"Production of Electricity with RES & CHP for Homeowners"

"PERCH"

INTERCONNECTION GUIDE

Production of

Electricity with

RES&

CHP for

Homeowners

www.home-electricity.org

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Overview

European Members States must provide guaranteed access for green electricity producers to the grid including the home and small business installations -Renewable Electricity directive (2001/77/EC)

Moreover as far as concerning the connection of electricity generation units using RES & CHP it is critical that the future owners of these systems (owners of individual dwellings, farms or even of small business) have the appropriate information and supporting framework to help them implement their potential installations
The project deals with interconnection issues (technical, contractual, tariff rates and metering issues) for electricity generation using small RES and micro CHP applications for home and small business power solutions in EU and candidate countries.

In the framework of the **PERCH projec**t the following have been developed for the Home and Small Business owners:

- **Web site with database**
  A comprehensive web site with interactive features and mapped information for the EU-25 and candidate countries
- **Technology guides**
  Technology descriptions for PV, micro - CHP and small wind applications
- **Best practices**
  The most successful home grid connected applications in Europe, with technical information and photos
- **Interconnection guidelines and procedures**
  These will include the normal procedures for inspection and approval along with the safety and power quality requirements
- **Supporting schemes and incentives**
  Overview of the local options for financial support
- **Local contact lists and references**
  Further resources for thorough research

Professionals and Experts benefit with:

- **Comparable National reports**
  Detailed reports that include interactive maps and tables in the web site
- **Technical information for installers and suppliers**
  Technical information is available with links for more thorough examination
- **Mapping the local market conditions through National events**
  Recording of the local market interactions concerning interconnection issues and supporting schemes.
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  Recording of the local market interactions concerning interconnection issues and supporting schemes
- **Exchange the experiences through a final European event**
  This will provide a platform for a debate for the policy makers

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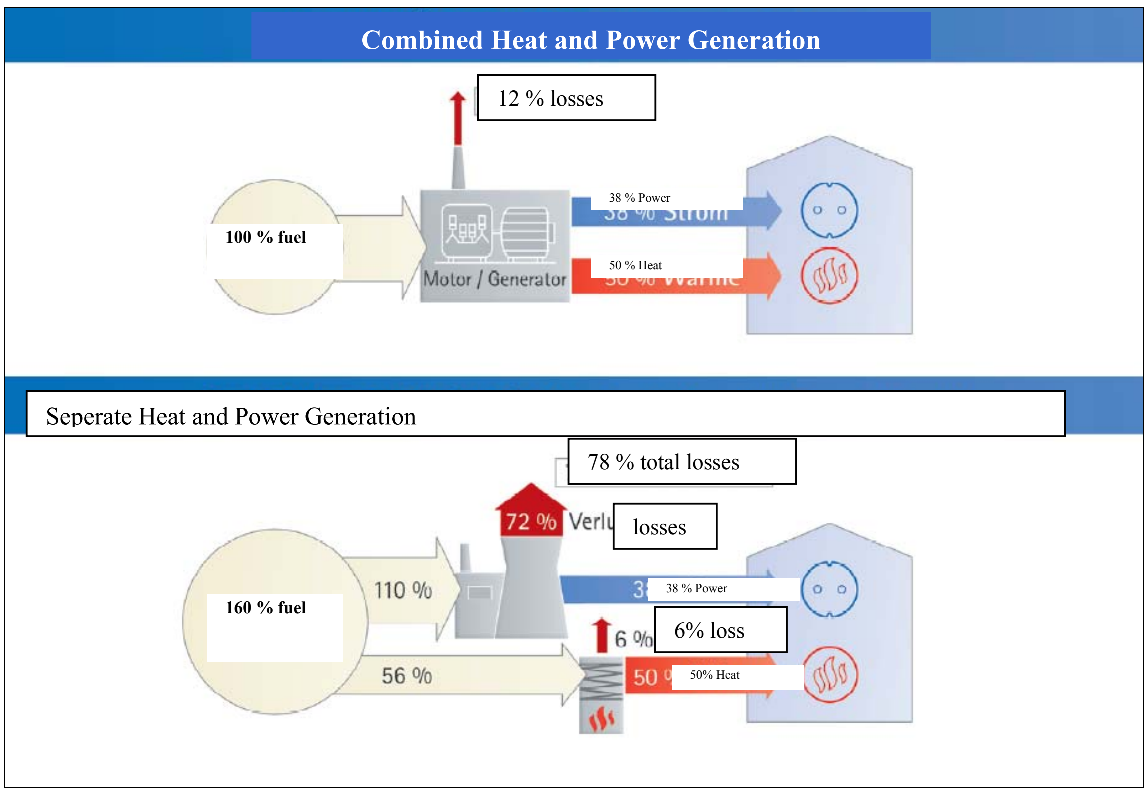
1. THE TECHNOLOGIES

1.1. MICRO-CHP

The principle of the combined heat and power generation (CHP) or cogeneration is improved fuel efficiency by producing heat and electricity simultaneously. The same amount of fuel generates more energy, and less energy is lost in comparison to conventional power plants, since the heat generated when fuel is burnt to produce electricity is captured and utilised for some useful purpose such as space heating, water heating or refrigeration.

Due to the improved energy efficiency, CHP helps to avoid CO_2 emissions, because the excess heat of electricity generation is directly used. In conventional power plants about 35% of the energy potential contained in the fuel is converted into electricity, whilst the rest is lost as waste heat. Even the most advanced technologies do not convert more than 55 % of fuel into useful energy. In comparison, cogeneration is able to achieve energy efficiency from about 90 % meaning that only circa 10 % of the used fuel is transformed into heat loss.



Source: BKWK

Less use of primary energy implies also less emission of CO_2. By using CHP, CO_2 emissions are reduced about 34% compared to the conventional generation of heat and power.

The advantages of CHP are obvious. That is why the European Union and its member states are willing to rise the percentage of CHP in electricity and heat production by a notable amount in the next years.

Cogeneration units have different sizes, ranging from an electrical capacity of less than 5 kWe (e.g. for a single-family house) up to 500 MWe (e.g. district heating or industrial cogeneration). Small scale units are most qualified sited close to the heat and power demand and, ideally, are built to meet this demand as efficiently as possible. In this decentralised generation, often more electricity is generated than is needed by the owner himself. The surplus electricity can be sold to the local grid operator or supplied to another customer via the net distribution system.

Small or Micro CHP are units which reach an electric power output up to 50 kWe (according to European Directive 2004/8/EG). The generation units are sited in close vicinity to the user where the heat is needed, because this reduces line losses to a minimum and puts operators in a position to open up economic profits for themselves. A CHP station consists of a CHP unit and a heating boiler to compensate peaks in the energy consumption on very cold days or to compensate blackout or technical service.

CHP is deployable manifoldly. Hotels, restaurants, schools, hospitals, housing or public buildings are using CHP already today. It can be used, wherever there is need for both electricity and heat. Each owner has to assess his needs for heat and power consumption to implement the right size of CHP for his individual energy consumption to run the CHP economically. CHP systems can, with the addition of a chiller, supply cooling for air conditioning systems as well as heating - such an arrangement is often called a 'trigeneration' system.

Supply of…	Electrical power / wattage (kW)	Thermal power (kW)	Supply with…
Residence, Single-Family Home, Duplex	Ca. 1	4 – 10	Heat/Power
Multi-family house	5 – 30	Up to 100	Heat/Power
Several Townhouses	5 – 30	Up to 100	Local Heat/Power
Retirement Home	10 – 30	Up to 200	Heat/Power
Hotel	Ca. 30 – 50	Up to 300	Heat/Power/Cold
School	Up to 50	Up to 300	Heat/Power

Source: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU)

A range of technologies can be applied to cogenerate electricity and heat. All cogeneration schemes will always include an electricity generator and a system to recover the heat. The most known technologies are steam turbines, gas turbines, combined cycle (gas and steam turbines), Diesel and Otto Engines. These technologies are readily available and approved. Three other technologies have recently appeared on the market, or are likely to be commercialised within the next few years: Micro-turbines, fuel cells and Stirling engines, mostly used for micro CHP.

- Diesel or gas engines have a standard engine driving an alternator to convert mechanical work produced at the engine shaft into electricity. The heat of exhaust gases, i.e. heat resulting form combustion during power generation, is used for process heat supply.
- Micro-turbines have small capacity between 1 and 250 KWe. The gas is burned in an external combustion chamber fed in pressurised air from a compressor. The flue gas produced is led into a turbine, where the chemical energy is partly converted into mechanical energy, which drives the alternator. The thermal energy remaining in the flue

gas at turbine outlet can be used in a heat exchanger to obtain process heat, i.e. steam or hot water.

- An alternative for small-scale electricity production is the Stirling engine. It is based on a closed cycle, where a working gas is alternately compressed in a cold cylinder volume and expanded in a hot cylinder volume. The heat is transferred form the outside through a heat exchanger in the same way as in a steam boiler. Therefore, the engine is comparable to the biomass combustion technology.
- In a steam turbine, where a gasifier or direct combustion is combined with a steam engine, mechanical energy is produced by the expansion of high-pressure steam. The heat is recovered at the exit of the engine. Flue gas, gas resulting form combustion passes through a boiler in which steam is generated. The steam flows into the steam engine where by expansion it is performing mechanical work that is later converted into electrical energy in the generator. After this, steam passes into the condenser where incidental condensation heat can be used as district or process heat. The water is brought to operation pressure by a feed water pump and then is fed to a boiler, thus closing the cycle.

CHP systems can be used with nearly every fuel: Either with fossil fuels such as coal, lignite, natural gas as well as oil or with renewable energies such as biogas, vegetable oil, pellets, wood or hydrogen. When using the same fuel, CHP is always superior to conventional power and heat generation in terms of energy savings and reduction of CO_2 emissions.

1.2. PHOTOVOLTAIC

The energy of the sun can be used to produce electrical energy. Photovoltaic is the technical term for the conversion of sunlight into electrical energy by the use of so-called PV or solar cells. They have been in use in everyday live in small calculators, wristwatches and parking payment machines and in larger systems on the roofs of buildings for a long time. By connecting single PV cells to modules, PV units are created that can be used to generate electricity from a few up to 100 Watts of direct current (DC). Apart from using this electricity to power electrical equipment, an inverter can transform the direct current into alternating current (AC) which can be fed into the electricity grid.

PV systems can be operated as stand-alone solutions. The generated electricity is directly used or temporarily stored in batteries – e.g. at night, when sunlight is not available and the electricity which was generated during the day can be used for electricity consumption. However, grid-integrated systems are experiencing global growth at the current state.

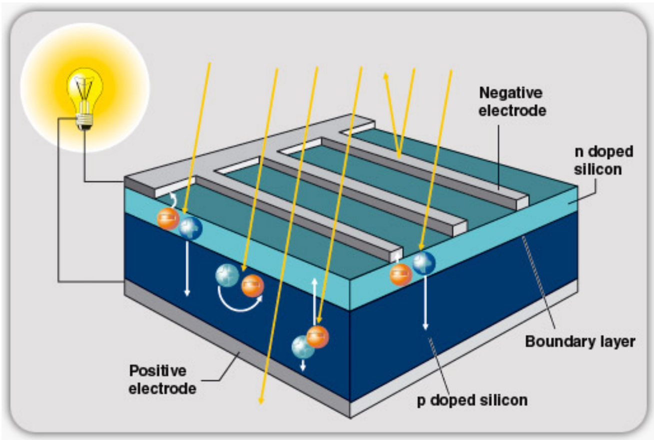
Until now, nearly 90% of all PV cells have been made of crystalline silicon, which was field tested over several decades. But there has been technical development lately and so-called thin-film cells are seen as a future option as well. These thin-film cells can be produced at lower cost since they are much thinner than the cells made from crystalline silicon.

- Crystalline silicon

Crystalline silicon is still the most important component of PV cells. Although it is actually not the ideal material for these cells, it is the second most abundant element in earth's crust and widely available, long tested and uses the same technology which was developed for other purposes. More than 20 % of energy efficiency has been reached with silicon cells in tests, but in serial generation cells are currently averaging efficiency between 13 to 17 %. The theoretical limit for crystalline modules approaches 30 %.

- Thin film

Thin film modules are constructed by depositing extremely thin layers of photosensitive materials on a low cost backing such as glass, stainless steel or plastic, which guarantee low production costs. Although the thin film cells have a price advantage, they are working with lower efficiency rates and they are not as well tested as the cells made of crystalline silicon. All of the currently available thin film cells have active layers that are only a few microns thick. The market share of thin film technology is still low, but is expected to increase in the future.



(Source: Solarpraxis AG)

The technological principle of the silicon PV cells is based on semiconductor silicon that is connected in various layers which produce an electric field. Semiconductors are materials, which become electrically conductive when supplied with light or heat, but which operate as insulators at low temperatures. When hit by sunlight, the electric field separates negative and positive charges which are available at the poles of the cell – comparable to a normal battery. PV cells function also without direct sunlight but the energy production is significantly smaller when it is cloudy.

Cost reductions from both increased manufacturing volume and such improved technology are expected to continue to drive down cell prices in the coming years to a level where the cells can provide competitively priced electricity on a large scale.

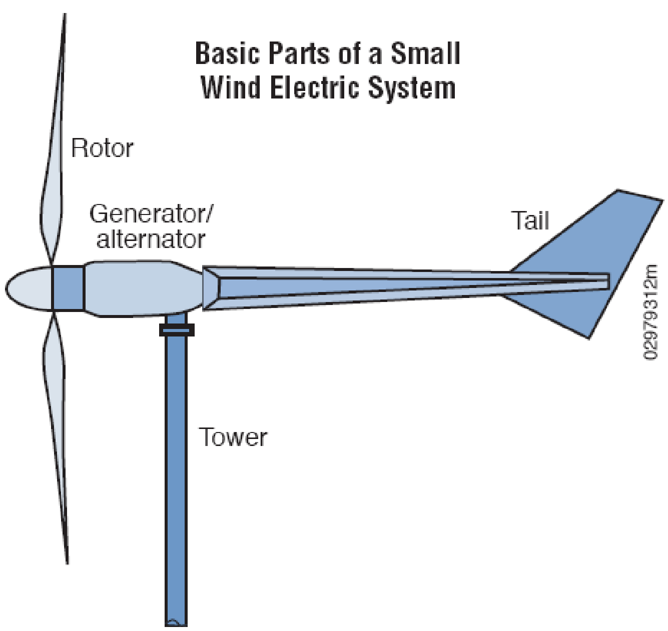
Solar PV roof in residential building

The most obvious advantage of PV cells is emission-free electricity generation. Furthermore, the needed fuel – sunlight – is delivered free of cost by nature. Technically, the modules are easy to install and flexible in use: more modules can be added at any time if needed. Low maintenance is needed to keep the system running and a long life span adds up to the easy implementation of a small PV unit. However, the owner has to deal also with rather high investment costs and has to install a backup system to guarantee security of supply at all times. PV cells cannot be installed everywhere, since a substantial surface is required.

Costs for PV systems depend on different criteria like size, type of PV cell and state of the building in question. The size of the system complies with the amount of electricity required, but the majority of domestic systems are installed with a capacity between 1.5 and 3 kW. Solar tiles are more expensive than conventional panels and panels that are integrated into the roof cost more than those that are mounted on top. PV systems are ideally used for a building with a roof or wall that faces within 90 degrees of south, as long as no other buildings or large trees are taking away the sunlight. If the roof is in shadow, the output of the system diminishes.

1.3. SMALL WIND

Wind is created by the unequal heating of the Earth's surface by the sun. Wind turbines convert the wind energy into mechanical power that runs a generator to produce clean electricity. Today's turbines are versatile modular sources of electricity. Their blades are aerodynamically designed to capture the maximum energy from the wind. The wind turns the blades, which spin a shaft connected to a generator that makes electricity.



Source: U.S. Department of Energy

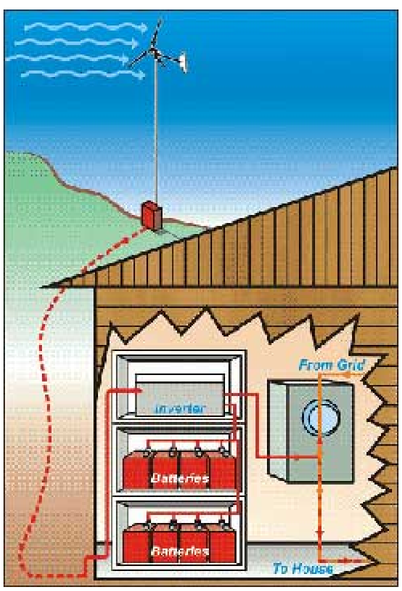
Wind turbines for a residential application typically range in electrical output capacity from 500 watts up to 10 kilowatts. In general there are two types of small wind systems: stand-alone units and grid-connected.

- Stand-alone systems

Small wind turbines are in use to generate electricity for charging batteries to run small electrical applications. There is need for this way of power generation for example in outlying locations where it is not economically sensible or physically possible to connect to the distribution grid, such as rural farms. Typical applications are electric fencing, small electric pumps, lighting or other small electronic systems needed, including security systems.

- Grid-connected systems

The output of a small wind turbine can be directly connected to the existing grid. This type of system can be used both for individual wind turbines and for wind farms exporting electricity to the electricity network. The energy generated by the homeowner's turbine can be used to reduce the need to buy energy from the local utility. The value of avoided electricity purchases is generally significantly higher than the value that can be obtained from exporting power to the grid. The interconnection with the distribution grid has to meet a high technical standard and therefore the cost of incorporating power import and export metering and approved electrical protection equipment can be high. For small wind turbines, the cost of grid connection can be a substantial part of the total project cost.



Grid connected small wind system

Small wind systems contain the following parts:

- Wind turbines

The rotors consist of two or three blades that are designed to capture the maximum energy from the wind. When the blades are turned by the wind, they spin a shaft connected to a generator that produces electrical energy. Small turbines are usually made with few moving parts and are designed robustly for deployment in areas where consistent maintenance is difficult and expensive.

- Tower

Turbines are mounted on towers, a mainframe that supports the rotor, a generator, and a tail which keeps the blades facing the wind. For small home systems, small towers around 4 to 6 meters can be used to assist in maintenance and transportability. For larger power systems, such as for schools on rural communities, the minimum tower height should be around 18m.

- Charge controller

The charge controller controls the charging of the battery by the wind turbine.

Additionally to the tower and turbine, a foundation usually made of reinforced concrete is needed. Furthermore, a wire run has to be installed, to conduct electricity from the generator to the electronics as well as a safety switch, which allows the electrical output to be isolated from the electronics.

Since the system does not provide constantly generated power, a battery can store the extra power which is generated at peak times. That power can be used in times of calm or low wind. Most household appliances use AC. Therefore, inverters are usually added to the system to convert DC into AC.

Glossary

DER	Distributed Energy Resources
PERCH	Production of Electricity with RES & CHP for Homeowners
RES	Renewable Energy Sources
RES-E	Renewable Energy Sources – Electricity
PV	Photovoltaic
EU	European Union
CHP	Combined Heat and Power Generation
DC	Direct Current
AC	Alternating Current

2. GUIDELINES FOR SYSTEM SELECTION AND DIMENSIONING

For realization of an idea or intention of a homeowner or potential user to use small RES-e or micro-CHP for production of electricity, he must study and make a decision on the following main propositions:

1. To define the characteristics of the electrical load (kWh/day; kWh/week; kWh/year and the load schedule for winter, spring, summer and autumn day).
2. The site is stand-alone and isolated from the electricity network and accumulator batteries should be envisaged or the RES-central can be connected to the network.
3. To define to possible situation (m2 and orientation) for construction of PV or putting a small wind generator.
4. To define the economic heat load and the respective power of the micro-CHP.

On the basis of the above overall data comparison should be made between a PV system, small wind or micro –CHP and to choose the most appropriate system or several systems in relation to the concrete local conditions.

Photovoltaic systems use cells to convert sunlight into electricity. The PV cell consists of one or two layers of a semi conducting material, usually silicon. PV cells are referred to in terms of the amount of energy they generate in full sunlight, know as kilowatt peak or kWp.

You can use PV systems for a building with a roof or wall that faces within 90 degrees of south, as long as no other buildings or large trees overshadow it. If the roof surface is in shadow for parts of the day, the output of the system decreases.

Solar panels are not light and the roof must be strong enough to take their weight, especially if the panel is placed on top of existing tiles.

The householders must consult with their local authority regarding planning permission.

Market status and government policy

Prices for PV systems vary depending on the size of the system to be installed, type of PV cell used and the nature of the actual building on which the PV is mounted. The size of the system is dictated by the amount of electricity required. The average domestic systems are usually between 1.5 and 3 kWp. The cost is different in different countries.

Solar tiles cost more than conventional panels and panels that are integrated into a roof are more expensive than those that sit on top.

If you intend to have major roof repairs carried out it may be worth exploring PV tiles as they can offset the cost of roof tiles.

Grid connected systems require very little maintenance, generally limited to ensuring that the panels are kept relatively clean and that shade from trees has not become a problem. The wiring and components of the system should however be checked regularly by a qualified technician.

Stand-alone systems, i.e. those not connected to the grid, need maintenance on other system components, such as batteries.

Savings are dependent on the level of on-site consumption and/or value of export tariff. Assume a 2.5kWp system with 50% - 100% on-site consumption with excess exported to grid on a typical export tariff.

The state subsidizing of the PV-systems in different countries is different. In Bulgaria, for example the produced electricity from PV is bought compulsory at a price of 0.40 Euro, whereas the average price of electricity is 0.07 Euro, i.e. at a price about 6 times higher than the average.

In most of the countries the construction of the PV installation itself is subsidized.

Micro wind

Micro wind turbine system

Most small wind turbines generate direct current (DC) electricity. Systems that are not connected to the national grid require battery storage and an inverter to convert DC electricity to AC (alternating current - mains electricity).

Wind systems can also be connected to the national electricity grid. A special inverter and controller converts DC electricity to AC at a quality and standard acceptable to the grid. No battery storage is required. Any unused or excess electricity may be able to be exported to the grid and sold to the local electricity supply company.

There are two types of wind turbines:

- Mast mounted - which are free standing and located near the building(s) that will be using the electricity.
- Roof mounted - which can be installed on house roofs and other buildings.

Individual turbines vary in size and power output from a few hundred watts to two or three megawatts (as a guide, a typical domestic system would be 1 - 6 kilowatts).

The following issues should be considered about small-scale wind.

- Wind speed increases with height so it's best to have the turbine high on a mast or tower.
- Generally speaking the ideal site is a smooth top hill with a flat, clear exposure, free from excessive turbulence and obstructions such as large trees, houses or other buildings.
- Small scale wind power is particularly suitable for remote off grid locations where conventional methods of supply are expensive or impractical.

It should be noted that the electricity generated at any one time by a wind turbine is highly dependent on the speed and direction of the wind. The windspeed itself is dependent on a number of factors, such as location, height of the turbine above ground level and nearby obstructions. Ideally, you should undertake a professional assessment of the local windspeed for a full year at the exact location where you plan to install a turbine before proceeding. In practice, this may be difficult, expensive and time consuming to undertake. Therefore we recommend that, if you are considering a domestic building mounted installation and electricity generation is your main motivation, then you only consider a wind turbine under the following circumstances:

- The local annual average windspeed is 6 m/s or more.
- There are no significant nearby obstacles such as buildings, trees or hills that are likely to reduce the windspeed or increase turbulence.

Planning issues such as visual impact, noise and conservation issues also have to be considered. System installation normally requires permission from the local authority, so it's important to always check with your local authority about planning issues before you have a system installed.

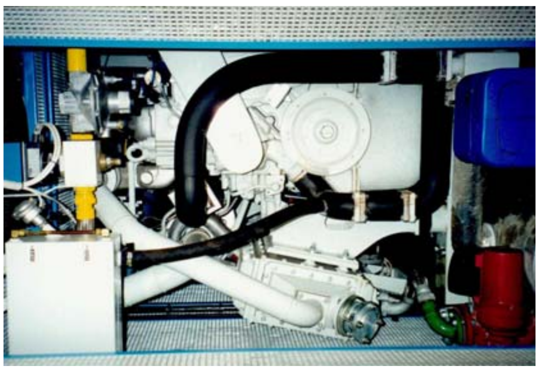
Market status and government policy

The price of the micro wind turbines vary significantly in the different countries. The amount of energy and carbon that roof top micro wind turbines save depends on several things including size, location, wind speed, nearby buildings and the local landscape. At the moment there is not enough data from existing wind turbine installations to provide a figure of how much energy and carbon could typically be saved. Larger systems of 2.5 kW to 6 kW are normally mast mounted.

Turbines can have a life of up to 22.5 years but require service checks every few years to ensure they work efficiently. For battery storage systems, typical battery life is around 6-10 years, depending on the type, so batteries may have to be replaced at some point in the system's life.

The state financial support for the different countries is in different forms. In Bulgaria for example the subsidizing is in the form of obligatory purchase of the electricity produced from wind turbines at preferential prices. In most countries, however, the construction of the installation is subsidized.

Micro-CHP systems



Cento 140 inside look – gas fired CHP

Micro-CHP systems, which operate in homes or small commercial buildings, are driven by heat-demand, delivering electricity as the byproduct. Because of this operating model micro-CHP systems will often generate more electricity than is instantly being demanded.

To date, micro-CHP systems achieve much of their savings, and thus attractiveness to consumers, through a net metering model wherein home-generated power exceeding the instantaneous in-home needs is sold back to the electrical utility. From a purely technical standpoint net-metering is very efficient.

Another positive to net-metering is the fact that it is fairly easy to configure. The user's electrical meter is simply able to record electrical power exiting as well as entering the home or business. As such, it records the net amount of power entering the home. For a grid with relatively few micro-CHP users, no design changes to the electrical grid need be made.

Micro-CHP systems are currently based on several different technologies:

- Internal combustion engines
- Stirling engines
- Steam engines
- Microturbines
- Fuel cells

The majority of cogeneration systems use natural gas for fuel, because natural gas burns easily and cleanly, it is available in most areas and is easily transported through pipelines. Natural gas is suitable for internal combustion engines, such as Otto engine and gas turbine systems, because it burns without producing ash, soot or tar. Gas turbines are used in many small systems due to their high efficiency, small size, clean combustion, durability and low maintenance requirements. Gas turbines designed with foil bearings and air-cooling; operate without lubricating oil or coolants.

The future of combined heat and power, particularly for homes and small businesses, will continue to be affected by the price of fuel, including natural gas. As fuel prices continue to climb, this will make the economics more favourable for energy conservation measures and more efficient energy use, including micro-CHP.

There are many types of fuels and sources of heat that may be considered for micro-CHP. The properties of these sources vary in terms of system cost, heat cost, environmental effects, convenience, ease of transportation and storage, system maintenance, and system life.

Some of the heat sources and fuels that are being considered for use with micro-CHP include: biomass, woodgas, and natural gas, as well as multi-fuel systems.

Integration with home energy systems

In order to be viable in domestic installations it is essential that micro CHP is compatible with the operational parameters of central heating, such as water flow rates and temperatures and that it does not require the addition of, for example, large storage tanks to provide thermal buffering. It is also important to bear in mind that micro CHP does not respond well to rapid on-off cycling and that engines are normally designed to meet about 60% of the peak design load. This maximizes useful run hours under average winter conditions, and normally leads to the bulk of annual demands being met by the primary system.

However, some form of supplementary heating may be required in sever weather conditions and to achieve rapid heat up, for example, after the home has been unoccupied for some time.

Economic benefits and barriers

The economic viability of micro CHP depends on both the marginal capital investment (compared with a gas boiler) and the value of electricity produced by the unit. For any given system, therefore, the payback relies on the unit's operating hours and consequently the total kWh produced annually.

The table below illustrates the economics for a typical home with 18,000 kWh annual thermal demand. It can be seen that the value of the electricity is also dependent on whether it is consumed within the home or exported and sold to the energy supplier.

Annual heat demand	18000	KWh
Running hours	3000	Hours
Electricity generated	2400	KWh
Own use of generation	85	%
Unit cost of avoided import	7.5*	Cent Euro/kWh
Value of avoided import	153	Euro
Unit value of export	8.0	Cent Euro/kWh
Value of export	29	Euro
Total value of generation	182	Euro
Additional gas cost	0	Euro
Marginal cost of unit	630	Euro

Simple payback	3~4	Years

*The average electricity price in Bulgaria

Micro CHP fulfils the four key goals of the EU: security of supply, economic competitiveness and alleviation of fuel poverty and mitigation of climate change.

One of the most significant potential barriers to the micro CHP is the ability or otherwise to connect the system to the electricity supply network. Although it is possible to run the units in isolation (given appropriate energy storage and control systems) this would negate the economic benefits. Domestic electrical loads are extremely volatile with baseloads of around 100 W, average 400-600W and peak loads upwards of 15-20kW. The simplest solution is therefore to use the network as the balancing system with surplus generation exported and any shortfall imported as is normal practice.

Market status, Government Policy and Financial Supporting Scheme

After studying both the energy needs (electricity and heat energy) of a given family or a small enterprise, as well as the possibilities of constructing a small RES-e or/and micro-CHP, the market opportunities in the respective country are studied.

The EU Energy Policy, as well as the policies of the different member states supports the maximal use of RES in the countries. In compliance with this support the Governments adopted different financial supporting schemes. In several countries the construction of small RES-e and micro-CHP installations is subsidized, and in others the produced electricity from RES and CHP is purchased from the producers obligatory at preferential prices.

The investor of a given small RES system of micro CHP has to get familiar with the existing financial supporting schemes in his/her country and to take advantage of them.

3. NET METERING

The Net Metering system for connection to the grid allows to utilities customers to have their own electricity generation units (wind, PV or micro-CHP) and still be connected to the utility grid through a bi-directional meter. When their generated energy surpass their own electricity consumption, the excess electricity feeds the utility grid to other consumers. Net metering is the simplest way of connecting to the grid for a residential electricity generation system. In most cases net metering is ideal for installations that the electricity production is equal or less than the individual consumption. This is evident by the fact that in most home or commercial buildings the available roof surface (for the case of PVs) is not enough to offset the electricity demand of the same building on an annual basis. Additionally the ***feed in tariff system*** uses a two-meter arrangement, which allows different prices to be set for purchasing and selling electricity from or to the grid. Usually the selling price is much higher than the retail price giving the incentive for the producer to oversize the system for maximizing the potential profit. This is particularly true for larger buildings with extended surfaces for installation of PVs or more room for micro-CHP.

PV village in Germany

Net Metering Rules in European Countries

In the countries where there are no “Simplified Rules” accepted, the metering is done in accordance with the respective rules for the different voltage and power.

Generally the metering point for small RES & CHP is installed at the connection point. The metering system has to meet the technical and organizational rules (TOR) for grid operators and users.

Elements of the metering rules for some countries are given as examples.

In Bulgaria the generated and consumed energy is metered by means of commercial metering – owned by the respective distribution company.

In Austria the location of the metering point is not determined. Generally it is installed at the connection point from the plant to the distribution grid.

In Cyprus the metering unit for the PV system must be separate from the traditional metering.

Net metering is not used as policy measure in **Finland**. Instead, policy types like obligations, third party financing, fossil fuel taxes, promotion tax credits, etc. are widely used for the further deployment of DG and RES.

Additional examples for Net Metering Rules can be found in the National reports in the PERCH Website http://www.home-electricity.org

4. SAFETY AND POWER QUALITY

Home electricity generators like PV, small wind and micro-CHP are potentially dangerous, if they are not installed properly accordingly to the valid National and European rules and standards. One major issue is the possibility for these small generators to provide electricity to the grid line while it supposed to be off-electricity in this ***islanding*** condition, possibly harming people and properties**.** Fortunately modern inverters incorporate built in safety features for cutting the operation as quickly as possible if such an event occurs. In the case of rotating generators like small wind turbines or micro-CHP turbines, where the inertia of the rotating parts continue to generate electricity, other systems like grade relays ensure shutting off the electricity generation safely. An external ***manual disconnect switch*** is often mandatory, offering an extra safety feature although the modern inverters do not require such systems.

Power quality is another issue that must be confronted both from utilities and the independent generators. In Europe 220 Volts are used by the consumers in single phase or three phase power according to the existing loads. The output from these generation devices (wind, PV or micro-CHP), converted through the inverters and other power systems, must meet specific technical criteria.

The grid operator determines the criteria, which have to be met by the distributed generator. It is the obligation of the grid operator to guarantee the maintenance of the voltage quality.

Regarding LV and MV it is provided that the voltage must not be higher or lower than 10% of the nominal values.

The selected connection point to the distribution grid has to be chosen in that way, so that no negative effect on the grid will be induced.

As an example can be given the **Croatian Additional technical requirements for the connection of micro power station**

Technical requirements for the connection of micro power station shall be passed by the Distribution System Operator.

Micro power stations are those power stations that meet the following criteria:

- Connected to the low voltage system (single-phase and three-phase);
- Connected within a customer facility;
- Electricity generation intended for auxiliary consumption;
- Electricity surplus is injected in the system;
- Total nominal capacity of up to and including 5 kW for a single-phase connection;
- Total nominal capacity of up to and including 30 kW for a three-phase connection.

A micro power station shall meet the following minimum criteria at the interface with the system:

- Measuring peak load in direct measuring, or measuring load curve, including the possibility of remote data collection in semi-direct metering;
- Active and reactive power metering in both directions;
- Possession of a disconnector.

Other technical and operating conditions shall be defined by the Distribution System Operator depending on the primary energy form, micro power station technology, as well as the consumption type and category.

Specific technical requirements and references for each European country according to the National Codes and Standards can be found in the National report and in the project website http://www.home-electricity.org

5. FINANCIAL AND SUPPORTING SCHEMES

The supporting financial schemes can be divided into two categories:

- Purchase of electrical energy from RES-electricity producers on preferential prices; and
- Subsidizing the installations for green electricity.

The first scheme is adopted **in Bulgaria** and according to the legislation in force the electricity transmission and electricity distribution companies are obliged to buy all of the produced electricity from RES on preferential prices.

Austrian policy supports RES-E also through Feed-in tariffs (FIT) that are annually adjusted by law. The responsible authority is obliged to buy the electricity and pay a feed-in tariff. Within the new legislation the annual allocated budget for RES-support has been set at EUR 17 million for "new RES-E" up to 2011. This yearly budget is pre-allocated among different types of RES (30% to biomass, 30% to biogas, 30% to wind, 10% to PV and the other remaining RES). Within these categories, funds will be given on a "first come-first served" basis.

The current subsidy **in Cyprus** is set by CERA (Cyprus Energy Regulatory Authority) at 6.32 c € per kWh. On top of this subsidy, the PV producer will be receiving subsidy by the Government. The contract will be signed for 15 years.

In Finland there is investment subsidy for wind and solar.

Additional examples for Financial and Supporting Schemes can be found in the National Reports and in the Website http://www.home-electricity.org

6. BEST PRACTICES

Photovoltaic system in Voula region (Greece)

Date of issue (year): 2007

Name of organisation: Data energy
Legal status: Private

Organisation status: Research and Services
Type of organisation: Industrial

Location (address): Isiodou str. 7 Koropi 19400 Athens Greece

Email address: info@datakat.gr

Tel: 211.600.7850 **Fax:** 211.600.7845

Website: http://www.dataenergy.gr

Description:

Here we have a grid connected system. Actually it's a Photovoltaic system of 6KW power in domestic house at Voula region in Athens city.

