NORDIC FOLKECENTER FOR RENEWABLE ENERGY
Kammersgaardsvej 16, Sdr. Ydby, DK-7760 Hurup Thy
www.folkecenter.net | info@folkecenter.dk
Tel +45 9795 6600 | Fax +45 9795 6565

WHAT WE DO

Welcome to the world of renewable energy and energy savings!
Experience modern energy technology and how can we play a worldwide role in transfer of technology and ecological way of thinking and acting.
Learn about solar and wind power, our work in Africa and climate solutions right here in Thy.

FOSSIL-FREE THY

FOSSIL-FREE THY

Electricity from renewables: 100%
Space heating from renewables: 85%

In 2012 the Folkecenter opened a new project: Fossil-Free Thy. We initiate and coordinate a range of regional activities with in renewable energies and technologies which can be used in order to create new network connections, which improve the area's external position in Denmark and the outside world as a showcase for climate solutions. This creates a solid foundation for future companies and jobs.

Thy, our peninsula is almost completely self-sufficient with renewable energy. 100% of electricity and about 85% of heat supply is coming from renewable energy. But the area is aiming for 100% during a few years. For these achievemets Thisted received the prestigious European Solar Prize in 2007.

In the Thy peninsular with its 46 000 inhabitants, 225 windmills and other renewables cover 100% of the annual need for electricity. Local energy production has become an important source of income. On days with strong wind, wind turbines may even produce four times more than the actual consumption and power quality still lives up to the highest standards. The local utility, Thy-Mors Energi has demonstrated real-time management of such big quantities of wind energy to visitors from all parts of the world. In the towns and villages in Thy, people get their space heating from hot water pipelines in the streets. It is environmentally and economically the best solution to use the excess wind power for the actual supply and storage in the big hot water reservoirs of the local district heating suppliers instead of exporting the surplus power to neighboring countries sometimes at low-spot market prices. A new municipal energy foundation plans to own further windmills. In 2012, 80 MW of new capacity were in the planning process. Income of the foundation may be up to €7 million per year earmarked for local energy initiatives which secures acceptance of the wind power and illustrates the benefits of change from investor policy to local supply.

Data Thisted Municipality (2008):

- **225 windmills**
- **124 600 kW installed wind power capacity**
- **35 800 kWel installed CHP capacity**
- **Power from wind energy 265 GWh**
- **Power consumption of 340 GWh**
- **80% from wind**
- **20% from biogas and CHP waste**
- **A small amount of PV**

