tiles, and it is expected that the school will be supplied with an electricity production of ca. 235,000 kilowatt-hours per year from the sun.

Solar cells are long-term investments

The solar cell project in Skive, which is running to June 2012, is expected to cost around 45 million DKK (approx. 6 million Euros), and it is subsided with 22 million DKK (approx. 2.9 million Euros) from the Danish ForskVE fund [1]. Skive local authority has raised the remainder through loans at a low rate of interest.

Engineer Michael Petersen is the man in charge of the solar cell project in Skive, and he is ready for more solar cells: "We have seen a significant reduction in prices for solar cells over recent years, and at the same time we have gathered a lot of experience with solar cells through the project, so we have actually already started thinking about more new systems", he tells. But even though the price of solar cells has fallen in recent years, it is still a long-term investment for the municipality.

The energy company EnergiMidt is responsible for delivery and installation of the in total 1.2 megawatt solar cells. EnergiMidt is also the electricity supplier for the area.

Advantageous loan schemes for local authorities

Part of the reason for that solar cells result in good accounts, is that it has been possible to get very advantageous loans. Local authorities and regions have, as a rule, strict conditions for loans, but when it comes to loans in order to conserve energy then the loans can be taken outside of the normal loan conditions; this means both low interest and longer terms. It means that local authorities and regions do not need to cut in other activities in order to invest in energy conservation. Michael Petersen is pleased about the arrangement: "When one can get favorable loans for energy conservation, it increases the incentive to really do something about energy usage in municipal buildings. The initiatives need to be profitable within their own lifetime, but this isn't actually a problem for our solar cell project".

1. The ForskVE programme is a result of the parliamentary decision in 2008 that set in motion a programme to make a selection of small VE technologies more widespread. In this context VE technologies are defined as: solar cells, wave power, and biomass gasification. The grants are administrated by Energinet.dk.

Ørslevkloster School.

The local authority in Skive is a pioneering authority in the field of energy, but there remains a lot of work needed in order to get other local authorities involved. It isn't a surprise to no one that one of the obstacles is economic, because many local authorities overlook the favorable loan possibilities on offer: "Many local authorities do not see the possibilities it gives when the money they save on operating costs can be used to pay back the loan-financed energy savings. You have to think a little more in long-terms", Michael Petersen points out.

Net metering has a significant importance for local authorities

Another incentive which makes solar cells attractive for local authorities is the so-called net meter deal. Municipal buildings and institutions can free deliver to the public grid when they produce more electricity than they use themselves, and in addition they can receive the electricity back again when they need it. When the solar cell system produces more energy than is used, the electricity meter literally runs backwards. The rule for municipal buildings and institutions applies, as long as no more than 6 kWp is installed for every 100 square meters of building area. "The scheme has significance for local schools if the energy use is very low, as in the summer holidays, for example, where solar cells produce a lot of additional electricity", Michael Petersen underlines. The net meter scheme is also applicable for private households.

50 solar heating systems on municipal buildings

Solar cells are not the only solar energy

Skive Library - 345 m2 PV.

Skive City Hall - 380 m2 PV.

initiative in Skive. Solar energy for heating has been a stable part of the sustainable energy efforts in the local authority for many years. The first solar heating system was set up back in 1994 in Højslev School, and the local authority runs today a total of 50 solar heating systems in different municipal buildings. On the town hall, which was built in 2006, a 265 square meter solar heating system has been implemented. The building is almost self-sufficient with solar heating, and therefore it uses hardly any supplementary district heating. "Normally a building like this would need approximately 800 MWh per year, but we buy just 20-30 MWh from the outside annually - only as a backup supply, in case the weather is unpredictable for a while", states Michael Petersen. The solar heating system is combined with a mini CHP (Combined Heat and Power system) which runs on bio-diesel.

Even the heating supply to the local ice rink is an integrated part of the system. The surplus heating, produced by the refrigerating system, is used for town hall space heating. But the solar heating plant is also used for cooling. In summer, when the heat demand at the town hall is minor, but the system still produces a lot of heat, the surplus heating is used to keep the temperature down in the EDP server room at the town hall by an absorption cooling system.

Skivehus School - 1225 m2 PV.

Collaboration with Højslev power station

The surplus heat which the 375 square meter solar heating system at Højslev School produces is utilized in the same way; but in this case the surplus production in summer forms part of the district heating. "We have established a fine collaboration with Højslev power station. When the heating demand in the school is covered, the system itself ensures that heating is bypassed to the district heating pipe in the school's neighboring building", says Michael Petersen. The only demand is that the water is heated to 75 degrees, which is the temperature level by the power station. "It is a win-win situation for the local authority and the power station as well. The school gets rid of its surplus heat and the power station gets cheap hot water. And furthermore at a cheaper price ", Michael Petersen stresses.

Højslev School's solar heating system delivers 60 MWh to the power station each year. For the school, the system produces 110 MWh annually. The system covers approximately a quarter of the school's annual heating needs. As stated earlier, the system is the oldest in the local district, but since 2007 Skive municipality has installed solar heating systems in additionally 15 schools and 18-20 systems in day-care institutions. The plan is to have in total 55 solar heating systems in public buildings in the municipality before the end of the year. The solar heating system in Højslev School is much larger than most systems in Skive. The rule of thumb in the municipality has been 10-15% solar heating per building and that naturally gives smaller systems.

Skive has a plan

Skive's solar cell and solar heating systems form part of a larger energy plan that should make the district CO2 neutral from 2029,

and totally CO2 free from 2042. Energy savings and sustainable energy are far from new buzz words in this enterprising local authority. The environment has stood high on the city's agenda for many years and Skive was, for example, the first local authority in Denmark to build low-energy houses, back in the 1970s.

In more recent years the city has been honored with numerous environmental prizes. For example, it was so bold as to take home all three energy prizes in 2007: "Årets Energisparekommune" (Energy saving Municipality of the Year), "Årets Energirigtige Kommune" (Energy Aware Municipality of the Year) and "Årets CO2-rigtige Kommune" (CO2 Aware Municipality of the Year). All three went to the city by Limfjorden.