PV Krhanice - tracker (CZ Republic)

Investor: Ing. Michal Juza, Krhanice 236, mail.juza@pin292.cz

Location: Krhanice, Benesov: country: The Czech Republic,

Installed capacity: 1,4 kW p

Orientations of panels: south

Cost of investments: 230,- tis. Kc (9 200 EUR)

Number of PV panels: 8 pieces

Kind of PV panels: FVI 175 W p

Kind of inverter: FVI 3,5

Influence of construction on the year power production: 25 %

Realization: 18. 5. 2006

Source: www.pin292.cz

Title: PV Krhanice - roof

Investor: Ing. Michal Juza, Krhanice 236, mail.juza@pin292.cz

Location: village Krhanice, Benesov: country: The Czech Republic

Installed capacity: 2,8 kW p

Orientations of panels: south

Cost of investments: 446,- tis. Kc (17 840 EUR)

Number of PV panels: 16 pieces

Kind of PV panels: FVI 175 W p

Kind of inverter: FVI 3,5

Realization: 18. 5. 2006

Source: www.pin292.cz

Electric supply from PV Krhanice - roof

		Actual	Solar map CZE	± Anticipated profit
Year	**Month**	**Roof 2,8 kW p (kWh)**	**Roof 2,8 kW p (kWh)**	**Roof 2,8 kW p (kWh)**
2006	January	-	-	-
2006	February	-	-	-
2006	March	-	-	-
2006	April	-	-	-
2006	May	-	-	-
2006	June	-	-	-
2006	July	448	385	16 %
2006	August	278	323	-14 %
2006	September	365	245	49 %
2006	October	218	138	58 %
2006	November	83	65	28 %
2006	December	77	45	72 %
Total year		**1468**	**1200**	**22 %**

		Actual	Solar map CZE	± Anticipated profit
Year	**Month**	**Roof 2,8 kW p (kWh)**	**Roof 2,8 kW p (kWh)**	**Roof 2,8 kW p (kWh)**
2007	January	63	67	-6 %
2007	February	114	113	0 %
2007	March	229	214	7 %
2007	April	409	269	52 %
2007	May	373	364	3 %
2007	June	341	383	-11 %
2007	July	350	385	-9 %
2007	August	337	323	4 %
2007	September	239	245	-3 %
2007	October	173	138	25 %
2007	November	64	65	-1 %
2007	December	42	45	-6 %
Total year		**2738**	**2610**	**5 %**

		Actual	Solar map CZE	± Anticipated profit
Year	**Month**	**Roof 2,8 kW p (kWh)**	**Roof 2,8 kW p (kWh)**	**Roof 2,8 kW p (kWh)**
2008	January	86	67	29 %
2008	February	167	113	48 %
Total year		**253**	**180**	**41 %**

System economy

Total price system: 445 994 Kc (17 840 EUR)

Operating costs (15 year): 31 500 Kc (1 260 EUR)

Total costs: 477 494 Kc (19 100 EUR)

Annual yield: 35 112 Kc

Grant: 30 % 133 798 Kc (5 352 EUR)

Bank credit

Rate of bank loan 55 % 245 297 Kc (9 812 EUR)

Freight prepaid 99 % 242 844 Kc (1% bank charges) (9 714 EUR)

Time perioda 10 year

Credit interest: 5 %

PV Brezová (CZ Republic)

Location: village Brezová, Slusovice u Zlína: country: The Czech Republic

Installed capacity: 4,35 kW p

Orientations of panels: south

Cost of investments: 574,- tis. Kc (22 960 EUR)

Number of PV panels: 30 pieces

Kind of PV panels: FCP 145

Kind of inverter: SolarMax 4000C

Realization: 27. 4. 2007

Source: Hitech Solar s.r.o .

Title: FV Libivá

Investor: Milos Palla,

Location: village: Libivá, district: Olomoucký, country: The Czech Republic

Installed capacity: 4 kWp

Orientations of panels: south

Cost of investments: 650,- tis. Kc (26 000 EUR)

Number of PV panels: 24 pieces

Kind of PV panels: Schüco SP 165

Kind of inverter: SMA 4200 TLHC

Realization: 2007

Photos PV Libivá

Transfer point PV to grid

Location of PV panels

Surge guard with switch-disconnector - Inverter SMA

Demonstration of PV system connected to the grid in a petrol station (Poland)

Location: petrol station Conrada

Installed capacity: 2 kWp

Orientations of panels:

Cost of investments:

Number of PV panels: 24

Kind of PV panels: Millenia

Kind of inverter: Sunny Boy 1100

Realization: in 2001


Encyklopedia Zdrowia

Northern Ireland Housing Executive, Northern Ireland

Location: Sunderland Road, Belfast, Northern Ireland

Description
The Northern Ireland Housing Executive (NIHE) is a leader in the installation of renewable energy technologies in the social housing sector.
In 2003, as part of the Department of Trade and Industry's Domestic Field Trials Programme, the NIHE installed 48 kWp of PV on the roofs of three blocks of flats in the Sunderland Road area of East Belfast. A total of 576 85Wp laminates were fitted which represents one of the largest PV projects in the UK. Monitoring of the PV arrays is being carried out by the University of Ulster on 24 of the 30 apartments.

Photovoltaics
The residents of the 30 apartments benefit from the electricity provided by the PV panels. Since the electricity must be used as it is generated, the NIHE fitted timers to the domestic appliances so that tenants could programme them to switch on during the day if they were not at home. This ensures maximum benefit from the PV systems.

Key Points
Photovoltaic arrays
• Total of 48kWp of PV panels
• Estimated power output 36,000kWh (based on 750kWh/kWp/year)
• Estimated total fuel saving £4,176/year (based on offsetting 36,000kWh at 11.6p/kWh). Saving per household £139/year
• Estimated carbon saving 20,808kgCO2/year (based on offsetting NIE's power generating mix at 0.578kgCO2/kWh)

Cost

• Total PV project cost £300,000
• Funding: The scheme was 100% funded via the Department of Trade and Industry's Domestic Field Trials Programme.

Contacts

Energy Saving Trust Advice Centre. Freephone 0800 512 012
www.energysavingtrust.org.uk/northernireland


One of the largest PV projects in the UK


PV Panels

Small scale CHP (Bulgaria)

Project started in 2002 ended in 2003
Location: town of Bankya, Sofia region

Description:

A small CHP unit on natural gas was installed in the summer of 2003 in Hotel Bankya Palace , town of Bankya (only 16 km from Sofia)

Bankya Palace is a spa hotel with a stable rate of occupation and all-year-round usable swimming pool. This justifies the introduction of CHP for space heating, domestic hot water and for heating up the swimming pool.

The CHP unit Cento 140 is manufactured by TEDOM company. The CHP operational hours are expected to reach about 6000 h/annum at full capacity.

Hotel Bankya Palace

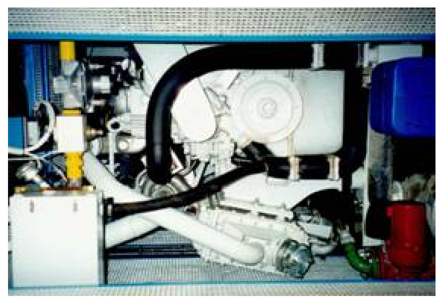
Hotel Bankya Palace-general view

The hotel swimming pool

The equipment:

Cento 140 is a gas fired CHP unit with electrical capacity of 150 kW and thermal capacity of 226 kW. It is driven by a gas combustion engine type Shkoda Liaz M1.2 G with LSA 46.2L6, Leroy

Somer generator. The system has overall efficiency of 87 % and consumption of natural gas of 45,5Nm3/hour at 100 % capacity utilization and 31,5 Nm3/hour at 50 % capacity utilization. The CHP generator is connected to 20kV system.



Cento 140 Inside look

There is also control and power switchboard mounted at the unit for fully automatic operating and permanent automatic diagnosis of its condition.

The investment

The overall project costs are about 145 000 Euro. The applied financing scheme is hotel's own financing at 10 year leasing agreement with the supplier with one year grace period.

Project benefits:

- The calculated payback of the CHP installation in Bankya Palace is 3,5 - 4 years under the agreed leasing conditions and current prices of natural gas.
- Energy prices - of heat, electricity, purchase price of excess electricity and/or heat. They will further increase with the foreseen market liberalization in Bulgaria, which will add to SSCHP projects additional economic benefits.

Contacts:

Names: Mrs. Veska Vasileva - Manager Mr; Stojan Popov - Head of Maintenance

Address: Hotel Bankya Palace; 70, Varna Blvd. 1320 Bankya, Bulgaria

Phone: +359 2 81 22 020

Fax: +359 2 997 70 64

E-mail: hotel@bankyapalace.com

Web site: bankyapalace.com

Villa 2000 House - Tuusula , Finland

Location: Finland

Description

Villa 2000 is an experimental house designed to be very flexible in use, very energy efficient and using only very little resources during its life time. It was realised for the Housing Exhibition in Tuusula, Finland, which was visited by 270 000 visitors during its one month long opening time. The flexible design allows users to change the house from one large unit into various different versions, including a three unit one.

The following technical goals were set for this house:

- The consumption of natural resources is 30% of that of standard modern houses

- The emissions during the construction and use are one third of the present day standard. Energy and water supply together with sewage treatment aim to high level of independence.

- The life cycle costs are one third of the present standard.

- The indoor air quality is clearly better than the present day standard.

- The interior spaces and functions can be changed the aim being flexibility and efficiency.

- The architecture is of high quality and experimental in its character.

The services are designed in a way that all systems and components area easily accessible and concentrated into areas supporting the architectural solution. The machinery, ducts etc. are located under the main floor. All components are easily replaceable; the control system is based on an open network (Lonworks).

Technical characteristics:

The construction is based on primary load bearing steel structures (columns and beams) where joints are made using bolts. All structures that will remain unseen are corrosion protected by hot zinc surfacing. The floor against the ground and the exterior walls of the basement are prefabricated concrete structures, other walls are made on site using pre-cut lightweight steel profiles and wooden surfaces. Roof is born by steel beams and a corrugated steel plate (153 mm high) - partly functioning as a hypocaust. The floor of the living space is an all-dry structure made of lightweight steel profiles supporting plywood and a floating woodboard floor. Only areas where wet spaces are located the floor is concrete poured on a corrugated steel plate.

The insulation is thick, against the ground it is 200 mm XPS (plastic) insulation, walls have 325 mm and roof 400 mm (also in floor when facing outdoor air). Extra attention is paid to the air tightness of the structures and protection against winds. There is a PV roof (2,4 kWp) made of panels laminated directly on the steel roofing material. Panels are using amorphous silicon thin-film cells by Uni-Solar , USA , the roofing material by Rannila in Finland . A second solar system is an energy roof for heating where the cavities of the corrugated steel are used as hypocausts and the warm air is led to the ventilation machinery where the heat is recovered and used for additional heating of the building. In summer the roof is cooled down using fresh air. The ventilation machinery uses solar energy.

Contacts

OWNER:

Suomen Asuntomessut

Finnish Housing Exhibitions

ARCHITECT

Kai Wartiainen Oy

Kasarmikatu 14A3

00130 Helsinki, Finland

Tel +358 9 612 9080

Fax +358 9 6129 0818

RESEARCH

VTT Construction Technology

Espoo, Finland

http://www.vtt.fi

PV SYSTEM

Uni-Solar

7. NATIONAL REPORTS

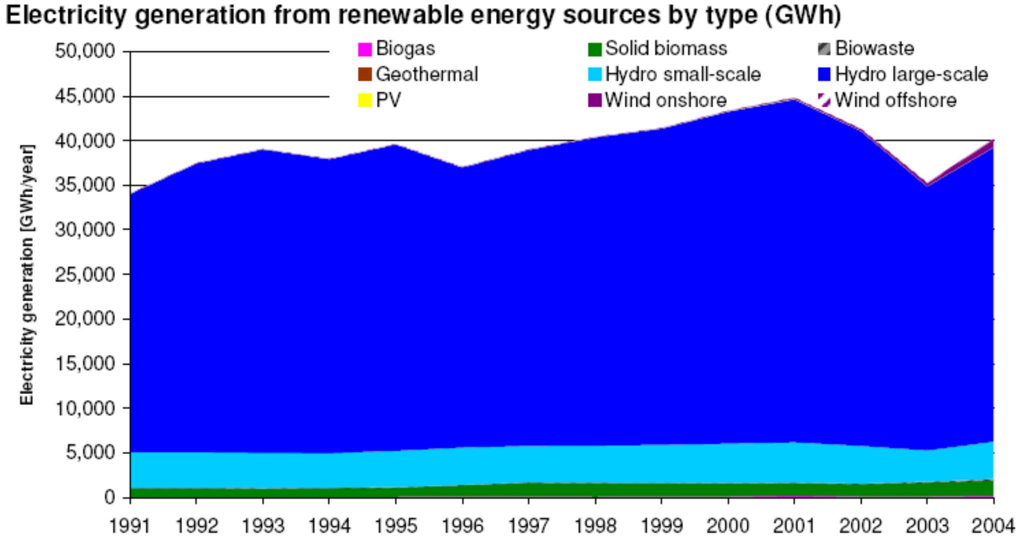
7.1. AUSTRIA

INTRODUCTION

With a share of 70% RES-E of gross electricity consumption in 1997, Austria was the leading EU Member state for many years. Large hydropower is the main source of RES-E in Austria. More recently, a steady rise in the total energy demand has taken place, and a decrease of the share of RES-E has been noted. In 2004, the share of RES of gross energy consumption amounted up to 62.14 %. In May 2006, the annual allocated budget for RES-E support was reduced, and tariff adjustments that are adjusted annually have been installed. The RES-E target to be achieved in Austria by 2010 is 78.1% of gross electricity consumption.

Austrian electricity production from RES increased moderately during the second half of the 1990s, and decreased slightly between 2001 and 2003. Large hydropower that dominates the RES market showed a 0.6 GW increase in capacity between 1990 and 2003, and small hydro power helped generate less electricity in 2003 (3.5 TWh) than in 1990 (4 TWh). The potential hydro power in this region is very high. In absolute figures, an increase of 1.180 GWh has been registered in the production of green electricity since 1997. Hydroelectric power stations are supplemented by thermal power plants, most of which are combined heat and power plants (CHP).

The figures recorded for electricity generation from solid biomass and biowaste almost doubled between 1993 (984 GWh) and 2004 (1 886 GWh). Wind energy as well shows significant growth with an increase in capacity of 46% in 2004 and of 35% in 2005.



Source: European Commission
http://ec.europa.eu/energy/res/legislation/share_res_eu_en.htm

INTERCONNECTION RULES

Website: www.e-control.at

Authority 1: Energie-Control Österreichische Gesellschaft für die Regulierung in der Elektrizitäts- und Erdgaswirtschaft mit beschränkter Haftung (Energie-Control GmbH)

Summary:

In Austria, the technical and organisational rules (TOR) are determined by the national regulatory agency and comprise national standards (ÖNORM) regarding the operation of electricity supply and distribution grids and the installation of electric plants.

Additional Resources:

- http://www.e-control.at/portal/page/portal/ECONTROL_HOME/STROM/MARKTREGELN/TOR_NEU - Technical and organizational rules (TOR)

Contact:

Verband der Elektrizitätsunternehmen Österreichs (VEÖ)
Brahmsplatz 3
Postfach 123
1041 Wien
Österreich
Tel.: +43-(0)1-50198 0
Fax: +43-(0)1-505 12 18
www.veoe.at

Energie-Control Österreichische Gesellschaft für die Regulierung in der Elektrizitäts- und Erdgaswirtschaft mit beschränkter Haftung (Energie-Control GmbH)
Rudolfsplatz 13a,
1010 Wien
Tel.: +43 1 24724 - 0
Fax: +43 1 24724 - 900
www.e-control.at

NET METERING RULES

Country: Austria

The location of the metering point is not determined. Generally, it is installed at the connection point from the DER to the distribution grid. The metering system has to meet the technical and organisational rules for grid operators and users (TOR) – Part F: Technical rules for Metering.

Authority 1: Energie-Control Österreichische Gesellschaft für die Regulierung in der Elektrizitäts- und Erdgaswirtschaft mit beschränkter Haftung (Energie-Control GmbH)

Website: www.e-control.at

FINANCIAL AND SUPPORTING SCHEMES

Title: Green Energy Act (Ökostromgesetz – ÖSG)

Country: Austria

Incentive type: Investment subsidies for CHP (RES, FF) for enterprises, possibly for home owners (Wohnbauförderung), Feed-in tariffs for electricity from RES (PV, Wind, Biomass, Small and medium hydro electric).

The ÖSG provides for the support of wind energy, solar energy, geothermal power, tidal power, hydropower, biomass, waste with a high biogenous share, landfill gas, sewage gas and biogas; however, hydropower is only supported if produced in small (up to a bottleneck capacity of 10MW) and medium-sized (bottleneck capacity from 10MW to 20MW) hydroelectric power plants. Electric power from firing carcass meal, spent lye, sewage sludge or waste (except waste containing a high percentage of biogenous materials), as well as from firing solid biomass in facilities lacking devices for the reduction of fine particles, is excluded from support.

The ÖSG also contains provisions on the promotion of highly efficient CHP generation. The main support mechanisms are investment subsidies for medium-sized hydroelectric power plants and for CHP plants as well as purchase guarantees and feed-in tariffs for power from other RES.

The feed-in tariffs are linked to CHP electricity. A support scheme exists for CHP from fossil fuels as well as subsidies for CHP from renewable energy. Furthermore, Austria gives subsidies for district heating CHP. Investments are supported with 15 – 30 % depending on heat supplied. Subsidies on industrial buildings rise up to 30 % on investments for district heating systems in case that the heat is produced on 100 % from renewable energy. Only 15 % of subsidies are granted when the CHP runs with fossil fuels.

System sizes: up to 2 MW_{th}

Authority:

- Ministry of Economics and Labour (http://www.bmwa.gv.at/EN/default.htm)
- Energy regulation authority (www.e-control.at)
- Green Energy Handling Agency (www.oem-ag.at)

Summary:

Austrian policy supports RES-E through Feed-in tariffs (FIT) that are annually adjusted by law. The responsible authority is obliged to buy the electricity and pay a feed-in tariff. The total budget available for this will decrease due to a decision taken in May 2006. Within the new legislation, the annual allocated budget for RES-support has been set at EUR 17 million for "new RES-E" up to 2011. This yearly budget is pre-allocated among different types of RES (30% to biomass, 30% to biogas, 30% to wind, 10% to PV and the other remaining RES). Within these categories, funds will be given on a "first come – first served" basis.

Contact
OeMAG Abwicklungsstelle für Ökostrom AG
Alserbachstrasse 14-16

1090 Wien
Tel.: +43 5 787 66-0
www.oem-ag.at

SAFETY AND POWER QUALITY REQUIREMENTS

It is the obligation of the grid operator to guarantee the maintenance of the voltage quality. The TOR determines the criteria which have to be met by the DER: Regarding LV and MV it is provided for by statute that the range of voltage must not be higher or lower than 10 % (+/-10 % subject to EN 50160).
The interconnection rules vary depending on the trade terms of the particular distribution grid operator. The power plant has to be connected at the most sensible point regarding the economic advantage of the grid user. The selected connection point to the distribution grid has to be chosen in that way that no negative effect on the grid will be induced.

References:

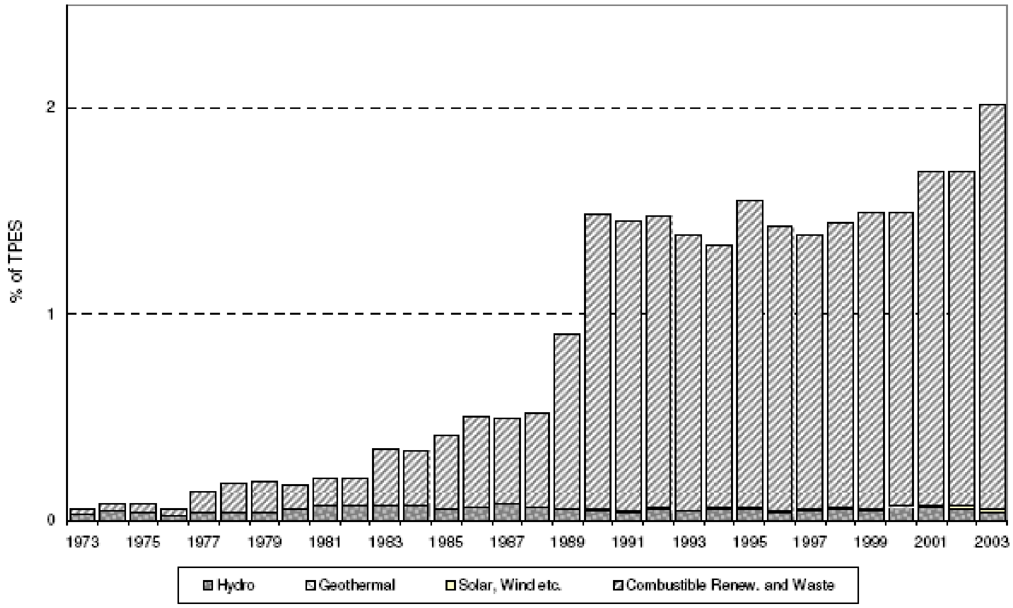
1. Key Figures of the Austrian RES-Market: http://ec.europa.eu/energy/res/legislation/share_res_eu_en.htm
2. Directive 2001/77 on the promotion of electricity produced from renewable energy sources in the internal electricity market [2001] O.J. L283/33.

7.2. BELGIUM

INTRODUCTION

Historic evolution of overall energy characteristics

Certain statistical indicators conventionally attribute some 'energy production' to the Belgian economy, such as the NACE code 23 on "manufacture of coke, refined petroleum products and nuclear fuel". However, since all energy products need primary energy that is imported from abroad, it is fair to say that since 1993, when the last Belgian coal mine has been closed, and as far as energy 'stocks' are concerned, Belgium is effectively energy dependent for about 100%. Only the currently small amount of renewable 'flows' reduces the import dependency to somewhat less than 100%. In statistics, care has also to be taken on the generation of electricity from hydro power. In many data the output of pumped hydro is also considered as being hydro-electricity, which is in fact incorrect. Rather than using the terminology hydro-output, pumped storage should be accounted for as indirect electric energy storage, compared to gas storage. As a consequence of what precedes, Belgium had no choice but to rely heavily on primary fuel diversification, as far as origin and nature is concerned. In Belgium the share of the total primary energy supply (TPES), coming from renewable sources is small and estimated at 2.3% in 2004, a rise of 14% comparing to 2003. The evolution over the period 1973-2003 can be represented as shown in Figure 1.2.



Renewable Energy as a Percentage of Total Primary Energy Supply, 1973 to 2003. [FPS Economy, DG Energy ,2007]

Compared with the share of renewables of the 26 IEA countries Belgium had in 2004 the fifth smallest part of TPES supplied by renewables. Biomass is by far the most important source (97%), while hydro was accounting for 2%. In Flanders, generation from renewable sources is expected to rise to 6% by 2010, being at 2% in 2004. In Wallonia, the objective for 2010 is a raise to 8% at the horizon 2010. In both regions there is a fast growing electricity generation coming from wind energy. Brussels-Capital has, because of its limited surface and electricity generation capacity, very limited renewable energy facilities, being mainly solar thermal demonstration projects.

National Energy Policy

Since the early 1970s, Belgium's overall policy objectives have concentrated on security of supply based on diversification of geographical sources and fuels, energy efficiency, transparent and competitive energy pricing and environmental protection.

The three regions, which are responsible for a large share of energy policy, have also outlined their energy policy goals. Flanders is focused on the permanent promotion of the efficient use of energy, including both reducing energy use in the residential sector and increasing energy efficiency in industry and the service sector. The region also aims to increase environmentally-friendly energy production through the use of renewables and combined heat and power (CHP). Another objective of the Flemish energy policy is to provide the best possible energy services at correct and socially acceptable prices for all social groups, through regulation of electricity and gas markets.

Wallonia's energy policy objectives are outlined in its Plan for Sustainable Mastery of Energy, which is currently being reviewed but has not yet been adopted by the government. These goals are to modify behaviour through increased public awareness of energy issues; promote the efficient use of energy in buildings, industry, the public sector and the tertiary sector; to develop the renewable energy sector; regulate electricity and gas markets and discuss and evaluate policies, actions and measures.

The Brussels-Capital policy goals are to improve public awareness of the efficient use of energy, to improve awareness of and develop decision-making tools for building developers on the energy performance of buildings, to provide finance training and other support to the tertiary sector (including public authorities) and to set up a support system for renewable and alternative energy projects.

On 6 December 2005, a Commission to analyse Belgian energy policy until the year 2030, the so-called 'Commission on Energy 2030', was set up by Royal Decree90. This Commission has to draw up a report setting out the strategic choices of Belgian energy policy in the long and medium term on the basis of scenarios defined by the Commission in consultation with the study services of the Federal Planning Bureau.

Accordingly the 'Commission on Energy 2030', Belgium should define its medium to long-term energy policy taking into account a substantial domestic GHG reduction effort and/or keeping in mind the possible costs for financing emission reductions abroad through, e.g., emission trading. In this context the main priorities are:

Belgium must do all that is 'reasonably acceptable' to exploit its potential on energy savings

- First and foremost, a behaviorally conscientious attitude with respect to energy use should be advocated through education and general information transfer, in schools and towards the public at large.
- Quality *Cogeneration* is to be continually encouraged and supported to implement the energetic potential based on the heat demand existing at the time of implementation.
- *Transport*-related energy use is linked to the more global issue of *mobility*. Air & noise pollution, GHG emissions and road congestion are major problems in this context, especially for Belgium with a logistic function in Europe. This requires a holistic approach, including road, rail, water and air transport, passenger and freight transport, private and public transport, congestion control, road safety etc. Well thought-through measures, without taboos must be considered. Solving the mobility issue appropriately, may lead to energy savings and emission reductions *Industry* must be incited to further concentrate on energy efficiency, both energy-intensive and the smaller industries. The voluntary and audit covenants are welcome tools when cleverly combined with the allocation of emission allowances
- To reflect scarcity of energy as an economic good as well as the external costs due to various energy-conversion processes, to avoid wasting of energy and keep sufficient pressure for rational use of energy, and to optimize load time management, **energy price increases must be fully passed on to the customer**.
- According to the present analysis, the achievement of stringent post-Kyoto targets of the order of 15-30% by 2030, for domestic reduction in Belgium **without nuclear power** and in the absence of CCS, is expected to be **extremely expensive**.
- Because of limited domestic potential of **renewables**, implementation of the EU directives in a clever and justified way to contribute to a healthy European energy mix and environmental-burden reduction.

On **security of supply**, four aspects are to be focused on as priorities.

- Diversity of supply of primary sources and technologies (type and origin) is the first and foremost rule. Especially the gas provision must be carefully observed. An optimal mixture of longterm and spot-market contracts must be strived for.

- A **comprehensive study** to find the appropriate energy mix (including renewables, gas, oil, coal, uranium), based on the **portfolio theory** must be effectuated for the Belgian situation.
- A **stable investment climate** must be guaranteed for competitive market players to have sufficient new *electricity-generation capacity,* to keep a substantial *refinery capacity* and to have sufficient *gasstorage capacity*. For supported technologies, such as renewables, governments must guarantee that commitments for support made are honored.
- **Transmission and distribution networks** must be 'allowed' to invest in extensions, adaptations, and preventive maintenance, so as to **avoid blackouts** and to allow the connection of renewables and to facilitate the European market; the Regulator must accept the costs involved being transmitted to the customers; environmental and construction permits must be delivered timely by the competent authorities.

  - The **liberalization** process for **electricity and gas in Belgium** must be developed in line with the common European energy market concept.
  - Enphasis and reinforcement of **research & development** means in energy.
  - Increase efforts on of **Education & Training in energy**, e.g., stimulation of advanced studies in energy science and engineering.
  - Establishment of a sustained/permanent **Strategic Energy Watching Brief**.

Generation capacity

The generation capacity for electricity in Belgium (expressed as the net rated power of the power plants), up to 2004, is as follows:

MW	2004	2003	2002	1999	1994
Nuclear	5,801.5	5,761.0	5,761.0	5,713.0	5,528.0
Classic thermic	6,800.3	6,800.1	6,845.9	7,226.4	7,427.5
Biogas	25.9	25.9	25.9	11.8	1.8
Waste and recuperation steam	201.3	200.1	196.9	147.1	124.0
Cogeneration	1,340.8	1,339.6	1,272.7	1,057.4	410.1
Hydraulic	107.6	107.6	106.0	97.0	95.5
Pumping stations	1,307.0	1,307.0	1,307.0	1,307.0	1,307.0
Wind	92.8	66.9	31.0	9.3	5.2
BELGIUM	**15,677.2**	**15,608.2**	**15,546.4**	**15,569.0**	**14,899.1**

Composition of the Belgian generation capacity (so-called developable power) up to 2004. [BFE-FPE, 2004]

Notice that by the end of 2006, wind generation has grown to 193 MW. Concerning CHP, the number for 2005 turns out to be artificially inflated since almost no real CHP has been installed in 2005 (because of uncertainty in legislation on CHP certificates in Flanders).

Electricity transmission – access and tariff policy

Another unique attribute of Belgium's electricity network is that because of its geographical characteristics, there is very little congestion within the Belgian grid. As a result, transmission is charged at a postage-stamp rate on a euro per kilowatt basis (*i.e.* charges do not vary according to transmission distance or congestion).

A 29 April 1999 law regulates access to the electricity transmission grids and requires that all transmission and distribution tariffs be approved by the CREG on an annual basis. The law also requires that tariffs related to connection to and use of the grid be based on reasonable costs to the grid operator, plus a reasonable return on capital investment. Under this "cost-plus" mechanism, the CREG has the ability to reject certain costs if they are considered unreasonable.

In June 2005, Belgium passed a law introducing a four-year tariff period in order to improve tariff predictability for customers, ensure regulatory stability and provide Elia with incentives for more efficient grid management. Before implementation, a royal decree must be issued.

Elia procures balancing energy to meet real-time electricity demand and charges these costs according to regulated imbalance tariffs. Billing of imbalances is hampered by missing and inaccurate metering data from the distribution network operators (DNOs). Changes are under consideration that would implement a more market-based and cost-reflective system.

Grid access is available on a non-discriminatory basis. Despite the difference between regional regulations, Elia has created a single grid access contract that is used in all three regions, improving simplicity and transparency.

Though the federal government is monitoring liberalisation and has some powers, much electricity market authority rests with the regional governments, which have the authority to regulate distribution and local transmission networks at and below 70 kilovolts (kV). The regional governments set up their own regulatory institutions. Flanders established the VREG (*Vlaamse Reguleringsinstantie voor de Elektriciteits- en Gasmarkt*). Wallonia established the CWaPE (*Commission wallonne pour l'énergie*). Brussels-Capital established the *Service de l'Energie*. Like CREG, VREG and CWaPE are autonomous entities from the government. The Brussels-Capital regulator is part of the government ministry.

All four regulatory bodies carry out regulatory tasks in the liberalised part of the electricity and gas markets, including advising government authorities about the electricity market and monitoring the markets to ensure implementation of the law and compliance with regulations.

Renewable Energy in Belgium

Background and prospects

The share of total primary energy supply (TPES) that comes from renewable energy sources is small in Belgium – 2% in 2003.

Wallonia reports that 2% of total final consumption was from renewables in 2000, which they hope will grow to 4% in 2010. Currently, 2.6% of electricity production is from renewables; Wallonia's objective is to raise the figure to 8% by 2010. Wallonia's 2003 and 2004 renewable energy capacity and production are presented in Table 23. While renewable capacity grew by just 4% between 2003 and 2004, total production grew by 16%. The largest sectoral growth was in wind energy. Though wind capacity grew by a negligible amount, total production nearly quadrupled.

In Flanders, generation from renewable sources is also expected to be at about 2% in 2004, rising to 6% by 2010. Though it remains a small share of total electricity production, renewable electricity production has risen dramatically since 1997. Biomass is expected to make up Flanders' remaining electricity generated from renewable energy sources in 2010, about 1 600 GWh of the 2 900 total annually. In absolute figures, the strongest growth is expected in biomass produced from timber, and the production of green electricity from timber waste is expected to triple.

In Flanders, electricity from hydroelectric power and solar energy will only make a marginal contribution in 2010 (40 GWh). A more substantial contribution from solar energy is expected in 2020. The application possibilities of hydroelectric power will remain limited in Flanders.

Given its small size and limited electricity generation supply, **Brussels-Capital** has few renewable energy facilities. The region has several large demonstration projects of solar thermal panels.

Policies and measures

Flanders

Flanders has had a green certificate scheme since January 2002, through which a producer is awarded one certificate for every 1 MWh generated from a renewable energy source. In 2004, electricity suppliers had an obligation to acquire green certificates for at least 2% of the electricity provided to customers. This obligation rises to 6% in 2010, in accordance with the 2001 EU Directive on Renewable Electricity Generation. Together with the distinct co-generation certificate scheme, generation from renewables and cogeneration will be 25% by 2010, a quota that Flanders sees as reasonable.

In addition, in 2004, to provide renewable energy suppliers with greater investment security, Flanders implemented a system of minimum certificate prices based on generation source. Minimum price levels were based on production costs, but also on existing support given in other countries. Solar is subsidised at a much higher level than other sources – EUR 450/MWh for solar versus about 80–95 for other types – in order to stimulate investment in the field and diversify the renewables portfolio.

Wallonia

In Wallonia's green certificate scheme, CWaPE, the region's regulator, awards one green certificate to producers for every 456 kilogram of avoided CO_2, which is equivalent to the CO_2 emitted from the production of 1 MWh of electricity from a gas turbine. In addition to electricity produced from renewable resources, generation from high-quality CHP installations is also eligible for the certificates.

The avoided CO_2 calculations convert to one green certificate awarded per MWh produced by wind, small hydro, biomass and solar photovoltaic (PV) installations, one certificate per 3.3 MWh produced by natural gas cogenerators and one certificate per 6.2 MWh produced by fuel oil co-generators.

Brussels-Capital

The Brussels-Capital green certificate scheme is similar to that of Wallonia, awarding green certificates on the basis of avoided CO_2. It requires suppliers to obtain green certificates to cover a share of total electricity generation: 2% in 2004, 2.25% in 2005 and 2.5% in 2006. An agreement between Wallonia and Brussels allows for the exchange of credits between the two regions. However, in order to encourage the development of green electricity sources within Brussels, Brussels discounts the value of Walloon certificates by 30%.

Federal level

In July 2002, the federal government instituted a green certificate scheme for installations that generate electricity from water or wind in the territorial sea and in the exclusive economic zone of Belgium – installations for which the federal government has jurisdiction. These certificates are given by the federal Electricity and Gas Regulatory Commission (CREG). Each certificate corresponds to 1 MWh of renewable electricity production.

Fiscal incentives and other support schemes

Federal

By virtue of royal decrees in 2000 and 2004, the Minister for Energy can provide territorial concessions for the construction of installations of water-, current- or wind-generated electricity installations in the territorial sea and the exclusive economic zone of Belgium. These concessions can provide lower-cost or free leases for offshore wind sites. In March 2005, the federal Council of Ministers decided that two coal-fired power plants must switch to biomass.

Flanders

In June 2003, Flanders began funding the seven-position Green Energy Taskforce with the task of intensifying actions to promote green electricity and heat production.

Wallonia

In Wallonia, the SOLTHERM programme aims to have 200 000 m2 of solar panels installed by 2010 through the use of an information campaign and fiscal incentives. For households, there is a subsidy of EUR 1500 for the first four m^2 plus EUR 100 for any additional m^2. Renewable energy supply investments may benefit from subsidies through a decree adopted in April 2004. This decree gives a new legal basis for financial incentives (*e.g.* subsidies, reimbursement of loan guarantees, tax exemptions and accelerated write-offs) for sustainable energy, investments in energy efficiency or production from renewable energy and CHP. This new legislation has been adopted according to the EU guidelines on government aid for environmental protection.