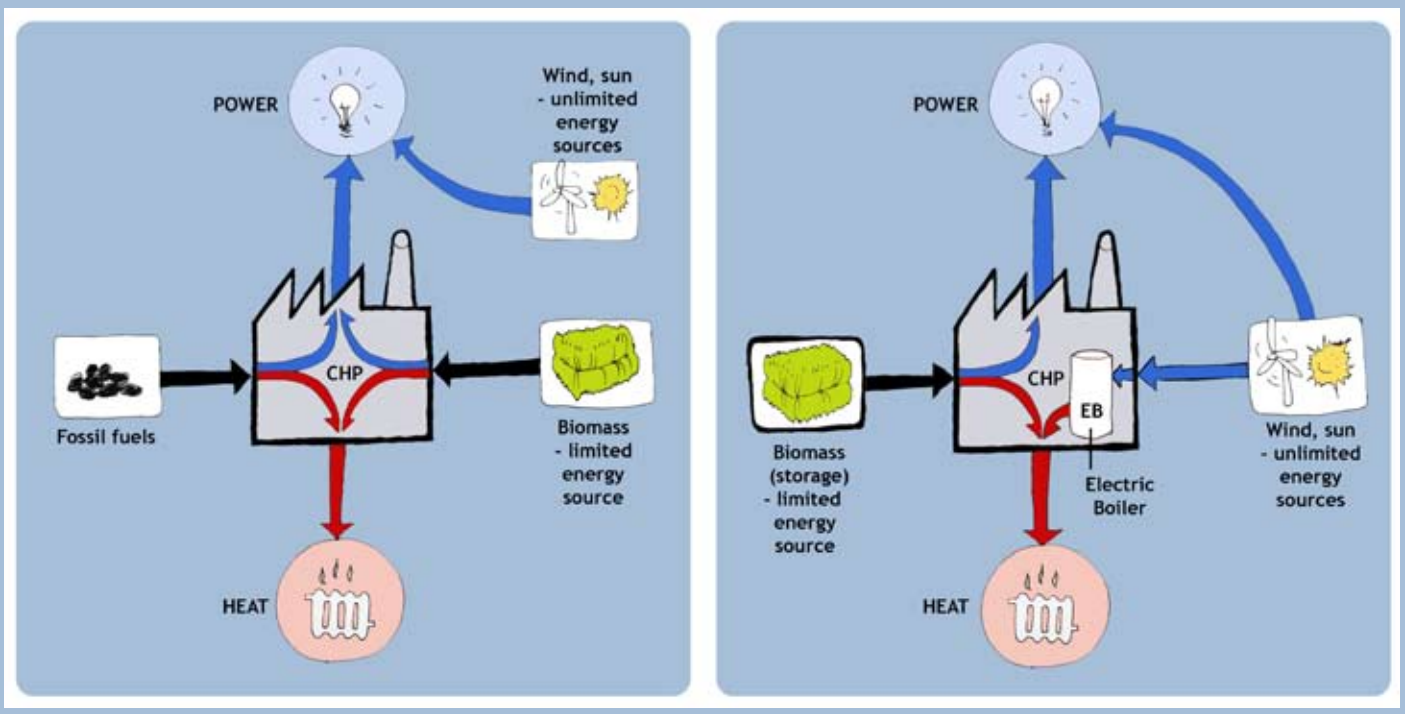
POWER BALANCING

No single renewable energy source can stand alone.

Renewable energy sources are clean and necessary alternatives to our power supply. Unlike conventional polluting methods of power production, their supply fluctuates and does not always match their consumption demands.

A lack of balance between supply and demand of power means that there may periodically be an increasing problem of excess power from the combined supply from decentralized energy sources such as wind turbines, solar power and combined heat and power plants. Persistent global attachment to the dominant fossil fuel-based energy system has significantly limited the development of combined solar and wind energies fluctuating into coherent, autonomous systems. One consequence of this is that renewable energies when generated in excess remain unutilized or even wasted. Wind turbines in regions with high shares of wind energy may be periodically shut down when they produce too much power. Similarly, when combined heat and power production coincide with excess wind energy, an excess power capacity may occur.

The primary task therefore, is to integrate the various forms of renewable energy, sometimes in combination with natural gas, in order to achieve the maximum utilization of renewable energy sources and supplies. To do so is daily practice in Thy.