In Skive, though, they are far from their goals in relation to energy saving, they have brought down CO2 emissions in municipal buildings by 25% since 2008. More smart solutions can still be found in order to achieve the objectives for CO2 neutrality in 2029, and making the municipality CO2 free in 2042. "With our ambitious climate goals there is of course focus on CO2, but we also have to look at the economic aspects. Solar heating is a good example of a sustainable source of energy, where the lifetime of the system is longer than the payback time. When a solar heating system lasts 25 years, but is paid for in 10-12 years, then this sounds like good business", concludes Michael Petersen.

Aakjær School.

Solar heating plant and micronet distribution network in Salzburg

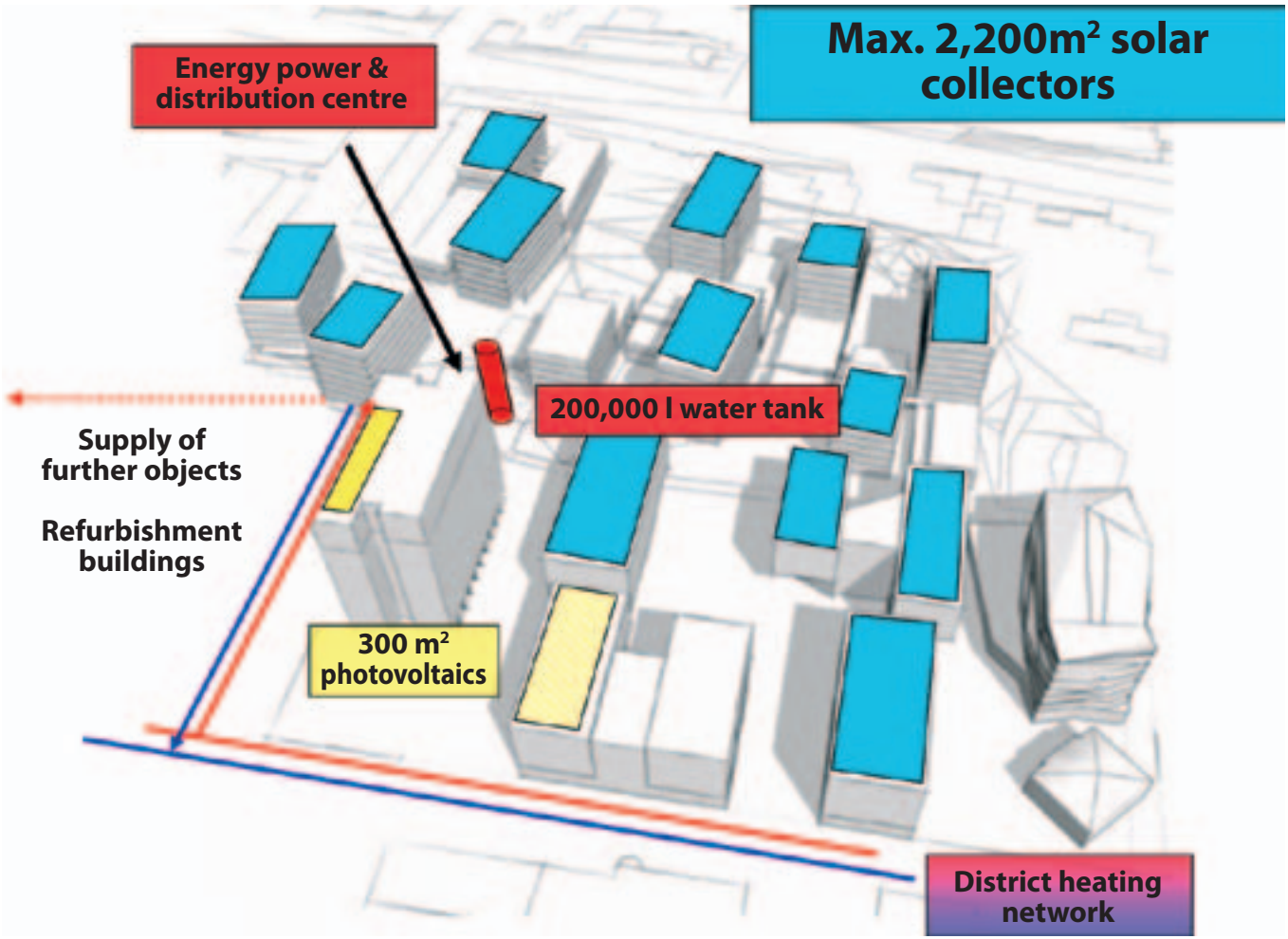
Boris Mahler, Steinbeis Institute - Helmut Strasser, SIR and Norbert Dorfinger, Salzburg AG.

Stadtwerk Lehen area is a inner city district of Salzburg. The project comprises new residential and live science buildings on a demolished old commercial site and refurbishment of residential multi family buildings. Developers of the site, the city of Salzburg and other involved parties have signed a "high quality agreement". Goal is to realise within a five year period an energy efficient, sustainable and social district.

Solar district heating

One main focus of the project is a heat supply with high share of renewable energy resources. Although a main district heating grid is close by, a new micro net will be installed using the main district heating as peak load supply. Within the micro net a large solar fraction of about 30% in combination with a high specific solar yield of 400 kWh/m²a is anticipated. To reach these high figures several aspects will be realised:

- reduction of heat demand by very well insulation of the buildings
- installation of 2.000 m² solar collectors
- installation of a 200 m³ buffer storage



- use of 160 kWh heat pump to increase the storage capacity and solar yield
- low temperature supply system with heat substations in every flat.

The design for the solar district heating was developed using dynamic system simulations. Within these simulations several options have been investigated in respect to investment cost, operation cost, energy and CO2-savings. The best performance was received using an electrical heat pump to "cool down" the lower part of the buffer storage and "heat up" the top part. In doing so, the solar collectors can operate with lower temperatures many times during the year and thus have a higher solar yield. An additional effect is the higher storage capacity of the buffer storage preventing overheating during summertime.