The Energy Fund finances household investments in heat production from renewable sources (*e.g.* wood heating, mass stoves). In addition, Wallonia subsidises APERE (*Association pour la promotion des énergies renouvelables*), a non-profit organisation active in the development of renewable energy sources.

A new subsidy for renewable energy investments is still under consideration. The legislation would provide financial incentives (*e.g.* subsidies, reimbursements of loan guarantees, tax exemptions and accelerated write-offs) for sustainable energy investments.

Brussels-Capital

Brussels-Capital has some fiscal incentives related to household use of renewable energy sources. To stimulate the use of solar water heaters, a subsidy of up to EUR 991 and up to 35% of the total investment is given. In addition, information campaigns were also launched through the diffusion of documents designed for the public and the organisation of both general and technical workshops. Some solar projects can have up to 50% of their costs financed by Brussels-Capital.

Legislative framework and regulations

FEDERAL LEVEL

- Law of 29 April 1999 related to the organisation of the electricity marlet.

- Royal decree of 27 June 2001 thar creates a technical regulamentation for management of electricity transmission and access grid.

REGIONAL LEVEL

- Agree of the Wallon Gouvernement of 4 July 2002 related to the promotion of green electricity.
- Agree of the Flemish Gouvernement of 28 September 2001 to incentive the production of electricity through renewables.
- Decree of 19 July 2001 related to the organisation of the electricity market in the Région de Brusells-Capitale.
- Decree of 12 April 2001 related the organisation of the regional electricity market.
- Agree of 15 December 2000 of arrêté aiming to concede financial support to solar hot water installations in buildings.
- Decree of 17 July 2000 related to the organisation of electricity market (Flemish region).
- Agree of 3 June 1999 of Brussels Region Gouvernement changing the Royal Agree of 10 February 1983 related to measures aiming to encourage and promote energy efficiency.

Information Sources

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[2] CREG - Commission for Electricity and Gas Regulation, Annual Report 2007 www. creg.be

[3] INTERNATIONAL ENERGY AGENCY Energy Policies of IEA Countries, BELGIUM, 2005 Review

[4] Assessment of the AMPERE Commission Report by an International Peer Review Group

[5] Portail de l´Énergie en Région wallone

[6] CWAPE - Commission Wallone pour l'Énergie web site

7.3. BULGARIA

INTRODUCTION

The Bulgarian energy policy follows the directions of the EU energy policy and regards the energy efficiency and the usage of renewable energy sources (RES) as highly important.

In the Energy law (8 th September 2006) chapter 11 concerns the promotion of power generation from RES and co-generation. The important points in the different articles are as follows:

Article 159. (1) The public provider and/or last suppliers who are granted an electricity supply license **shall buy out the entire volume of electricity generated in a plant using renewable energy sources** and registered with a certificate of origin with the exception of the volumes for which the producer has entered into contracts pursuant to Chapter Nine, Section VII or with which he participates in the balancing market.

(2)The public provider and/or last suppliers shall be **obliged to buy out the electricity generated in plants using renewable energy sources, including hydroelectric plants, with total installed capacity up to 10MW** at preferential prices.

Article 160(2) The costs of connecting the power plant to the respective grid (to the property boundary of the electrical equipments) shall be covered by the producer.

Article 162a (1) Transmission and distribution companies **are obliged to priority connect all plants, generating electricity, from highly-efficient combined generation with installed capacity up to 10 MW** , to the transmission, respectively destributin grid.

(2) The costs for the connection of the plant to the grid, up until the ownership boundary of the electrical facilities, are covered by the producer.

The electrical power mentioned in paragraph 1 is purchased at preferential prices.

The Law for Renewable and Alternative Energy Sources and Biofuels is published in State Gazette issue 49, 19 th June 2007.

The main points in the Law, concerning the Production of Electricity with RES&CHP for Homeowners are:

- Generation of Energy from RES is promoted when rendering the characteristics of different types of RES and technologies for the generation of electrical power.
- Compulsory priority connection of producers of energy from RES to the electrical grid from the company closest to the location of the electrical facility.
- Setting of preferential prices for purchase of energy generated from RES, with the exception of energy generated by hydro power plant (HPP) with installed power over 10 MW
- Softer administrative regulations on energy generated by RES
- The distribution company is obliged to connect to the grid every producer of electricity from RES, who is also a domestic consumer. The boundary of ownership of electrical facilities and the location of the measuring devices should be at close proximity. It should point to the minimal connection scheme.
- The State Energy and Water Regulatory Commission(SEWRC), issues the producer certificates for origin of energy from RES, named "Certificates of Origin"
- The obligatory purchase is done according to purchase contracts. The contract term is 12 years.

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Technical Rules for Designing RES Power Plants

Regulation 14 from 15.06.2005, from the Minister of regional development and public works and the Minister of energy and energy resources, chapter IV , provides the technical rules and regulations for the designing of power plants producing energy from RES

Article 127.The power plants producing energy from RES are:

1. Hydro power plants
2. Wind power plants
3. Geothermal power plants
4. Solar Photovoltaic power plants
5. Biomass power plants

Article 131. Solar photovoltaic power plants, called "PV systems", are clasified as follows

1. Depending on the power:

a) Small PV systems with power capacity of 1-10 MW

1. Depending on the ways of usage of the generated electrical power

a) Private sources of electrical power;

b) Connected to an independant grid

c) Connected to the distribution grid

Ministry of regional development and public works

www.mrrb.government.bg

INTERCONNECTION RULES

Regulation 6 from 09.06.2004 "Connection of producers and users of electrical energy to the transmission and distribution grids" defines the terms and procedures for connecting producers and users of electrical energy to the transmission and distribution gids.

In Chapter IV "Procedures for connecting electrical power plants to the electrical grid" Article 50(2) it is stated that a written request should be handed over to the distribution company, when the combined electrical power is 5MW or less.

The regulation does not specify the conditions for the connection of small producers of energy from RES and small CHP for Homeowners.

To this moment there are no specific conditions for the connection of small generators of energy for homeowners, therefore we are giving the main existing technical requir e ments for the connection of producers of energy. These requirements are the basis for the specific conditions

The main small producers of energy are small hydro and wind power plants and PV systems.

The connection of small hydro and wind power plants is generally at 20 KV.

Due to the relatively small power output of the PV systems (around 10KW), they are connected to a low voltage grid.

This means that they have to be connected to a suitable distribution company

There are three distribution companies in Bulgaria.

• CEZ Bulgaria (www.cezbg.com) (part of CEZ, Czech Rep.) which controls the distribution grid in western Bulgaria (region Sofia, Sofia-city and Pleven)

• E.OnAG (part of E.On, Germany), which controls the distribution grid in eastern Bulgaria (G.Oriahovitza and Varna)

• EVN (www.evn.bg) (part of EVN, Austria), which controls the distribution grid in southern Bulgaria (Plovdiv, Stara Zagora)

The Regulation envisage for the technical requirements for the connection of producers :

When examining a demand for investigation of the conditions for connecting a producer to the distribution grid the distribution company may demand information about:

• Generator type - synchronous, asynchronous

• Primary engine type

• Exciting system type

• Methods of synchronization

• Minimal and maximal frequency, at which the generator switches off

• The consumed reactive energy or the presence of compensating devices

• With a wind turbine as power generator - the grid connection scheme (with/without an inverter)

• The power of the generators factor (0,85 - 0,9 recommended)

Requirements for connection of small hydro and wind power plants to the system grid

• The plant must be connected to the medium voltage grid on 20 kV by a transformer post, which contains following cells:

• Cables input-output;

• Transformer;

• Protection of the transformer;

• Auxiliaries;

• Metering;

• Low voltage panel and automation system.

• Requirements for technical parameters of the equipment:

• Cables cell has a knife switch;

• Transformer cell has a circuit breaker and a knife switch;

• Auxiliaries cell has a safety fuses 20 kV.

3. Automation system includes a protection for disconnection of the plant in case of a voltage out of range event, maximum power protection, maximum voltage protection, minimum voltage protection and frequency protection.

4. Metering system is on a medium voltage side of the transformer. Every phase of the transformer has own power and voltage meter.

5. The meters should be suitable for a remote control.

6. The plant must have an own equipment for a compensating of a reactive energy and a providing of cosf=0.9.

7. The metering system must be separated from the protection system.

8. The contracts for a connection to the grid between the owners of the plants and the distribution company contain following sections for the technical characteristics and the operation of the plants:

• Voltage f luctuation;

• Frequency f luctuation;

• Disconnection and reconnection to the grid;

• A vailability of harmonics;

• Need of reserve capacity;

• Monitoring system.

9. The intensive construction of small hydro and wind plants requires significant additional investments for new lines and substations.

Requirements for connection of PV systems

With the Solar photovoltaic plants the generated electricity is direct current (DC). A DC/AC inverter is needed for the connection of a PV system to the distribution grid.

• The connection of a PV plant is performed at the point of connection to the distribution grid

• When designing a PV plant, research is done into the technical characteristics of the device, at the point of connection. The following characteristics are examined:

• Voltage variation

• Active and Reactive current

• Frequency variation

• Presence of harmonics

These characteristics of the distribution grid may vary according to the location of the point of connection of the PV plant. They are examined to verify whether the inverter , originally foresaw after the research , corresponds to them

• The Bulgarian distribution grid has no specific requirements for the connection of a PV plant.

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METERING RULES FOR ELECTRICITY

Country: Bulgaria

In Bulgaria there are Rules for electricity quantity metering (posted in State Gazette, issue 67, from 2nd August 2004. The rules are posted on The State Energy and Water Regulatory Commission (SEWRC) web site - www.dker.bg

The main rules are:

- For connection to the distribution grid, a metering device is provided.

- The electrometers for commercial and control metering, measure and register kWh and/or kVArh at the location of the metering.

- The amount of active and reactive energy is metered simultaneously over periods, determined in the purchase contract

- The generated and the consumed energy, is metered by means of commercial metering - owned by the respective distribution company

SAFETY AND POWER QUALITY REQUIREMENTS

REQUIREMENT	VALUE	REFERENCE STANDARD OR GUIDE
PROTECTION REQUIREMENTS		
Is an external accessible disconnecting switch mandatory?	YES	www.ucte.org
What is the acceptable range of AC voltage for operation of DER?	+-10%	www.ucte.org
Is monitoring of voltage of each phase required?	YES	www.ucte.org
What is the maximum allowed time for disconnection of DER in case of a voltage out of range event	5 secs	www.ucte.org
What is the acceptable range of frequency for operation of DER	+-10%	www.ucte.org
What is the maximum allowed time for disconnection of DER in a case of a frequency out of range event	10 secs	www.ucte.org
What is the minimum time for reconnection after a disconnection of DER	5 secs	www.ucte.org
Other protection requirements	NA	
IMPACT ON GRID-POWER QUALITY		
What is the allowable variation of voltage at LV side of LV/MV transformer, due to DER connection	+- 10%	www.ucte.org
What is the limit of harmonic current emissions of DER	Individual Harmonic order, h- max distortion (%) h<11: 4,0 11<h<17: 2.0 17<h<23: 1.5 23<h<25: 0.6 35<h : 0.3	
Requirements regarding power factor	0.9 leading<Power Factor<0.9	

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PV SPECIFIC REQUIREMENTS		
Is an AC disconnecting switch mandatory for a PV plant	YES	
What is the acceptable range for the settings of under-voltage disconnection	-10%	
What is the maximum allowed time for disconnection of a PV inverter in case of a voltage out of range event	Depends on the type of PV inverter	
What is the acceptable range of settings for under- over frequency disconnection	+-5%	
What is the maximum allowed time for disconnection of a PV inverter in case of a frequency out of range event	The PV Inverters have no protection in case of out of range frequency	
What is the minimum time for reconnection after a disconnection of a PV inverter	Depends on the power and type of the inverter	
What is the limit of the total harmonic distortion of current of a PV inverter		
Is an isolation transformer required for a PV inverter	It is recommended	
What is the maximum allowable DC current injected to the grid	There is no limit, depends on the system	
Is any special protection required for transformerless inverters	Electric circuit breaker	
Is an anti-islanding protection for the PV inverter mandatory		
What method of anti-islanding protection is acceptable		

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FINANCIAL AND SUPPORTING SCHEMES

The main stimulus for the generation of electricity from RES is the preferential price at which it is purchased.

According to Article 32, from the Energy Law, The State Energy and Water Regulatory Commission (SEWRC) sets preferential prices for sale of electricity generated from RES and from cogeneration by plants with combined generation of electric and heat energy.

- Preferential prices are not set at less than 70 percent of the average selling price of electricity for the preceding calendar year for public consumers, or last suppliers and surplus, set by SEWRC, according to criteria, depending on the primary energy source.
- The preferential price for the energy, co-generated from plants with combined heat and electricity generation , is determined on the basis of the individual expenses for generation and a surplus , set by SEWRC

Depending on the RES the cost of the electrical power is:

From 01.01.2007 **the price of the energy generated by wind power plants** with new devices, installed after 01.01.2006 , is as follows:

• For wind power generators with full effective working hours of up to 2250 per year, - 17,5 st/ KWh (8,95 € cent/ KWh) without VAT

• For wind power generators with full effective working hours above 2250 per year - 15,6 st/KWh (7,98 € cent / KWh) without VAT

From 01.01.2007 **the preferential prices, without VAT, for energy, generated by PV plants** , are set as follows"

• For PV plants with installed power up to 5 KW, 78,2 st / kWh (39,98€ cent/kWh) (with 67,49 lv/MWh, which is 70 percent of the average price of public providers for 2005 with a surplus of 714,51 lv/MWh);

• For PV plants with installed power above 5 KW, 71,8 ??/ kWh (36,71€cent/kWhl)(with 67,49 lv/MWh, which is 70 percent of the average price of public providers for 2005 with a surplus of 650, 51 lv/MWh);

The current price for purchase of electricity from HPP is 8 st/KWh or (4,09€ cent /kWh). The price is without VAT.

- **In Bulgaria , there is no fund , supporting the investments in RES technologies. There are, however, different opportunities :**

    - The Kozlodui National Fund administrated by EBRD. Financial support could also be gained for usage of RES (for example wind/water generated energy, biomass, solar energy)The support could be a grant or partial financing in other structures for co-financing with other appliers for loans.
    - Usually the owners of projects with RES are granted a 20% discount from the principal sum of the loan after the completion of the project.
    - The USAID program and some banks (credit lines). This USAID program guarantees 50% of the credit. As well as that, a consultant helps the customers to design their own project.

- **Administrative support and obstacles:**

    - There is a lack of financial resources in the budgets of the government and local authorities for the construction of small plants fueled by local RES.
    - The decentralization of government management and greater autonomy for local and regional authorities will lead to development of their natural resources, because their benefits are: economical development, improvement of local environment and increased employment.

- **Market obstacles:**

    - Underdeveloped commercial grid and the related commercial activities;
    - Lack of qualified technical maintenance;
    - Need for information campaigns ;
    - Lack of authorized laboratories for quality control.

5. Opportunities, assisting RES:

- Increasing concern for the preservation of the environment RES are considered a clean source of energy in the future.

- From 01.07.2007 the energy market is liberalized.

CONCLUSIONS

- In Bulgaria "the Renewable Energy Sources and Biofuels Law" was passed on 7 th June 2007.In this Law the main directions for the government's support for the generation of energy from RES are outlined. The corresponding rules and regulations for the enforcement of the Law are still to be published. One of the main conclusions is:

The lack of detailed rules for the connection of small plants using RES to the distribution grid in order to account for the specifics was imposed by the different technologies.

• **Another important point is the decentralization and the different locations of RES plants. Besides, it has to be mentioned that:**

• The inconsistent generation of energy, due to the dependence on meteorological conditions;

• Non-regulated generation;

• Reversed power flows in the power system.

• **The connection contracts should include conditions for the technical characteristics of the energy system and the working conditions of RES plants.**

• Voltage variation;

• Frequency variation;

• Overrating voltage;

• Connection and Disconnection;

• Harmonics.

• **The connection requires the construction of the necessary link from the plant to the point of connection to the distribution grid. The distribution grid should have the required characteristics beyond the point of connection. For the construction of this link certain investments are required. Here it has to be mentioned that that the following is required:**

• Rules for correct calculating of the connection expenses;

• Fair distribution of the connection expenses.

• **With mass introduction of small generators, the electrical energy grid, demands for large investments for:**

• New lines or strengthening of the existing ones;

• Reserve powers;

• Frequency and voltage regulation;

• Relay for protection and automatics.

• **From 01.07.2007 The Bulgarian electrical energy market is fully open. This will inevitably affect upon the small producers with more expensive energy.**

• **At the present moment the procedure for the connection of small RES Plants to the distribution grid is:**

• The energy producer gives a written request for connection to the distribution grid to the respective distribution company. Producers with power up to 5-6 MW are connected to the distribution grid at 20 kV;

• After the distribution company examines each request individually, it determined the requirements for the connection;

• The requirements for the connection are determined by Regulation 6 from 09.06.2004 "Connection of producers and users of electrical energy to the transmission and distribution grids".

• **The distribution companies are conservative when it comes to connecting small RES plants, due to:**

• The compulsory purchase of the generated electrical energy at preferential prices. In this case the, higher cost of the energy is covered by the consumers of the respective distribution company, not by all the consumers in the country;

• The definition and the decisions for the automatics of each small RES plant, being determined for each case separately;

• The compulsory investment of additional funds for the strengthening of the grid to the point of connection of the small RES plants;

• **The purchase of electrical energy generated from RES should be carried out by a single buyer. This is due to the fact that, the higher cost of the electrical energy is to be covered by all the consumers, not just those in the given area.**

• Bulgaria has an "Environmental Energy Producers Association". This Association should pose the question of preparing Rules for simplified conditions and procedures for access of small RES plants to the distributional company, before The State Energy and Water Regulatory Commission.

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7.4. CROATIA

INTRODUCTION

National policy

The Energy Strategy outlines the energy policy and planning of the development of the energy sector In Croatia. The Energy Strategy deals with: ensuring the secure and reliable supply of energy and its efficient generation and use, specifically the use of different renewable energy resources, care for the environment in performing all energy activities; promotion of competition in the energy sector on the principles of non-discrimination and transparency; protection of energy consumers; the connection of the Croatian energy system or its parts with the European energy systems or the systems of other countries by taking into account economic development trends and energy needs; drawing up National Energy Programmes, capital investments, incentives for investments in renewable energy resources and energy efficiency programmes and implementation of measures for environmental protection.

The Ministry of Economy, Labour and Entrepreneurship, in the Regulation on a minimal share of incentivized electricity production from renewable energy sources and cogeneration, has set a goal to achieve 5.8% as the minimum share of electricity produced from RES in total consumption in Croatia by 31 December 2010. Since "green energy" includes the electricity generated by hydropower plants, about 50% of electricity generated in Croatia comes from RES.

However, since the share of other RES is minimal, the intention is to incentivize electricity production from RES through support mechanisms.

	Installed thermal capacity	**Thermal energy production**	**Installed electrical capacity**	**Electricity production**
Solar	N/A	N/A	49,96 kW	49,1 MWh
wind	0	0	17,15 MW	19,0 GWh
biomass	512,0 MW	14,77 Pj**	2,0 MW	6,0 GWh
small hydro	0	0	32,76 MW	109,6 GWh
Geothermal	113,9 MW	0,56 PJ	0	0
Total	**625,9 MW**	**15,33 PJ**	**51,96 MW**	**134,6 GWh**

In accordance to EU commitments, the Ministry of Economy, Labour and Entrepreneurship, in the Regulation on a minimal share of incentivized electricity production from renewable energy sources and cogeneration, has decided to achieve a minimal share of 2% of electricity produced from cogeneration in total electricity consumption in the Republic of Croatia by the 31 December 2010.

Present situation in RES in Croatia

Croatian electricity production from renewable energy sources is largely dominated by hydropower, with a minor contribution from wind power, solar energy and biomass. Croatia has not yet set itself a target to increase the share of electricity from renewable energy sources in total electricity consumption, but a draft regulation is expected to bring the share of electricity produced from incentivised renewable energy sources up from **0.8% in 2004 to approx. 5.8% in 2010**. For the purpose of providing incentives, Croatia does not take into account RES electricity from large hydropower (capacity of 10 MW or more). However, Croatia states that if one includes large hydropower plants calculated on the basis of their ten-year average production (6092 GWh), Croatia's share of RES electricity in 2005 amounted to 34.7% and is foreseen to increase to 36.0% in 2010. Croatia states that due to the short time for implementing its incentive mechanism, it does not consider as realistic to define a more ambitious target than 5.8% for the share of electricity generated from incentivised RES by 2010.

Table: Renewable energy sources in Croatia in 2006 (without large hydropower stations)

National legislation

Energy sector regulation in Croatia is set by the following legal documents:

- Energy Act (Official Gazette 68/01)

- Act on Amendments to the Energy Act (Official Gazette 177/04)
- Electricity Market Act (Official Gazette 177/04)
- Act on the Regulation of Energy Activities (Official Gazette 177/04)

Energy related secondary legislation

- Ordinance on Acquiring the Status of Eligible Electricity Producer (Official Gazette 67/07)
- Tariff System for the Production of Electricity from Renewable Energy Sources and Cogeneration (Official Gazette 33/07)
- Electricity Market Rules (Official Gazette 135/06)
- Grid Code (Official Gazette 36/06)
- General Conditions for Electricity Supply (Official Gazette 14/06)

INTERCONNECTION RULES

1. **Eligible renewable /other technologies:**

☒ biogas

☐ wood gas

☒ photovoltaic

☒ cogeneration

☐ oil

☐ steam power plant

☒ hydro

☐ wind

☒ incinerator

☐ gas

☐ others: ………………………………………………………………

2. **Applicable sectors:**

☒ housing

☒ services

☒ health and social facilities

☒ school and educational facilities

☒ small businesses

3. **Limit on System Size/Overall Enrollment**

Power stations of the total capacity of up to and including 500 kW are connected to the low voltage network. Power stations of the total capacity in the range of 500 kW up to and including 10 MW are connected to the medium voltage network (10, 20,30 and 35 kV).

4. **Rules for net metering systems:**

Rules for net metering systems are set in General Condition for Electricity Supply and the Grid Code.

General conditions

Energy undertakings can start carrying out an energy activity only on the basis of a licence that allows them to carry out such activity. The Licence is issued by the Energy Regulatory Council. The Licence is not required in case of the generation of electricity for one's own use or when the electricity is produced in facilities not exceeding 5 MW.

On the web pages of Croatian Energy Regulatory Agency (CERA) a list of issued licences to carry out energy activities is available. According to this list CERA has issued the licence to carry out the electricity supply to the following companies:

- HEP-Opskrba d.o.o.
- KORLEA d.o.o.
- HEP-Operator distribucijskog sustava d.o.o.
- HEP-Toplinarstvo d.o.o.

According to secondary legislation concerning the renewable energy sources and cogeneration the proceeding for obtaining the status of eligible producer and the right to purchase electricity at an incentive price is the following:

- Preliminary Energy Approval for construction of a new plant (issued by the Ministry of Economy, Labor and Entrepreneurship);
- Energy Approval for construction of a new plant (issued by the Ministry of Economy, Labor and Entrepreneurship);
- Preliminary Grid Connection Contract or Grid Connection Contract (concluded with Croatian Distribution System Operator HEP-Operator distribucijskog sustava d.o.o. or Croatian Transmission System Operator HEP-Operator prijenosnog sustava d.o.o.);
- Preliminary Decision on status of eligible producer (issued by Croatian Energy Regulatory Agency, CERA);
- Decision on status of eligible producer (issued by CERA following the plant construction).

In case of a solar power plant of capacity up to 30 kW, such as solar power plant on a family house, a Preliminary Energy Approval is not required.

After obtaining a Preliminary Energy Approval the eligible producer shall sign Electricity Purchase Contract with HROTE. The Contract takes immediate effect from the validity date of the Decision on status of eligible producer.

Connection to the grid

The preliminary conceptual design required for issuing the location permit for the building to be connected to the grid shall include the following data required for issuing the provisional connection authorization:

- maximum import capacity of the connection
- production category and tariff model
- deadline for connecting
- rated power and characteristics or electricity production facilities

- anticipated annual electricity production
- other data (e.g. technical data on the private supply source, data on existing metering point, etc.)

The producer shall submit together with the application for issuing the connection authorization the following data and documents to the transmission system operator or the distribution system operator:

- details on the owner of the building
- address of the building
- reference number of the provisional connection authorization and its date of issue
- reference number of the connection contract and its date of conclusion
- production category and tariff model
- building permit or another appropriate document on the basis of which the building can be constructed
- part of main design or of the detailed design relating to the producer's electric power facilities and installations
- confirmation by the contractor that the producer's electric power facilities and installations have been built and tested pursuant to the provisional connection authorization, the design documentation and technical regulations and standards, with an explicit statement by the contractor that the said facilities and installation my be connected to the grid as well as the required prof of quality
- evidence of payment for the costs of issuing the connection authorization.

The transmission or distribution system operator may reject the application for issuing the provisional connection authorization in case of technical or operational constraints in the grid. If so, they must notify the applicant thereof stating the reasons of refusal.

The (provisional) connection authorization shall include following:

- details on the investor/owner of the building
- name, type, address, and reference number of the land plot of the building to be connected to the grid
- point of connection of the building to the grid
- maximum import capacity
- type and method of execution of the connection
- production category and tariff model
- technical conditions of the charging metering point
- deadline for connecting
- economic conditions
- conditions significant for the location of the building relative to the site of the existing electric power facilities and future ones envisaged by the physical plan currently in force
- rated voltage at the charging metering point

- permissible power factor (cos Φ)
- conditions for grid usage
- other data (e.g. technical data on the private supply source, data on existing metering point, etc.)
- validity of the provisional connection authorization
- conditions for termination of validity
- instructions concerning the right to complaint

In addition, it may include following:

- technical conditions prevailing at the site of the building
- parameters of the grid to which the building is to be connected, or maximum and minimum three-pole short circuit current and single-pole short circuit or earthing current
- equipment to be installed or reconstructed in order to install the connection
- possible variations in voltage quality parameters exceeding those prescribed
- permissible reverse impact on the grid
- technical safety system in the grid and in the producer's building
- rated current of the current load limiter
- sort, type, accuracy, class, measuring range, place and the method of installation of the metering equipment
- type and calibration of the safety euipement
- operational and metering data and the method of exchange thereof
- method of demand management
- technical conditions relating to private sources of electricity supply
- anticipated time of connecting
- expected annual electricity production pattern
- the obligation to conclude the contract on the producer's operations
- program for mandatory testing of electric power facilities and installation of the producer prior connecting.

Maximum import capacity of the connection specified in the provisional connection authorization or in the connection authorization shall by approved by the transmission or distribution system operator based on the request of the producer and on technical or operational conditions in the grid, while use shall be made conditional upon installation of the import capacity measuring device for connected import capacity above 30 kW or upon installation of the current load limiter at maximum import capacity up to and including 30 kW.

The transmission or distribution system operator shal:

- elaborate and procure the documentation needed for connection
- achieve technical conditions in the grid
- install connection

- outfit the metering point
- perform necessary tests
- energize the connection
- maintain the connection at its own expanse
- replace the connection at its own expanse where necessary, save when replacement is requested or caused by the producer.

The connection of the building site shall, as a rule, be effected as a part of the connection of the building, in which case the customer shall, apart from the connection fee, bear any other additional costs related to the connection to the building site.

If during the billing period a producer consumed the import capacity exceeding the connected one, the system operator shall urge him in writing to bring down the import capacity use to the limits of the connection maximum import capacity or to apply for granting the provisional connection authorization.

The connection contract shall be concluded between the transmission or distribution system operator and producer in the procedure of connecting to the grid or increasing the maximum import capacity of the grid. The content of the contract is set In General Conditions of Electricity Supply.

The producer's network usage contract shall be agreed for an indefinite period of time by the transmission or distribution system operator and the producer. The contract shall include:

- particulars on parties to the contract
- subject of the contract
- billing address
- reference number and the date of issue of the connection authorization
- details of connected capacity and other energy values
- level of quality of electricity supply
- level of permissible reverse impact on the grid
- cases in which the contractual level of quality of electricity supply may undergo change
- conditions for accessing the metering point and reading
- conditions for usage and calculating the balancing energy
- method of acquisition, transfer and validation of metering and calculation data
- calculation of the charge for metering services
- calculation of variations from the contractual energy values
- conditions under which the customer is obliged to resort to energy saving or restriction in delivery of electricity and capacity ensuring from the contract
- description and type of business data subject to confidentiality
- reporting and data exchange
- method of ascertaining and estimating damage in the case of failure to perform the contract or irregularities in the performance of the contract

- other mutual obligations
- details of the contract duration, termination and the period of notice
- method of settling dispute

NET METERING RULES

Electrometer, measuring and directive devices

The transmission or distribution system operator shall provide a standard level of quality of electricity supply at a charging metering point of a grid user, in the accordance with the provision of General Conditions for Electricity Supply, the Grid Code and the condition approved by the Energy Regulatory Agency when enacting the development and construction plans for transmission and distribution grids.

The standard level of quality of electricity supply shall be demonstrated by indicators of voltage quality, reliability indicators of electricity supply and other indicators of electricity supply quality prescribed in the General Conditions.

The transmission and distribution system operator are bound to implement the provisions on voltage variations in low voltage grids in compliance with the Ordinance on standardized voltages for distribution low voltage electric grids and electric equipment.

The indicators of reliability of electricity supply are represented by the total frequency of all disruptions and the duration of all disruption in electricity supply at a single metering point during a calendar year.

The producer is responsible for the security, operation and proper working order of their electric power facilities and installations.

The electricity exported shall be metered using meters at the charging metering point of export of electricity. Each charging metering point shall be fitted with metering equipment consisting of meters and other metering equipment specified in the connection authorization.

The meters shall comprise:

- electricity meters
- voltage and instrument transformers
- time switches
- measuring and connecting power lines and terminals
- security devices
- electric load limiters
- tariff control devices
- communication devices
- overvoltage protection devices for metering and communication devices
- other

The transmission or the distribution system operator shall for each metering point establish technical characteristics of the meters and other metering equipment, the place and method of installation thereof, fully in accordance with the Metrology Act, ordinances governing metrology requirements for individual types of metering equipment and the Grid Code.

The characteristics and the structure of meters and other metering equipment for charging metering points of individual producers shall be determined in the Grid Code and in the technical conditions for charging metering points.

Meters in accounting points at generator site shall have at least the following standard characteristics, and shall be of the following accuracy class:

a) at low voltage, direct metering :

- With peak capacity metering,
- Active power meter, accuracy class 1 with bi-directional metering, reactive power meter, accuracy class 2 with bi-directional metering in four quadrants.

b) at low voltage, semi-direct metering :

- Current transformer, accuracy class 0,5, safety factor 5,
- Active power meters, accuracy class 1 with bi-directional metering, reactive power meters, accuracy class 2 with bi-demensional metering in four quadrants,
- Storing load curves
- Data collection via system for the collection of metering system.

c) at medium voltage for all generators with connection capacity of up to and including 5 MW:

- Indirect metering
- Voltage transformers, accuracy class 0,5
- Current transformer, accuracy class 0,5 safety factor 5,
- Active power meters, accuracy class 1 with bi-directional metering, reactive power meters, accuracy class 2 with bi- demensional metering in four quadrants,
- Storing load curves
- Data collection via system for the collection of metering system.

Minimum technical documentation for the connection to the transmission system

Facility / documentation	Beginning of negotiations on the transmission system connection agreement	Beginning of power station and switchyard construction	Beginning of the commissioning program	Power station/switchyard acceptance by the Transmission System Operator
1. Power station				
Basic technical data on a power station: - nominal active power - nominal apparent power - power station type	Concept description First issue of the technical documentation	Revised technical documentation	Revised technical documentation	Revised technical documentation
Location of power station facilities on site	First issue of the technical documentation	Revised technical documentation		Revised technical documentation
Single line diagram: - connection to transmission system - power station's auxiliary consumption with basic data on generator, unit transformer and auxiliary supply transformers	First issue of the technical documentation	Revised technical documentation	Revised technical documentation	Revised technical documentation
Generator output diagram		First issue of the technical documentation		Revised technical documentation
Chart of generating unit protection with settings and block diagram of the generating set control system		First issue of the technical documentation	Revised technical documentation	Revised technical documentation
All information required for analysis of steady and dynamic system states		First issue of the technical documentation	Revised technical documentation	Revised technical documentation
Power station-network communication devices		First issue of the technical documentation	Revised technical documentation	Revised technical documentation
Power station operation - basic/mean/peak load - planned active power schedule - planned reactive power schedule - deduction of heat for district heating Operation during network unavailability - safe tripping onto auxiliary supplies - black start capability	First issue of the technical documentation	Revised technical documentation	Power station commissioning program	1. Revised technical documentation 2. Acceptance testing 3. Monitoring and evaluating unit behavior under disturbance conditions
-Participating in frequency maintenance -Primary/secondary control - Minutes reserve -Power station participation in restoration of supply	First issue of the technical documentation		Power station commissioning program	Revised technical documentation Acceptance testing

Costs for metering devices

Applicant pays the fee for issuing the connection authority, connection to the grid and for increasing the maximum import capacity.

Connection of the building with at least four housing and/or business units may comprise the external part, which consist of the power line running from the point of connection to the grid up and including the connection cabinet of the building and the internal part comprising the power line running from the connection cabined of the building up and including meter cabinets within the building with no metering at the charging metering point.

The transmission system operator or the distribution system operator is the investor in the connection and for connections comprising the external and the internal part, the distribution system operator shall be the investor in the external part connection and the metering equipment.

SAFETY AND POWER QUALITY REQUIREMENTS

REQUIREMENT	VALUE	REFERENCE STANDARD OR GUIDE
PROTECTION REQUIREMENTS		
Protective devices in electric power facilities and installations of the producer shall be designed in accordance with the valid technical regulations, Croatian standards and the provisional connection authorization. The electric power facilities and installations of the producer shall be designed, maintained and operated so that their reverse impact on the grid or interruptions and interferences are kept within the limit which do not jeopardize the prescribed quality level of electricity supply. The producer shall take all the requested measures and bring the disturbances within the limits specified in the connection authorization or the grid usage contract, the transmission or distribution system operator may ultimately resort to the measure of switching off the electricity supply.		
Is an external accessible disconnecting switch mandatory?	yes	General Condition
What is the acceptable range of AC voltage for operation of DER?	In normal operating conditions voltage level is maintained within the limits given bellow: In the 400 kV network: 400 – 10% +5% = 360-420 kV In the 220 kV network: 220 ± 10% = 198-242 kV In the 110 kV network: 110 ±10% = 99-121 kV In operation under disturbance conditions voltage level can be within the limits give below: In the 400 kV network: 400 kV ± 15% = 340-460 kV In the 220 kV network: 220 kV ± 15% = 187-253 kV In the 110 kV network: 110 kV ±15% = 94-127 kV Permissible deviation from nominal value in normal operating conditions except	Grid Code

Is monitoring of voltage of each phase required?	Voltage control is a system service securing safe and quality electricity supply for which the Transmission System Operator is responsible.	Grid Code
What is the maximum allowed time for disconnection of DER in case of a voltage out of range event	NA	
What is the acceptable range of frequency for operation of DER	In interconnected operation, when the frequency drops to 49 Hz begins system operation under extraordinary conditions. In normal operating conditions permissible frequency deviation from the nominal value (50 Hz) is ±50mHz. Maximum deviation from the set value, in temporary stationary state, in interconnected operation shall no exceed ±180mHz. Momentary frequency deviation from the nominal value shall not exceed ±800mHz. Frequency deviation from the set value exceeding ±20mHz shall be corrected through the operation primary regulation. Underfrequency load shedding as a measure of frequency drops bellow 49,2 Hz.	Grid Code
What is the maximum allowed time for disconnection of DER in a case of a frequency out of range event	NA	
What is the minimum time for reconnection after a disconnection of DER	NA	
Other protection requirements	Generating unit may be disconnected at frequencies lower than 47,50 Hz, asynchronous operation, at temporary steady system voltages lower or equaling 80% of the nominal voltage	

IMPACT ON GRID-POWER QUALITY		
What is the allowable variation of voltage at LV side of LV/MV transformer, due to DER connection	Transformers should be automatically controlled at least with degrees ±10 x 1,5 % at low voltage grid and ±2 x 2,5 % at medium voltage grid. Declared limits of deviation from the nominal voltage level in normal operation are the following: For low voltage +6%/-10% (by 2010) and ±10% (after 2010)	
What is the limit of harmonic current emissions of DER	The total harmonic distortion factor caused by either generator or user connection at the withdrawal and injection point shall typically amount to at most: ▪ 1,5% at 400 kV and 220 kV ▪ 3% at 110 kV ▪ 2,5 % at 0,4kV ▪ 2% at 10 and 20 kV ▪ 1,5% at 30 and 25 kV	Grid Code
What is the limit of the voltage fluctuations and flicker for DER	Planned values of flicker exceed 0,7 for short term flickers and 0,5 for long term flickers	Grid Code
Requirements regarding power factor		The producer shall take all the measures to maintain the power factor within the limits specified in the connection authorization or the grid usage contract (General Condition)
Other requirements for impact on grid-power quality	Limit load values for generating units are between the minimum stable generation and available capacity of generating unit.	