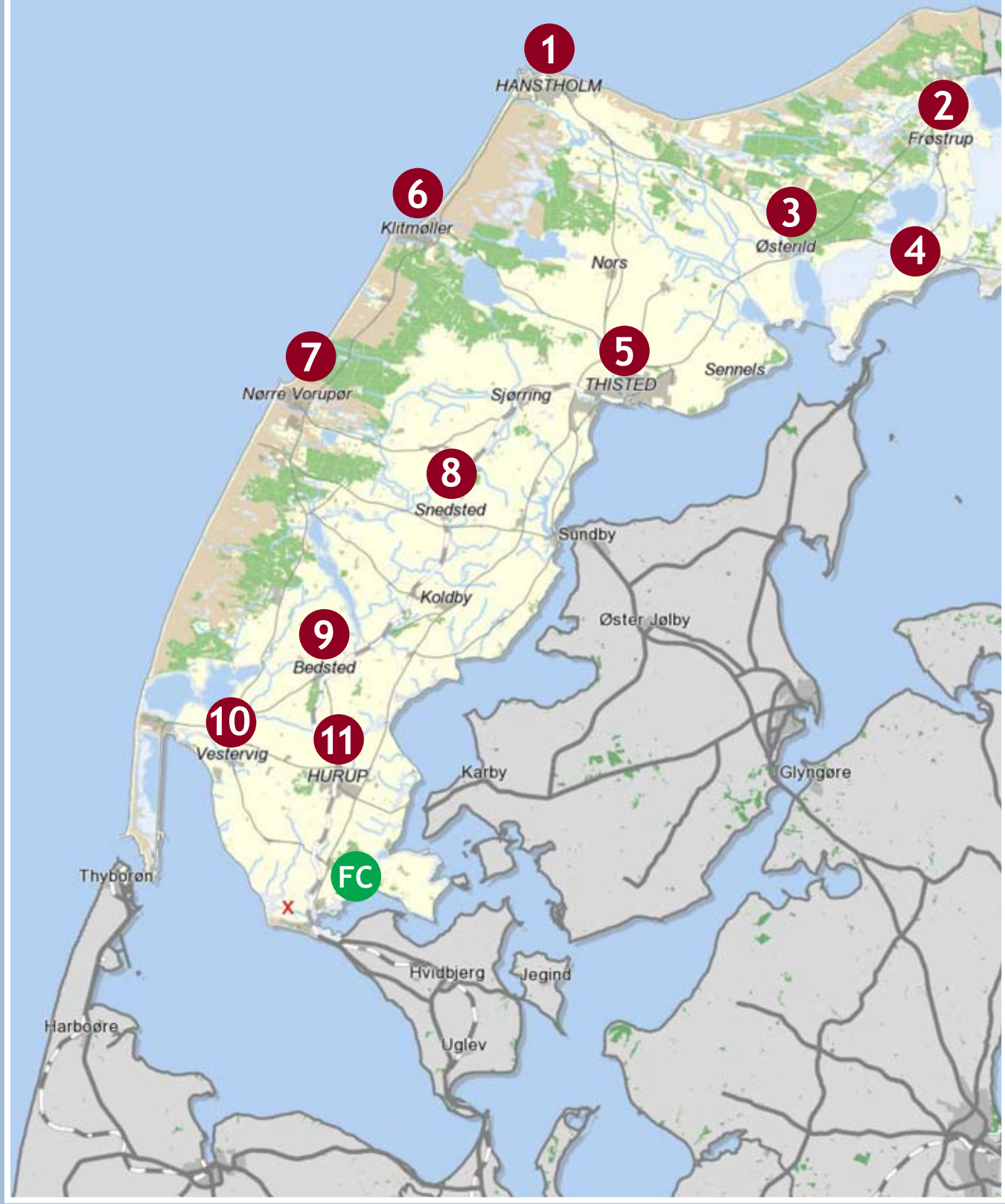


THE SUPPLY DOCTRINE

1. Further development can make wind & solar power the primary source for electricity and heating
2. With local surplus of fluctuating electricity it will be used in local CHP plants and replace biomass and natural gas
3. Biomass and natural gas are back-up storage when wind and solar energy is not sufficient
4. Biomass and natural gas are limited resources and should not be used when sufficient solar and wind are available

District Heating & CHP in Thy

Network of District Heating and CHP* plants in Thy



*CHP = Combined Heat & Power

District Heating & CHP in Thy

HANSTHOLM
Hanstholm 1 - heating plant (biomass)
Hanstholm 2 - CHP with 10 MW boiler
Supplies heat to Ræhr (4.5 km distance)

FRØSTRUP
Heating plant
(waste wood)

ØSTERILD
Heating plant (wood chips)

KLITMØLLER
CHP plant (natural gas)

VESLØS
Heating plant (wood chips)

THISTED
CHP plant (waste); Geothermal heating; CSH (concentrated solar heating); Straw
Supplies Hillerslev

VORUPØR
CHP plant (natural gas),
1 MW electric boiler

SNEDSTED
CHP plant (natural gas),
6 MW electric boiler

BEDSTED
Heating plant
(wood pellets)

VESTERVIG
Heating plant
(wood chips)
Supplies Agger

HURUP
1: Heating plant (wood chips)
2: Heating plant (wood chips)