Figure shows roof spaces for thermal solar (and PV). As the district will develop during several years (first residential units, then commercial area, last retrofit buildings) the energy balance will also develop. The backup heating is a central district heating from the utility Salzburg AG.

The Concerto project realizes a heat supply with specific emissions of approx. 8t CO2/MWh heat. This is 92% less than a standard gas supplied energy system.

At the moment the building construction of the residential buildings is well advanced and the installation of the solar collector arrays and the buffer storage started.

Biogasification

- as the prime mover towards a fossil free energy supply system

Erik Christiansen, EBO Consult A/S, Hillerød Biogasification P/S.

The Danish Climate Commission in its report of 28 September 2010 emphasized that biomass will play an important role as a backup for wind turbines. Also the government's energy proposal, 24 February this year, focuses on biomass as an important future energy source. Biomass is preferred due to the fact that as regards the use of wood it is considered CO2 neutral because the burning of biomass with CO2 emissions is replaced by growing up of new biomass with consumption of CO2 in the growing season.

Thus the use of biomass is assumed to be neutral in relation to CO2 emissions. In this way biomass is considered as a renewable energy source throughout the EU. Seen in this light, the use of biomass in the form of wood is one of the important roads to follow when Denmark should be independent of fossil fuels.

Another important element of both energy policy proposals is energy efficiency, ie. is the utilization of biomass effective enough?

Biogasification as described in this paper meets both the requirement for CO2 neutrality as well as the requirement for energy efficiency.

What is biogasification?

In days with less wind in Denmark it may be needed to focus on one of the new renewable technologies like biogasification. Here you burn woodchips, and achieve a very high utilization of the woodchips in the production of both electricity and heat (CHP) opposed to traditional chip-fired plants, which alone produce heat.

Biogasification technology is an old favorite. Some might remember seeing the technique of World War II cars with gas generators mounted.

The technique has in recent years come back to honor and dignity, though in a higher technological version.

It is the development of the technology in Denmark which makes it possible to establish a demonstration project for biogasification among others in Hillerød.

Short and simple told as the principle of the earlier gas generators – a gas generator is operating as a kind of stove, where the "air" is dragged through the fire zone with burning wood.

The air is sucked out in the middle of the glow pile under the fuel. In this zone there is gasified wood, which is on its way higher up to be mixed with air and then turns into flames in the oven.

The air that is sucked in from the gas generator simply contains unburned gas from the wood, typi-

cally carbon monoxide (CO) and plenty of other gases. The gas is pretty dirty because it contains both ash and tar, and the complete generator system therefore consists of the generator, followed by multiple filters and coolers, which will make the gas cleaner and colder, so it can be used in an engine.

Today woodchips are used where the woodchips through combustion are converted into gas. The conversion is made in a gasifier – the gas generator, where the woodchips through the heating and various chemical reactions are transformed into a flammable gas that drives an engine that can produce electricity. Today Electricity is the valuable source of energy.

The biogasification plant in Hillerød

The biogasification plant is expected to be located in connection to the wastewater purification plant in Hillerød, just beside an operating natural gas based heating plant.

The biogasification plant has a size of 300 kW power and 750 kW heat. Electricity is supplied to the grid, while heat production is supplied to the existing district heating system, which is owned by the local municipal heating company. District heating is showing its potential in terms of integration of renewable energy systems in existing facilities, as the plant is established in conjunction with and partially replaces the natural gas based heating plant.

Electricity production is paid for according to the principles of the Danish law on promotion of renewable energy, while heat production is settled after an agreement with the local heating company. It is agreed that the settlement heat price for the chip-based generation shall be lower than the natural gas price.

The actual plant construction can be seen on the biogasification company website: www.bioforgasning.dk. It is BioSynergi Proces ApS by director Henrik Houmann Jakobsen that is responsible for the development and delivery of the plant.

The theory and technology behind the demonstration plant is developed with particular financial support from the Danish Energy Agency and Energinet.dk 's PSO programs. The Danish Energy Agency program has allocated 10 million DKK for the construction of the plant, while remaining funding is provided through public shares.

The plant is expected to be commissioned at the end of 2012.

The organization of the biogasification plant as a public-owned utility

The biogasification plant energy supply utility will be owned by an independent company.

The company provides the facility available for heat production to the local district heating network and electricity to the grid, assuming that the plant is running full time. The plant is fully financed by the company.

The facility is offered to investors, including users, citizens, etc. in the municipality Hillerød , in the same way that renewable projects in wind and solar are offered to public ownership in Denmark.

Setting up of wind and solar guilds has shown that the population has a broad interest in being involved in influencing the development of renewable energy and use of new CO2-neutral energy technology. Examples include the Middelgrunden Offshore Windmill Guild in Copenhagen, which has approx. 8,600 shareholders, who own 10 units of 2 MW wind turbines and the Solar Guild Copenhagen with approx. 100 shareholders, which owns two plants of total 55 kWp. For both guilds there are long waiting lists of potential investors, including individuals, corporations, foundations and others.

In Hillerød 1,050 shares were sold during approx. 2 months, mainly to local investors. President of Hillerød Biogasification P / S is an old-age pensioner who wants to help put a CO2 neutral footprint on the local level.

Public ownership model once again proved its strength by being a catalyst for a broad acceptance of and adherence to new forms of energy supply around the country. Therefore the public ownership model helps to create local and national acceptance and embedding of environmental and energy innovations.

What are the future perspectives of biogasification?

With the technical and financing concept described above, it will be possible to integrate and scale the biogasification system according to local needs - and without having to raise money to fund the construction. It can be an advantage for new energy supply plants and existing natural gas based plants that can see advantages both environmentally and economically by integrating a biogasification plant in the existing system - or by new build.

This leaves the question whether there will be a sufficient supply of woodchips?

First and foremost it must be noted that woodchips are formed through solar energy - and the amount of solar energy is without limits. Secondly, timber production can be planned and controlled. The majority of Danish woodchips origins from thinning of young forests, which indeed is formidable wood for biogasification because of its high moisture content.