	Connecting a power station with synchronous generators in parallel operation with the distribution system requires the use of synchronizers, under following condition: - voltage difference below ±10% of nominal voltage, - Frequency difference below ±0,5 Hz (for wind farms: ±0,1 Hz) - Difference of phase angle below ±10 degrees	

<u>Additional technical requirements for the connection of micro power station</u>

Technical requirements for the connection of micro power station shall be passed by the Distribution System Operator.

Micro power stations are those power stations that meet the following criteria:

- Connected to the low voltage system (single-phase and three-phase),
- Connected within a customer facility
- Electricity generation intended for auxiliary consumption,
- Electricity surplus is injected in the system,
- Total nominal capacity of up to and including 5 kW for a single-phase connection,
- Total nominal capacity of up to and including 30 kW for a three-phase connection.

A micro power station shall meet the following minimum criteria at the interface with the system:

- Measuring peak load in direct measuring, or measuring load curve, including the possibility of remote data collection in semi-direct metering,
- Active and reactive power metering in both directions,
- Possession of a disconnector.

Other technical and operating conditions shall be defined by the Distribution System Operator depending on the primary energy form, micro power station technology, as well as the consumption type and category.

FINANCIAL AND SUPPORTING SCHEMES

In accordance with Article 13, Paragraph 3 from the Tariff System for the Production of Electricity from Renewable Energy Sources and Cogeneration and with the Article 8 from the Electricity Market Rules, eligible producers shall sign Electricity Purchase Contract with HROTE at incentive price and that shall not be considered electricity trade. Eligible producers who produce electricity from RESCO not having the Electricity Purchase Contract concluded with HROTE shall be on the electricity market considered equal to all other producers who sell electricity produced in their own facilities.

The duration of the Contract is 12 (twelve) years and is defined by the Tariff System for the Production Electricity from Renewable Energy Sources and Cogeneration.

The price of electricity produced from RESCO, for producer who obtained status of eligible producer and concluded Electricity Purchase Contract with HROTE, is defined by the Tariff System for Production of Electricity from Renewable Energy Sources and Cogeneration.

Different options are available for the implementation of such a project in Croatia, which can be generally divided into the following:

- financial support for research, preparation of RES projects, construction and testing of a plant using RES, etc.,
- financial support after the plant has been built and connected to the electricity system.

Regarding the first option information can be found on the websites of Environmental Protection and Energy Efficiency Fund (Fond za zaštitu okoliša i energetsku učinkovitost) and Croatian Bank for Reconstruction and Development (Hrvatska banka za obnovu i razvitak).

For the electricity supplied from its plants to the power system eligible producer can conclude an electricity purchase contract with HROTE. Based on the contract, HROTE will pay to the eligible producer an incentive price according to the Tariff System for Electricity Production from Renewable Energy Sources and Cogeneration.

Tariff system for the production from RES (source - Croatian Energy Market Operator (HROTE)

Feed in tariff system for RES (feed-in), (€cents /kWh) after 2007			
		<1 MW	>1MW
Solar	< 10 kW	44,2	
	10 – 30 kW	39	
	> 30 kW	27,3	
Small hydro	<5000 GWh/y, < 10 MW	8,97	8,97
	5000 – 15000 GWh/y		7,15
	> 15 000 GWh/y		5,46
Wind		7,68	8,45
Biomass	Forestry and agriculture	15,6	13,52
	Wood industry	12,35	11,0
Geothermal		17,26	16,4
Biogas		16,38	13,52

Tariff system for the production from RES (source - Croatian Energy Market Operator (HROTE)

	(€cents /kWh) after 2007	
	HT	LT

Cogeneration plants with installed power up to and including 50 kW, so-called micro-cogeneration units and all cogeneration plants using hydrogen fuel cells	7,93	4,16
Cogeneration plants with installed power exceeding 50 kW and up to and including 1 MW, so-called small scale cogeneration units	6,63	3,38
Cogeneration plants with installed power exceeding 1 MW up to and including 35 MW, so-called medium scale cogeneration units connected to the distribution network	5,72	2,86
Cogeneration plants with installed power exceeding 35 MW, so-called large scale cogeneration units, and all cogeneration plants connected to the transmission network	3,9	2

Note: Higher (HT) and lower (LT) daily tariff items

The other financial supports to RES projects

The other kinds of support refer to financial programmes through:

- Environmental Protection and Energy Efficiency Fund
- Croatian Bank for Reconstruction and Development(through International Bank for Reconstruction and Development)

Conclusion

- New legislation on RESand cogeneration in Croatiawith the remuneration system as the payment to eligible producers for electricity producedin their facilities and feed into electricity gridare warmly welcomed by investors;
- Some improvements in legislation are necessary (too low cap for PV systems, administrative and grid barriers);

Information sources:

www.hrote.hr

www.hep.hr

www.pv.pl

General Conditions for Electricity Supply

Grid Code

7.5. CYPRUS

INTERCONNECTION RULES

Eligible renewable /other technologies: PV

Applicable sectors: All sectors

Breakpoint for Small System (Simplified Rules): 20 kW

Rules for net metering systems: yes

Authority 1: EAC (Electricity Authority of Cyprus) as acting DSO, Technical Instruction KE1/33/2005

Limit on System Size/Overall Enrollment: No limit

(single phase or multiple phase)
Standard Interconnection Agreement: Yes

Additional Insurance Requirements: Not allowed for systems eligible for net metering

External Disconnect Required: Yes

Rules for non net-metered DG: Not allowed for PV systems connected to the grid

Date Enacted: 1/11/2005

Effective Date: 7/11/2005

Expiration Date: NA

Summary:
The initial application for interconnection of a PV system - integrated in an already electrified facility (house, etc) - is done by the PV producer to the EAC. The applications for PV systems have priority from the regular electricity applications and are investigated immediately. The position of the future PV metering unit is agreed at a site visit by the PV producer, the electrician and the EAC personnel. The metering unit for the PV system must be separate from the traditional metering unit for the electricity consumption of the facility. The two meters must be in the same location for ease of monitoring. The monitoring takes place every two months.

After agreement on the location of the PV metering unit, EAC Commercial unit prepares the official PV system Interconnection rules which must be accepted by the PV producer in order for the process of interconnection to proceed further.

The Interconnection rules include the following:

- Description of the location size and other technical requirements that are required by the EAC for the installation of the single phase PV metering unit. All expenses for the construction and positioning of the PV metering unit are to be undertaken by the PV producer.
- The official EAC technical rules that apply for approval of a PV system interconnection to the distribution grid.
- The formal acceptance of the PV producer of the EAC rules for interconnection and the acceptance of the subsidy to be received from EAC. EAC will provide the agreed subsidy to the PV producer as long as the technical rules of interconnection are not violated. A contract will be signed for a 15 year duration that can extend to another 5 years if requested by the PV producer. The current subsidy by the EAC is set by CERA (Cyprus Energy Regulatory Authority) at 6.32c€ per kWh. This subsidy may be revised by CERA each year. On top of this subsidy, and as explained previously, the PV producer will be receiving subsidy by the Government payable to him by EAC (EAC will deduct this amount from its other payables to the Government). If the EAC subsidy is reduced by CERA during this 15 year period, the Government subsidy will be automatically adjusted so that the total amount of subsidy remains the same during the whole 15 year period.

After agreement and signature of the Interconnection rules, a formal copy of the signed Interconnection rules is given to the PV producer so that he can include it in his application for subsidy from the Government (Ministry of Commerce, Industry and Tourism) under the Governmental schemes. Only after the initial approval for the Government subsidy, the PV producer may begin with the PV system implementation. The Ministry of Commerce, Industry and Tourism will be responsible for the supervision of the PV system implementation so that the final PV system will be in accordance to the requirements of the Governmental subsidy scheme. A license from the Department of Town Planning and Housing is also necessary for the PV system implementation unless a special waiver is provided.

After the PV system is implemented, the PV produced must apply again to the EAC for the PV system final inspection for interconnection approval. In this application, the PV producer must also enclose the following documents:

- Initial approval by the Ministry of Commerce, Industry and Tourism for subsidy under the RES subsidy schemes
- License for the PV system installation by the Department of Town Planning and Housing (a license waiver can be provided in certain cases)
- All the technical standards for the specific PV system as published by the PV manufacturer
- Copy of the Declaration of Conformity of the manufacturer to the European standards for the equipment used in implementing the PV system

During the inspection, EAC will ensure that all the technical rules for the Interconnection of PV system in the distribution grid apply. The PV system implementation must be in accordance to the European standards 73/23/EEC (Electrical Apparatus Low Voltage Directive), 89/336/EEC (Electromagnetic compatibility) and 93/68/EEC (CE Marking) and also to be accompanied by the Declaration of Conformity by the PV manufacturer for the equipment to be used.
The connection of the PV system to the distribution grid must be in accordance to the interconnection diagram (Figure 1). The technical rules are described in Section D of this questionnaire. In addition, some other technical rules are:

- No grounding of the inverter AC neutral while the PV system is synchronized to the grid.
- The area of responsibility of EAC ends just after the two metering units

In the cases where the facility is not already electrified, then two separate applications to the EAC must be made. Two separate rules of Interconnection will be made one for the facility (e.g. house) and one for the PV system. The remaining procedure is then the same as explained above.

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NET METERING RULES

Eligible renewable/Other Technologies: PV
Applicable Sectors: All sectors

Limit on System Size: 20 kW

Limit on overall Enrollment: No limit on overall enrollment

Treatment of Net Excess:

The amount of kWh produced and are fed to the Distribution grid are multiplied by the amount of 6.32c€ (see next section) which is the EAC subsidy per kWh. The same amount of kWh is also multiplied by the amount of 14.18c€ or 31.95c€ (depending on the subsidy option chosen from the schemes of the Government -Cyprus Institute of Energy CIE –see Section C). The total amount (either 20.5c€ or 38.27c€ per kWh) is then sent by the EAC to the customer in the form of a checque to his name within 30 days from the date of the last monitoring of the PV meter. This checque, the customer can deposit in his banking account. EAC may also deposit the amount directly to the customer's selected banking account. EAC will deduct the amount that it paid to the PV producer on behalf of the Government from its payables to the Government each year.

Utilities Involved: EAC

Interconnection Standards for Net Metering: Yes

Authority 1: EAC as acting DSO Technical Instruction KE1/33/2005

Website: http://www.eac.com

Date Enacted: 1/11/2005

Effective Date: 7/11/2005

Summary: (max 1000 words)

In addition to the application and payment procedure already described in Section A above, the following rules apply to the net metering interconnection:

- The acting DSO (EAC) has the right to continuous and unlimited access to the metering units location within the PV producer's property. This is required in order to allow for the monitoring, repair and replacement of the metering units if necessary.

- The acting DSO has the right to randomly check the accuracy and the operation of the PV metering unit and also check the PV system's power factor. In case of power factor divergence from the range dictated in the technical interconnection rules, EAC will request corrective measures on behalf of the PV producer.

- No kWh estimations, based on previous values, are allowed to be made regarding the PV power supplied to the grid. EAC operators have to visit the metering unit once every two months and record the actual readings of the unit. However, if the metering unit stops recording, the PV power supply to the grid has to be estimated based on previous values

- In the case that either EAC or the PV producer has any doubts regarding the accuracy of the PV metering unit, these have to be expressed to one another in writing and the metering will be checked. In case a fault is found, each party has to pay back the amount for owed with the current daily interest rate.

- In case of delay of payment by the EAC to the PV producer, the payable amount will be charged with the current daily interest rate.

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FINANCIAL AND SUPPORTING SCHEMES

Title: Grant Scheme for the Promotion of Renewable Energy Sources Utilization

Incentive type: Feed in Tariff/Investment subsidies

Eligible renewable /other technologies: Photovoltaic, Small Wind

Applicable sectors: Physical or legal entities that do not exercise economic activity

Terms, budgets and requirements: see summary below
System sizes: see summary below
Authority: Cyprus Institute of Energy (under the Ministry of Commerce Industry and Tourism)

Summary:
The support Scheme for the promotion of RES for individuals and organisations to the extent that they do not exercise economic activity covers investments, regarding the electricity production, in the following main areas:

- Wind Energy
- Photovoltaic

Wind energy category refers to small wind energy systems with generating capacity up to 30 kW. The subsidization for such systems reaches 55% of the eligible capital costs with a maximum grant of €51,258. Furthermore, EAC will pay 6.32€c/kWh produced and supplied into the electricity network.

For small PV systems with generating capacity up to 20 kW connected to the network the total amount of subsidy will depend on the supplier's choice. He can either receive 55% subsidy on the investment cost with the maximum grant being €64,929 and a further 20.50€c/kWh subsidy on the produced energy, or he can choose to receive increased subsidization on the produced energy of the order of 38.27€c/kWh with no subsidy for the purchase and installation cost. EAC will contribute 6.32€c/kWh produced and supplied into the electricity network while the remaining subsidy

(14.18€c/kWh in the first case and 31.95€c/kWh in the second) will come from the Special RES Fund set up by the Government.

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SAFETY AND POWER QUALITY REQUIREMENTS

COUNTRY: (Cyprus)

REQUIREMENT	**VALUE**	**REFERENCE STANDARD OR GUIDE** (including link)
PROTECTION REQUIREMENTS		
Is an external accessible disconnecting switch mandatory?	YES (description: visible disconnecting switch with safety in the isolation position)	BS EN60947
What is the acceptable range of AC voltage for operation of DER?	230V +-10% (after 31/12/2009) 230V +10%, -6% (up to 31/12/2009)	EN 50160
Is monitoring of voltage of each phase required?	No (EAC is allowed to randomly check the inverter)	NA
What is the maximum allowed time for disconnection of DER in case of a voltage out of range event	5 secs	
What is the acceptable range of frequency for operation of DER	50 Hz +-1%	
What is the maximum allowed time for disconnection of DER in a case of a frequency out of range event	5 secs	
What is the minimum time for reconnection after a disconnection of DER	3 minutes	
Other protection requirements	Automatic disconnection of PV systems is mandatory	
IMPACT ON GRID-POWER QUALITY		
What is the allowable variation of voltage at LV side of LV/MV transformer, due to DER connection	+- 10% (after 31/12/2009 +10%, -6% (up to 31/12/2009)	EN 50160

<table>
<tr>
<td>What is the limit of harmonic current emissions of DER</td>
<td>
<table>
<tr><th>Harmonic</th><th>% voltage distortion LV</th></tr>
<tr><td>2</td><td>0.7</td></tr>
<tr><td>3</td><td>0.75</td></tr>
<tr><td>4</td><td>0.7</td></tr>
<tr><td>5</td><td>2.0</td></tr>
<tr><td>6</td><td>0.5</td></tr>
<tr><td>7</td><td>2.0</td></tr>
<tr><td>8</td><td>0.5</td></tr>
<tr><td>9</td><td>0.5</td></tr>
<tr><td>10</td><td>0.5</td></tr>
<tr><td>11</td><td>1.5</td></tr>
<tr><td>12</td><td>0.5</td></tr>
<tr><td>13</td><td>1.5</td></tr>
<tr><td>14</td><td>0.5</td></tr>
<tr><td>15</td><td>0.5</td></tr>
<tr><td>16</td><td>0.75</td></tr>
<tr><td>17</td><td>0.75</td></tr>
<tr><td>18</td><td>0.5</td></tr>
<tr><td>19</td><td>1.0</td></tr>
</table>
</td>
<td>EN 50160</td>
</tr>
<tr>
<td>What is the limit of the voltage fluctuations and flicker for DER</td>
<td>For Wind Parks:
P_{st}=0.35 and P_{lt}=0.35

For other DG:
• Frequency of flicker events: 0.22 – 600 per minute, P_{st}=0.7 and P_{lt}=0.5
• Frequency of flicker events: 0.02 – 0.22 per minute, maximum allowed value is 3%
• Frequency of flicker events: <0.02 per minute, maximum allowed value is 5%</td>
<td>IEC 1000-3-7</td>
</tr>
<tr>
<td>Requirements regarding power factor</td>
<td>The power factor of DG units connected to the distribution grid (if these DG units have inductive generators) must be 0.95 lagging to 1.00 leading. If the DG generators are synchronous then these must be operated with a power factor that is agreed with the DSO. Typically, these generators must operate with a</td>
<td></td>
</tr>
</table>

	power factor between 0.85 lagging and 0.95 leading.	
Other requirements for impact on grid-power quality		
PV SPECIFIC REQUIREMENTS		
Is an AC disconnecting switch mandatory for a PV plant	YES (with safety in the isolating position)	
What is the acceptable range for the settings of under-voltage disconnection	-10% (after 31/12/2009) -6% (up to 31/12/2009)	
What is the maximum allowed time for disconnection of a PV inverter in case of a voltage out of range event	5 secs	
What is the acceptable range of settings for under- over frequency disconnection	+-1%	
What is the maximum allowed time for disconnection of a PV inverter in case of a frequency out of range event	5 secs	
What is the minimum time for reconnection after a disconnection of a PV inverter	3 minutes	
What is the limit of the total harmonic distortion of current of a PV inverter		
Is an isolation transformer required for a PV inverter	No	
What is the maximum allowable DC current injected to the grid	5mA	
Is any special protection required for transformerless inverters	Overcurrent protection Fuses	
Is an anti-islanding protection for the PV inverter mandatory	YES	
What method of anti-islanding protection is acceptable	Under-frequency protection	

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7.6. CZECH REPUBLIC

Introduction

National policy

State Energy Policy of the Czech Republic

Resolution of the Government of the Czech Republic of March, 2004 No. 211.
The State Energy Policy's vision defines the basic priorities for creating the long-term development framework of the energy sector of the Czech Republic.

The basic priorities of the State Energy Policy:

Maximum independence

- Independence on foreign energy sources
- Independence on energy sources from risky regions
- Independence on reliability of supplies from foreign sources

Safety

- Reliability of supplies of all kinds of energy
- Energy sources safety including nuclear safety
- Reasonable decentralization of all energy systems

Sustainable development

- Environmental protection
- Economic and social development

Individual targets and measures

- achieving a 6% share of RES in total consumption of primary energy sources by 2010
- achieving at least an 8% share of electricity from RES in gross electricity consumption by 2010
- Promote investments in to the use of thermal energy produced from RES
- Act no. 180 of 31 March 2005 on Support for the electricity production from RES

Some environmental requirements on energy policy

- support greater utilization of renewable and secondary energy sources and potential savings through the Act on Support for Production of Energy from RES and in the framework the National Program for support of energy efficiency and use of RES, create conditions for greater use of RES in gross electricity consumption (8% in 2010, minimally 15% in 2030), create conditions for the gradual improvement in the fraction of RES in domestic consumption of primary energy sources at a level of at least 15% in 2030.
- Support scientific and technical developments towards sustainable energy production.
- Support the introduction of modern energy-production technologies with high efficiency and lowest possible external costs (e.g. fuel cells, heat pumps, photo thermal systems, central heating using biomass, cogeneration using biomass and biogas) and combined production of electricity and heat.
- Ensure access to distribution networks for decentralized production of electricity and heat.
- Support the construction of the necessary capacities for treatment of wastes suitable for processing into fuel, unless their material use is more advantageous and support the construction and use of suitable technologies for utilization of fuels produced from wastes.

National Program for the Energy Efficiency and the Utilization RES

Resolution of the Government of the Czech Republic of 2005 No. 884

National Program for years 2006 - 2009 is a mid-term document for achievement of objectives of **State energy policy of the Czech Republic**.

General priorities:

- maximization energy efficiency and utilization savings of energy
- higher utilization of renewable and secondary sources of energy
- higher utilization of alternative fuels in the transport sector

National Program is compatible with steps of EU and support realization of guideline requirements EU:

- Energy efficiency (Directive 2003/8/ES support of the cogeneration electricity and heat)
- Renewable sources energy utilization (Directive 2001/77/ES support of the electricity from RES in the internal market EU)
- Alternative fuels in the transport (Directive 2003/30/ES support of alternative fuels)

Indicative objectives of National Program: year-on-year to 2009

1. Maximization of energy efficiency and energy savings utilization:

	year-on-year to 2009
Total energy efficiency, savings of energy	a) average increase in efficiency minimally about 2,6%
Electricity / energy efficiency and savings of	average increase in efficiency minimally about

2. Higher utilization of renewable and secondary sources of energy:

	objective for year 2009
The share of RES in consumption of primary source of energy	minimally 5,6%
The share of RES in consumption of electricity	minimally 7,5%
Higher energy utilization domestic wastes	minimally 1,5 - 2 PJ/year

3. Higher utilization of alternative fuels in the transport:

	objective for year 2009
The share of bio fuels in consumption of fuels	minimally 5,6% energy volume
The share of gas in consumption of fuels	minimally 1,8% energy volume
Higher energy utilization domestic wastes	minimally 1,5 - 2 PJ/year

State Environmental Policy of the Czech Republic

The State Environmental Policy was adopted by Resolution of the Government of the Czech Republic of March, 2004 No. 235 and states the targets and measures for environmental improvement and also for increase of utilization of renewable energy sources and energy efficiency improvement.

Electricity balance in 2006 in the Czech Republic, Gross electricity production

	(GWh)	**(%)**
Thermal power plants [1)]	**55 009**	**65,2**
Hydro power plants	**3 257**	**3,86**
Wind power plants	**49**	**0,06**
nuclear power plants	**26 046**	**30,88**
Total	**84 361**	**100**

Note: 1) Including data of steam-gas cycle and co-generation units

Situation with solar energy technology (PV plants) in the Czech Republic

In 2007 was rapid development of large scale on-grid PV installations in the Czech Republic stimulated by favourable legislation, The total installed on-grid PV power increased seven times within a year, mainly due to large scale on-grid commercial solar power stations. The Feed-in Tariff guarantee period was extension for PV to 20 years for new equipments installed after 1.1. 2008 (until 2008 it was 15 years). It is expected, that the guarantee will further stimulate PV investments in the Czech Republic favouring installed power growth.

The cumulative installed PV power in 2005-2007

2005			**2006**			**2007**		
Off-grid	On-grid	Total	Off-grid	On-grid	Total	Off-grid	On-grid	Total
(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
178	292	470	194	546	740	197	5 269	**5 466**

National legislation

Legislative tools for the support of National program

- Energy act no. 458 of 28th November 2000 on Business Conditions and Public Administration in the Energy Sectors - priority purchase, transfer and distribution of the electricity from RES and cogeneration, obligatory purchase of heat from RES
- Act no. 406 of 25th October on 2000 Energy management - support for cogenerations, RES in Local Energy Conceptions, requirement of new guidelines EU
- Emissions Allowance Act no. 695 of 2004 - limitation of emissions greenhouse gas, market with allowance units
- Act no. 180 of 31 March 2005 on Support for the electricity production from renewable energy source - measure to reach indicative objective the share RES in consumption electricity

Energy Management Act

Act no 406/2000 Coll. on energy management stipulates the rights and obligations of natural and legal persons in the management of energy, in particular electricity and heat, as well as gas and other fuels. It shall contribute to the economical use of natural resources and protection of the environment, as well as to more efficient use of energy, enhanced competitiveness, more reliable energy supplies, and to the sustainable development of society.

The Energy management act defines many obligations to government, ministries, regional governments, authorities, legal and natural persons. Among others it sets the obligation to announce National Energy Policy, Territorial Energy Policies, and national program for economical energy management and use of renewable and secondary energy sources etc.

To implement the Program, subsidies may be granted from the national budget in support of:

- conservation measures to increase the efficiency of the exploitation of energy;
- development of combined heat and power generation;
- upgrade of energy generation and distribution facilities;
- state-of-the-art technologies and materials needed for conservation measures;
- promotion of the use of renewable and secondary energy sources;
- education, training and counselling in the field of energy management;
- science, research and development in the field of energy management;
- drafting of the Territorial Energy Policies.

This act also defines minimal efficiency levels for buildings and heat and electricity generators. It sets obligation to manufacturers or importers of energy appliances to provide energy appliances with energy labels.

It also defines buildings and other objects that are obliged to execute energy audit and the requirements to the energy auditors.

Act no. 180 of 31 March 2005 on Support for the electricity production from RES

This standard is new in the Czech Republic and in accordance with the legislation of the European Communities - Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market.

Act regulates the method of promoting the production of electricity from renewable energy sources and from mining gas from closed mines, the performance of state administration, and the rights and obligations of natural and legal persons connected therewith.

The purpose of this Act is, in the interest of protection of the climate and protection of the environment, to

- promote the use of renewable energy sources;
- ensure constant increase of the share of renewable sources in consumption of primary energy sources;
- contribute to economical use of natural resources and sustainable development of society;
- create conditions for fulfillment of the indicative target for the share of electricity from renewable sources in the gross consumption of electricity in the Czech Republic amounting to 8 % in 2010, and for further increase of this share after 2010.

This standard regulates:

- Rights and obligations of the entities on the market in electricity from renewable sources.
- Conditions for promotion, purchase and recording of electricity production from renewable sources.
- Amount of prices for electricity from renewable sources and green bonuses.

Promotion pursuant to this Act shall apply to production of electricity from renewable sources produced in plants in the Czech Republic using renewable sources and promotion is consists in fix price of the electricity and green bonuses for 15 years (In 2008 is extension of the feed-in tariffs guarantee, e.g. PV to 20 years). (Producer of the electricity from RES could choose putting electricity on the obligatory purchase to district system operator (DSO) at the price in accordance with Energy Regulation Office or selling by electricity market - green bonuses. Definition of green bonuses is amount which raised of the market-price of the electricity. Grid operator covers this green bonus to the producer of electricity from RES. The green bonus implementations lowered environmental damage by utilization RES in comparison with burning fossil power, kind and dimension of the plants and quality of the supply electricity.

Promotion of electricity production from renewable sources is stipulated differently regarding to the type of the renewable sources and the magnitude of the installed capacity of the production plant and, in case of electricity produced from biomass, also according to the parameters of the biomass laid down in an implementing regulation.

Fixing the purchase price - price setting

The Energy Regulation Office determines amount of purchase prices for electricity from renewable sources and green bonuses in the Czech Republic in terms of Act no. 180 of 31 March 2005 on support for the electricity production from renewable energy sources.

The Energy Regulation Office shall always determine the purchase prices for electricity from renewable sources for the subsequent calendar year in advance, separately for the individual types of renewable sources and green bonuses so as to:

1. after the date of entry into force of this Act, fifteen-year period of recovery of investment is achieved with promotion by purchase prices, under the condition of compliance with the technical and economic parameters, including in particular the costs of an installed unit of capacity, efficiency of use of the primary energy contents in the renewable source and the period of use of the plant, which are stipulated in an implementing regulation,

2. after the date of entry into force of this Act, the level of revenues per unit of electricity from renewable sources is maintained, as a minimum, with promotion by purchase prices, for a period of 15 years from the year of putting the plant into operation, taking into account the price index of industrial products; completion of reconstruction of the technological part of an existing plant, a change of fuel or completion of modernization, resulting in an increase in the technical and environmental level of the existing plant is also regarded as "putting a plant into operation";

Purchases prices for individual RES are located in chapter 5.1.

INTERCONNECTION RULES

Eligible renewable /other technologies:

- ☒ biogas
- ☐ wood gas
- ☒ photovoltaic
- ☒ cogeneration
- ☐ oil
- ☐ steam power plant
- ☒ hydro
- ☐ wind
- ☐ incinerator
- ☐ gas
- ☐ others: ……………………………………………………………………

Applicable sectors:

- ☒ housing
- ☒ services
- ☒ health and social facilities
- ☒ school and educational facilities
- ☒ small businesses

For enterprise and for operation of generation electricity is necessary to obtain licence for business in the energy industries. This licence is issued by Energy regulatory office (ERO) on the basis of Decree No. 426/2005 Coll., of 11. October 2005, on the details of awarding licences for business in the energy industries.

Limit on System Size/Overall Enrollment

Power PV plants, which are to connected to LV grid, is limited with single-phase connection on 4,6 kVA, whereas maximum power on entrance of inverter must to be restrict to max. 110%.

Rules for net metering systems:

Website:

- **Public Notice No. 51/2006 Coll., conditions for connection to grids (1)**
  http://www.hitechsolar.cz/fotky/down_soubor1015.htm?PHPSESSID=
  http://www.eru.cz/htm/vyhl_2006_51.htm
- **91 ACT The full text of act no. 458/2000 Coll., on business conditions and public administration in the energy sectors and on amendment to other laws (the"energy act"),** http://www.eru.cz/index_aj.html
- **Annex 1 of Public Notice No. 51/2006 Coll., Application for connection to the distribution or transmission grid**
  http://www.eon.cz/file/cs/info/legislative/priloha_Vyhlaska_51_2006_Sb.pdf
- **Local distribution system grid code – business measurement**
  ERU (ERO- Energy regulatory office) : http://www.eru.cz/pplds5.doc
- **Operation rules distributions systems - business measurement**
  http://www.eon.cz/file/cs/distribution/regulations/PPDS_2006_5.pdf
- **Operation rules distributions systems (ČEZ, PRE, EON):**
  http://www.cezdistribuce.cz/edee/content/file-other/distribuce/energeticka_legislativa/PPDS/2008/PPDS_2008_2801.pdf

Utilities:

District system operator DSO 1:
ČEZ distribuce
Teplická 874/4, 450 02 Děčín
www.cez.cz

District system operator DSO 2:
E.ON Distribuce
Lannova 205/16, 370 49 České Budějovice
www.eon.cz

District system operator DSO 3:
PRE Distribuce
Na Hroudě 1492/4, 100 05 Praha 10
www.pre.cz

General conditions

A founder who wants to establish own generation of power, has to comply with the conditions (e.g. valid rules and regulations). The generation of power must be acceptable for parallel operating with grid DSO, interference (current) incidence for grid and for next customers must be impossible.

For operation of electric devices are necessary to keep following rules:

- The valid rules and regulations for operating and for establishment of power generation, mainly [1], [2] a [3]
- Valid standards ČSN (Czech Technical Standard), PNE PDS [4], [5], [6], [7], [8], [9], [10], [11], [12], [13]
- Regulations for saving employees and for labour protection [14] [15]
- Regulations and instructions DSO (PRE a.s., EON a.s., ČEZ a.s.)

Specialized firm must carry out the process of project development, engineering, building and connecting electrical power plant to the electrical grid. The connecting to the electrical grid must be discussed and approved with distribution system operator (DSO). The distribution system operator can request changes and completion of energy equipment. The reasons for changes are safety and trouble-free operation and also the capacity of the grid.

Enrolment procedure

Category of producers:

a) An electricity producer, who is connected to high voltage (HV) grid or lower or with total installed capacity lower than 5 MW
b) An electricity producer, who is connected to high voltage (HV) grid or higher and with total installed capacity higher than 5 MW and lower than 30 MW
c) An electricity producer, who total installed capacity is 30 MW and higher

The electricity producers have to abide by the guides of distribution network. Distribution system operator uses information from electricity producers for elaboration of district network model and decision about the method and tension level of interconnection.

Necessary data for enrolment:

Part A: Generally data

Required information for every category of producers:

The electricity producers must give information about power generation and termination point to distribution network operator.

a) Power generation data

- Rated output voltage
- Rated apparent power kVA
- Rated active output (power) kW
- Maximum supplied active power or requirements for idle power (kVAr)
- Kind of generator – synchronic, asynchronous, etc.
- Drive
- Operating mode of electricity production, (e.g. continuous (permanent), discontinuous)
- Contribution to short-circuit current
- Operating tension

- Transformer data
- Requirements for self consumption protection
- Ability of isolated-network operation and black start
- Results of metering in energy source
- Method of line from generator to transfer point

b) Resolution of transfer point

- Method of synchronization between distribution network and producer
- Detailed data about transfer point method solution
- Method of connection and disconnection from distribution grid
- Data on network (grid) protection

Part B: Technical data

- Situation plan of plot boundary and location of production unit
- electrical unit scheme, rated levels of electrical units,
- Shunt off resistance delivery station
- Electrical data on transformer feeding, which means power, transfer, short circuit voltage, etc.
- Description of protection with exact data on kind, producer, connection and function
- Self production contribution to opening short-circuit current in transfer point
- Description and method of gear and generator operation
- Invertors, frequency transducer and synchronous generator have to have test report
- Wind power plants: certificate and test report concerning reverse impact (rated power, fluctuation of active and idle power, inside angle of source, limits for driving of power factor)

Application for connection

Documents necessary for connection decision:

- agreement of neighboring owners touched by building up
- agreement of municipality and appropriate building office with realization of power generation

If application doesn´t contain all the requested data, operator of distribution network is going to request completing of application. The term of application completion is considered as term of assumption application.

Connection statement application

Operator of distribution grid determines if an applicant has to elaborate attest studies of connection to distribution grid.

In case that the attest studies are not necessary or an applicant supplied attest studies with acceptance results, obligation statement is produced during 30 days from application delivery. The obligation statement contents:

- place, method and date of connection
- place, method and type of take-off measurement
- eligible costs of operator distribution grid, which are evoked by connection to grid

Next parts of the obligation statement are requirements for obtaining of a valid spatial planning permission and building permission and project documentation of power generation. Validity of statement is 180 days.

Project documentation

Requested operational project documentation has to contain following foundations:

- Realization according to requirements of distribution grid operator
- Lengths, kinds and diameters of lines between power generation unit and district grid transfer point, parameters of disposable transformer
- Situation solution of connection to district grid
- Kinds, parameters and proposal values of extension electric protection of power generation in continuity with distribution grid
- Proposal of commercial measurement performance

DSO gives statement to project documentation during 30 days from request. Parts of the obligation statement are requirements for put in:

- a revision report of generation power,
- a revision report of connection to district system,
- a revision report of protection related with connection to district system,

In case, that connection to district grid is going to evoke eligible costs of distribution grid operator, eligible costs will be on applicant's account. DSO concludes contract with an applicant.

Connection to the grid

DSO determinates method and transfer point with regard to existing net conditions, power and method of operating of own power generation, according to competent interest of producer. Reason is security against trouble effect and protection of the other customers.

Connection to grid takes place in switch point with separation function. This switch point is available to the staff of distribution network operator at any time.

The examples of connection are presented below. Simplification of connection to the district grid is possible in these cases:

- the sources (power generation units) have low period exploitation
- service (operating) is not joined with production technology
- producer does not request usual secure connection (e.g. wind power)

NET METERING RULES

Electrometer, measuring and directive devices

Kind and number of necessary metering devices (electrometer of distribution system operator = DSO) and controlling devices (commutator rate) according to the contract conditions for commissioning and supply of electricity appropriate DSO.