District Heating in Thy

INTEGRATED ENERGY SYSTEM

at the FOLKECENTER

FOLKECENTER AUTONOMOUS ENERGY SYSTEM

At the Nordic Folkecenter for Renewable Energy located in the Thisted municipality, a prototype autonomous renewable energy system is installed. The energy system supplies heat and electricity to 2000 m^2 of offices, meeting rooms, laboratories, workshops, and residential facilities. Sources of energy supply are wind turbines of 75 kW_{el} and 37 kW_{el}, 42 kW_{th} electric boiler, 35 kW_{th} wood pellet stoker with automatic start-up and stop, 8 kW_{el}/20 kWth plant oil CHP unit with automatic start-up and stop, 12 kW_{el} PV and 50 m^2 solar thermal panels. Wind and solar energy are the primary sources for heat and electricity. Biomass (wood pellets and plant oil, PPO) is used for backup.

The system is connected to the public grid. The overall principle is not-to-sell/not-to-purchase from the grid. The CHP unit, however, can operate in island mode in case of a power blackout. At summer nights with no wind and sufficiently stored solar-generated heat, the CHP unit will not start up; the grid will supply the need for power only, as there is no electric storage capacity in the system and the CHP generated heat would be wasted. In practice, excess wind power covers 60% of the annual demand for heat, with the balance coming from solar and biomass. The technology and strategy of the autonomous system was pioneered, developed and implemented by the Folkecenter in 2007 and in daily operation since. For a 100% supply of power and heat/cooling from renewable energies, the same principles and strategy should be applied at the regional and national level as well. Initial steps have been taken at some of the local CHP stations. The system delivers a realistic solution to questions often made about alternative energy sources.

The combined high CHP and wind power production causes a potentially major problem in the power sector. However, supply and demand can as demonstrated in the Folkecenter Autonomous Energy System be balanced by feeding on windy days the excess wind power into the electric boiler. The electric boiler makes it possible to avoid the combustion of wood pellets in the stoker and use of liquid biomass in the CHP unit at periods with excess wind and solar energy.With increased renewable energy shares in the future, more and more often fluctuating solar and wind energy will be sufficient to satisfy both the need for power and heat, and can be given priority, while solid and liquid biomass is reserved for periods without sufficient wind and solar.

INTEGRATED ENERGY SYSTEM

at the FOLKECENTER

HEAT


CHP 8/16 kW


Solar panels


Stoker 50 kW


Electric boiler 42kW

ELECTRICITY


PV solar cells


Windmill 75 kW


Thyristor Load Control


CHP 8/16 kW

HOT WATER
StorageTank

10 000 litres

POWER FLOW CONTROL


GRID

AUTONOMOUS INTEGRATED RENEWABLE ENERGY SYSTEM AT FOLKECENTER

- Wind and solar energy are the primary sources for heat and electricity. Biomass is used for back up, and not when wind and solar energy is available.
- The power flow control directs surplus electricity through the thyristors to the electric boiler.
- When the electric boiler does not supply sufficient wind-generated heat, the wood pellet stoker is activated.
- In case of no wind, and a need for heat and electricity, the combined heat and power unit (CHP) running on plant oil, is activated. Combined production of heat and electricity covers the cost of vegetable oil and operation.
- Over-production of wind- and solar-generated heat is stored in the 10.000 litres hot water storage tank to be used at a later time.

WIND ENERGY

DANmark windmills

Years of continuous innovation and development at the Folkecenter resulted 1983 to 1992 in a series of advanced and reliable wind turbines ranging from 13 kW to 525 kW - the DANmark series. With support of 6 experienced Folkecenter engineers, Preben Maegaard developed a contemporary concept based on design principles of the very durable F.L.S. Aeromotor wind turbine from the 1940s. The design package included technical desciptions, drawings for manufacturing, lists of component details, and load documentation for certification. DANmark windmill series are characterized by simplicity and innovative design. Main features are three-bladed rotors with tip brakes from major blades manufacturers, integrated gearbox with main shaft, main bearings, gear and flanges for the induction generator in one compact unit similar to the F.L.S. concept. The design had negative calipers to provide braking and a hydraulic or electrical yaw system.