Danish Forestry estimates that there are substantial production opportunities beyond the amount of woodchips, which today is produced from forests. There is an expectation that the current Danish woodchip production will be 3-doubled, and that wood could become a greater resource than wind. It should be noted that the transport of woodchips represents 0.6% of the energy of the transported wood measured in CO2 consumption.

The biogasification system will therefore be able to launch a new industrial potential of energy systems while helping to develop a large forest industry, where the forest management is based on sustainable principles, for example according to the "Nordic Swan Label".

CO2 neutral district heating

Ejvin Beuse, chairman PlanEnergi.

Braedstrup Solar Heating Plant - 8000 m2.

Conversion from fossil fuels into renewable energy is not only an option – it becomes a necessity within a short time. This will happen not only because there is less fossil fuels but because of the increasing uncertainty associated with the suppliers and last the impact on environment.

A large proportion of energy use in Europe is for heating buildings – about 40% of total energy consumption. And an increasing share of this heat is covered by district heating.

In Denmark we are quite experienced in and well off linking large-scale solar heating plants to our district heating systems. A qualified estimate is that the future district heating supply will be based on a mix of renewable energy technologies. The optimal solution is mainly depending on local conditions. In PlanEnergi we have specialized in strategic planning and optimal use of renewable energy sources.

The big challenge in utilization of solar heating - and renewable energy in general - is how to store energy in the best and cheapest way from periods of surplus production to periods with heat demand. In the future our energy will be generated by many different sources such as windmills, solar heating, solar cells and perhaps wave power. Compensation between the periods of over- and under-production must be addressed if renewable energy must replace fossil fuels 100%.

One can achieve several environmental benefits by combining large-scale solar heating and CHP plants: environmental benefits for the companies, financially it looks reasonable, national economically it looks reasonable and - perhaps most surprisingly - it will help to stabilize the power system.

Braedstrup has shown the way

There are 650 CHP plants in Denmark. The fuel is waste, wood chips, wood pellets, biogas or as in the case of Braedstrup natural gas. One quarter of the Danish natural gas consumption is used in CHP plants. In areas designated for CHP it is crucial to respond flexibly to electricity prices. But there might be difficulties to accommodate large amounts of wind into the electricity system. An analysis by Energinet.dk has shown that integration of large amounts of solar energy can have a stabilizing effect. This is due to that the heat bound electricity is reduced. At the same time it is more profitable to build large solar installations, as construction and operating costs are less than for individual plants.

Braedstrup is located in an area where it is not legal to use other sources than natural gas for heating purposes. According to legislation Braedstrup District Heating company is not allowed to switch from a taxed fuel to non-taxed fuel, like wood chips or wood pellets. Thus there are two opportunities: biogas and solar energy. After having dropped the idea of using biogas Braedstrup changed into solar heating instead.

A solar power plant of 8,000 m² which is designed to produce 4 million kWh annually, equivalent to approx. 10% of the district heat production in Braedstrup is now established. The environmental benefit is a CO2 reduction of 4,300 tonne annually. The financial gain is calculated to be 67 Euro per consumer each year. With higher natural gas prices, savings will also be higher.

The price calculations behind the planning of Braedstrup project are made by Energinet.dk. Financing is made on rather conservative calculation based on a crude oil price at $ 56 per barrel in 2030. At this writing (March 2011), the price is over $ 100 for a barrel of crude oil with upward trend.

Besides of being the first plant to establish solar heating in connection with natural gas Braedstrup shows the way for further 2 areas:

In a new residential area, Ring Soepark, the aim is to base 100% of the annual heating on renewable energy. A common solar heating plant combined with solar heating

Braedstrup Solar Heating Plant - 8000 m2.

at some rooftops will deliver heat directly to the district heating network. The amount of heat delivered to the district heating system in the summer will balance heat used in the winter time. Additionally, the district heating network is designed to have an expected net loss of 15-20% of consumption in the newly constructed homes. The project will be established in 2011.

Also in 2011 the establishment of the pilot phase in "Braedstrup solar parks" is initiated. The pilot phase consists of additional 10,600 m² solar panels, a drilling hole storage of 8,000 m³ (soil), a storage tank of 5,000 m³ and a heat pump which will be using the drilling hole repository as a heater. The drilling hole storage consists of 48 holes of 45 m depth with a distance of approx. 3 m. The holes contain two sets of PEXtubes surrounded by a mass of bentonite blend. The surplus of the solar heat is in the summer used to heat the storage, and in winter time heat pumps will draw back heat and thereby cool the storage. The fully fledged solar heating can be increased to 50,000 m² and the drillinghole storage can expand to the 10-fold. Afterwards the plant will cover 50% of the heat produced in Braedstrup.

The world's largest solar plant in Dronninglund

While the share of electricity generated by renewable energy sources such as solar, wind and waves increases, the need for energy systems to be more flexible will gradually increase. This challenge is now discussed at Dronninglund in Jutland, where they plan to establish the world's largest solar heating plant.

Using long term storage of solar heating into a mega store from where the heat pumps generate the heat, you will simultaneously demonstrate that it is feasible to supply CO2-free district heating.

The demonstration plant will be built along Dronninglund district heating plant and will comprise 35,000 sq meters of solar collectors, 60,000 m³ of seasonal heat storage and 3 MW heat pumps. The plant is expected to be operational in 2012.

The project in Dronninglund is outstanding because no such large solar heating system with seasonal storage and heat pumps has been seen before. Especially not in combination with a CHP plant also producing electricity. This provides additional challenges because the CHP plant must combine the solar energy into its daily

operations. In turn, solar, seasonal storage and heat pump is a unique opportunity for the power plant to become an actor in the electricity market, and thus help to establish e.g. more wind turbines. The current heat pump is a newly developed type that has great potential for CHP plants.