Electrometers and next controlling devices are located in appropriate points, which DSO determined. Measurement is designed according to tension level, where generation power works and separately from power.

- low tension: by power generation direct (to 80 A) or half direct
- high tension: to power transformer 630 kVA including – measuring on side low voltage,

half direct from power 630 kVA – measuring on side HV – half direct

- 110 kV: measuring on side 110 kV, half direct

DSO provides supply and montage, electricity producer pay eligible costs and installation. Measuring and controlling devices and transformers are parts of equipments power generation. Measuring and controlling devices have to perform requested technical parameters.

Costs for metering devices

Authorized DSO provides:

- Electrometer verification costs
- Operational verification of measuring devices costs, finding rightness, linkage and methods
- Operational costs of verification and data providing, including operational long-distance transmission values

Producers and authorized customers provide:

- Purchase and installation costs of measuring transformers and costs for office verification, purchase costs for connective cables, cable terminal box or switchgear, short circuit protection
- Purchase and operational costs of telephone line
- Installation measuring devices (electrometer, chart recording instrument)

SAFETY AND POWER QUALITY REQUIREMENTS
COUNTRY:

REQUIREMENT	VALUE	REFERENCE STANDARD OR GUIDE
PROTECTION REQUIREMENTS		
Is an external accessible disconnecting switch mandatory?	yes	www.cez.cz
What is the acceptable range of AC voltage for operation of DER?	±10 % for U_n = 230 V or 400 V	ČSN EN 50160 ČSN 33 0120 PNE 33 3430-7
Is monitoring of voltage of each phase required?	No, measured is only power	www.cez.cz
What is the maximum allowed time for disconnection of DER in case of a voltage out of range event	During DS, individual 0,1 s – 0,05 s	www.cez.cz
What is the acceptable range of frequency for operation of DER	±1 Hz with frequency 50 Hz	ČSN EN 50160 ČSN 33 0120 PNE 33 3430-7

What is the maximum allowed time for disconnection of DER in a case of a frequency out of range event	Immediately 0,1 s – 0,05 s	www.cez.cz
What is the minimum time for reconnection after a disconnection of DER	1 min.	-
Other protection requirements	Tension and under-voltage, watt protection	During DSO
IMPACT ON GRID-POWER QUALITY		
What is the allowable variation of voltage at LV side of LV/MV transformer, due to DER connection	±10 %	ČSN EN 50160
What is the limit of harmonic current emissions of DER	According to regulations	ČSN EN 61000-3-2 ČSN EN 61000-3-12
What is the limit of the voltage fluctuations and flicker for DER	**±10 % U_n** for U_n= 230 V or 400 V	ČSN EN 50160 ČSN 33 0120 PNE 33 3430-7
Requirements regarding power factor	cos φ= 0,95-0,97	-
Other requirements for impact on grid-power quality	-	-
PV SPECIFIC REQUIREMENTS		
Is an AC disconnecting switch mandatory for a PV plant	YES	
What is the acceptable range for the settings of under-voltage disconnection	80 % U_n	
What is the maximum allowed time for disconnection of a PV inverter in case of a voltage out of range event	0,05 s	
What is the acceptable range of settings for under- over frequency disconnection	±1 Hz for explicit frequency 50 Hz	
What is the maximum allowed time for disconnection of a PV inverter in case of a frequency out of range event	0,05 s	
What is the minimum time for reconnection after a disconnection of a PV inverter	To 1 min.	
What is the limit of the total harmonic distortion of current of a PV inverter	-	
Is an isolation transformer required for a PV inverter	To 200 kW LV – No Over 200 kW HV - Yes	
What is the maximum allowable DC current injected to the grid	There isn´t limit, it depends on the system	
Is any special protection required for transformerless inverters	YES, surge guard	
Is an anti-islanding protection for the PV inverter mandatory	YES	
What method of anti-islanding protection is acceptable	-	

FINANCIAL AND SUPPORTING SCHEMES

<u>Fixing the purchase price - price setting</u>

The Energy Regulatory Office determines amount of purchase prices for electricity from renewable sources and green bonuses in the Czech Republic in terms of Act no. 180 of 31 March 2005 on support for the electricity production from renewable energy sources.

Following tables show purchase prices for electricity produced from renewable sources determined by the Energy Regulatory Office for year 2008 (www.eru.cz).

For comparison: Current electricity purchase price for households, whose don´t use electricity for heating and electric water heating in 2008 is 4,20 CZK/MWh (0,17 CZK/MWh).

Purchase prices and green bonuses of electricity generated by small hydroelectric plants

Date of commissioning	Purchase prices of electricity supplied to the network, in		Green premiums, in CZK/MWh	
	Kč/MWh	€/MWh	Kč/MWh	€/MWh
Small hydroelectric power stations commissioned on new sites after 1st January 2008, inclusive	2600	104	1400	56
Small hydroelectric power stations commissioned on new sites between 1 January 2006 and 31st December 2007	2450	98	1250	50
Small hydroelectric power stations commissioned after 1st January 2005, inclusive, and refurbished small hydroelectric power stations	2220	88,8	1020	40,8
Small hydroelectric power stations commissioned before 1st January 2005	1730	69,2	530	21,2

Note: exchange rate is 1€ = 25 Kč

Purchase prices and green bonuses of electricity generated by PV plants

Date of commissioning	Purchase prices of electricity supplied to the network, in CZK/MWh		Green premiums, in CZK/MWh	
	Kč/MWh	€/MWh	Kč/MWh	€/MWh
Electricity generation using solar radiation, for plants commissioned after 1st January 2008, inclusive	13 460	538,4	12 650	506
Electricity generation using solar radiation, for plants commissioned between 1st January 2006 and	13 800	552	12 990	519,6
Electricity generation using solar radiation, for plants commissioned before 1st January 2006	6 570	262,8	5 760	230,4

Note: exchange rate is 1€ = 25 Kč

Purchase prices and green bonuses of electricity generated by wind plants

Date of commissioning	Purchase prices of electricity supplied to the network, in CZK/MWh		Green premiums, in CZK/MWh	
	Kč/MWhWh	€/MWh	Kč/MWh	€/MWh
Wind power stations commissioned after 1st January 2008, inclusive	2 460	98,4	1 870	74,8
Wind power stations commissioned between 1st January 2007 and 31st December 2007, inclusive	2 520	100,8	1 930	77,2
Wind power stations commissioned between 1st January 2006 and 31st December 2006	2 570	102,8	1 980	79,2
Wind power stations commissioned between 1st January 2005 and 31st December 2005	2 820	112,8	2 230	89,2
Wind power stations commissioned between 1st January 2004 and 31st December 2004	2 960	118,4	2 370	94,8
Wind power stations commissioned before 1st January 2004	3 280	131,2	2 690	107,6

Note: exchange rate is 1€ = 25 Kč

Purchase prices and green bonuses for electricity generated from combined heat & power plants (CHP)

The following prices and specified conditions shall apply to electricity from combined heat & power plants (CHP) having a total installed electricity generating capacity of up to 1 MWe, inclusive, with the exception of plants using renewable energy resources or firing drained gas:

1. Contributions to electricity prices have been set as fixed prices under a separate legal regulation.
2. An electricity generator from combined heat & power with a total installed capacity of up to 1 MWe per generating plant, inclusive, will charge the regional distribution system operator serving the respective area, or the transmission system operator, if it is connected to the transmission system, a contribution to electricity price of 330 CZK /MWh for each reported MWh of electricity generated under a separate legal regulation.
3. If the electricity generator supplies electricity to an electricity trader or eligible customer, or the electricity generator itself consumes this electricity at the time of high rate applicability for a total of eight hours a day, the electricity generator will charge the respective system operator a contribution to electricity price of **1,420 CZK /MWh** for each reported MWh of electricity generated at the time of high rate applicability under a separate legal regulation 2). This electricity trader or eligible customer, or directly the electricity generator, shall define the high rate band. The electricity generator shall determine the high rate band solely if it consumes all the electricity it generates. In the case of applying the contribution in the high rate band there is no entitlement to a contribution under (2) and (4).
4. If the electricity generator supplies electricity to an electricity trader or eligible customer, or if the electricity generator itself consumes this electricity at the time of high rate applicability

for a total of twelve hours a day, the electricity generator will charge the respective system operator a contribution to electricity price of **940 CZK /MWh** for each reported MWh of electricity generated at the time of high rate applicability under a separate legal regulation 2). This electricity trader or eligible customer, or directly the electricity generator, shall define the high rate band. The electricity generator shall determine the high rate band solely if it consumes all the electricity it generates. In the case of applying the contribution in the high rate band there is no entitlement to a contribution under (2.) and (3.)

5. The duration of high rate applicability under (3.) or (4.) may only be changed as of the first day of a calendar month.

Operational Program Enterprise and INNOVATION - Title: ECO-ENERGY

The Ministry of Industry and Trade makes public the version of the Operational Program Enterprise and Innovation (OPEI) 2007 - 2013 that was approved by the Government of the Czech Republic and transmitted to the European Commission.

The Operational Program Enterprise and Innovations develops an important part of the strategic objective of the National Strategic Reference Framework of the Czech Republic for the years 2007 - 2013 named "Competitive Czech Economy", and is based on the main strategic documents of the Czech Republic (Strategy of the Economic Growth, Strategy of the Regional Development, etc.) and complies with the Community strategic guidelines on economic, social and territorial cohesion 2007 - 2013.

The OPEI drafting process respected the partnership principle as the document was continually discussed with other ministries, representatives of economic and social partners and other interested parties. The global objective of the Operational Program Enterprise and Innovation is by the end of the programming period to increase the competitiveness of the Czech economy and bring the innovational performance of the sector of industry and services closer to the level of leading industrial European countries. The OPEI is aimed at increasing the competitiveness of the industry and enterprise, keeping the attractiveness of the Czech Republic, its regions and cities for investors, supporting innovations, speeding up the implementation of the R&D results into the production sector namely due to the stimulation of the demand for the R&D results and commercialisation of the results, supporting the entrepreneurial spirit and economic growth based on knowledge, increasing the use of new technologies, innovative products and ICT.

ECO-ENERGY - the aim of the subprogram is to stimulate the activities of enterprises in the area of renewable and alternative energy sources and in reducing the consumption of energy during production. The program is part of the Operational Program Enterprise and Innovation and is focused particularly on increasing the effectiveness of generation, transmission and consumption of energy and the use renewable and alternative energy sources. The call for proposals, the complete text of the program, selection criteria, categories of supported SCEA, and the list of products excluded from the program based on Annex 1 of the European Treaty and other documents are available on websites **www.mpo.cz** and **www.czechinvest.org**.

Incentive type: Operational Program Enterprise and Innovations (OPEI) 2007-2013

Eligible renewable /other technologies: Small Hydroelectrics, CHP on biogass from biomass, Photovoltaics, Heat Pump

Applicable sectors: Small entrepreneurs

Terms, budgets and requirements:

Minimal amount of subvention is 0,5 mil CZK, maximal amount of subvention is 100 mil CZK.
Maximal amount of subvention in % of eligible costs is defined:

- Small Hydroelectrics 35 %
- CHP biomass and biogass 30 %

- Photovoltaics 30 %
- Heat Pump 20 %

Authority: Ministry of Industry and Trade

Contact:
Ministry Of industry and Trade
Na Frantisku 32, 110 15 Praha 1
+420 224 851 111
posta@mpo.cz
www.mpo.cz

NAtional Program - Title: PROGRAM EFEKT

The EFEKT program serves the Ministry of Industry and Trade for the influencing of energy saving and the utilisation of renewable energy sources (RES). It focuses on educational activity, energy planning, small—scale investment events and pilot projects. It is a supplementary programme for the energy programmes supported from the European Union structural funds.

"National Program" is focused on energy savings applications in area energy production, transmission, distribution and consumption, higher utilization renewable resources and secondary resources and expansion of CHP. This "Program" set rules according to statutory order 63/2002 about administration of state budget dotation for National program activities. Program budget for year 2008 is 70 mil. Kč. (2,8 mil. EUR).

Incentive type: National Program for the Support of Energy savings and Renewable sources
Eligible renewable /other technologies: Small Hydroelectrics, Biomass and Biogas, Heat Pump, Micro CHP

Applicable sectors: Small entrepreneurs, nonprofit-making organizations, universities, municipalities

Authority: Ministry Of Industry and Trade

Summary:

Supported RES activities in 2008

Area of action	**Title of the area of action**		**Kind of applicant**	**max. limit % subsidy**		**Validity of application**
				tis. Kč	**%**	
RES	C.1	Small hydroelectric plants	P	5 000	40	31.1.2008
	C.2	Heat pumps combinated with solar-thermic system	P	2 000	40	31.1.2008
	C.3	Equipments for use heat or power waste energy	P	3 000	40	31.1.2008
Energetics	B.1	CHP units for landfill gas and for biogas	P	3 000	30	31.1.2008

P - entrepreneurial subjects

Contact:
Ministry Of industry and Trade
Na Frantisku 32, 110 15 Praha 1
+420 224 851 111
posta@mpo.cz
www.mpo.cz

Operational Program Environment Title: SUSTAINABLE USE OF ENERGY (Priority axis 3)

Incentive type: The Operational Program Environment for the period 2007-2013
Area of action 3.1: Construction of new facilities and reconstruction of the existing facilities with the aim to increase the use of renewable energy sources (RES) for heat generation, electric energy generation and for combined heat and electric electrical energy generation.
Area of action 3.2: Realization of energy savings and the use of waste heat in non-commercial carrying sector
Eligible renewable /other technologies (area of action 3.1):

- installation of photo-thermic systems for hot water preparation and heat supply, or for a possibility of added heating,
- installation of photovoltaic systems for electric energy generation,
- installation of heat pumps for heat supply and for hot water preparation,
- installation of biomass boilers and systems using biomass for energy generation, for heat supply and for hot water preparation, possibly in combination with the construction of central fuel production plant including technological line,
- installation of cogeneration units for combined heat and electric energy generation from biomass, landfill gas, biogas, etc.
- installation of systems for heat supply including hot water preparation, for electric energy supply and combined heat and electric energy generation with the use of geothermal systems
- installation of wind power plants,
- installation of small hydro-electric power plants

Applicable sectors (area of action 3.1):

- territorial self-governing units and their associations,
- endowments and endowment funds,
- civic associations and churches,
- allowance organizations,
- public benefit corporations,
- organizations established on the basis of a special law,
- organizations established by the state and organizations directly managed by them,
- nonprofit-making organizations,
- legal entities owned by public organizations

Form of support
Non-refundable financial contribution
Implementing bodies
The Managing Authority is the Ministry of the Environment; the Implementing Body is the State Environmental Fund

A Strategy to Achieve the Objectives
The major problem is insufficient use of RES and slow-paced boosting given to energy savings within the whole spectrum of the society. System of investment support, with regard to availability of financial resources, is insufficient. Low awareness of the public of RES and energy savings advantages together with insufficient investments may give rise to a problem to meet the objectives of the national policies.

Expected Results and Impacts
The support should result in an increase of installed capacity of facilities using RES and waste heat for heat generation and electric energy generation and for combined heat and electric energy generation (cogeneration). An expected impact is also a reduction of energy consumption for heating of non-business carrying sector objects. An accompanying effect will be improved awareness of the public of RES and energy savings.
Categories of Expenditure

- Renewable energy: wind 18 129 385 €
- Renewable energy: solar 54 388 155 €
- Renewable energy: biomass 235 682 275 €
- Renewable energy: hydroelectric, geothermal and other 54 388 155 €
- Energy efficiency, co-generation, energy management 310 383 317 €

Indicative distribution of the financial allocation within the priority axis 3 to individual areas of action is shown in the following table:

Area of action	**Title of the area of action**	**EU Fund**	**mil. €**
3.1	Construction of new facilities and reconstruction of the existing facilities with the aim to increase the use of RES for heat generation, electric energy generation and for combinedheat and electric energy generation	FS	362,59
3.2	Realizing energy savings and the use of waste heat for nonbusiness carrying sphere	FS	310,38
3	**Sustainable use of energy sources**	**FS**	**672,97**

Particular subsidy established in terms of financial analysis in profitable projects or in dependence on characteristic of project in light of public support. The maximum subsidy is 85 % from summary eligible costs for public subject.
<u>**Contact:**</u>
State Environmental Fund
Kaplanova 1931/1, 148 00 Praha 4 - Chodov
+420 267 994 300
www.sfzp.cz,
www.strukturalni-fondy.cz

Title: Support of investment projects for use of renewable energy sources

Program for year 2007
Incentive type: State program for support of energy savings and the use of renewable sources of energy.
Eligible renewable /other technologies: biomass boilers, installation of solar-thermic systems for hot water preparation and heat supply or for a possibility of added heating
Applicable sectors: Individuals, unbusinesslike subjects, entrepreneurial subjects
Terms, budgets and requirements:
Reception applications: since 12.2.2007 to 27.9. 2007

Direct finance subsidies for realization remedies are in following tables:

No. Program	**Program name**	**Kind of applicant**	**max. limit % subsidy, from basis for calcuate support**
1.A.	Investment support for environmental susceptible methods heating and hot water preparation for housing and flats, includes ecological production electrcity for self consumption: a) biomass boilers, b) solar-thermic system for hot water preparation c) solar-thermic system for hot water preparation and for a possibility of added heating, **d) photovoltaic systems for electric energy generation**	E (individuals)	a) 50/50 1) b) 50/50 1) c) 50/50 2) **d) 50/50 3)**
7.A.	Investment support for building devices for common production of electricity and heat from biomass and biogas	A P	70/40 50/25

Key to table:

A – non-commercial subjects, E – Individuals, P - entrepreneurial subjects

1/ Maximum level of subsidy for one action is 50 000 Kč (2000 EUR)
2/ Maximum level of subsidy for one action is 60 000 Kč (2400 EUR)
3/ Maximum level of subsidy for one action is 200 000 Kč (8000 EUR)

Program renowned for year 2008

The support for year 2008 unlike 2007 does not include any support for small electricity sources due to the lack of finances. The plans of government for next period are unclear, but the support of small RES is still among its targets.

Reception applications: to 31.12.2008

No. Program	Program name	Kind of applicant	max. limit % subsidy, from basis for calculate support
1.A.	Investment support for environmental susceptible methods heating and hot water preparation for housing and flats, includes ecological production electrcity for self consumption: a) biomass boilers, b) solar-thermic system for hot water preparation c) solar-thermic system for hot water preparation and for a possibility of added heating	E	a) 50 1) b) 50 1) c) 50 2)
4.A.	Investments support for heating flats and family houses from heat pumps	E	30 2

Key to table:

E – Individuals,

1/ Maximum level of subsidy for one action is 50 000 Kč (2000 EUR)

2/ Maximum level of subsidy for one action is 60 000 Kč (2400 EUR)

Summary:

Investment support for environmental friendly methods heating and hot water preparation for housing and flats, includes ecological production electricity for self consumption:

2007

a) biomass boilers,
b) solar-thermic system for hot water preparation
c) solar-thermic system for hot water preparation and for a possibility of added heating,
d) photovoltaic systems for electric energy generation

2008

a) biomass boilers,
b) solar-thermic system for hot water preparation
c) solar-thermic system for hot water preparation and for a possibility of added heating,
d) heat pumps

During this year isn´t direct support for production electricity from renewable sources. These programs are changing every year. **On the other side was extended Feed-in tariff guarantee period for PV from 15 to 20 years for new PV systems, which are installed after 1.1. 2008. (The Energy Regulatory Office (ERO) - www.eru.cz**

Contact:
State Environmental Fund
Kaplanova 1931/1, 148 00 Praha 4 - Chodov
+420 267 994 300
www.sfzp.cz,
www.sfzp.cz/ke-stazeni/185/2684/detail/priohy-ii-pro-rok-2008/

INFORMATION SOURCES:

[1] 91 ACT The full text of act no. 458/2000 Coll., on business conditions and public administration in the energy sectors and on amendment to other laws (the”energy act”)

[2] Public Notice No. 51/2006 Coll., conditions for connection to grids

[3] ČSN EN 50160: Characteristics tension of electrical energy supplied from distribution grid

[4] ČSN EN 61000-2-2: Electromagnetic compatibility – part 2-2: Environment – Compatibility level for low frequency disturbance spread line

[5] PNE 33 3430-0: Calcuate evaluation of reversal influences consumers and sources of distribution grids

[6] PNE 33 3430-1: Parametres quality electrical energy - Part 1: Harmonics and between harmonics

[7] PNE 33 3430-2: Parametres quality electrical energy - Část 2: Voltage fluctuation

[8] PNE 33 3430-3: Parametres quality electrical energy - Část 3: Voltage unbulance and changes of frequency

[9] PNE 33 3430-4: Parametres quality electrical energy - Část 4: Declines and short interuption of tension

[10] PNE 33 3430-5: Parametres quality electrical energy - Část 5: Transistent tension – pulsed disturbance

[11] PNE 33 3430-6: Parametres quality electrical energy - Část 6: Limitations of reversal influences for centralized ripple control

[12] PNE 33 3430-7: Characteristics tension of electrical energy supplied from distribution grid

[13] ČSN 33 3080: Compensation of induction power by static compensators

[14] ČSN 33 2000-4-41: Electrical directives – Electric devices - Part 4: Safety

[15] ČSN 33 3201: Electrical installation over AC 1 kV

7.7. DENMARK

INTRODUCTION

Danish offshore wind capacity remains the highest per capita in Europe (400 MW in total in 2006) and reach an average growth of 71 % per year. Two new offshore wind parks (200 MW each), are under construction. Other RES technologies are steadily penetrating the market supported by a wide array of measures such as a new re-powering scheme for onshore wind.

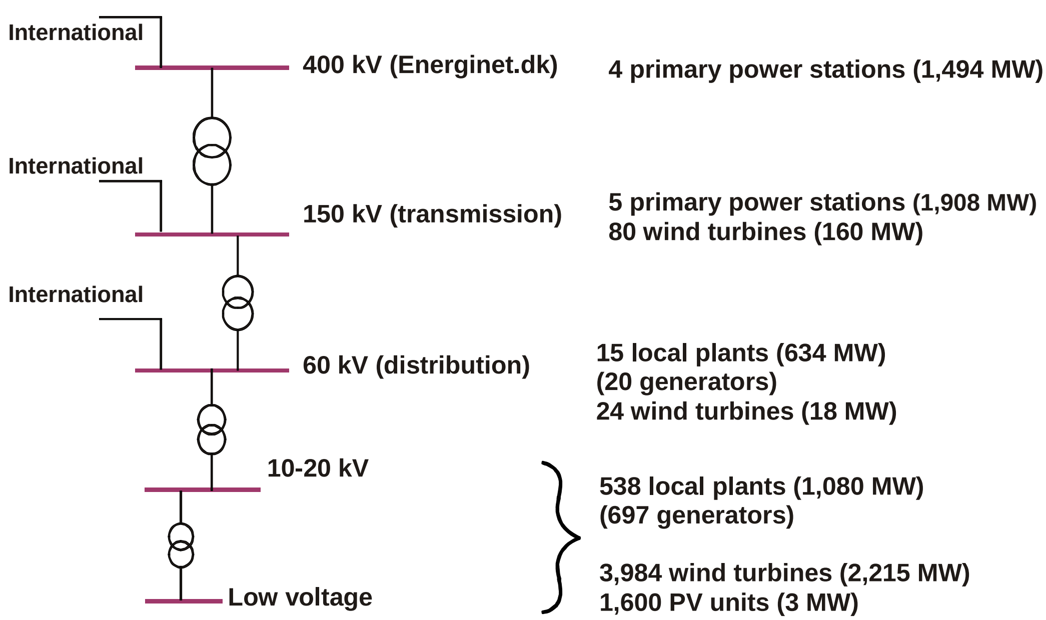
The country is currently close to reaching its RES-E target for 2010, which was set at 29 % of gross energy consumption. Today, the share of renewable energies in gross energy consumption is at 26.3 % rising from 9 % in 1997.

Denmark has been developed to a decentralised energy society since the 1930s when large scale CHP was installed in the capital Copenhagen. After the energy crisis of 1973, strategies were implemented which led to 60 % share of district heating in 2002, 74 % of which are CHP. In 2003, small-scale CHP had a share of 23 % in the installed generating capacity, wind power reached 32 %.

INTERCONNECTION RULES

In 2005, the State took over responsibility as transmission system operator for both electricity and gas from the commercial suppliers.

The quality of the grid benefits from the interconnection to the neighbouring areas (Scandinavia, Germany). The different grid levels are dominated by different generation capacities:



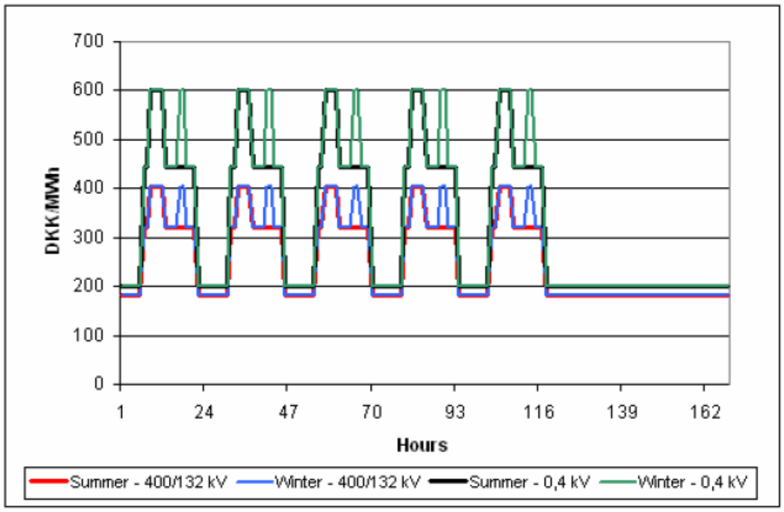
(Source: Energinet.dk)

At the end of the year 2007 the number of distribution network companies amounted to 101, which operate most of the network at lower voltage (0.4 – 50/60 kV).

Website: www.energinet.dk

FINANCIAL AND SUPPORTING SCHEMES

Until 2005, electricity generation at local CHPs was sold according to a feed-in tariff (three stage tariff):



The three stage tariff during a week. (Source: Bregnbæk/Schaumburg-Müller 2005)

Due to the legislation, since 2005 all CHP units larger than 10 MW must operate on market terms. Plants of or under 5 MW are eligible for a subsidy depending on when electricity production takes place. Combined with the market price, the subsidy ensures a tariff called three-tier tariff. At the start of 2005 the tariffs are approx. 22 øre/kWh at low demand, approx. 46 øre/kWh at high demand and approx. 59 øre/kWh at peak demand. Consequently, a typical mean annual tariff of 30-40 øre/kWh is achieved.

Regarding RES, Denmark established fixed feed-in tariffs in 1993, which oblige utilities to pay up to 85% of end-user prices for wind power. The subsidies have been gradually reduced over the last years. In 1999, a system for tradable green certificates was proposed and postponed. Current feed-in tariffs for on-shore wind amount to the market price + 10 øre/kWh (for 20 years). For new offshore wind parks, a tender procedure was introduced. Furthermore, subsidies for wind power depend on the connection of the turbine to the grid and the age of the particular system.

Website: http://www.energistyrelsen.dk/sw23746.asp (Danish Energy Agency)

SAFETY AND POWER QUALITY REQUIREMENTS

The biggest challenge for the Danish distribution network is to integrate the power generated by the numerous wind power plants in Denmark. Critics of wind energy state that the enormous amount of wind power is very heavy to assess. Newer wind turbines take an active part in the control and regulatory functions of power systems, in contrast to older turbines that did little to support the stability of the grid.

7.8. ESTONIA

INTRODUCTION

According to the national "Long-Term Fuel and Energy Sector Development Plan" directing to the year 2015, which is based on the Estonian Sustainable Development Act, the strategic objectives of the Estonian energy policy include:

- By 2010 renewable electricity forms 5.1 per cent of the gross consumption;
- By 2020 electricity produced in CHP production stations forms 20 per cent of the gross consumption.

Since Estonia is a very small country with about 1.3 million inhabitants and an area of about 45.2 thousand km^2. Estonia is nearly self-sufficient when it comes to energy supply: 60 % of the energy generation comes from oil shale, 10 % each from wood fuels and peat. Estonia's power system consists of the national grid (five thousand km of transmission lines over 110 kV, 131 substations), distribution networks (59.1 thousand km of lines17 thousand substations) and the following power plants: Narva oil shale fired power plants (Eesti PP installed electrical capacity 1610 MW and Balti PP 1290 MW), the Iru CHP Plant (190 MW), some industrial CHPs (about 120 MW), wind generators (2.2 MW) and hydro power plants (about 2.5 MW).

The share of RES-E in gross energy consumption increases at about 27% per year. The biggest potential for the implementation of RES are biomass based technologies; wind power and small hydro power are also options for RES-based electricity generation. Estonia's share of RES-E stood at 0.7% in 2004, compared to 0.2% in 1997.

Dominant sources of RES-E in Estonia are solid biomass and small scale hydro power. With 23 GWh and 22 GWh respectively, they covered over two thirds of the country's RES-E in 2004 (60 GWh). Their contribution in 2004 amounted to 7 GWh and 8 GWh respectively. Since then, installed wind power has further increased, from 6 MW in 2004 to 32 MW in 2005. Up to 50 MW is estimated to be feasible without upgrades to the grid.

Since the service area in Estonia is very small, many efforts are being made to improve the cooperation between the Baltic States regarding energy policies and to create a Single European Energy Market.

INTERCONNECTION RULES

According to findings of the Ministry for Economics and Communications, the Estonian grid needs massive investments for efficiency improvement and reduction of energy losses. Until today, the national legislation does not support new and innovative technologies or the integration into the grid. The Estonian grid is still linked with the Russian electricity grid, which brings along problems regarding technical, commercial and political issues. Nevertheless, the interconnection with the other Baltic States brings along some possibilities for the future. Additionally, Estonia along with the other Baltic States is trying to achieve interconnection with the other European grids. Therefore, the high voltage grid has to be reshaped, according to the study "Analysis of Energy Supply Options and Security in the Baltic States".

FINANCIAL AND SUPPORTING SCHEMES

In 1998 a supporting scheme for the use of renewable energy sources for electricity generation was established in Estonia. The Electricity Market Act (EMA) describes the obligation for grid operators to purchase RES-e. Up to May 2007 the rate of the feed-in tariff has been 0.81 EEK/kWh (51.77 EUR/MWh). In May 2007, amendments of the EMA came into force that established subsidies for high efficiency cogeneration of heat and electricity (CHP). The new regulation supports CHP with feed-in tariffs – like RES – if CHP uses RES or peat, waste or oil shale gas or if a CHP plant (up to 10 MW) has been started on the basis of a former heat only boiler (HOB) plant. Before that, there was no political or financial support for CHP in Estonia.
The operator can choose between two options of support schemes: either to select the combination of purchase obligation with the feed-in tariff, or to apply for a subsidized tariff only.

Energy Source	Tariff alternatives (EUR/MWh)	
	Compulsory feed-in tariff	Subsidized tariff
Renewable energy sources (facilities < 100 MW_e)		
Wind	73.50 [1)]	53.69 [2)]
Other renewables	73.50	53.69
RES in efficient CHP	73.50 [3)]	53.69 [3)]
Efficient cogeneration		
Peat, waste, oil shale gas	51.77 [3)]	31.96 [3)]
CHP plant replacing HOB plant	51.77	31.96

Table 3: Support to electricity from RES-E and/or CHP (EUR/MWh). Notes: 1) up to the total (in Estonia) annual production of 200 GWhe from wind; 2) up to the total (in Estonia) annual production of 400 GWhe from wind; 3) a different tariff rate may be approved by the Energy Market Inspectorate.

SAFETY AND POWER QUALITY REQUIREMENTS

The only utility in Estonia is the national energy company Eesti Energia. Electrical appliances must comply with European safety standards; the European CE signs and national signs (in Estonia EEI) indicate conformity with these regulations. Outlets operate at 220 V/ 50 Hz.

7.9. FINLAND

INTERCONNECTION RULES

Country: Finland

Eligible renewable /other technologies: (small wind, small CHP, reciprocating engines, fuel cells)

Applicable sectors: Residential, Commercial, Schools, Government

Breakpoint for Small System (Simplified Rules): 20 kW

Rules for net metering systems:-

Website: http://www.nordel.org

Authority 1: Nordel - Organisation for the Nordic Transmission System Operators

Website: http://www.fingrid.fi

Authority 2: Fingrid - Transmission System Operator of Finland

Summary: (max 1000 words)
The current penetration of DG in Finland seems to be very low. There is power production in small units, but these plants are most often owned and operated by power companies. Because the share of DG in power production is so low, network companies in Finland don't have much experience in the area. For the time being there has not been an urgent need for recommendations dealing with other production technologies, because the penetration of DG, especially not owned by utilities, has been very low. The situation seems to be changing due to development of technologies and governmental subsidies to renewals.