Various types and sizes were manufactured several SMEs: Dencon, Vind-Syssel, Codan, Reymo, Møns Energi Service A/S, Hanstholm Møllen, Smedemester, Baltic Power, Tacke and others. Since 1992, the design experiences have been licensed to other countries. Since 2000, many types of small windmills for the single household have been tested and demonstrated at the Folkecenter's own test field prior to commercialisation.

The DANmark 75 kW wind turbine was installed on the Folkecenter Test Field in 1984; it has generated an average of 140 MWh/year since then with unusual regularity. No gears or other mechanical parts have been replaced after 150.000 hours of operation in a rough environment. Similar windmills have been installed on the South Atlantic island of Fernando de Noronha in Brazil, Swarzewo near Gdansk in Poland and in northern Russia.

DANmark 757 kW windmill in Hanstholm

DANmark 75 kW windmill

UNImill

UNImill

In 2003, based on its own know-how, Folkecenter developed a 7,5 kW windmill for educational purposes. UNImill is designed with scaled-down components like in bigger windmills. It is very suitable for education and testing.

Power generators

Folkecenter developed and tested a number of different permanent magnet generators for windmills of 2 kW up to 150 kW capacity.

Folkecenter's integrated gear

WIND ENERGY

TECHNOLOGY TRANSFER

St. Petersburg, Russia
A second-hand 75 kW WindMatic windmill was re-erected in 2002 in close cooperation with professor Victor Elistratov of the renewable energy faculty of the State Polytechnic University.

ST PETERSBURG

POLAND

A 100 kW “Smedemester” windmill was installed at Swarzewo, near Gdańsk, in 1991. Part of the windmill was locally manufactured under license.The project was carried out in cooperation with the local power utility, who owned and operated the windmill.

BRASIL

A 75 kW windmill was installed at Fernando de Noronha, Brazil, a small island in the South Atlantic. A cooperation was established in 1992 between Folkecenter, and the NGO Eolica, Recife, Brazil. The result was the first modern windmill in South America.

SAMARA

A WindWorld windmill, previously installed on the island of Lolland, Denmark was transferred to Samara as part of a repowering programme. The windmill is installed at the Volga River and belongs to a sanatorium for supply of its power needs.

KALININGRAD

A 600 kW WindWorld windmill was installed at the Russian enclave Kaliningrad in 1996. The windmill was installed in cooperation with the utility company “Yantarenergo”.

Small windmill technology. Folkecenter has since 1992 cooperated with CETER of the Technical University in Havana, Cuba. Small and micro wind system know-how has boosted the knowledge of windmill technology in Cuba.

CUBA

KOMANDORSKY

KOMANDORSKY ISLAND
Folkecenter in cooperation with ELSAM-Projekt installed two 250 kW NEG-Micon windmills near Beringa on the Komandorsky Island, 11 time zones away from Denmark. The project included training of technical personal. The windmills started production in 1996.

SOLAR ELECTRICITY

ARCHITECTURE – integration of photovoltaics into buildings
Folkecenter has conducted several projects within building-integrated photovoltaics, and has hands-on theoretical and practical know-how in the area. There have been developed five solar cell products for integration into buildings. Three of these plants can be seen at the Folkecenter. Two other sites are in Randers. Photovoltaics integrated into buildings have obvious architectural advantages. Almost all buildings have surfaces suitable for installation of photovoltaics.

SkibstedFjord
In 1995 Folkecenter received from the Danish Energy Agency grants to install the first integrated solar facade in Denmark. The prototype was installed in Skibsted-Fjord. The "electronic curtain" has polycrystalline and monocrystalline solar cells embedded between 2 layers of tempered glass. The plant covers 20m^2 and produces 2 000 kWh/year. In 1998 Folkecenter and companies involved received the European Solar Prize for this project. In 2010 new solar cells with 155 Wp standard modules were installed.

Folkecenter main building
Folkecenter installed solar power plant in the corridor, a demonstration of integration of semi-transparent thin-film solar modules into thermo panels. Solar modules produce annually 1000 kWh of electricity that is fed through an inverter directly into the standard in-house installation. The solar modules provide shading and prevent overheating in the corridor. The thin-film modules allow 30% of the light to pass through.