Mega seasonal heat storage at the island Aeroe

One of the major challenges in achieving a high coverage of heat demand by solar energy is to make the "storage" from summer to winter as cheap as possible. One option is to use traditional steel tanks, but they are rather expensive and also are very visible in the landscape. A cheaper and nearly invisible alternative is to store heat in the earth in a steam storage which in principle is a large well-insulated hole filled with water. Such a system is planned in the EU supported development project SUNSTORE 4 that is realized by Marstal District heating at Aeroe. Long term storage of solar heat in a mega store that the heat pumps can use as a heat source, complemented by a boiler for energy willow, will demonstrate that it is feasible to supply CO2-free district heating. At the same time the solar collector will be extended from the current 19,000 m² to 33,000 m² and will thus be one of the world's largest thermal solar plants. The plant is expected to be operational in 2012.

In a European perspective this has a high potential. Currently, the use of solar energy in the European district heating systems is rather modest - both in absolute terms and compared to the potential that the European solar association ESTIF has calculated. At least 5% of the heat supplied by district heating plants will be covered by solar heating and the first percent before 2020.

By bringing experts from the district heating sector and the solar sector together in developing guidelines and standards for solar heating there will be an increase in the use of solar energy in district heating areas. The goal is to launch a comprehensive market introduction in utilizing the combination solar and heat which will involve 18 European countries. From Denmark the association Danish District Heating participate represented by Marstal District Heating and Braedstrup District Heating – and also PlanEnergi participate.

Many benefits of using solar energy

CO2 reductions: Solar heating causes no CO2 emissions.

Security of supply: The supply of solar energy is safe and there will be no rationing or problems with the supply of energy source used for heat or electricity production.

Produced 20-30 times as much energy on one acre, where there are solar, as if the area used for growing biomass.

The system can help to increase the regulatory possibilities of the electrical system and such integration of more wind turbines.

For the district heating plants the heat price will be safe: the price of heating from the solar system will be known for the next 20 or 25 years as investments are made now and increases in fuel costs will not provide surprises in the future.

On-line monitoring energy consumption

Georg Thor, Energy Consulting Salzburg.

Energy Accounting is a term used since many years and has often been both over- as well as under-estimated so far. There are various levels of detail regarding the implementation – and experience shows the potential danger of a "cemetery for data" without appropriate evaluation and guiding measures put into practice. Therefore, the real challenge of our time is not the mere acquisition of data as such, as this can be realized efficiently and cheap via automatic systems, but the transformation and profitable realization of this data.

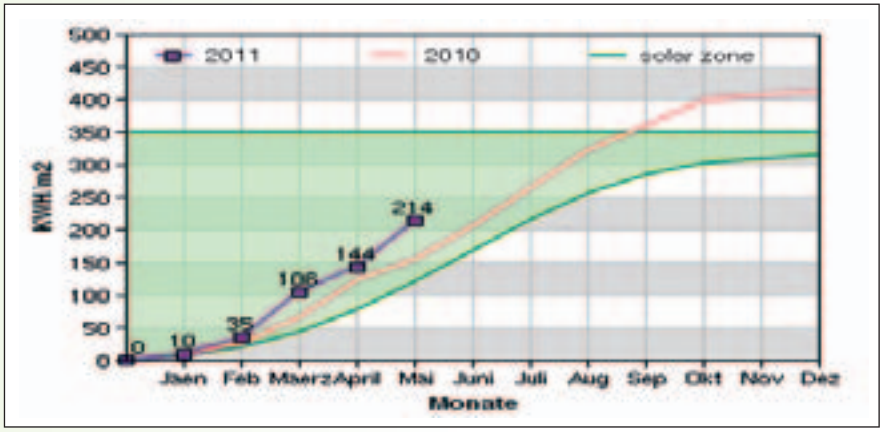


Figure 1:
Sample presentation of output of a thermal solar system, source: www.energiebuchhaltung.at

Considering energy consumption, there are generally two different methods to distinguish:

1) Calculation of Energy-NEED – Top-Down-Method
2) Acquisition of Energy-CONSUMPTION – Bottom-Up-Method

A common example of calculating energy needs is the Energy Certificate. Consumption, on the other hand, is typically acquired via Energy Accounting Systems which work either manual or automated.

With regards to Subsidized Housing in Salzburg, the use of automated Online Energy Accounting Systems is being promoted since 2003. By taking these measures, it is possible to add a € 1.000,- to the sum of promotional loans for an average household. This guarantees a very high acceptance on the part of building promoters, especially in multi family dwellings.

In order to gain such promotion, a public access to data is required – in this way self-control as well as benchmarking with others is possible.

Several providers have emerged in Salzburg, for example LUF-Controls (www.energiebuchhaltung.at) and Siemens (www.energiemonitor.at). Also some operators of district heating companies offer their customers the service of public Online Energy Accounting, according to the valid guidelines for promotion.

Presentation of Data and Reference Values, Thermal Solar Systems as Example

The Subsidized Housing in Salzburg prescribes a specific output for communal areas of 350 kWh minimum per m² collector surface and year. Based on this, the presentation of output enables a direct comparison to the arithmetical target-values, *see figure 1.*

By using this mode of representation, it is easy to evaluate the efficiency of the thermal solar system. Values in the green domain – as shown in the example – are facilities of good quality. Low values indicate that an examination of the system would be advisable.

Modern facilities additionally compare the measured solar radiation to the thermal output of the solar system. As a result, these measures facilitate an observation of the various operating states of the system and subsequently, the hydraulics of hot water heating and backup heating can be adjusted in an optimal way. In addition, it's possible to depict any occurring disturbances imme-

diately through this comparison of values.

Via the online platform www.energie-buchhaltung.at there are currently over 20.000 m² thermal solar systems monitored. Most of the documented buildings are located in the province of Salzburg.

Through the funds of Subsidized Housing Salzburg, 20% to 40% of the general subsidized residential building area have constantly been equipped with an online Efficiency-Observing-System since 2006.

Benefit for End Customers, Operators of Facilities, Politics and Public Authorities

By a targeted use of efficiency criteria emerges a depicted sequencing of efficiency. Due to public benchmarking, the companies and persons responsible find themselves in a competitive situation. By means of making data available, the pressure to justify middle or poor efficiency increases and this triggers very often measures of improvement. A further result of constant efficiency observation is that acute errors are clearly pointed out and automatic warnings inform the system operators.