A general layout of the status of Distributed Generation in Finland is summarized as follows:

- Full use of local fuels (inc. wood waste) and CHP opportunities have a long history and strong position
- Diversified ownership from the beginning of electrification: industry, municipalities, private parties
- Grid connection: via Fingrid or local distribution companies, based (mostly) on pre-defined technical and commercial rules
- Power delivery: bilateral or pool trading
- No special arrangements needed: "DG" is part of the liberalised market
- Quite few specific incentives from Government anymore
    - investment subsidy for wind and solar
    - grants for new technology
    - some tax incentives
- Market based incentives
    - emission trading (CO2)
    - voluntary premium price for green electricity

Additional Resources: There are many Distribution Network operators in Finland. The Energy Market Authority has granted the Distribution Network Licence according to the Electricity Market Act to the companies listed below. The Licence includes geographical areas of responsibility. Contact data for the DNOs of Finland are presented in the following:

Company	Address			Tel
Alajarven Sahko Oy	PL 52	62901	ALAJARVI	+358 6 5577470
Asikkalan Voima Oy	Markkinatie 1	17200	VAAKSY	+358 3 882650
Ekenas Energi	PB 31	10601	EKENAS	358 20 6192810
Enontekion Sahko Oy	Ounastie 165	99400	ENONTEKIO	+358 16 556111
ESE-Verkko Oy	PL 166	50101	MIKKELI	+358 15 1951

Esse Elektro-Kraft Ab	Steinpottvagen 3	68820	ESSE	+358 6 7662068
Etela-Suomen Energia Oy	PL 37	4201	KERAVA	+358 9 5849551
Finnish Chemicals Oy	PL 7	32741	AETSA	+358 20 43111
Forssan Verkkopalvelut Oy	PL 111	30101	FORSSA	+358 3 4126713
Fortum Espoo Distribution Oy	PL 100	48	FORTUM	+358 10 45111
Fortum Sahkonsiirto Oy	PL 100	48	FORTUM	+358 10 45 57111
Haminan Energia Oy	Reutsinkatu 12	49400	HAMINA	+358 5 758661
Haukiputaan Sahkoosuuskunta	PL 31	90831	HAUKIPUDAS	+358 8 5612600
Helen Sahkoverkko Oy	Kampinkuja 2	90	HELEN	+358 9 6171
Herrfors Nat-Verkko Oy Ab	Storgatan 8	68600	JAKOBSTAD	+358 6 7815300
Hiirikosken Energia Oy	Kopingintie 6	66440	TERVAJOKI	+358 6 4785047
Iin Energia Oy	Asemantie 13	91100	II	+358 8 8180220
Iitin Sahko Oy	Paimenpolku 3	45100	KOUVOLA	+358 5 885111
Ilmailulaitos Helsinki-Vantaan lentoasema/Energia ja Vesi	PL 29	1531	VANTAA	+358 9 82771
Imatran Seudun Sahkonsiirto Oy	Karhumaenkatu 2	55120	IMATRA	+358 5 68355
Inergia Oy	PL 61	99801	IVALO	+358 16 687111
Jakobstads Energiverk	Victor Schaumansespl. 1	68600	JAKOBSTAD	+358 6 7851111
Jeppo Kraft Andelslag	Kiitolavagen 1	66850	JEPPO	+358 6 7888700
JE-Siirto Oy	PL 4	40101	JYVASKYLA	+358 14 624144
Joroisten Energialaitos	PL 39	79601	JOROINEN	+358 17 5784310
Joutsenon Energia Oy	PL 10	54101	JOUTSENO	+358 5 6326400
Jylhan Sahkoosuuskunta	PL 49	62201	KAUHAVA	+358 6 434 6300
Jarvi-Suomen Energia Oy	PL 3	50101	MIKKELI	+358 10 21041
Kainuun Sahkoverkko Oy	PL 5	87101	KAJAANI	+358 10 226 000
Karhu Voima Oy	PL 7	48601	KARHULA	+358 10 226 5600
Kemin Energia Oy	PL 1100	94700	KEMI	+358 16 259303
Keminmaan Energia Oy	Jauholantie 4	94450	KEMINMAA	+358 16 4588400
KENET Oy	PL 165	67101	KOKKOLA	+358 6 8289111
Keravan Energia Oy	PL 37	4201	KERAVA	+358 9 5849550

Keuruun Sahko Oy	PL 50	42701	KEURUU	+358 14 754754
Koillis-Lapin Sahko Oy	PL 49	98101	KEMIJARVI	+358 16 877111
Koillis-Satakunnan Sahko Oy	PL 25	34801	VIRRAT	+358 3 485 511
Kokemaen Sahko Oy	Skaffarinkatu 14	32800	KOKEMAKI	+358 2 5464300
Kronoby Elverk	PB 3	68501	KRONOBY	+358 6 8242200
KSS Verkko Oy	Paimenpolku 3	45100	KOUVOLA	+358 5 885111
Kuopion Energia	PL 105	70101	KUOPIO	+358 20 52070
Kuoreveden Sahko Oy	Korpitie 5	35600	HALLI	+358 3 5320121
Kymenlaakson Sahkoverkko Oy	PL 9	47201	ELIMAKI	+358 5 778 01
Koylion-Sakylan Sahko Oy	Kuninkaanlahteentie 76	27800	SAKYLA	+358 2 8386200
Lammaisten Energia Oy	Myllykatu 2	29200	HARJAVALTA	+358 2 535 2011
Lankosken Sahko Oy	Hirvijarventie 8	29810	SIIKAINEN	+358 2 528 8800
Lappeenrannan Energiaverkot Oy	PL 191	53101	LAPPEENRANTA	+358 20 1776111
Lehtimaen Sahko Oy	Peralantie 3	63500	LEHTIMAKI	+358 20 7598350
Leppakosken Sahko Oy	PL 1	39501	IKAALINEN	+358 3 45031
LE-Sahkoverkko Oy	PL 93	15141	LAHTI	+358 3 82300
Muonion Sahkoosuuskunta	PL 15	99301	MUONIO	+358 20 7 999 830
Mantsalan Sahko Oy	Sepantie 3	4600	MANTSALA	+358 19 68991
Naantalin Energia Oy	PL 33	21101	NAANTALI	+358 2 4362900
Nurmijarven Sahko Oy	PL 4	1901	NURMIJARVI	+358 9 878071
Nykarleby Affarsverk	Kvarnvagen 20	66900	NYKARLEBY	+358 6 7856111
Oulun Energia Siirto ja Jakelu Oy	PL 116	90101	OULU	+358 8 5584 3300
Oulun Seudun Sahko Verkkopalvelut Oy	Voimatie 2	90440	KEMPELE	+358 8 3101 460
Outokummun Energia Oy	PL 53	83501	OUTOKUMPU	+358 13 563011
Paneliankosken Voima Oy	Makilantie 7	27430	PANELIA	+358 2 8386100
Parikkalan Valo Oy	PL 14	59101	PARIKKALA	+358 5 43901
Pellon Sahko Oy	Myllytie 1	95700	PELLO	+358 16 551100
PKS Sahkonsiirto Oy	PL 141	80101	JOENSUU	+358 13 266 3311
Pori Energia Sahkoverkot Oy	PL 9	28101	PORI	+358 2 6212300
Porvoon Sahkoverkko Oy	Mannerheiminkatu 26	6100	PORVOO	+358 19 661411
Raahen Energia Oy	PL 39	92101	RAAHE	+358 8 29921
Rantakairan Sahko Oy	Lanssitie 1	95200	SIMO	+358 16 266061
Rauman Energia Oy	Kairakatu 4	26100	RAUMA	+358 2 837781

Rovakaira Oy	PL 8013	96101	ROVANIEMI	+358 16 33771
Rovaniemen Verkko Oy	PL 8216	96101	ROVANIEMI	+358 20 1 525800
Sallila Sahkonsiirto Oy	Loimijoentie 65	32440	ALASTARO	+358 2 76431
Savon Voima Verkko Oy	PL 1024	70781	KUOPIO	358 290 223 111
Seiverkot Oy	Varastotie 5	60100	SEINAJOKI	+358 20 7601400
Tampereen Sahkoverkko Oy	PL 175	33101	TAMPERE	+358 3 5653 5112
Tenergia Oy	Keskustie 81	95300	TERVOLA	+358 16 242411
Tornion Energia Oy	Asemakatu 5	95420	TORNIO	+358 16 43211
Tornionlaakson Sahko Oy	Myllytie 1	95700	PELLO	+358 16 551100
Turku Energia Sahkoverkot Oy	PL 105	20101	TURKU	+358 2 2628111
Utsjoen Sahkoosuuskunta	PL 32	99981	UTSJOKI	+358 16 677321
Vaasan Sahkoverkko Oy	PL 26	65101	VAASA	+358 6 3245111
Vakka-Suomen Voima Oy	PL 11	23801	LAITILA	+358 2 85061
Valkeakosken Energia Oy	PL 89	37601	VALKEAKOSKI	+358 3 5865111
Vantaan Energia Sahkoverkot Oy	PL 95	1301	VANTAA	+358 9 82901
Vatajankosken Sahko Oy	PL 12	38701	KANKAANPAA	+358 2 578 257
Vattenfall Verkko Oy	PL 2	33901	TAMPERE	+358 20 586 11
Verkko Korpela Oy	Junkalantie 15	69100	KANNUS	+358 6 8747311
Vetelin Sahkolaitos Oy	Aijapatintie 4	69700	VETELI	+358 6 8663600
Vimpelin Voima Oy	Uusituvantie 6	62800	VIMPELI	+358 6 5617200
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Safety Tecnology Authority
http://www.tukes.fi

NET METERING RULES

Net metering is not used as policy measure in Finland. Instead, policy types like obligations, third party finance, Fossil fuel taxes, Production Tax credits, etc. are widely met for the further deployment of DG and RES.

FINANCIAL AND SUPPORTING SCHEMES

Title: Electricity Market Act 386/1995

Country: Finland

Incentive type: Tax Subsidies, discretionary investment subsidies: new investments are eligible for subsidies up to 30% (40% for wind), guaranteed access to the grid for all electricity users and electricity-producing plants, including RES-E generators

Eligible renewable /other technologies: Photovoltaics, Wind, CHP

Applicable sectors: Commercial, Industrial, Residential

Authority: Local city, State etc.

Summary:

Electricity pricing and making electricity suppliers compete

The Electricity Market Act has opened the Finnish electricity market to competition. Today, customers can buy their electricity from any electricity supplier in Finland. Small-scale electricity users, whose main fuse size does not exceed 3x63 ampere and connection capacity is max. 45 kW, can invite tenders from electricity suppliers without additional costs. Customers using more electricity must have an hourly meter when they wish buy electricity based on competitive tendering. Today, electricity comprises two commodities, the distribution service and electric energy. The sale of the distribution service continues to be the local electricity company's exclusive right. Tenders can be invited for electric energy. The proportion of electric energy in the electricity bill varies between different customer groups. In the electricity bill of a private consumer, the electric energy for which tenders can be invited typically accounts for 40-50% of the invoice amount.
In Finland the electricity companies set the tariffs and other conditions by themselves. Network tariffs and retail tariffs that are within obligation to supply have to be published. The Energy Market Authority (regulator) has the possibility to intervene and ensure adjustments to ensure compliance with the electricity market legislation.
The regulator does not give to the companies any strict rules concerning the methodology or revenue level. The network companies have an obligation to inform the regulator about the new tariffs, but any pre-acceptance from the Energy Market Authority is not required. The regulator is monitoring the tariffs afterwards on a case-by-case basis (ex-post regulation).

In Finland there are separate tariffs for network services and for electrical energy.
According to the Electricity Market Act the tariffs of network services (connection to the network, transmission and measurement of electricity) must be published, and the pricing principles of

network services must be equitable and non-discriminating. The pricing of network services must in Finland be based on a so-called postal stamp tariff system. According to this system, a customer connected to the network at one point, after having paid the necessary fees to the network operator in question, has the right to use the entire Finnish electricity network from his connection point. The location of the customer within the distribution network operator's area of responsibility must not affect the tariffs of network services. The tariffs of network services differ from each other in different distribution networks, but customers cannot invite tenders. The network tariffs is determined, among other things, by the quantity of electrical energy supplied to the customer, the power demand, and the voltage level at which the customer has been connected to the network. Lower voltage level network tariffs include also a part of the costs of the upper voltage level network.
As the consumers are allowed to buy the electrical energy from any retailer, the consumers might have also negotiated tariffs for electrical energy. Electricity retailers should have public list prices for consumers that are within obligation to supply.
In Finland there are more than 90 distribution network operators and there are also about 10 separate regional network operators. All of these have own tariffs.

Network tariffs

Network tariffs for very large-scale industrial consumers (connected to national grid at the 110 kV or above level) consist of a market place fee and a use of grid fee. Both fees are euro/MWh. The market place fee is based on the consumption of electric energy beyond the connection point between the customer and the national grid. The use of grid fee is based on the volume of electric energy transmitted through the customer's connection point, and it is specified separately for winter weekdays and other times. Winter weekdays are Mondays to Saturdays from November 1st to March 31st between 7am and 10pm daily.

Network tariffs for large-scale industrial consumers (connected to regional transmission network at the 110 kV) are quite often similar to the transmission tariffs in the national grid. The prices include both the costs of regional network and the fees for transmission in the national grid. Some regional network operators have also fixed and/or demand charges.

Network tariffs for medium-scale industrial consumers (connected to distribution network at the 0,4 kV or 6-70 kV level) consist normally of a standing charge, a demand charge and several energy rates, typically two to four. The energy rates differ depending on the time of day or the time of year. There may also be a reactive demand charge.

Network tariffs for the smallest industrial consumers (connected to distribution network at the 0,4 kV level) and for domestic consumers typically consist of a standing charge and one or two energy rates. Standing charges depend typically on the size of the user's main fuse in rural areas. In larger urban areas standing charge is same for all customers. Tariffs for the smallest domestic consumers (apartments or houses without electric heating) typically consist of a standing charge and an energy rate. Standing charges depend typically on the size of the user's main fuse in rural areas. In larger urban areas standing charge is same for all customers. Tariffs for other domestic consumers (houses with electric heating) typically consist of a standing charge and two energy rates. Standing charges depend typically on the size of the user's main fuse in rural areas. In larger urban areas standing charge is same for all customers. The energy rates differ depending on the time of day or the time of year.

Tariffs of electrical energy

Tariffs of electrical energy for industrial consumers vary a lot between the retailers. The public list prices for industrial consumers consist normally of a standing charge, a demand charge and several energy rates. Some of the retailers have only energy rates at their tariffs of electrical energy. Negotiated prices may have the same structure as the public list prices or these tariffs might for example be connected to the Nord Pool spot-prices.
The public list prices of the electrical energy for domestic consumers have normally the same structure as the network tariffs. Some of the retailers have only energy rates at their tariffs of electrical energy. Negotiated tariffs of electrical energy for domestic consumers have normally the same structure as the public list prices.

Taxation

The electricity taxation system in Finland is based on the taxation on consumption of electricity. The system has two separate electricity tax levels. Industrial customers and greenhouses pay 0,44 cent/kWh while others pay a higher rate of 0,73 cent/kWh. There is also a Precautionary Stock Fee of 0,013 cent/kWh for all customers.
Value Added Tax on electricity has been in effect in Finland since August 1986. The current rate is 22 % and is recoverable by industrial customers.

Contact
Energy Market Authority of Finland
http://www.energiamarkkinavirasto.fi

SAFETY AND POWER QUALITY REQUIREMENTS

COUNTRY: Finland

In Finland due to the existence of many DSOs there is no specific image on standardized safety and power quality requirements. Some of the issues answered in the following are covered from the transmission system code which is issued by Nordel and is valid for all Nordic countries.(http://www.nordel.org).

REQUIREMENT	**VALUE**	**REFERENCE STANDARD OR GUIDE** (including link)
PROTECTION REQUIREMENTS		
Is an external accessible disconnecting switch mandatory?	YES (description: visible disconnecting switch with safety in the isolation position)	Nordic Grid Code
What is the acceptable range of AC voltage for operation of DER?	+5% -10%	Nordic Grid Code
What is the acceptable range of frequency for operation of DER	49-51 Hz	Nordic Grid Code
What is the maximum allowed time for disconnection of DER in a case	10 secs	

of a frequency out of range event		
Other protection requirements	NA	
IMPACT ON GRID-POWER QUALITY		
What is the limit of harmonic current emissions of DER	Individual Harmonic order, h- max distortion (%) 2 : 1 % 3 : 3 % 4 : 0.7 % 5 : 3 % 6 : 0.5 % 7 : 2.5 % 8 : 0.3 % 9 : 1.5 % 10 : 0.2 % 11 : 1.7 % 12 : 0.2 % 13 : 1.7 % 15 : 0.5 % 17 : 1.5 % 19 : 1.5 % 21 : 0.5 % 23 : 0.8 % 25 : 0.8 % Even>12 : 0.2 % Odd multiple of 3 >21 : 0.3 % Odd other than multiple of >25 : 0.5 % Total harmonic distortion (THD) for the voltage < 3%	Nordic Grid Cod
Requirements regarding power factor	0.9 leading<Power Factor<0.9 lagging	

7.10. FRANCE

INTRODUCTION

NATIONAL ENERGY POLICY

Faced with an energy context which has undergone profound changes over the last thirty years (substantial technical progress, fluctuation in energy prices, reorganisation of energy markets, emergence of environmental issues), France derives great benefit from the consistency of its energy policy, still organised around four major concerns. At present, French energy policy is defined by the Energy Act of 13th July 2005 defining energy policy priorities. It is expressed in the form of four major objectives:

To contribute to national energy independence and guarantee security of supply

France has very limited energy reserves. In this context, meeting France's energy needs involves a risk that should be managed. In macroeconomic terms, the aim is to limit the exposure of our economy to fluctuations in energy prices, in particular by developing domestic production. In terms of physical supplies, the aim is to ensure the availability of sufficient capacity to cope with the problems of shortages of electricity (capacity and availability of generation plants, transmission quality and interconnection level), gas (management of stocks) and oil (management of security stocks).

To ensure competitive energy prices

The price, quality and availability of energy are determining factors in France's attractiveness and thus in the development of employment, particularly in sectors with high energy consumption. French energy policy is therefore designed to guarantee a competitive energy price to our businesses, particularly those facing strong international competition.

To protect human health and the environment, in particular by fighting against climate change

Energy production and consumption can have major impacts on the environment, the most important of which are emissions of greenhouse gases, but also the emission of pollutants contributing to the degradation of air quality and the production of radioactive waste. Energy policy should therefore contribute to the control of the dangers of climate change and ensure that the risks of the nuclear sector are properly managed.

To guarantee social and territorial cohesion by ensuring access to energy for all

Energy is one of the major necessities of life. It is therefore important that the energy policy provides everyone, and in particular the most deprived, with access to a high quality energy source at a competitive price. In order to reach these objectives, four principal areas of action were identified in the energy programme law mentioned above:

- **to control energy demand,** through a series of incentives and programmes, including an energy saving certificate scheme, standards and regulations, together with tax incentives;

- **to diversify sources of energy,** by increasing the use of renewable energies, keeping the nuclear option open and, in general, by developing a high-performance energy production infrastructure;
- **to increase research** into energy, because this is essential in order to meet long-term challenges, for example for bioenergies, fuel cells, clean vehicles, energy-efficient buildings, solar energy, capture and underground storage of CO_2, 4th-generation nuclear energy;
- **to provide methods of transporting and storing energy,** adapted to requirements, in particular in order to guarantee the quality of the electricity supply, reinforce the security of the gas and electricity grids and, in general, improve the safety of France's energy supply.

To provide a framework for these decisions, quantitative objectives were laid down by the Energy Act of 13th July 2005 defining energy policy guidelines:

- **a quartering** of CO_2 emissions by 2050,
- **average reduction** of final energy intensity of at least 2% per year from 2015 and of 2.5% from 2015 to 2030,
- **production of 10% of energy needs** from renewable energy sources by 2010,
- incorporation of **bio-fuels and other fuels** of renewable origin to a level of 2% in 2006, 5.75% by the end of 2008 and 7% in 2010.

Opening-up of energy markets to competition

The opening up of the French market, brought about by the European directives of 1996 for electricity and 1998 for gas, is a reality. Since 1st July 2004 all Professional customs, associations and institutions have been eligible in France. From 1st July 2007 it will be the turn of individual consumers.

In addition, with the establishment of an independent regulator, the CRE (energy regulation committee), regulated access by third parties to the electricity and natural gas grids at regulated rates and access to natural gas stocks negotiated under transparent and non-discriminatory conditions, France has a system that provides transparency and competitive efficacy.
Within the context of an open European energy market, the law of 9th August 2004 on the status of the electricity and gas companies transformed EDF and Gaz de France into corporations, and a gradual opening of their capital is planned, whilst keeping them within the public sector.

Electricity and energy policy

The law of 8 April 1946 established Électricité de France (EDF) as an industrial and commercial public undertaking, the purpose of which was to meet the nation's electrical energy requirements "under the best conditions of cost and service quality, in the public interest". This mission led EDF to ensure the bulk of power generation in France as well as power distribution to the various types of consumers. Two European directives setting common rules for the internal power market (96/92 of 19 December 1996 and 2003/54 of 26 June 2003) were transposed into French law by the Act of 10 February 2000 governing the public electricity service, by the Act of 9 August 2004 governing electricity and gas companies and by the Act governing the energy sector passed in November 2006.

Henceforth, power generation is a competitive activity subject to ministerial authorisation. Calls for tender may be organised within the framework defined in the long-term investment programmes for electricity generation. This system is designed to ensure security of supply and to develop renewable energy sources and cogeneration, for which a purchase obligation procedure was introduced. As for electricity trading, this activity is subject to a reporting system. A system of grid access regulation, with tariffs set on proposal by the CRE (*Commission de régulation de l'énergie*), France's energy regulator, was designed to promote transparency and effective competition. To consolidate this situation, measures were implemented to separate regulated operations from competitive operations: transmission is handled by RTE EDFTransport, an entity legally distinct from EDF. RTE EDF-Transport operates and maintains the public power transmission grid; it is responsible for developing the grid for purposes of both user connection and access (e.g. producers, distribution grids and consumers), and interconnection with other grids.

Regarding regulation, the CRE operates alongside the Minister Delegate for Industry, in charge of defining electricity policy and public service missions, as na independent, specialised regulatory authority. In line with its authority over grid access, the CRE is responsible for ensuring smooth competitive operation in the power market.

All professional customers became eligible as of 1st July 2004. As a result, roughly 70% of the French power market is already open to competition, and will be entirely as of 1st July 2007. Furthermore, RTE EDFTransport (RTE) organises bids for tender to purchase the electricity required to offset physical power losses in the French transmission grid at the best price.

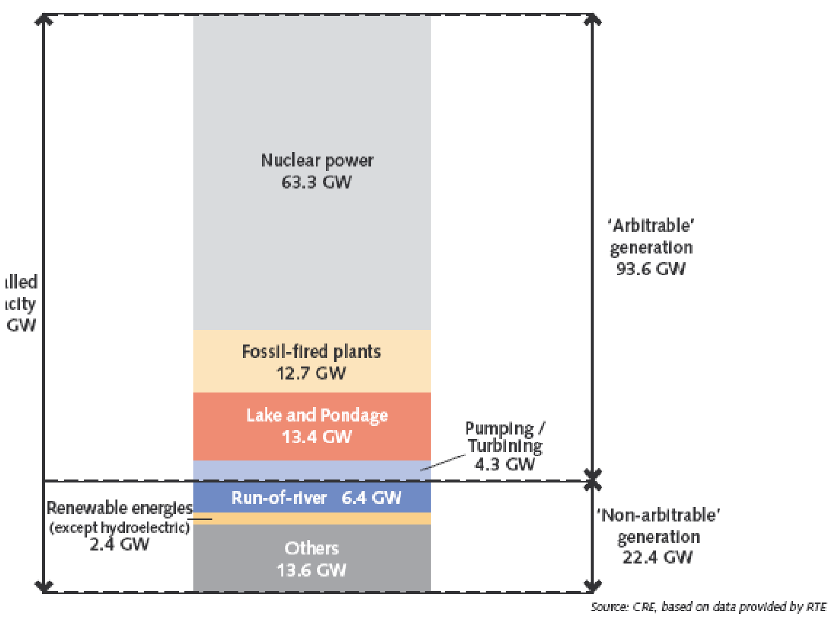

Fig. 1: Government holdings in energy companies in France, 2002

<u>NATIONAL ENERGY EFFICIENCY</u>

To reduce France's energy dependence, it has been decided to promote energy saving and invest in nuclear electricity generation and renewable energies. These energies provide a reliable long-term supply without greenhouse gas emissions, and nuclear energy ensures stable electricity prices.

Construction of an EPR - in 2004 it was decided to commence construction of a demonstration model EPR (European Pressurized Water Reactor), not only in order to have the option of eventually using this technology to replace the present generating facilities, but also to support these facilities and maintain industrial capacity whilst leveraging exports. Furthermore, transparency in nuclear matters is of vital importance in ensuring the continuity of nuclear energy.

Promotion of energy savings - a tax credit for energy saving and renewable energies was introduced on 1st January 2005 and reinforced in 2006. The tax credit rate has been increased:

- from 40% to 50% for energy production equipment using a renewable energy source and certain types of heat pump;
- from 25% to 40% for condensing boilers and thermal insulation materials under certain conditions.

Introduction of the **energy saving certificate scheme** - the principle of energy saving certificates is based on an obligation imposed on energy sellers by the public authorities to generate energy savings over a given period (electricity, gas, heating, refrigeration and domestic fuel oil). A savings target of 54 TWh has been set for the period from 1st July 2006 to 30th June 2009.

ELECTRICITY MARKETS

The commercial value chain for electricity may be divided into four stages: generation, trading, transmission / distribution, and supply to end consumers. Generation of electricity has been open to competition since the Law of 10 February 2000 came into force.Any company may generate electricity in France, for:

- sale on wholesale and retail markets;
- consumers,wholly or in part, for their own needs;
- sale to EDF or to local distribution companies (LDCs) in the context of the purchase obligation system;
- export.

In France, generation of electricity is dominated by EDF, which has 85% of generation capacities. Four other generators operate high power facilities, together representing 6% of existing capacity.The remaining 9% is made up of small generating plants operated by:

- a large number of independent generators, mostly selling the electricity they generate to EDF, in the context of purchase obligations;
- industrial companies, which consume the electricity they generate.

LEGISLATION AND REGULATION FOR MICROGENERATION SYSTEMS

The Role of french Public Authorities in the Field of Energy in the Framework of Liberalized Markets.

France took its first steps towards opening its energy markets in 1992, with passage of the oil law on December 31, 1992, and continued this process in 1995 with regard to coal, and in 2000 with the electricity law of February 10. The process is expected to be completed in 2002 with a law relating to gas, although in this latter case liberalization has in major respects already been implemented through direct application of a European directive.

In the wake of this successive legislation, public authorities have seen their role change, but have continued to maintain their prerogatives, which have often been transformed and sometimes complicated or even enhanced. Public authorities remain responsible for defining and enforcing adherence to the rules within which the various market players must act. However, the nature of the corresponding tasks differs significantly between network energy sources, on the one hand, and other forms of energy such as petroleum products, coal and renewables on the other.

An ongoing decline in public ownership

In France, despite recent changes, the State retains an important role as trustee or majority shareholder in several energy companies, from which it acquires the ability to implement a part of its energy policy by means of contracts that stipulate multiyear objectives without interference in company management. The government can thus establish objectives regarding security of energy supply, regional planning and public service.

However, all of the oil companies operating in France have already been completely privatized, although the government continues to hold a golden share in the capital of TotalFinaElf (which has finally disappeared the 5th of October 2002). In addition, it is likely that in the near future, there will be transfers of capital in some of the remaining State-owned companies, with the result that this form of regulation will tend to diminish, under conditions similar to those found in most industrialized countries.

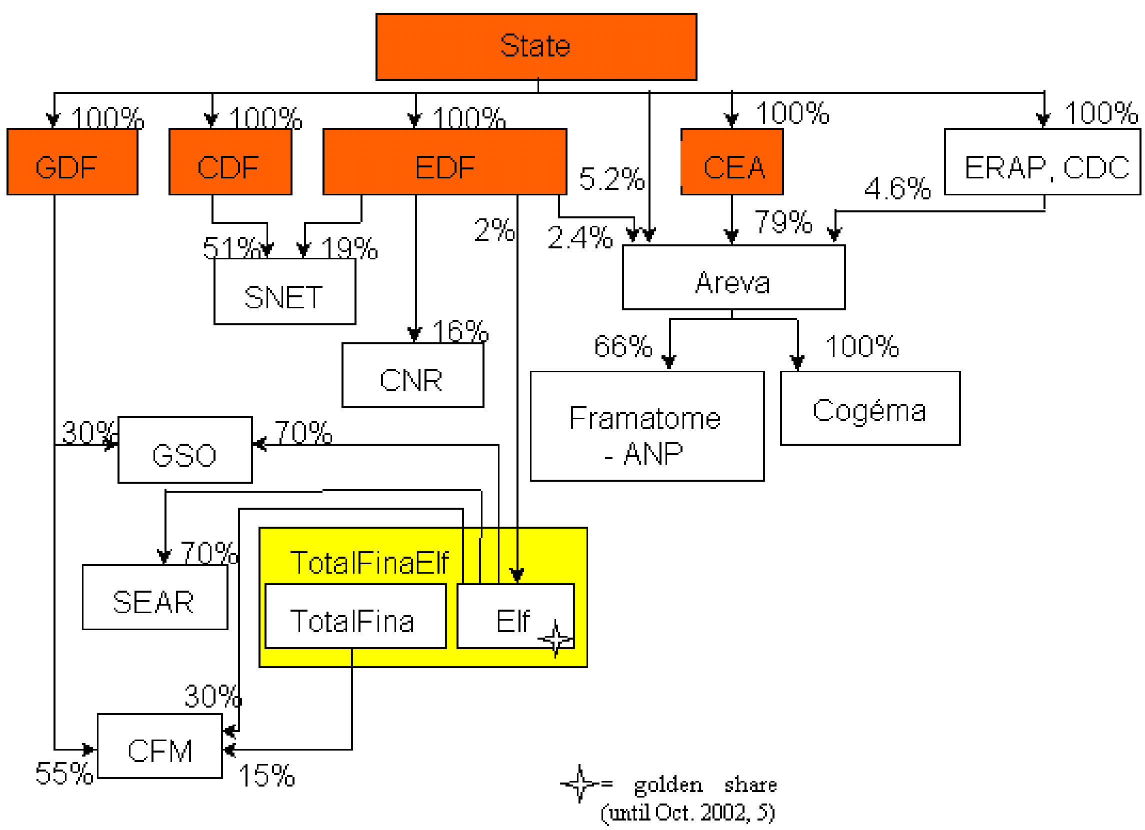

Fig. 2: Government holdings in energy companies in France, 2002

A growing concern: ensuring security of energy supply

Of course, public authorities retain other traditional governmental activities: preparation and development of regulations, energy taxation, public service obligations, personnel safety, and installation safety, identification of external factors and, more generally, protection of the environment. They have also the general responsibility of preparing the future by supporting R&D efforts when private companies alone would not engage by themselves appropriate involvement.

The complexity of the energy system requires that a suitable logistical framework be established to ensure that the system functions properly. Businesses must contribute to this objective with appropriate technologies and infrastructures. In the case of France and about electricity, the central government, working in tandem with local authorities, retains some control over RTE's planning with regard to developing the transmission network.

Appropriate modeling tools are to be designed so that the outlook for energy supply and demand can periodically be assessed in the various business sectors that make up the national economy. From this we can deduce the country's future requirements in terms of the production and infrastructure resources needed to ensure a supply of energy that is compatible with the country's economic development. For instance, France regularly establishes a multiyear electricity generation investment program and can ensure compliance with this program through the use of tools such as a "tendering procedure" or a "purchase obligation." Use of this system can, for example, influence the development of specific branches of energy production, either directly or through the adjustment of incentives—including rate-based or other incentives—regarding these branches. In this way, a potential surplus of gas-fired electricity power stations, the insufficient use of renewable or nuclear energy, as well as gaps in transmission capacities can be detected and corrected before they give rise to harmful consequences.

Finally, ensuring a secure overall energy supply remains a prerogative of public authorities and can be promoted by bilateral or multilateral diplomacy.

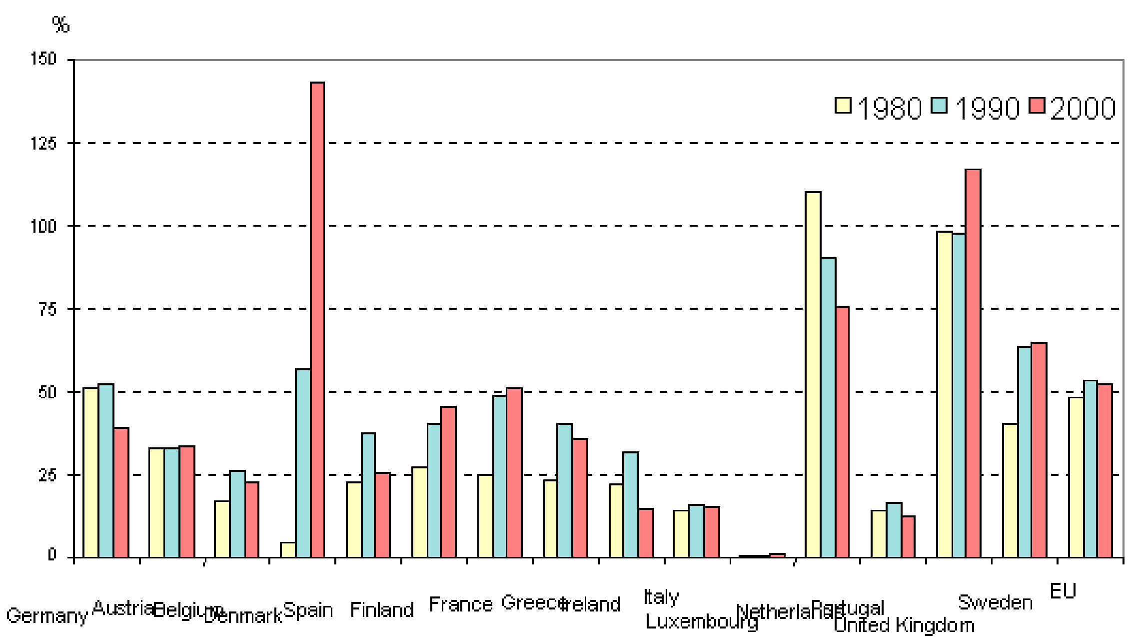

Fig. 3: Changes in rates of energy self-sufficiency within the EU

An approach that increasingly neglects a long-term outlook

The search for high short-term profitability, which can be traced in part to the expansion of the private sector, means that investment projects are selected on the basis of a high rate of return. Without government intervention, there is hence a risk that projects essential for meeting significant middle- and long-term challenges will be neglected. This is particularly true of energy research and development, a field in which, over the past few years, the level of investment has dropped in most of the countries that have opened their markets.

<u>REGISTRATION AND LICENSING OF MICROGENERATION UNITS</u>

Renewable energies

Renewable energies are an interesting opportunity to reduce our greenhouse gas emissions and our energy dependency and, in the case of decentralised renewable energies, deal with the shortcomings of the electricity grid.

In terms of volume, France is currently Europe's leading producer of renewable energy and has progressed considerably in the last three years. In three years therefore, the installed wind power base has been multiplied by five, the installed power using photovoltaic panels has doubled, as has the solar power market.

In the 13 July 2005 law, the French government aims to diversify its energy mix still further, by increasing the share of renewable energies and optimising its hydro-power potential in particular. Thanks to hydro-electricity, but also nuclear power, we today emit 40% less greenhouse gases per inhabitant than the average in the developed nations. The French multiyear sectorial estimates act on energy policy, in conformity with and indeed going further than the European directives, thus sets the following goals for the end of 2010:

- 50% rise in the production of heat from renewable sources;
- increase the bio-fuel share to 7% of national consumption;
- generate 21% of electricity from renewable energy sources (in particular by developing wind power while protecting the countryside from visual pollution);
- installing 200,000 solar water heaters and 50,000 photovoltaic heating roofs per year in 2010.

With regard to bio-fuels and as stipulated in the 2003/30 directive, France will as a priority encourage fuels with an excellent overall environmental balance, particularly with respect to greenhouse gas emissions, soil occupancy, degree of intensity of cultivation and use of pesticides, and profitability, while not ignoring competitiveness and security of supply.

In the more general field of **biomass,** France warmly welcomes the recent communication from the Commission concerning the biomass action plan, and supports the main initiatives, particularly the measure concerning the rapid adoption of a decision enabling member States to apply a lower rate of VAT for district heating systems using biomass as an energy source.

Nonetheless, despite the considerable efforts made at European level to promote and develop renewable energies, they will be unable to replace the other forms of energy, for which capacity will in any case have to be retained, in order to compensate for the intermittent nature of renewable energies.

Given the higher cost of renewable energies, it is important that Europe increase its research efforts in this field in order to improve the competitiveness of the various technologies.

In the field of renewable energies, France proposes that the EU:

- envisage a thermal renewable energies directive , which would supplement the existing directives on the production of electricity from renewable energies and bio-fuels;
- within the framework of community strategic guidelines, recommend that the member States devote part of the structural funds to actions in favour of developing renewable energies;
- encourage the substitution of fossil fuel energies, beginning with the most polluting such as coal**,** with renewable energies, particularly in the residential sector.

INTERCONNECTION TYPES AND REQUIREMENTS

Until 2004, interconnection capacities between France and its neighbouring continental European Member States were managed using administrative mechanisms: priority lists and pro rata mechanisms. These congestion management systems originated from the period when interconnections were mainly used, in addition to their role of grid safety, to export surplus nuclear electricity generated in France, under long-term contracts.

With the prospect of setting up a European electricity market, these administrative mechanisms had to evolve into market mechanisms that would allow competition to develop, in accordance with Community regulations and case law (Regulation (EC) No 1228/20031 and the Judgment of the European Court of Justice of 7 June 2005).

In its roadmaps drawn up jointly with the regulators in neighbouring Member States in 2005, CRE took particular care, having consulted the market operators, to implement the EU’s requirements by demanding the introduction by 1 January 2006 of auction mechanisms to allocate interconnection capacities on France’s borders with the other Member States.