Sunblind with integrated thin-film solar modules
The sunblind at the Folkecenter main building was installed in 2002. The sunblind filters the sunlight in the summertime, when the sun is high on the sky, but allows more of the sunlight into the building in the wintertime, and in the evening, when the sun is low. Sunblind filters the sunlight, but allows 30 % of the light to pass by. The 27m^2 thin-film solar modules have a nominal effect of 750 Watts.

Polycrystalline arrays
On the south side of the main building there are 41 Solarex polycrystalline sillicon modules installed. Each of them has approximately 57 W output. This array will be connected to the grid. The total power output is 2.3 kW approximately.
(Architect: Kenneth Olsen, Vestervig, Thy).

SOLAR ELECTRICITY

APPLICATIONS

PV-windmill hybrid system
The PV-windmill hybrid system was developed for supply of electricity in unserved areas. It contains 25 monocrystalline modules, a small windmill and 27 lead-acid batteries. The installation of the system is relatively easy - the equipment and other electronics (AC/DC inverter) are packed in a container, which can be installed in rural areas in Africa to cover energy demands. This system can supply electricity into a local grid or it can function as a battery charger station. The hybrid solar-wind system can produce 10 kWh per day on average or 3600 kWh annually.

Grid-connected PV at Folkecenter
There are different types of grid-connected PV to see at the Folkecenter. Two installations on the roof of the workshop were set up in June 2010 as part of a PSO-supported demonstration project. An array of PV panels can directly charge an electric car.

Water pumping system
At the Folkecenter solar-water pumping system demonstrates that solar electricity can be used by small electric motors to provide people with drinking water in rural areas.
This installation contains an array with 7 monocrystalline modules which produce DC electricity. After inverting this DC electricity to AC, the electric pump can utilize this energy to lift 30m3 of water a day from 5 meter deep. It was installed in 1988 and demonstrates the durability of solar cells.

TRANSPORT

Folkecenter conducts research & development projects based on experience and innovative approach in areas of sustainable transportation including plant oil, hydrogen and electric vehicles. There are various two- and three-wheel vehicles at Folkecenter, which operate on renewable energy.

Charging Station for Electric Car
At the Folkecenter visitors can get their electric vehicle (electric scooter, car or tractor) charged with 230 volts wind energy.

Electric cars at the Folkecenter
Electric cars running on traditonl coal generated power do not represent an ecological sustainable transition for the future.

Hydrogen cars
As the only place in Denmark Folkecenter developed the whole wind-hydrogen car chain with electrolysis plant at 20 kW, storage of hydrogen and filling station for tanking of cars with hydrogen.
Folkecenter converted a standard Ford Focus 2-litre petrol engine to run on hydrogen. A prototype car was converted, tested and first presented to the public in July 2003.

Plant oil cars
Folkecenter has done research and has developed solutions for production of plant oil since 1994. The focus is on decentralised production of PPO, pure plant oil, for transportation purposes. Folkecenter has a Plant Oil Laboratory for testing of equipment, demonstration of systems, education and quality control of the PPO. Services and measurements has been offered to the industry, farmers and authorities.

Electric motorbikes and bikes
Electric motorbikes and bikes allow clean transportation using renewable energy sources and can simultaneously combine healthy exercise with the necessary transportation.

TECHNOLOGY TRANSFER

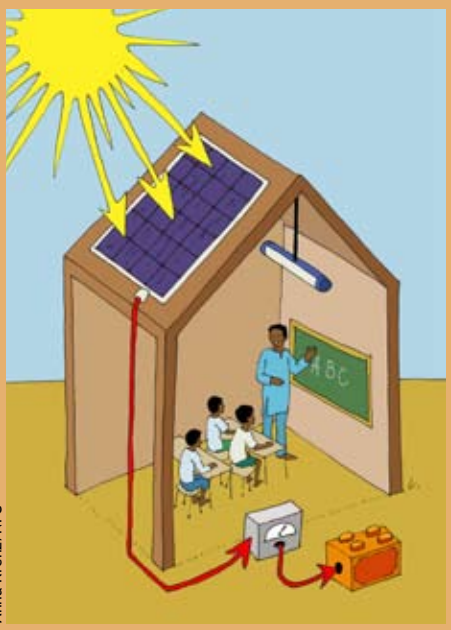
Over the years Folkecenter has exported know-how around the globe. Farm biogas digesters, windmills and solar systems as well as integrated systems have been installed. Projects in Europe, Asia, Africa, North- and South America are realised with design know-how from Folkecenter. The projects are completed in cooperation with local industries, NGO's or governmental authorities. This way renewable energy know-how has been spread to several corners of the globe, to the benefits of the world society, and future generations.