More and more property managements make data individualized available for their residents, either in form of online-accounts or partly via additional notification and signal systems located on central positions directly in the settlements (see figure 2). By doing so, energy and energy efficiency can be made visible and this leads to a general increase in perception and significance of these key issues in our society.

In Energy Consulting, accounting data forms a valuable basis for qualified consultations. An analysis of the load profile enables to draw conclusions concerning individual consumers or specific conditions of consumption which are very often not perceived as such by the operators or sometimes are even underestimated.

In order to conduct such evaluations, permanent measurements are useful but in most cases a valuable estimation can also be achieved through electronic or written records over a period of several days.

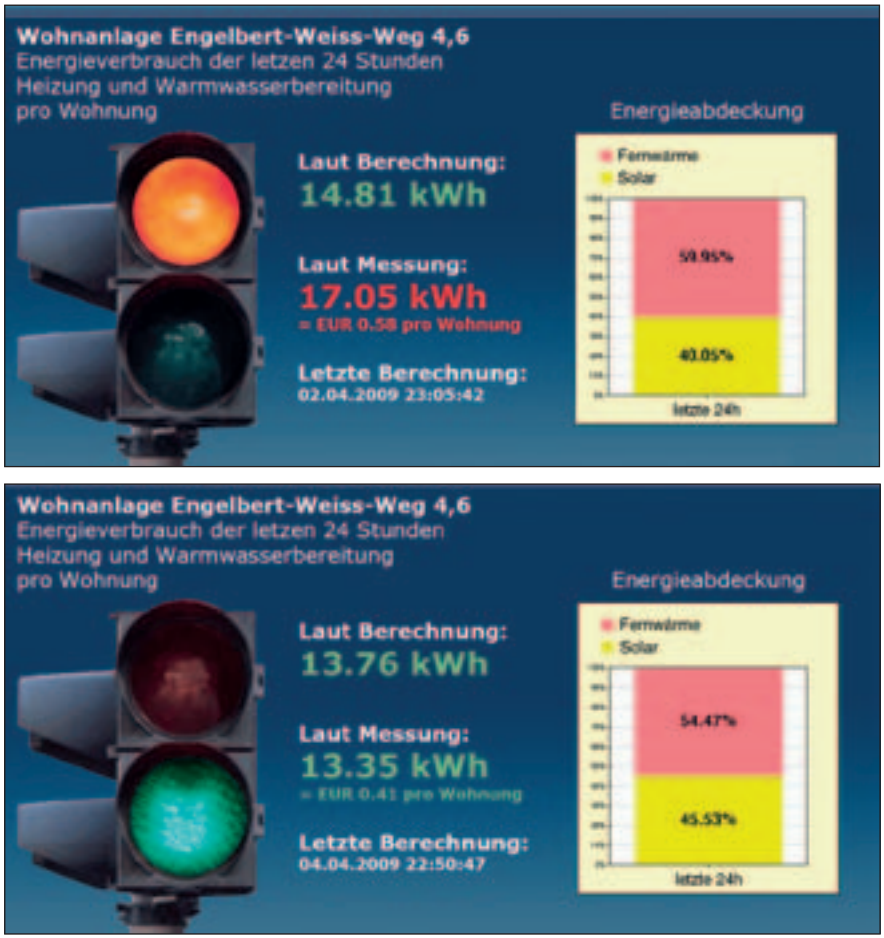


Figure 2: "Traffic light" on energy website - green/red: consumption lower/higher than expected.

Looking into the Future

By the projected large-scale application of Smart Meters it will be possible to collect and evaluate – also additionally – energy-relevant data in an efficient and relatively cost-effective way.

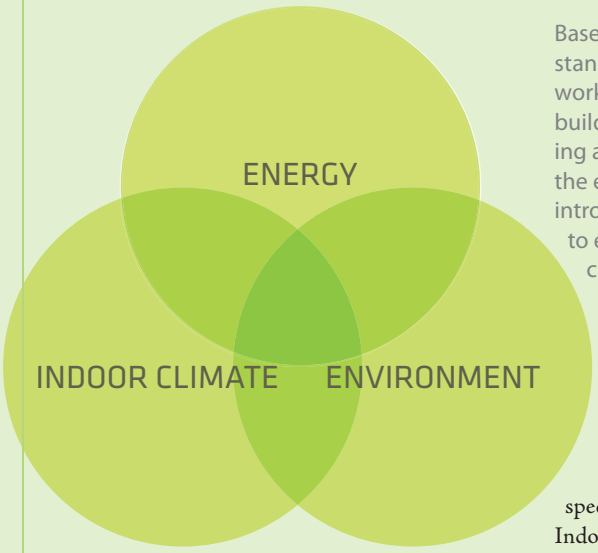
The automatic combination and alignment of the Energy-Consumption-Data with the Energy-Need-Data from the Energy Certificate [saved on the online platform for Energy Certificate "ZEUS" www.energieausweise.net] forms the next important step of data controlling.

It's of utmost significance that the professions engaged with the relevant building (energy certificate calculators, design engineers and executive workers) have access to both data sources. And more than that, they should get information concerning inefficiency or possible improvements automated via their generally used EDP-tools.

Especially for legislators, precise knowledge concerning typical consumption and saving potentials is mandatory and forms prerequisite conditions for setting limit values and energy efficiency requirements. For this purpose, energy accounting is used increasingly as it can make a significant contribution to energy politics as such.

"Active House" concept
– from calculated standards to monitored standards

Peder Vejsig Pedersen, Cenergia Energy Consultants.

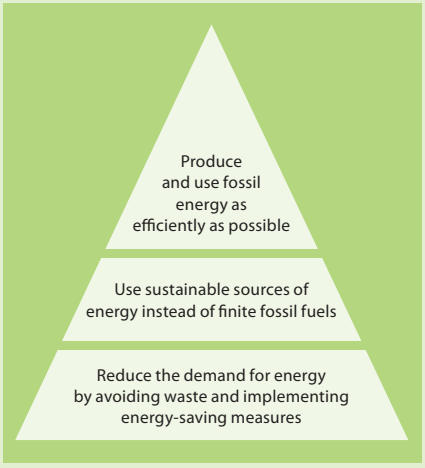


Based on EU directive about "near zero" standard in 2020 it is very important to work on ideas of how the zero energy buildings of the future look like, including a view to how far you need to reduce the energy use before you e.g. try to introduce photovoltaics or thermal solar to ensure that the zero energy standard can be met by help of local renewable energy sources.