In 2006, two important events occurred that had an impact on interconnection management:

- In February, the launch by ERGEG of the Regional Electricity Initiatives with the aim of speeding up market integration at a regional level so as to end up with a single European Union market. France belongs to four of the seven regions (see inset 2) defined by the European Commission and ERGEG:
    - Central-West (with Germany, Belgium, Luxembourg and the Netherlands);
    - Central-South (with Germany, Austria, Greece, Italy and Slovenia);
    - South-West (with Spain and Portugal);
    - United Kingdom and Ireland.

- In December, the entry into force of the new guidelines for Regulation (EC) No 1228/20033. While the Regulation set out the general principles for congestion management, the new guidelines explain precisely the improvements to be made to the current mechanisms. In particular, they require a coordinated approach at regional level for the calculation and allocation of interconnection capacities.

OVERVIEW OF THE TRANSMISSION SISTEM

The opening of the energy markets has led to the emergence of new industry players, be they producers, importers traders or carriers of energy products. The competition that arose among these companies initially resulted in improved selling terms for their customers. But market laws lead to consolidations, mergers and acquisitions that, unless precautions are taken, could lead to market distortions, excessive prices and, more broadly, a deterioration in the quality of services provided, sacrificed in the pursuit of short-term gains. It was in particular in order to avoid such problems that "independent," specialized regulatory bodies were established to intervene on the State's behalf, while remaining uninfluenced by its financial or current economic policy considerations.

These regulatory bodies are performing a completely new task, insofar as the industry in which they intervene was formerly a monopoly. In addition, while under government control, a monopoly could easily perform internally certain tasks that are necessary to the relevant market's operation, such as conducting strategic infrastructure planning research and development, establishing conditions for the use of transmission systems and setting rates for consumers. It has now become necessary to provide for transparency in the performance of these various responsibilities in such a way as to avoid distortions of competition and distortions generated by cross-subsidies. Thus, in France, an entity has emerged that specializes in the transmission of electricity, RTE (TSO), offering every guarantee of independence vis-à-vis the producer and distributor, EDF.

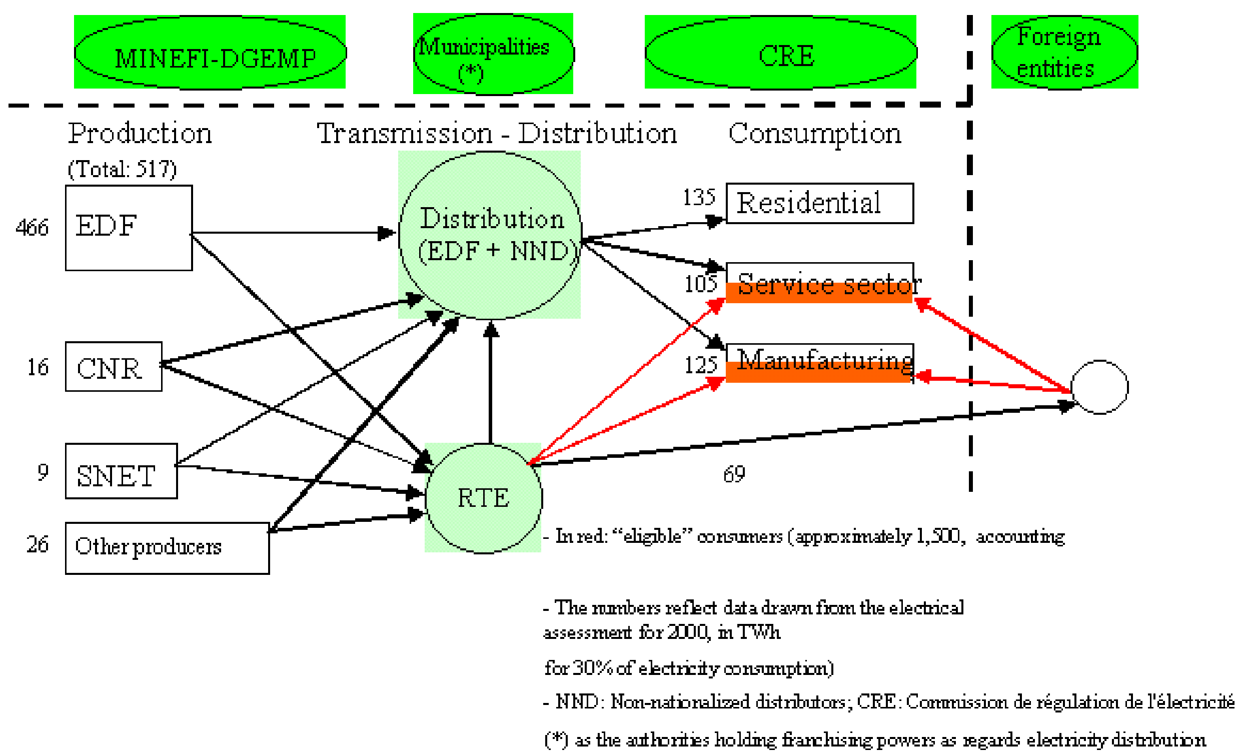

Fig. 4: France's electricity system since the electricity law of February 10, 2000

Market transparency requires that statistical and economic data be collected and distributed in a format that respects the statistical, industrial and commercial privacy of the various entities involved. The public authorities alone have the requisite neutrality and independence. In addition, the growing demands of international organizations, notably in order to meet the quantified objectives that are more and more commonly used in European regulations, are contributing to expanding this governmental activity.

General technical requirements for connection of users to public electricity grids

Technical design and operation requirements for connection to public transmission and distribution grids with which grid user equipment must comply, in application of articles 14 and 18 of the Law of 10 February 2000 have been completed.The regulatory framework for connection to public electricity grids is illustrated in figures 15 and 16.

With improved understanding of requirements applicable to them, public grid users can now make rational technical and economic choices for connection of new equipment. The Ministerial Order of 6 October 2006 governing such technical requirements complements the regulatory framework for connection to the public transmission grid. However, the Government has not taken account of the four main criticisms contained in CRE's opinions of 24 March 2005 and 26 July 2006:

- too great a number of components left for agreement between parties, whereas access must be regulated and not negotiated;
- absence of a QA plan for the protection system, contrary to what is stipulated for users other than distribution grids;
- absence of regulatory obligation concerning transit of reactive power to the delivery point;

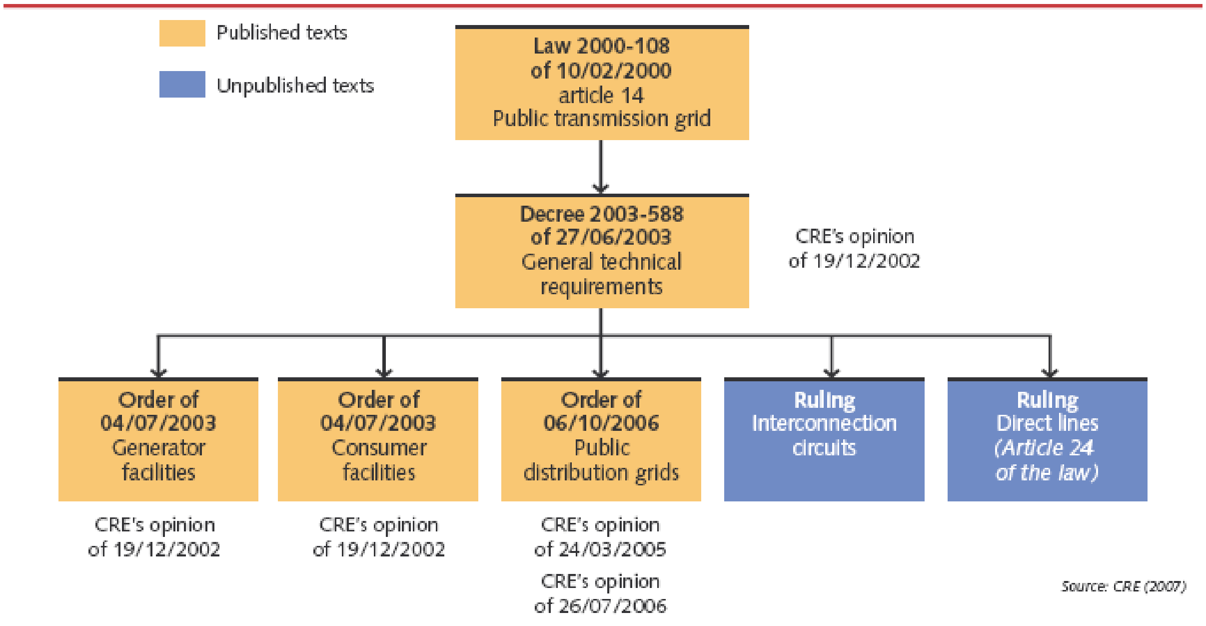

Fig. 5: Legal framework for connection to the public transmission grid

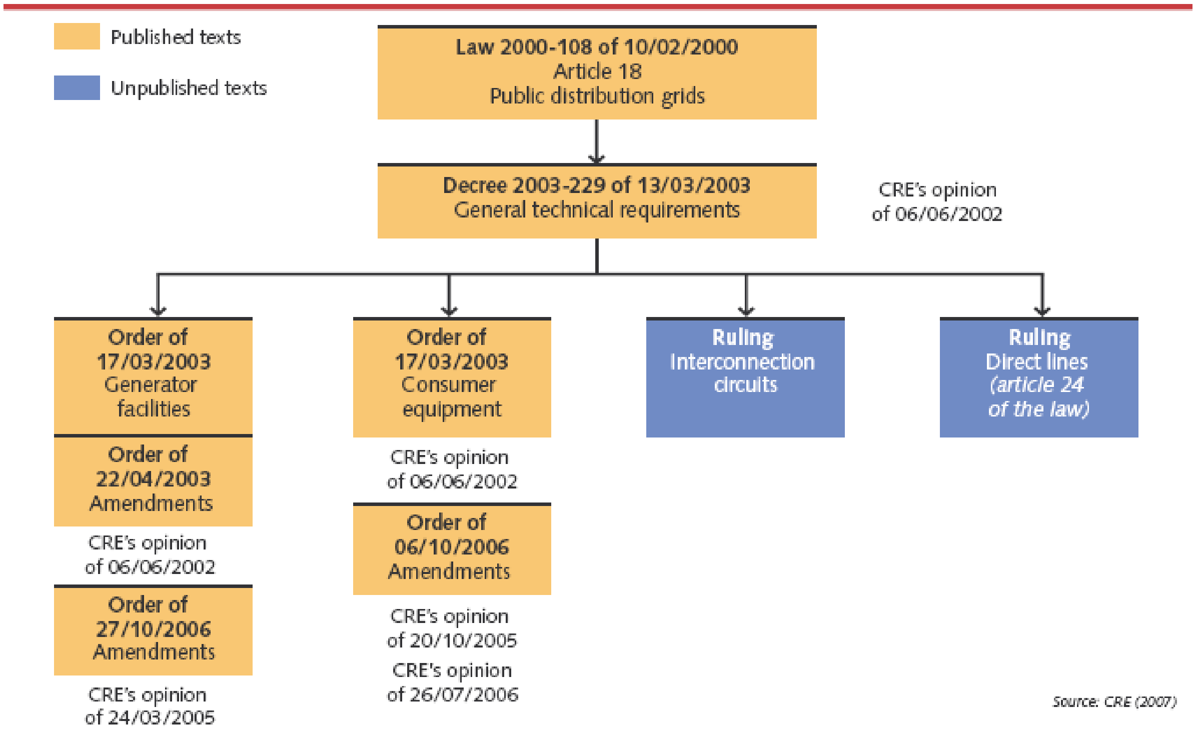

Fig. 6: Legal framework for connection to the public distribution grid

Regulations in force are unable to cover all technical measures pertaining to public electricity transmission and distribution grids, which is why, on 7 April 2004 and basing itself on article 37 of the Law of 10 February 2000, CRE decided to oblige public electricity grid operators to publish technical guidelines.

In compliance with article 35 of the standard technical specifications for public electricity transmission grid franchise, "the public transmission grid franchisee shall communicate to CRE and the Minister for Energy, prior to publication, technical reference documentation and results of consultation with representatives of the various categories of grid users".

PAYMENT SCHEME FOR RENEWABLE ELECTRICTY PRODUCTION

- **Systems of obligatory purchase** by EDF and the other electricity distributors of electricity generated by power plants of less than 12 MW have given new impetus to interesting sources, such as electricity generated from wind energy.
- In parallel, for plants larger than 12 MW, calls for tenders have been issued by the public authorities within the framework of multi-annual investment programming (PPI).
- Renewable energies benefit from the **tax** credit since 2005. This procedure has been a great success, since the solar energy market for heating or hot water production has experienced spectacular growth (more than 100,000 sq. m of solar panels were installed in 2005). The more

established wood-burning stove market also showed significant growth, sales reaching more than 400,000 units in 2005.

THE PUBLIC ELECTRICITY AND NATURAL GAS SERVICE

The public electricity service comprises three missions:

- development and operation of public transmission and distribution grids;
- supply of electricity in the national territory to customers who have not exercised their eligibility, at regulated retail prices, and emergency supply of electricity to other customers;
- balanced development of electricity supply.

CRE participates in implementation of the second and third missions, which are the subject of this section, by carrying out the following tasks:

- it implements the procedure for calls for tender put out by the Minister for Energy as a means of achieving the aims of the multi-year investment programme;
- upon referral from the Minister, it advises on feedin tariffs set up in order to develop renewable energies and cogeneration;
- each year, it assesses public electricity service costs for the following year, along with the corresponding unit contribution. Such costs result from support given to cogeneration and renewable energies, tariff equalisation in non-interconnected territories, and social measures in force since early 2005.

Under the provisions of the Law of 7 December 2006, public service must also cover gas.

Support systems for electricity generation: cogeneration and renewable energies

Promotion of renewable energies, instituted by the Directive of 27 September 2001, is a priority in the European energy policy.Renewable energies help to reduce the effects that energy consumption has on the environment and to ensure the security and diversification of sources of supply. The Law of 10 February 2000 provides for two systems of support for electricity generation: calls for tender (article 8) and purchase obligation (article 10).

On 7 September 2006, CRE was commissioned by the Minister for Industry to draft technical specifications regarding a call for tender for electricity generation facilities using biomass energy, the second call for tender in the biomass sector.Total target capacity was 300MW, composed of 80MWfor facilities with unit power of between 5 and 9 MW, and 220 MW for facilities with power superior to 9 MW. Selected candidates will be awarded a contract for purchase of electricity generated at the price they propose, for a period of 20 years. Conditions set by the Minister regarding the call for tender stress the importance of facility energy performance and of the quality of the supply plan.Weighting of the price criterion is much lower in comparison with the previous call for tender.

A maximum of six months after reception of bids, planned for August 2007, CRE will send the Minister a review sheet for each project, including an assessment of costs based on application of criteria set out in the technical specifications, and a summary report. Finally, it will issue an opinion on the choice of candidates envisaged by the Minister.

In January 2005, the previous call for tender led to permits to operate being granted to 15 facilities, for a total power of 216 MW.The average price of selected bids was set at 86 €/MWh for 15-year contracts.

Purchase obligation

On 7 June 2006, CRE was asked to give an opinion on four draft orders modifying purchase obligation conditions for electricity generated by facilities using biogas, mechanical wind energy, solar energy and geothermal energy, and, on the 6 February 2007, on a draft decree modifying conditions for purchase of electricity generated by hydropower plants using water from lakes, rivers, and the sea.

- As regards the **biogas** sector, CRE issued an unfavourable opinion on the envisaged tariff, as it would result in too high a return on equity capital, after taking account of the fiscal systems currently in force, in particular as it concerns plants using dump biogas. Bearing in mind that capture of dump biogas is a legal obligation in the processing of waste,CRE judged that, in application of the 'polluter-payer' principle, corresponding costs,which made up a major part of electricity generation costs, could not legitimately be passed on to electricity consumers.
- CRE also issued an unfavourable opinion regarding the **wind power** sector. It considered that tariffs, rising steeply even though use of this particular system was increasing more rapidly than for any other, led to return on projects and equity capital far greater than the level deemed necessary to encourage investment, and therefore gave a disproportionate amount of support to the sector.
- CRE's opinion was also unfavourable with regard to the **photovoltaic** sector. It considered that the base tariff envisaged for national use was reasonable in terms of return,but that it was overvalued in Corsica, in Overseas Departments, and in Mayotte. In these areas, increase in solar resource along with fiscal advantages was in general sufficient to compensate for recorded increases in costs. It also considered that the level of the premium for integration into the building applicable in metropolitan France was unjustified in comparison with corresponding additional costs, taking into account the very limited technical requirements necessary to benefit from it.
- In the case of the **geothermal** sector, CRE's opinion was favourable as regards tariffs to be applied in Overseas Departments. In metropolitan France, it considered that the support system was inappropriate to the single project envisaged, taking its experimental nature into account.
- For the **hydropower** sector, CRE issued a favourable opinion on the tariff envisaged for new facilities in metropolitan France, as long as degressive tariffs were introduced in line with producible quantities, andthat a lower tariff was applied for renovated plants, in a legal framework conforming to European Community rules.

INFORMATION SOURCES

[1] ADEME, Agence Française de Maîtrise de l'Energie e de l'Environment, http://www.ademe.fr/

[2] ADEME, Guides et cahiers techniques, Photovoltaïque intégré au bâti, Quelques exemples, CONNAÎTRE POUR AGIR.

[3] Report of the French Energy Regulatory Commission (CRE) www.cre.fr

[4] Direction Générale de l'Énergie et des Matières Premières, Observatoire de l'Économie de l'Énergie et des Matières Premières, Observatoire de l'Énergie, November 2006

[5] Alain MORCHEOINE, Energy efficiency for a sustainable energy mix in France

7.11. FYROM

INTRODUCTION

The electricity sector

AD “Elektrani na Makedonija” (AD ELEM), share hold, state owned company holder of the license for performing the energy activity: generation of electricity. AD MEPSO, share hold, state owned company, holder of the licenses for performing the following energy activities: transmission of electricity, operation of the power system, operation and organization of the electricity market, and wholesale supply of electricity for tariff customers; EVN MAKEDONIJA AD Skopje (90% by EVN – Austria, 10 % state owned) holder of the licenses for performing the following energy activities: distribution of electricity, operation of the distribution system, generation of electricity, and retail supply of electricity for tariff customers; TPP Negotino (crude fuel oil thermal power plant) share hold, state owned company for generation of electricity; Up to now ERC issued 23 licenses for performing energy activities in the electricity sector, from which 11 are licenses for trade with electricity. In the second half of 2007, upon written requests by the tariff customers connected to the transmission network, ERC issued brought 9 Resolutions for announcing the status of eligible customers of electricity to the customers connected to the transmission network.

Current energy issues

- Harmonization of the energy policy according to the Energy Community Treaty.
- Energy Law (Official Gazette of RM, no.63/06 and 36/07).
- New amendments of Energy Law in parliamentary procedure.

- The Grid Code for electricity transmission has been adopted in August 2006 (Official Gazette, 95/2006).
- The Grid Code for electricity distribution and the Market Code will be adopted in the first half of 2008.
- The new tariff system for electricity and the Rules on the conditions for supply of electricity will be adopted in 2008.

Renewable energy

- On 09.02.2007 ERC brought the “Rulebook on the method and procedure for establishing and approving the use of feed-in tariffs for purchase of electricity produced from small hydro power plants” and Decision for establishment of the feed-in tariffs for sale of electricity produced and delivered from small hydro power plants, which have qualified as a preferential producer, published in the “OGRM”, no. 16/07.
- On 16.05.2007 ERC brought the “Rulebook on the method and procedure for establishing and approving the use of feed-in tariffs for purchase of electricity produced from wind power plants” and Decision for establishment of the feed-in tariff for sale of electricity produced and delivered from wind power plant, published in the “OGRM”, no. 61/07.
- On 22.11.2007 ERC brought the “Rulebook on the method and procedure for establishing and approving the use of feed-in tariffs for purchase of electricity produced from power facilities which use biogas got from biomass” and Decision for establishment of the feed-in tariffs for sale of electricity produced and delivered from power facilities which use biogas got from biomass, which have qualified as a preferential producer, published in the “OGRM”, no. 142/07

- ERC will issue “Rulebook on the method and procedure for establishing and approving the use of feed-in tariffs for purchase of electricity produced from solar energy” in first half of 2008.

Information Resources

Energy Regulatory Commission of the Republic of Macedonia (F.Y.R.O.M.)
Dimitrie Cupovski No.2, 4th floor, 1000 Skopje, Republic of Macedonia (F.Y.R.O.M)
Tel: +389-2-3233-580, Fax: +389-2-3233-586
Official website: http://www.erc.org.mk

7.12. GERMANY

INTRODUCTION

The use of renewable energy sources and cogeneration systems in Germany has been rising very significantly over the last years. In 2007, about 14 per cent of the primary energy consumption was produced from RES.

Current from RES 2007 in Germany

Power Generation in billion kilowatt hours (bn kWh) and percentage of the gross energy consumption

	2004	2005	2006	2007*	Share 2007 (per cent)
Hydropower**	21.7	20.8	20.0	20.1	3.3
Wind Energy	25.5	27.2	30.7	39.5	6.4
Biomass	8.4	11.2	15.5	19.5	3.2
Waste**	2.1	3.0	3.7	4.3	0.7
Photovoltaic	0.6	1.3	2.2	3,0	0.5
Total	**58.3**	**63.5**	**72.1**	**86.4**	**14.1**

*provisional and rounded

**only RES

(Source: BDEW 2008)

The share of the energy generation from combined heat and power in Germany is currently limited to only 9 per cent. The German Government is aiming for a share of 25 % until the year 2020.

The development of these technologies requires interconnection standards of the DER with the grid to guarantee a stable operation. The grid operators are organised in the new Association of the Energy and Water Industries (BDEW - Bundesverband der Energie- und Wasserwirtschaft), which was formed by five associations of the industries in question in 2007. The former Association of the Grid Operators (VDN - Verband der Netzbetreiber) defined the technical connections conditions for the low and medium voltage grid. These specifications contain recommendations to the grid operators regarding the interconnection standards of DER.

Legislation:

- EEG (Renewable Energy Act)
- KWKG (CHP Act)

Directive

- Technical Connection Requirements (TAB 2007)
- Generation in the LV grid - Directive for Connection and Parallel Operation (VDEW 2001, Amendments 2004 and 2005)
- Generation in the MV grid - Directive for Connection and Parallel Operation (VDEW 2001, Amendments 2004 and 2005)

INTERCONNECTION RULES

Eligible renewable /other technologies: Wind, Photovoltaic, CHP, Hydropower, Fuel Cells

Applicable sectors: Commercial, Residential

Breakpoint for Small System (Simplified Rules): 50 kW

Limit on System Size/Overall Enrollment:

Power PV plants, which are connected to the LV grid, are allowed with single-phase connection on 4.6 kVA, plants with a performance above 4.6 kVA have to be connected on multi-phase.

Standard Interconnection Agreement: No

NET METERING RULES

Country: Germany

Eligible renewable/Other Technologies: Photovoltaic, Wind, CHP

Applicable Sectors: Operator of DER/Grid user

Utilities Involved: Grid operator

Interconnection Standards for Net Metering:

In LV and MV, metering systems must not count in both directions meaning that separate meters are installed for energy generation and consumption. Only calibrated meters are allowed.

The minimum standard for net metering is defined by the particular grid operator. The contracts between grid operator and user (contract about grid use and contract about mains connection) regulate the detailed conditions of net metering.

Authority 1: Association for the Energy and Water Industries (BDEW)

Website: www.bdew.de

Authority 2: Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway (Bundesnetzagentur)

Website: www.bundesnetzagentur.de

Summary:

Grid users have the right to enter into a contract about the use of the grid. The contract has to consider the regulations of the Energy Industry Act (EnWG) and has to contain the following aspects:

- Requirements of the net use
- Net Metering
- Billing
- Data processing
- Liability
- Determination of feed-in and withdrawal points in accounting grids

Contact:

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10117 Berlin

E-Mail info@bdew.de

Telefon +49 30 / 300 199-0

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Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen

(Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway)

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FINANCIAL AND SUPPORTING SCHEMES

Title:

- Renewable Energy Sources Act 2004 (EEG)
- CHP Act 2002 (KWKG)

Incentive type:

- Renewable Energies: Feed-in tariffs
- CHP: Feed-in tariffs

Eligible renewable /other technologies:

- **EEG:** Hydropower, landfill gas, sewage treatment plant gas and mine gas, biomass, geothermal energy, wind energy, photovoltaic
- **KWKG:** Generation units using CHP

Applicable sectors: Operator of DER

Terms, budgets and requirements:

The following tables give some orientation about the feed-in tariffs according to the regulations of the EEG and KWKG.

CHP (KWKG/EEG)

	Combined Heat and Power (CHP) (Units according Paragraph 3)			
Year of putting into operation	Up to 150 kW in ct/kWh	Up to 500 kW in ct/kWh	Up to 5 MW in ct/kWh	Up to 20 MW in ct/kWh
2004	13.50	11.90	10.90	10.40
2005	13.33	11.75	10.77	10.27
2006	13.16	11.60	10.64	10.15
2007	12.99	11.46	10.51	10.03
2008	12.83	11.32	10.38	9.91
2009	12.67	11.18	10.25	9.79
2010	12.51	11.04	10.13	9.67
2011	12.35	10.90	10.01	9.55
2012	12.19	10.77	9.89	9.44
2013	12.04	10.64	9.77	9.33

Degression: 1.5 %; Bonus 2.0 ct/kWh; period of allowance: 20 years

The tariff of the particular year will be paid for the whole 20 years.

	Combined Heat and Power (CHP) using RES for power generation (Units according Paragraph 2, sentence 1 and 2 as well as paragraph 3)				**Combined Heat and Power (CHP) using wood for power generation** (Units according Paragraph 2, sentence 2 as well as paragraph 3)	
Year of putting into operation	Up to 150 kW in ct/kWh	Up to 500 kW in ct/kWh	Up to 5 MW in ct/kWh	Up to 20 MW in ct/kWh	From 500 kW to 5 MW in ct/kWh	Up to 20 MW in ct/kWh
2004	19.50	17.90	14.90	10.40	13.40	10.40
2005	19.33	17.75	14.77	10.27	13.27	10.27
2006	19.16	17.60	14.64	10.15	13.14	10.15
2007	18.99	17.46	14.51	10.03	13.01	10.03
2008	18.83	17.32	14.38	9.91	12.88	9.91
2009	18.67	17.18	14.25	9.79	12.75	9.79
2010	18.51	17.04	14.13	9.67	12.63	9.67
2011	18.35	16.90	14.01	9.55	12.51	9.55
2012	18.19	16.77	13.89	9.44	12.39	9.44
2013	18.04	16.64	13.77	9.33	12.27	9.33

Degression: 1.5 %; Bonus 2.0 ct/kWh; period of allowance: 20 years

The tariff of the particular year will be paid for the whole 20 years.

	Innovative Units, using Combined Heat and Power (Units according Paragraph 3 and 4)			
Year of putting into operation	Up to 150 kW in ct/kWh	Up to 500 kW in ct/kWh	Up to 5 MW in ct/kWh	Up to 20 MW in ct/kWh
2004	15.50	13.90	12.90	10.40
2005	15.33	13.75	12.77	10.27
2006	15.16	13.60	12.64	10.15
2007	14.99	13.46	12.51	10.03
2008	14.83	13.32	12.38	9.91
2009	14.67	13.18	12.25	9.79
2010	14.51	13.04	12.13	9.67
2011	14.35	12.90	12.01	9.55
2012	14.19	12.77	11.89	9.44
2013	14.04	12.64	11.77	9.33

Degression: 1.5 %; Bonus 2.0 ct/kWh; period of allowance: 20 years

The tariff of the particular year will be paid for the whole 20 years.

Wind Energy (EEG)

	Onshore		Offshore	
Year of putting into operation	Increased starting allowance in ct/kWh	Basis allowance in ct/kWh	Increased starting allowance in ct/kWh	Basis allowance in ct/kWh
2004	8.70	5.50	9.10	6.19
2005	8.53	5.39	9.10	6.19
2006	8.36	5.28	9.10	6.19
2007	8.19	5.17	9.10	6.19
2008	8.03	5.07	8.92	6.07
2009	7.87	4.97	8.74	5.95
2010	7.71	4.87	8.57	5.83
2011	7.56	4.77	5.71	5.71
2012	7.41	4.67	5.60	5.60
2013	7.26	4.58	5.49	5.49

Degression: 2.0 %; period of allowance: 20 years

Photovoltaic (EEG)

	PV on roofs and noise barriers (Units according to paragraph 2, sentence 1)		
Year of putting into operation	Up to 30 kW in ct/kWh	Over 30 kW in ct/kWh	Over 100 kW in ct/kWh
2004	57.40	54.60	54.00
2005	54.53	51.87	51.30
2006	51.80	49.28	48.72
2007	49.21	46.82	46.30
2008	46.75	44.48	43.99
2009	44.41	42.26	41.79
2010	42.19	40.15	39.70
2011	40.08	38.14	37.72
2012	38.08	36.23	35.83
2013	36.18	34.42	34.04

Degression: 5.0 %, period of allowance: 20 years

The tariff of the particular year will be paid for the whole 20 years.

	PV on fassades (Units according to paragraph 2, sentence 2)		
Year of putting into operation	Up to 30 kW in ct/kWh	Over 30 kW in ct/kWh	Over 100 kW in ct/kWh
2004	62.40	59.60	59.00
2005	59.53	56.87	56.30
2006	56.80	54.28	53.74
2007	54.21	51.82	51.30
2008	51.75	49.48	48.99
2009	49.41	47.26	46.79
2010	47.19	45.15	44.70
2011	45.08	43.14	42.72
2012	43.08	41.23	40.83
2013	41.18	39.42	39.04

	PV in open space and further PV (Units according to paragraph 1)
Year of putting into operation	in ct/kWh
2004	45.70
2005	43.42
2006	40.60
2007	37.96
2008	35.49
2009	33.18
2010	31.02
2011	29.00
2012	27.12
2013	25.36

Degression: 5.0 % (after January 1 st, 2005), in the following years the degression comes up to 6.5 % (from January 1 st, 2006); period of allowance: 20 years

Authority: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU)

Summary:

The growth in renewable energies over the last years has meant the minimum target for 12.5% of electricity consumption to come from renewables by 2010 was already exceeded in 2007.

On the one hand, the Renewable Energy Sources Act (EEG) incurs costs; on the other hand it also has a range of positive economic effects. The costs mainly consist of the fees payable under the EEG and the resulting differential costs.

The strong growth in electricity generated from renewable sources in Germany gave rise to an increase in EEG-related remuneration payments, from €3.6 billion (2004) to €5.8 billion (2006). The differential costs (additional procurement costs for electricity suppliers) rose from €2.5 billion to €3.3 billion over the same period. Thus the proportion of the residential electricity rate calculated to be attributable to the EEG rose from around 3% to around 4% between 2004 and 2006. Additional cost factors involved in the EEG, e.g. the need for additional control and balancing energy and transaction costs, amounted to between €300 and €600 million in 2006.

In terms of economic benefits from the EEG, we should first cite turnover in Germany. Attributable to the Act. in 2006 these came to €14.2 billion, or over 60% of the year's total domestic renewable energy turnover (€22.9 billion). Secondly, the EEG has been causing a clear increase in jobs for several years: in 2006 around 134,000 jobs were attributable to the Act (renewables overall: 236,000 jobs). An additional benefit is the avoidance, due to the EEG, of energy imports totalling approximately €0.9 billion and external costs totalling approximately €3.4 billion in 2006. Equally, EEG electricity lowered prices on the electricity market by up to €3 - €5 billion (due to the merit order effect).

Contact:

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU)

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SAFETY AND POWER QUALITY REQUIREMENTS

REQUIREMENT	**VALUE**	**REFERENCE STANDARD OR GUIDE** (including link)
PROTECTION REQUIREMENTS		
Is an external accessible disconnecting switch mandatory?	• For plants with a performance less or equal 30 kVA is a facility for the monitoring of the grid with a particularly assigned switch in sequence necessary (ENS) • > 30 kVA: external accessible disconnecting	• DIN VDE 0100-551 (VDE 0100-551) • DIN VDE 0100-537 (VDE 0100-537) • DIN VDE 0126 (VDE 0126)

	switch mandatory	• Directives of the Association of the Energy and Water Industry
What is the acceptable range of AC voltage for operation of DER?	+/-10 % for Un = 230 V or 400 V Undervoltage: 0,7 - 1,0 of rated voltage Overvoltage: 1,0 - 1,15 of rated voltage	• DIN EN 50160 (April 2008) • DIN IEC 60038 (Standard Voltages) • DIN VDE 0100-551 • IEC 60364-5-51
Is monitoring of voltage of each phase required?	No	
What is the maximum allowed time for disconnection of DER in case of a voltage out of range event	• Voltage dip: 10 to 100 per year (10 ms up to 1 s, 1% up to 90% U n) • Short disconnection: 10 to 100 per year, 70% < 1 s (Duration: < 3 min) • Long disconnection: 10 to 50 per year (duration: > 3 min)	
What is the acceptable range of frequency for operation of DER	Underfrequency: 47 - 50 Hz Overfrequency: 50 - 52 Hz	• DIN EN 50160 (April 2008) • DIN VDE 0100-551 • IEC 60364-5-51
What is the maximum allowed time for disconnection of DER in a case of a frequency out of range event		
What is the minimum time for reconnection after a disconnection of DER		
Other protection requirements		
IMPACT ON GRID-POWER QUALITY		
What is the allowable variation of voltage at LV side of LV/MV transformer, due to DER connection	+- 10%	DIN EN 50160 (April 2008)
What is the limit of harmonic current emissions of DER	According to regulations	• EN 61000-3-2 • EN 61000-3-12

What is the limit of the voltage fluctuations and flicker for DER	• LV : According to regulations • MV: A lt : 0,1 P lt : 0,46	• EN 61000-3-2 • EN 61000-3-12
Requirements regarding power factor	• No compensation for DER up to 4.6 kVA in LV grids: 0.9 leading to 0.8 lagging is tolerated	
Other requirements for impact on grid-power quality		
PV SPECIFIC REQUIREMENTS		
Is an AC disconnecting switch mandatory for a PV plant	YES	DIN VDE 0126 (VDE 0126)
What is the acceptable range for the settings of under-voltage disconnection		
What is the maximum allowed time for disconnection of a PV inverter in case of a voltage out of range event		
What is the acceptable range of settings for under- over frequency disconnection		
What is the maximum allowed time for disconnection of a PV inverter in case of a frequency out of range event	200 ms	DIN VDE 0126 (VDE 0126)
What is the minimum time for reconnection after a disconnection of a PV inverter		
What is the limit of the total harmonic distortion of current of a PV inverter		
Is an isolation transformer required for a PV inverter		
What is the maximum allowable DC current injected to the grid		
Is any special protection required for transformerless		

inverters		
Is an anti-islanding protection for the PV inverter mandatory		
What method of anti-islanding protection is acceptable		

7.13. GREECE

INTERCONNECTION RULES

Country: (Greece)

Eligible renewable /other technologies: (PV, micro CHP, small wind)

Applicable sectors: Residential, Commercial, Schools, Government

Breakpoint for Small System (Simplified Rules): 20 kW

Rules for net metering systems: yes

If yes then

Authority 1: Regulatory Authority for Energy - RAE - www.rae.gr
Authority 2: Hellenic Transmission System Operator DESMIE / HTSO - www.desmie.gr
Authority 3: Public Power Corporation DEI / PPC - www.dei.gr
Authority 4: Hellenic Organisation for Stanardisation - ELOT- www.elot.gr

Limit on System Size/Overall Enrollment:
There is no explicit limit given for the maximum generation capacity which may be connected to a certain point of coupling. The level of maximum DG Power which can be injected to the grid is an issue of economic and technical factors which mainly are the following:
-The existing network infrastructure
-The cost of grid reinforcement and extension works
-The cost of power and energy losses on the interconnecting network
-The possible implications in the construction of major grid works
-The effects on power quality, voltage profile, fault level, protection, etc.
However, two general limitations are implemented in practice:
-DG facilities of power capacity greater than 20 MW cannot be connected to LV network
-DG facilities of power capacity greater than 100MW cannot be connected to MV network
The above remarks have lead to the following (only indicative) practical rules concerning the possible (or preferable) way of interconnection of DG facilities according to their capacity:

Capacity (MW)	Possible interconnection
<= 0.1	LV network
<= 4	MV network at existing line (possible reinforcement)
<= 6	MV network through dedicated line (single circuit)
<= 20	MV network through dedicated line (double circuit)
> 20	HV network (construction of explicit substation MV/HV)

Standard Interconnection Agreement: Yes

External Disconnect Required: Yes

Rules for non net-metered DG: Yes

Authority 1: Technical Requirements for the Connection of Independent Generation to the Grid - Public Power Corporation

Authority 2: NA

Date Enacted: 2004

Summary: (max 1000 words)

Because of the new needs created by the reformed electrical energy environment the interconnection guide has lately been radically updated. The guide is planned and issued by the unique so far Distribution Utility - the Public Power Corporation (PPC) - which owns and operates the distribution network. Most of the provisions and requirements of the guide are based on the European and international standards. The guide bears the title "Technical Requirements for the Connection of Independent Generation to the Grid". The main issues described in the guide are:

-Coupling devices
-Protection requirements
-Coupling conditions
-Reactive power compensation
-Network capacity
-Fault level contribution
-Influence on voltage profile (slow and fast voltage variations, flicker and harmonic emissions)
-Impact on remote control acoustic frequency systems

It should be noted that the above-mentioned guide has been instructed by the commitments of the country to comply with the new environment for liberalised electricity market. However, it has been issued by PPC who is the major participant in the fields of power generation. Towards the completion and clarification of the market one independent Distribution Network Operator is about to be set up in the next few months for the Greek mainland and one for the Greek islands. The new authorities will be responsible for the issue and update of the grid code, incorporating all technical and legal matters for the interconnection of producers to the grid, forming thus the DG development of the country.