FOLKECENTER in MALI

Mali Folkecenter, Bamako, Mali, West Africa | www.malifolkecenter.org

Mali Folkecenter (MFC) is a Malian NGO that was established by the Danish Folkecenter for Renewable Energy. MFC was initiated in 1999 by Preben Maegaard, Director of the Nordic Folkecenter for Renewable Energy in Denmark, as a follow-up of his consultancy to the president of Mali, Dr. Alpha Konaré. Several projects, including biogas digesters and photovoltaics were established, to help develop the country.Dr. Ibrahim Togola has been director of the MFC since it was opened. MFC in 2009 had a staff of 45 people.

One of Folkecenter's projects in Mali is **"Light over Mali: Solar Cells for Malian Schools"**. Almost 90% of women in the villages have never attended school. The sun shines 330 days a year in Mali, so there is plenty of energy for solar cells. With lamps in schools women can attend evening classes. Education and awareness is the beginning of a good development for the benefit of all. In Mai 1000 schools wereidentified to install solar panels. Electrical supply for a single school consists of a 100 Watt photovoltaic module (approx. 70x100cm) installed on the roof, a charge controller, two truck batteries, wires and two lamps in two classrooms. It takes about one day to install the whole system. Mali Folkecenter is responsible for setting the PV systems in cooperation with local authorities and rural women's associations of cities, which are owners of the plants. They are thus a part of the infrastructure in the community to benefit all regardless of income. Already Mali Folkecenter has installed over 150 solar systems and hybrid (solar/wind) for electrification of schools and health centres, as well as water pumping systems, solar battery charging systems in rural settlements. MFC provides comprehensive practical training and education at its own technical school to people who are trained to be solar electricians, and be able to install, operate, maintain and repair the solar systems. This system has worked well for many years; facilities are properly maintained and no thefts occured.



Anna Krenz/NFC

FOLKECENTER in UGANDA

JEEP Uganda
Jeep was founded in 1983 in Uganda and has among others co-operated with MS-Uganda. At the Jeep head office are offices as well as several agriculture and forestry demonstration sites including the following: vegetable garden with compost, agroforestry (live fencing), tree nurseries, energy technologies (stoves and solar), fruit orchards, and livestock (pigs and poultry).

The Folkecenter in Uganda opened in 2005. In the period from October 2007 to September 2009 Folkecenter in cooperation with JEEP Uganda has conducted a project about knowledge and technology transfer within solar cells. The project has been possible due to cooperation between the Folkecenter and Ms Lene Hoegh, a voluteer expert with many years of field work in the developing world and especially Uganda. The Jeep Folkecenter has conducted training programmes in capacity building and practised installation of several types of solar energy at JEEP head office and in remote, unserved villages as well for solar mobile phone charging, lighting, small crafts etc.

www.jeepfolkecenter.org

BIOMASS / BIOGAS

In the integrated food-energy-water system was developed in 1992-96 to deliver heat and power (biogas), cultivates fish of various kinds, vegetables, water plants and clean water as the final product. Higher up the chain rapeseed oil and cake are also produced. The oil is used for cars, tractors and cogeneration. Rapeseed cake (2/3 parts of rapeseed) is used to feed animals, which also includes bacon and meat in the process, providing manure for biogas. All in all a very complex and high performance cycle system, which is a research contribution from the Folkecenter's side on how the future can make an autonomous, integrated energy, water and food cycle in an intelligent, coherent system. The plant was the only of its kind in Northern Europe.