In this field there is an interesting contribution from the socalled "Active House" concept (see: www.active-house.info).

Here there is defined a number of specifications within areas like, Energy, Indoor Climate and Environment. And in the Energy area there is a focus on the areas: Energy Balance, Energy Design, Energy Supply, Energy Monitoring, Verification and Follow Up.

In the area of Energy Balance this is based on a calculation of all energy uses in a building incl. electricity using appliances and the used energy supply system. Here an "Active House" can be classified in 4 classes based on the yearly energy balance:



Class A	≤ 0 kWh/m²	for the building incl. all electricity use.
Class B	≤ 0 kWh/m²	for the building but only including electricity use for operation.
Class C	≤ 15 kWh/m²	for the building but only including electricity use for operation.
Class D	≤ 30 kWh/m²	for the building but only including electricity use for operation (at renovation).

It is important to note that there is a demand for energy monitoring, verification and follow-up. This is new compared to the situation in Denmark today where there is a lot of focus on good calculation procedures, but no link to what the actual energy use will be in practice in realised building projects.

A good possibility here could be to introduce the same demands for "verification" of all new building projects within a two year period, which already have been introduced in Sweden.

In Denmark there is in fact no actual responsibility concerning the realised energy quality in building projects, and this is having a severe influence on how much focus consultants and contractors have on the realised energy quality in practice.

One area where there is an actual focus on energy quality in practice in Denmark is however in the area of air-tightness of constructions.

This can be controlled quite easily and due to this and a 5 year quality period for building failures, there is now consensus on the importance of living up to this demand in the building regulations.

Future intelligent energy systems

- individual and collective systems

Jens Ole Hansen, COWI.

The future energy systems, smart grid, smarter cities, eco-towns are all covering the same: the desire for a sustainable and economic energy system. The question is how we get there and how municipalities and developers must act now in order not to place restrictions on the development. COWI thinks that it will be necessary to integrate the electrical, heating and cooling markets into all development projects instead of running in three separate tracks.

The many directions

Much is happening within the energy sector at the moment. As for the electricity sector, there is a major focus on smart grid, however without the branch yet being able to explain what that is about.

Within the district heating sector, fourth-generation district heating is being mentioned, whereas district cooling is very limited in Denmark. The construction sector is talking about passive houses, zero energy houses and even on active houses.

Finally, the association Dansk Industri (Confederation of Danish Industry) and several municipalities are talking about the cleantech industry, being the next export adventure.

Smart grid

Danish Climate Minister Lykke Friis has established a "smart grid" working group to define the future energy system. Originally, it had a purely electric focus, but ended up with inputs from other industries, including

Consumers	Reduced energy costs	0 – 10%
	Fewer breakdowns in supply	2 – 10%
	Increased consumer satisfaction	5 – 10%
	More opportunities for consumers	10 – 20%
Transmission /Distribution Companies	Increased lifetime of networks and network components	10 – 20%
	Reducing operating costs	0 – 30%
	Reduction of costs of network reinforcements	30 – 80%
	Reduction in network losses	20 – 30%
	Reduction of peak load and base load	5 – 20%
Energy-System and Society	Reduce electricity consumption	5 – 10%
	Integrate more renewable energy than system is designed for	15 – 20%
	Reduction of CO2 due to reduced waste	5 – 20%
	Increased potential for electric cars	90 – 100%

Source: Intelligent Energy Systems – a White Paper with Danish perspectives, 2010. DI.

Figure 1:
Potential for savings by using smart grid.

the district heating sector.

Smart grid is about integration of more renewable energy in the Danish grid system (and all others, for that matter), without getting problems with the capacity and fluctuations in the grid. If the consumption by the end users can be controlled more appropriately - or even be moved in time - there may be no need to expand the capacity.

The metering industry is a major driver in the smart grid development, because two-way communication is a prerequisite.

It is envisaged that the smart grid itself provides energy savings. It is currently unclear how large energy savings, and especially who will get them. Many estimates of the potential have been made, and in Denmark, Dansk Industri (Confederation of Danish Industry) has made an estimate, which can be seen in figure 1 as appears, there are savings at all stages.

The smart grid project iPower

In spring 2011 a large smart grid research project was initiated which will seek to answer the many cur-rent questions regarding smart grid. Risø DTU (Danish Technical University) is lead on the project, which has 32 partners, including COWI. Hopefully, practical demonstration will emerge from iPower, in which Danish housing associations, municipalities and developers can get an active role.

Zero-energy houses

In Viborg Town Hall, district heating and electric driven cooling/heating machines are combined with a groundwater system. The groundwater provides free cooling and heat to heat pumps. Additional heating and cooling are almost freely available from a heat driven or an electric driven machine, so that the consumption can be adjusted to the market for energy: using electricity when it's cheap, and district heating when it's cheap. Additionally, heating and cooling can be stored in the heavy structures depending on the expected use for the following day. Thus, Viborg Town Hall is "Smart Grid ready".

The Viborg Town Hall project is part of the EU demonstration project BEST ENERGY.