BIOGAS TECHNOLOGY TRANSFER

Technology transfer:
3 x 300 m3 farm biogas digestors
Kaunas, Lithuania.
The project in Kaunas was initiated and designed by Folkecenter and commissioned in 1998. Was financially supported with 88% from the Danish Environmental Protection Agency. The remaining 12% has been financed by the AB VYCIA Farming Company, where the biogas plant was installed and operated. The project was a pilot demonstration and education plant for Lithuania and the surrounding Baltic countries.

Technology transfer:
biogas digester
Yubetsu, Japan.
In 2001 a biogas digester was installed in Yubetsu, Hokkaido, Japan, as part of a bigger biowaste-processing unit. Folkecenter delivered the know-how and the technical documentation through a license to Kawasaki Engineering that undertook the installation of the digester. The Japanese state, as well as the local municipality supported the project.

ART at FOLKECENTER

In August and September 1998, three artists from St. Petersburg: Nikolai Semenov, Alexandre Souchnikov and Nikolai Alekhine, were staying at the Folkecenter as trainees. They have made three iron sculptures and each expresses the relation between energy, nature and art in its own way. For the shaping of the artworks they used open coal-fired forge and the old blacksmith tools supplied by local blacksmiths.

There are several artworks – paintings and sculptures – exhibited at the Folkecenter. Many artists have stayed at the Folkecenter through the years to learn about renewable energy and to get inspiration for their art.

IMPORTANT VISITORS

Jane Kruse, Tage Leegaard (local conservative candidate for the parliament), Per Oerum Joergensen (member of parliament for the Conservatives)

Connie Hedegaard, Danish climate and energy minister

Energy Minister George Smitherman from Ontario, Canada

David Suzuki (TV-host and environmentalist) and his daughter Sarika.

Ole Vagn Christensen, Jim Stjerne Hansen (President of DS Crafts and Industry) and Preben Maegaard

Preben Maegaard and Torsten Schack Pedersen, member of the Danish Parliament

Jens Chr. Lund MP for the Social Democrats and Henning Holm member of Sydthy municipality council

Jane Kruse, Britta Thomsen (MEP, member of the European Parliament for the Social democrats) and Ole Vagn Christensen (MP)

IMPORTANT VISITORS

SF's new environment spokesman in parliament Lisbeth Bech Poulsen and MP Steen Gade and councilor for SF Mogens Kruse

Ib Poulsen MP for the Danish People's Party and chairman of the Association for Household Wind Turbines Morten V. Petersen

Simon Kollerup, parliamentary candidate for the Labour Party in Thisted and Jane Kruse

Prof. Nasir El Bassam (director of IFEED) and Preben Maeggard, authors of "Integrated Renewable Energy for Rural Communities"

Martin Lidegaard, Danish Minister for Climate, Energy and Building and Preben Maegaard

Francisco Villegas Porcel (Secretary Council), Preben Maegaard, Eugenio P. Anaguaya (Bolivian Ambassador in Denmark), Hane Leni Andersen and Jane Kruse

Minister of Rural development and Planning, Carsten Hansen (middle), Preben Maegaard and Ole Vagn Christensen (right)

TRAINEES

The Training Programme at Folkecenter has since 1986 attracted hundreds of trainees and students from all over the world, highly educated and motivated to supplement their theoretical skills with invaluable out-of-classroom practical experience within renewable energy. The duration of a traineeship is normally three to ten months.

The general aim of the trainee programme is to provide scientific and technical knowledge about a variety of aspects of renewable energy including hands-on experiences that often are not available in the academic institutions. The trainees work on basis of teamwork under the leadership of a professional advisor, including practical as well as theoretical activities, study excursions and field studies.

VISITORS

We raise awareness of thousands of visitors, both individuals and groups, who visit Folkecenter every year. Visitors are given an explanatory talk and they can see full-scale functioning renewable energy solutions: solar, wind power, transportation with plant oil and hydrogen.
Integration of energy systems and self-supply of food demonstrate a future sustainable community.

VISITORS