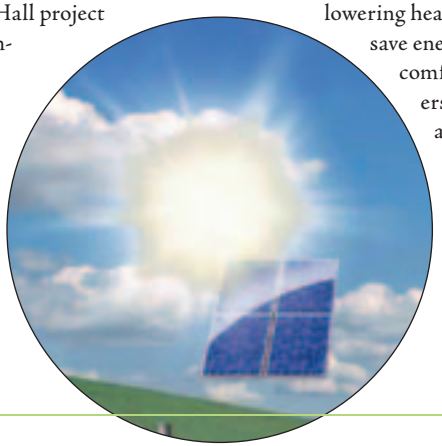
4G - Fourth Generation District Heating

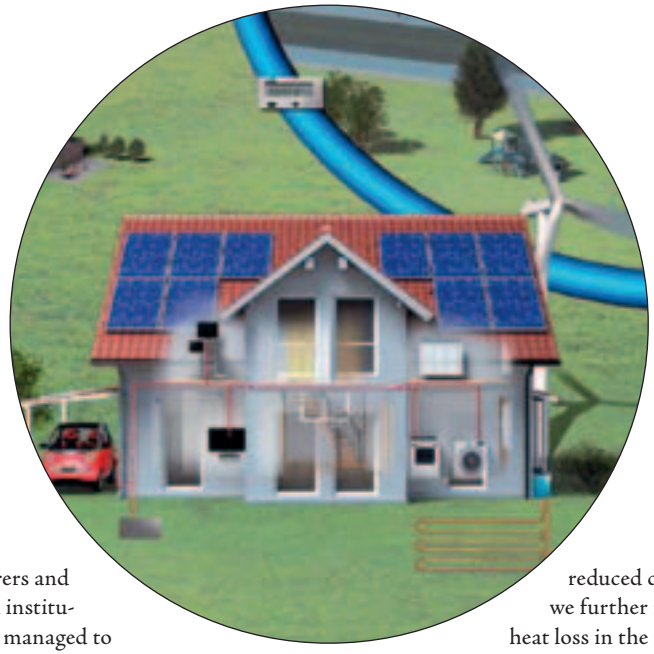
Fourth-generation district heating is rapidly evolving. Fourth-generation district heating is defined by the inlet temperature being equal to (or less than) the hot water temperature. The aim is to provide an alternative to individual heat pumps in new low-energy houses. In addition to reducing the energy consumption, district heating will become a part of the future intelligent energy system - as a buffer for electricity production. Fourth-generation district heating is particularly interesting for new urban areas. See the generations in table 1.

4G in Lystrup near Aarhus

At present 4th generation district heating is being tested in 40 new low-energy houses in Lystrup near Aarhus, Denmark. The system - the first of its kind in the world - is part of a Danish Energy Agency development project that will examine whether lowering heating temperatures can save energy without reducing comfort for the consumers. The initial results are promising and have proven to be cost effective.

The multidisciplinary development team - which includes consulting engineers,





manufacturers and educational institutions - have managed to reduce heat losses in the network by 30 percent compared to traditional water-based district heating systems.

Two factors contribute to the success of the system:

- Firstly, the circulation temperature to the consumer was reduced to 50 ° C without loss of comfort
- Secondly, twin-pipes were used, the latest technology in district heating pipes, reducing the heat loss by 20 percent. This was more cost effective than single-pipe systems.

Innovative district heating units

The project has shown that low-temperature district heating is working fine with traditional hot water heat exchangers. However, a new type of low-temperature heating units was developed and tested. The solution involves collecting water from the district heating system rather than storing tap water because of the risk of forming bacteria such as Legionella in a container with heated water.

If we use pre-insulated twin-pipes with reduced dimensions, we further reduce the heat loss in the net-work to a minimum. Based on preliminary measurements, the annual losses in the network are expected to be only 17 percent, which is unusually low for an area with low-energy houses.

The intelligent energy system

It is important that the smart-grid development is linked up with developments in the heating sector. District heating flexibility and acceptance of all fuels and saving potentials are necessary for the smart-grid sector development.

Get Smart Grid ready!

All new buildings must now be smart-grid ready. This means that it must be ensured that the buildings will fit into the future power system: the local renewable energy production must be able to supply to the energy system, and the buildings may be used as warehouses, or it must be possible to move the time of energy consumption. ✹

Table 1.
District heating generations.

1. G	Steam	300 °C/572 F
2. G	High-temperature hot water	120 °C/248 F
3. G	Hot water	80 °C/176 F
4. G	Low temperature	50 °C/122 F

Concerto project Green Solar Cities

Concerto project Green Solar Cities is expected to be a driving force for change into climate protection, use of renewable energy and demonstrate sustainable energy efficient building for large reconstruction areas in Copenhagen and Salzburg.

Prefab low energy Karensminde finished May 2008.

Neue Mitte Lehen finished November 2008.

Elderly Centre Langgadehus finished March 2011.

In Copenhagen urban district Valby 200 kWp PV is being integrated to match electricity use for ventilation in 500 housing units, and solar thermal collectors are combined with water savings to obtain 30-50% solar for domestic hot water (DHW) for 150 retrofit units and 50% for 70 nearly passive house rooftop apartments (36 kWh/m2/year), while 280 other new built apartments will get 30-50% solar DHW.

Kuben Management is Concerto Project Coordinator and local Valby project coordinator in cooperation with Valby Local City Council, Green Valby (local environmental centre) and DONG Energy Supply.

In Salzburg urban district Lehen it is being demonstrated how you can expand the use of solar heating to a higher share of the total need for heating and DHW, e.g. from 15% today to expected future 45% in the best new apartment building schemes. This is done by combining with a gasified heat pump. At the same time will be established a micronet connected to the district heating which is based on biomass and industrial waste heat.

The SIR is local Salzburg project coordinator including research and local dissemination activities. Further project partners are the city of Salzburg, the non-profit housing associations "gswb", "HÖ" and "Die Salzburg" and the builder "Prisma" for the commercial area – further the energy supply company "Salzburg AG". Steinbeis (Germany) is assisting on RTD work especially regarding the new big solar plant.

International partners are Technical University Delft (The Netherlands) on socio-economic analysis and sustainable energy community planning, Lund University (Sweden) on RTD work low energy standards especially regarding passive house concepts, EMI (Hungary) for connecting to associated city Szentendre near Budapest and similar WE Consultants (The Netherlands) for connecting to associated cities Eindhoven and Maastrict besides RTD work on ventilation etc.

Cenergia is overall technical coordinator besides energy specialist on Valby demo projects – and Green Cities is assisting Kuben Management with project administration, website and dissemination through e.g. European Green Cities Network and Danish Association of Sustainable Cities & Building.

Read more:
www.greensolarcities.com