NET METERING RULES

Country: Greece

Eligible renewable/Other Technologies: Solar Thermal electric, Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric

Applicable Sectors: Commercial, Residential

Limit on System Size: -

Limit on overall Enrollment: Tariff will be re-evaluated after 1% of load is served by distributed generation from renewable resources

Treatment of Net Excess: Credited to customer's next bill

Utilities Involved: Public Power Corporation, Hellenic Transmission System Operator, Regulatory Authority for Energy

Interconnection Standards for Net Metering: Yes

Authority 1: Ministry of Development

Website: www.dei.gr, www.desmie.gr, www.rae.gr, www.ypan.gr

Summary: (max 1000 words)

The metering of the electric energy supply to the grid is implemented at the Point of Common Coupling (PCC) at the end of the dedicated line where also the study of the possible impact of the DG installations operation takes place (see next Figure). The metering of the consumed energy by the loads of the installation takes place at the Connection Point (CP).
When the segment of the dedicated line is too small the location of the two metering devices may be common at the exit of the installation of the producer. In any case, separate metering devices must be used for the produced and consumed energy, even in case of LV connections, although for the latter case it may be possible to use common metering device. The energy which the producer provides and absorbs from the grid is transmitted through the same feeder.

FINANCIAL AND SUPPORTING SCHEMES

Title: Law 3468/2006 "Generation of Electricity using Renewable Energy Sources and High-Efficiency Cogeneration of Electricity and Heat and Miscellaneous Provisions"

Country: Greece

Incentive type: Feed-in-Tariffs

Eligible renewable /other technologies: Photovoltaics, Wind, Biomass, geothermal energy

Applicable sectors: Commercial, Industrial, Residential

Terms, budgets and requirements:

System sizes: 10 to 150 kW

Authority: Government

Summary:
Energy prices in Greece are set by the market, the government, or the RAE, depending on the type of energy and at which level of the market the prices are set. A wholesale day-ahead electricity market

exists in which prices are set by competitive bidding. All electricity consumers, apart from residential consumers, who become eligible customers in July of 2007, are free to choose their suppliers, but only 2.8% of electricity was delivered by suppliers other than the PPC in 2004. Tariffs for electricity consumers are also set by the government as long as the PPC's market share is above 70% by volume of electricity sold. A uniform tariff applies to the whole of Greece, varying by connection voltage level and type of consumer, and not taking into account geographical variations, even on grid-isolated islands. Network access prices are set by the government, with consenting advice from the RAE necessary. Special discounts for electricity retail prices apply in the agricultural sector, to PPC employees and to families with at least four children.
Accroding to D6/F1/14610 Ministerial Decision the RES-e prices are as in the following table.

Generation of electricity from	**Price of energy (€/MWh)**	
	Interconnected System	**Non-intercon-nected islands**
(a) wind energy	75.82	87.42
(b) wind energy from sea wind farms	92.82	
(c) hydraulic energy exploited in small-scale hydroelectric plants with an installed capacity up to fifteen (15) MW_e	75.82	87.42
(d) Solar energy utilized in photovoltaic units with an installed capacity less than. or equal to one hundred (100) kW_{peak}. and which will be installed in a lawfully owned or possessed property or in adjacent properties of the same owner or lawful possessor	452.82	502.82
(e) Solar energy exploited in photovoltaic units with an installed capacity of over one hundred (100) kW_{peak}	402.82	452.82
(f) Solar energy exploited in units employing a technology other than that of photovoltaics with an installed capacity up to five (5) MW_e	252.82	272.82
(g) Solar energy exploited in units employing a technology other than that of photovoltaics with an installed capacity of over five (5) MW_e	232.82	252.82
(h) Geothermal energy. biomass. gases released from sanitary landfills and biological treatment plants and biogases	75.82	87.42
(i) Miscellaneous RES	75.82	87.42
(j) High-efficiency cogeneration of heat and electricity	75.82	87.42

Contact

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105 64, Athens GREECE
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FAX: 2103255460
E-mail: info@rae.gr
Web site: www.rae.gr

SAFETY AND POWER QUALITY REQUIREMENTS

COUNTRY: (Greece)

REQUIREMENT	**VALUE**	**REFERENCE STANDARD OR GUIDE** (including link)
PROTECTION REQUIREMENTS		
Is an external accessible disconnecting switch mandatory?	YES For operational and safety reasons all generators have to be equipped with a disconnection switch accessible to the grid operator. The switch must at least be capable of disconnecting load current. If isolated operation of the installation is not predicted the switch dedicated to the de-coupling protection can be used as well. In any case the switch must guarantee the galvanic separation of the three phases and it must provide short circuit protection inside the installation If isolated operation is predicted, the switch is placed at the limit of the islanded installations and it must be equipped with synchronization system for their parallel operation with the grid.	NA
What is the acceptable range of AC voltage for operation of DER?	+-10%	EN 50160
Is monitoring of voltage of each phase required?	YES (via GSM modem)	NA
What is the maximum allowed time for disconnection of DER in case of a voltage out of range event	5 secs	EN 50160
What is the acceptable range of	+-10%	EN 50160

frequency for operation of DER		
What is the maximum allowed time for disconnection of DER in a case of a frequency out of range event	10 secs	EN 50160
What is the minimum time for reconnection after a disconnection of DER	5 secs	EN 50160
Other protection requirements	NA	
IMPACT ON GRID-POWER QUALITY		
What is the allowable variation of voltage at LV side of LV/MV transformer. due to DER connection	+- 10%	EN 50160
What is the limit of harmonic current emissions of DER	Individual Harmonic order. h- max distortion (%) 2: 2% 3: 5% 4: 1% 5: 6% 6: 0.5% 7: 5% 8: 0.5% 9: 1.5% 10: 0.5% 11: 3.5% 12: 0.2% 13: 3% 15: 0.3% 17: 2% 19: 1.5% 21: 0.2% 23: 1.5% 25: 1.5% Even>12: 0.2% Odd multiple of 3>21: 0.2% Odd other than multiple of >25: 0.2+1.3* (25/h) % THD: 8% at LV	IEC 61000-2-2, and IEC 61000-3-6
What is the limit of the voltage fluctuations and flicker for DER	Frequency of switching operations, r (h^{-1}: per hour, d^{-1}: per day) For r > 1 h^{-1}: Steady-state change, dc	IEC 61000-4-15, IEC 61000-3-3, IEC 61000-3-5, IEC 61000-3-11, IEC 61000-3-7

	<=3 % Maximum change, dmax <= 4 % For 2 $d^{-1} < r < 1 h^{-1}$: Steady-state change, dc <=3 % Maximum change, dmax <= 5.5 % For $r < 2 d^{-1}$: Steady-state change, dc <=3 % Maximum change, dmax <= 7 %	
Requirements regarding power factor	0.95 leading<Power Factor<0.95 lagging	
Other requirements for impact on grid-power quality		
PV SPECIFIC REQUIREMENTS		
Is an AC disconnecting switch mandatory for a PV plant	YES	"Interconnection guide for photovoltaic stations to the LV network", Public Power Corporation
What is the acceptable range for the settings of under-voltage disconnection	-10%	"Interconnection guide for photovoltaic stations to the LV network", Public Power Corporation
What is the maximum allowed time for disconnection of a PV inverter in case of a voltage out of range event	<=3 secs	"Interconnection guide for photovoltaic stations to the LV network", Public Power Corporation
What is the acceptable range of settings for under- over frequency disconnection	+-10%	"Interconnection guide for photovoltaic stations to the LV network", Public Power Corporation
Is an isolation transformer required for a PV inverter	YES	"Interconnection guide for photovoltaic stations to the LV network", Public Power Corporation
What is the maximum allowable DC current injected to the grid	In case of transformerless inverters incorporation, the DC component should not exceed 0.5% of the nominal value of the output current per phase of the inverter	"Interconnection guide for photovoltaic stations to the LV network", Public Power Corporation

Is any special protection required for transformerless inverters	Electric circuit breaker	“Interconnection guide for photovoltaic stations to the LV network”, Public Power Corporation
Is an anti-islanding protection for the PV inverter mandatory	YES	“Interconnection guide for photovoltaic stations to the LV network”, Public Power Corporation
What method of anti-islanding protection is acceptable	Under/over-voltage, Under/over-frequency relays	“Interconnection guide for photovoltaic stations to the LV network”, Public Power Corporation

7.14. HUNGARY

INTRODUCTION

In 1998, based on the results achieved and the requirements of the EU connection, the Hungarian government initiated a new market model of the energy sector with the active participation of the private energy companies.

The energy policy focused on the safety of the energy supply, the establishment of market conditions, environmental protection and improvement of energy efficiency. New regulations and institutional background also had to be created. The former state-owned energy companies have been privatised by foreign companies. A national programme for promoting energy saving and improving energy efficiency has been developed and an action plan summarised the concrete activities to be carried out.

Hungarian Renewable Energy (RES-E) electricity target **3,6 %** for 2010 has been already achieved in 2007 especially due to the biomass contribution. However other RES such as solar, geothermal and wind energy are hampered by administrative constraints (i.e the permit process) and a non-effective, neither stable policy framework. As regards the policy framework, promotional schemes are being used and refined, and subsidies are available under certain conditions for the development of RES. Until 2020, Hungary aims at covering 11% to 15% of its energy demand from renewables. Most of the excess capacity will be provided for by new biomass power plants.

<u>Hungarian RES targets</u>

- The share of RES in total primary energy consumption was of 4.87% in 2006. Biomass is the main RES source representing more than 89% of RES primary consumption, follow by geothermal (8.2%) and Hydropower (1.7%)
- The share of RES in the gross final energy consumption was 4.3% in 2005.
- The share of RES in the gross electricity production was 3.7 % in 2006 in 2007 4.3%.
- The share of biofuels in the transport sector in 2006 was 0.28%.
- Hungary energy dependence on imports amounts to 63 % in 2005
- Mandatory targets set by the newly proposed RES Framework Directive from 2008 are 13% share of RES on the final consumption of energy in 2020.
- At least 10% share of biofuels of final consumption of energy in transport in that Member State in 2020.

6.15. ITALY

INTERCONNECTION RULES

Country: Italy

Eligible renewable /other technologies: (PV, micro CHP, small wind)

Applicable sectors: Residential, Commercial, Schools, Farms

Breakpoint for Small System (Simplified Rules): 20 kW

Rules for net metering systems: yes

If yes then

Website: http://www.autorita.energia.it

Authority 1: Autorità per l'energia elettrica e il gas (Regulatory Authority for Electricity and Gas)

Website: http://www.enel.it/eneldistribuzione
Authority 2: ENEL Distriduzione, Italy Power Corporation/Distribution

Limit on System Size/Overall Enrollment: In general, in medium voltage, total installed power cannot make the transformer operate beyond the maximum limits fixed by the distributor for its exploitation (usually 65%). In low voltage, it cannot exceed the load admitted by the transformer.
Standard Interconnection Agreement: No

Additional Insurance Requirements: -

External Disconnect Required: Yes

Rules for non net-metered DG: Yes

Website: http://www.autorita.energia.it

Authority 1: Autorità per l'energia elettrica e il gas (Regulatory Authority for Electricity and Gas)

Authority 2: NA

Summary: (max 1000 words)

In Italy, there are not many official requirements to build the DG development framework. The standards may be, in many cases, confusing and not defining. There are not simplified specifications for very small generators, even both in Low Voltage and Medium Voltage the same requirements are asked many times. The long monopoly era of the electric system has still a strong influence and new requirements are needed to face the new challenges imposed by the Distributed Generation development in the electricity network.

Additional Resources:

http://www.dispower.org

Contact:
Autorità per l'energia elettrica e il gas
Piazza Cavour, 5
20121 Milano
tel. 02655651 - fax 0265565266

NET METERING RULES

Country: Italy

Eligible renewable/Other Technologies: Solar Thermal electric, Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric

Applicable Sectors: Commercial, Residential

Limit on System Size: 20 kW

Limit on overall Enrollment: Tariff will be re-evaluated after 1% of load is served by distributed generation from renewable resources

Treatment of Net Excess: -

Utilities Involved: ENEL Distribuzione (Italian Power Coproration/Distribution) - http://www.enel.it

Interconnection Standards for Net Metering: Yes

Authority 1: Autorità per l'energia elettrica e il gas (Regulatory Authority for Electricity and Gas)

Website: http://www.autorita.energia.it

Authority 2: Comitato Elettrotecnico Italiano **-** Italian Organization for Standardization (electrical, electronic and telecommunication fields).

Website: http://www.ceiweb.it
Summary: (max 1000 words)
Italy has launched new feed-in tariffs for Solar PV. The new tariffs replace a complex and bureaucratic system of net metering and feed-in tariff incentives. For small rooftop systems, the new program pays $0.74 USD/kWh ($0.79 CAD/kWh), among the highest payments for solar PV in Europe. Building integrated solar PV will receive a total value of $0.80 USD/kWh ($0.86 CAD/kWh). The new tariffs finally put Italy on a par with tariffs in Germany and France.
The new program is itself complex with tariff differentiation by project size and application. In this regard, the new program is similar to that in Germany and France.
Italy has an advantage of higher insolation than Germany and northern France. Yields for central Italy are about 1,400 kWh/kW of installed capacity, 50% greater than those in Germany and about 17% greater than those of Toronto, Ontario.

The Italian program still hasn't completely broken from the influence of the country's quota model (RPS) for developing renewable energy. The Italian solar PV program still includes net metering and payments for wholesale generation costs. The feed-in tariffs are on top of the net-metering rate.
Only solar PV has been shifted out of the country's RPS program.
The new program also lifted the annual installation cap and increased the total program cap to 1,200 MW

http://www.wind-works.org

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CEI - Comitato Elettrotecnico Italiano
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Via Saccardo, 9
20134 Milano
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FINANCIAL AND SUPPORTING SCHEMES

Title: Legislative Decree No 387 of 29/12/03: Implementation of Dir. 2001/77/EC on promotion of electricity produced from RES in the internal electricity market

Country: Italy

Incentive type: Priority Access to the grid for RES and CHP, Tradable Green Certificate, Feed-in-Tariffs

Eligible renewable /other technologies: Photovoltaics, Wind, CHP

Applicable sectors: Commercial, Industrial, Residential

Terms, budgets and requirements:-

System sizes: no limit

Authority: Government

Summary:
The Green Certificates system is a cap and trade mechanism to promote renewable energy sources. It is based on the obligation given to companies that supply the grid with at least 100 GWh/year to supply a provided percentage (3,05% in 2007 for the energy produced in 2006) with RES.
To certify such supply, these companies shall present a correspondent number of Green Certificates, each equivalent to 50 MWh of renewable energy production. The Green Certificates can be issued both to the obliged companies and to every power producer. The obliged companies can decide to invest in renewable energy, or to buy green certificates issued to other companies.

By Ministerial Decree 11/11/99, the energy production from renewable sources can obtain Green Certificates for 12 years (legislative decree 152/06). Before March 31st of each year, importers and producers must self-certify the production from renewable sources.
On 28 Jul. 2005, jointly with the Ministry of the Environment and Land Protection, the Ministry of Productive Activities issued the Ministerial Decree referred to in Art. 7, para. 1 of Legislative Decree no. 387 of 29 Dec. 2003. The Ministerial Decree defines criteria for incentivising electricity generation by photovoltaic solar plants. On 14 Sept. 2005, the "Autorità per l'Energia Elettrica e il Gas" (AEEG - electricity & gas regulator) adopted its Decision 188/05, which identifies GRTN (now GSE) as "implementing body" in charge of granting incentivising tariffs. On 6 Feb. 2006, the second decree on photovoltaic solar generation, extending and supplementing the Ministerial Decree of 28 Jul. 2005, was enacted. The incentive scheme applies to photovoltaic (PV) solar plants or systems (new, renovated or repowered/upgraded) which have a capacity of 1 to 1,000 kW and which have become operational after 30 Sept. 2005. The PV projects which may be implemented and benefit from incentivising tariffs for twenty years fall under three capacity classes:
Class 1: 1 P<20<0.445 kW ("scambio sul posto", i.e. net metering) 0.460 €/kWh
Class 2: 20< P<50 kW 0.460 €/kWh
Class 3: 50< P<1,000 kW, 0.490 €/kWh (maximum value subject to bidding procedure)
The incentivising tariffs are increased by 10%, if the PV modules are used in new or renovated buildings. The incentive applies to electricity generated, measured at the output terminals of the direct current-alternating current converter. For systems not exceeding 20 kW and having opted for "scambio sul posto" (net metering), the incentive only applies to electricity generated and consumed on site. GSE will assess the incentive applications in accordance with the provisions of the Ministerial Decrees of 28 Jul. 2005 and 6 Feb. 2006 and with AEEG's Decision 188/05. Ninety days prior to the expiration of each quarter, GSE will notify applicants of the approval or rejection of their application. GSE will grant the incentivising tariffs after the plants or systems have become operational within the timescales specified in the Ministerial Decree of 28 Jul. 2005 and after verifying their compliance with the above legislation. A new Ministerial Decree incentivising PV solar generation is expected to be issued within a short time, based on the results of the latest meetings held between the representatives of the Ministries of the Environment and of Economic Development.

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e-mail: info@gsel.it
www.grtn.it

SAFETY AND POWER QUALITY REQUIREMENTS

COUNTRY: (Greece)

REQUIREMENT	**VALUE**	**REFERENCE STANDARD OR GUIDE** (including link)
PROTECTION REQUIREMENTS		

Is an external accessible disconnecting switch mandatory?	YES (description: visible disconnecting switch with safety in the isolation position)	National Standard CEI 11-20 http://www.ceiweb.it Company Recommendation DK5950 http://www.enel.it
What is the acceptable range of AC voltage for operation of DER?	0.8 V_n~1.2 V_n	CEI 11-20 DK 5940
Is monitoring of voltage of each phase required?	YES	
What is the maximum allowed time for disconnection of DER in case of a voltage out of range event	0.1 s ± 10ms	CEI EN 50263 IEC 61000-2-2
What is the acceptable range of frequency for operation of DER	49.7<f<50.3 Hz	CEI EN 50263 IEC 61000-2-2
What is the maximum allowed time for disconnection of DER in a case of a frequency out of range event	0.1 s ± 10ms	CEI EN 50263 IEC 61000-2-2
What is the minimum time for reconnection after a disconnection of DER		
Other protection requirements	NA	
IMPACT ON GRID-POWER QUALITY		
What is the allowable variation of voltage at LV side of LV/MV transformer, due to DER connection	+- 10%	EN 50160
What is the limit of harmonic current emissions of DER	Total Harmonic Distortion (THD) must be lower than 3% for DG installations <500kVA	CEI 11-20 DK 5940
What is the limit of the voltage fluctuations and flicker for DER		
Requirements regarding power factor	Unit power factor	CEI 11-20 DK 5940
Other requirements for impact on grid-power quality		
PV SPECIFIC REQUIREMENTS		
Is an AC disconnecting switch mandatory for a PV plant	YES	CEI 11-20 DK 5940
What is the acceptable range for the settings of under-voltage disconnection	0.8 V_n	CEI 11-20 DK 5940
What is the maximum allowed time for disconnection of a PV inverter	<=0.2 sec	CEI 11-20 DK 5940

in case of a voltage out of range event		
What is the acceptable range of settings for under- over frequency disconnection	49.7 Hz	CEI 11-20 DK 5940
What is the maximum allowed time for disconnection of a PV inverter in case of a frequency out of range event	Without intentional delay	CEI 11-20 DK 5940
What is the minimum time for reconnection after a disconnection of a PV inverter		
What is the limit of the total harmonic distortion of current of a PV inverter		
Is an isolation transformer required for a PV inverter	YES	
What is the maximum allowable DC current injected to the grid	<0.5% of the rated current	IEEE 1547
Is any special protection required for transformerless inverters	Electric circuit breaker	
Is an anti-islanding protection for the PV inverter mandatory	YES	CEI 11-20 DK 5940
What method of anti-islanding protection is acceptable	Low and high frequency relays Low and high voltage relays Rate of frequency change relays(only in particular cases)	CEI 11-20 DK 5940

7.16. IRELAND

Production of Electricity from RES and CHP in Ireland

Irish Country Targets for Renewable Energy and CHP

According to the proposed targets by EU, for Ireland the target is 16% renewables in 2020 as share of gross final energy consumption compared to 3.1% in 2005. The RES-E target for Ireland, set by the EU Directive to be met by 2010 is 13.2% of gross electricity consumption.

Ireland has published an Energy White Paper in 2007, according to which the country set the following targets:

Share of RES in electricity and heat consumption (%)

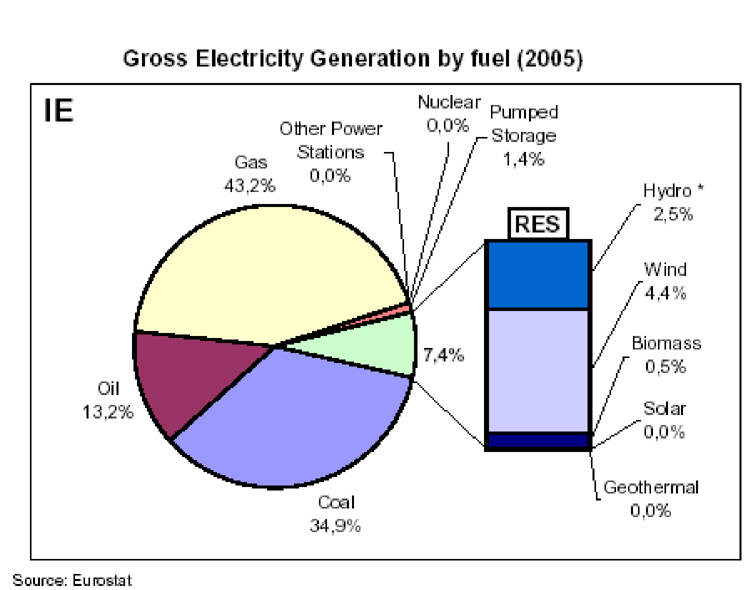
	2006 (actual)	Target 2010	Target 2020
Share of RES in electricity consumption	8.6%	15%	33%
Share of RES in heat consumption	4.7%	5%	12%

In the National Climate Change Strategy Ireland set a target of achieving 0.25Mt CO2 savings/yr from CHP by 2010, approximately equal to an additional 250MWe of CHP plants. At the end of 2004 approximately 2.4% of Ireland's electricity consumption was met from 145MWe of CHP.

According to a Study "All Island Grid Study" of January 2008 by the Department of Communications, Energy and Natural Resources of Ireland, a precondition for implementation of high renewable shares, is a substantial reinforcement of the existing transmission networks. This is a substantial planning challenge and the typically long lead times require an immediate policy response if the targets are to be met.

Key figures for RES in Ireland

Hydro and wind power make up most of Ireland's RES-E production. Despite an increase in the RES-E share during the past decade, the target is still far off. The RES-E share increased from 6.8% in 2005 to 8.6% in 2006.



Main supporting policies

Between 1995 and 2005, a tender scheme (**the Alternative Energy Requirement – AER**) was used to support RES-E. The tendering system, involved a series of tendering competitions, where prospective investors or generators compete among each other based on the bid price per kWh. Successful competitors are offered long-term power purchase agreements. The excess costs of power purchase from RES projects are passed through a levy on all electricity customers. The competition mechanism leads to the selection of the most cost effective options; however the associated administration costs tend to be rather high.

Since 2006, the **Renewable Energy Feed-In Tariff (REFIT)** has become the main tool for promoting RES-E. EUR 119 million will be used over 15 years from 2006 to support 55 new renewable electricity plants with a combined capacity of 600 MW. Feed-in tariffs are guaranteed for up to 15 years, but may not extend beyond 2024. During its first year, 98% of all the REFIT support has been allocated to wind farms. From 2006, this new scheme is expected to provide some investor certainty, due to a 15-year feed-in tariff guarantee. No real voluntary market for renewable electricity exists.

Features of the Renewable Energy Feed-In Tariff:
• Prices indexed to CPI.
• 15 years duration.
• Generator MUST source a supplier to purchase power bilaterally.
• Typical project developer is an independent new entrant.

Grant aid is available through the **Greener Homes Scheme** and the **ReHeat Programme** for the development of RES-H.

An **Energy White Paper** was published in March 2007, setting the energy policy framework for 2007- 2020. The government has presented policy proposals to significantly increase the use of biomass in electricity generation by co-firing it in peat-fired power stations.

Process for connection to the distribution network for producers of electricity in Ireland

- ♦ An application to the Distribution System Operator which includes: load or generator details; final address details; an application fee of €100 (where a site visit is required); site and location maps; electrical line and functional block diagrams; and generator details.
- ♦ On receipt of the completed application, a Quotation Letter and Connection Agreement will be sent to the customer. The connection offer will provide a costing for the works to be undertaken by the Distribution System Operator up to the connection point. Connection works will be carried out in accordance with the quotation letter on receipt of:

  - payment in full, or payment of the first installment;
  - signed Connection Agreement or Acceptance of Offer Form; and
  - completion of relevant documents if transfer of the substation site to the ESB is required.
- Timescales for applications (subject to wayleaves, planning permission and customer's acceptance of offer) are outlined below:

Time Scale Description	From	To
Quotation sent to customer	Receipt of completed application	18 weeks
Acceptance of Offer	Period for which quote is valid	3 months
Connection Works	Acceptance of Offer	9 months

Final Energisation	Date of customer's notification / advice of completion of Customer Connection Works	1 month
Typical Project Duration	Receipt of completed applications	12 months

Major issues connected to the expansion of RES and connection to the grid in Ireland

1. Necessity of adoption of an all-island approach to the development of generation from renewable sources. The interconnected power systems of the Republic of Ireland and Northern Ireland effectively form a single synchronous power system; fluctuating generation in one system will affect both systems equally. Thus the assessment of policy options must take account of the impact on the combined power system.

2. Any policy should take account of the need to ensure system reliability, and the assessment of policy options should take account of any complementary measures needed to maintain an acceptable level of reliability.

3. A future all-island policy on renewables should set a clear strategic direction.
A significantly increased penetration of renewables will require a wide range of complementary actions to ensure satisfactory integration into the power system. These could include:

- Investment in major transmission infrastructure developments to cater for the resulting changes in power flows
- Introduction of new approaches to system operation and control, with a need for investment in new communications and control facilities and decision support mechanisms.
- Possible re-configuration of distribution systems to cater for increased levels of embedded generation.

These and other measures will require substantial levels of investment, which must ultimately be borne by electricity consumers. The policy, which is ultimately adopted, should set a clear direction such that the Transmission System Operators and Distribution System Operators and other agencies can adopt plans in the confidence that the associated investments are justified and are unlikely to be "stranded".

4. Policy should facilitate steady development towards any future targets rather than stop-start and sudden large increases. The integration of high levels of renewable generation presents the Transmission System Operator with unprecedented challenges. There are no "off-the-shelf" solutions to these challenges. Steady progress towards the ultimate targets will facilitate the progressive development of the necessary complementary measures and will afford the Transmission System Operator the opportunity to build on experience in the earlier stages to refine solutions for the later stages.

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7.17. LATVIA

INTRODUCTION

The territory of Latvia is 64,589 km2. The country has a population of about 2.33 million. About one third of the population lives in the capital Riga.

The Energy Market Law aims at 49.3 % share of renewable energy in gross energy consumption in 2010. The Latvian Energy Development Guidelines for 2007-2016 determines that the share of electricity generated in CHP units by biomass has to reach 16 %. Almost half of the Latvian electricity consumption is provided by RES, among which hydro power is the main resource. The substantial increase of the RES share of the market between 1997 (42.4 %) and 2004 (47.1 %) can be ascribed to the support scheme (double tariff), which was phased out in 2003 and replaced by quotas that are adjusted annually by the Latvian Ministry of Economy. A body of RES-E legislation is currently under development in Latvia.

Small-scale hydro- and onshore wind power recorded average annual growth rates of 61% and 54%, respectively, between 1997 and 2004. In distinction from this fact, geothermal and solar heat generation is negligible.

At present, there are plans to build a new nuclear power plant in Lithuania and use the generated electricity for Latvia and Estonia as well. In 2006, the Ministry of Economy launched "Guidelines for Development of Energy Sector for 2007-2016", which aim at security of supply, increasing Latvia's self-sufficiency regarding energy consumption and raising the use of renewable energy and CHP in electricity and heat generation.

INTERCONNECTION RULES

As the European Renewable Energy Council states, there are some administrative barriers for development of RES in Latvia. A new project must have a permit within a yearly quota of RES for electricity. As can be seen from the chapter on supporting schemes, the quotas are very small and even these were not used. This fact depends on the difficult conditions for grid interconnection. The requirements for the necessary licenses regarding the use of land, environmental requirements, connection to the grid etc. is quite high.

According to findings of the Latvian Investment and Development Agency, one very important aspect which is a barrier for the implementation of RES and CHP in Latvia is the incomplete and insufficient infrastructure. Additionally, net access is not guaranteed for any producer of electricity. Connection of a new facility to the electricity network can be carried out by Latvenergo, or by any other licensed electrical-engineering supplier.

The Government promotes the interconnection with the European electricity grid to dissolve the isolation of the Baltic energy markets from the rest of the EU.

Website: www.energo.lv

NET METERING RULES

A number of utility services in Latvia are still owned by the state. In order to ensure reasonable pricing in these areas, the national regulator – the Public Utilities Commission of Latvia, whose responsibilities include utilities, telecommunications, and post and railway services – regulates the tariff policies of monopoly utility providers.

Website: www.sprk.gov.lv

FINANCIAL AND SUPPORTING SCHEMES

Until 2003, Latvia had a feed-in tariff scheme, which guaranteed doubled electricity prices to producers of electricity from renewable energies over eight years. After the amendment, there is guaranteed purchase only for a fixed amount of electricity from RES. The cap is annually decided upon by the Cabinet of Ministers.

Resource	**Technology**	**Support level (€cents/kWh)**	**Start year**	**Duration of support**
Wind	Power plant with capacity not over 0,25 MW	For the first 10 years from the beginning of operation $C = \frac{T_g \times k}{9,2} \times 3,5$	2007	10 years
Wind	Power plant with capacity not over 0,25 MW	after 10 years from the beginning of operation $C = \frac{T_g \times k}{9,2} \times 2,6$	2007	10 years

(Source: European Renewable Energy Council)

C = price of electricity without VAT
T_g = natural gas tariff approved by the Regulatory Authority (without VAT)
k = factor used for price differentiation depending on the installed capacity of the power plant (varies in the range from 1,240 to 0,965)

In 2004, the Cabinet of Ministers capped the capacity of electricity produced from renewable energies at the volume of 2 MW: 1 MW for biomass, wood or peat and 1 MW for electricity production from waste or biogas.

SAFETY AND POWER QUALITY REQUIREMENTS

The power systems of Baltic States Estonia, Latvia and Lithuania are interconnected by 330 kV transmission electric power lines and simultaneously form one of components for electric rings which incorporate 330, 500 and 750 kV electric networks, belonging to neighbouring state power systems - Byelorussian and Russian. According to scientific research, the existing transmission and distribution network in Latvia and the whole Baltic region will ensure the flow of electricity only within the nearest years' period. There is urgent need for new substations, power plants and power transmission lines.

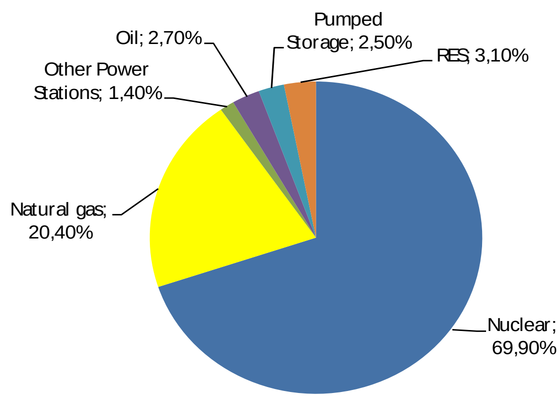
7.18. LITHUANIA

INTRODUCTION

The EU is working to reduce the effects of climate change and establish a common energy policy. As part of this policy, European Heads of State or Government agreed in March 2007 on binding targets to increase the share of renewable energy. By 2020 renewable energy should account for 20% of the EU's final energy consumption (8,5% in 2005). To meet this common target, each Member State needs to increase its production and use of renewable energy in electricity, heating and cooling and transport.

Statistical data

Energy gross inland consumption structure in Lithuania in 2005:



Source:Eurostat

Renewable sources in Lithuania

Wind Turbines

Only in 2004 the first wind turbine capacity 600 kW was erected in Lithuania.
In 2006 the first wind park of 8 turbines capacity 2 MW each was erected and connected to electricity network. According to government resolution till 2010 in Lithuania there will be erected 200 MW total capacity of wind turbines.

Hydro energy

In Lithuania there are large and small hydro power plants (HPP)
Large HPP (capacity more as 10MW):
Kaunas HPP
Total capacity 105 MW;
Production in 2005 384.6 GWh.

Small HPP
(capacity less as10MW)
In 2005
Number: 77
Capacity 24.8 MW
Production 66.1GWh

Situation with solar energy technology (PV plants) in Lithuania
One from the most important eligible sources for homeowners is photovoltaic, which is not too support in Lithuania. There are only a few small realizations of PV system, but only off-grid (focus on research). The number of installed power is in follow table.

The cumulative installed PV power in 2005-2007

2005			**2006**			**2007**		
Off-grid	On-grid	Total	Off-grid	On-grid	Total	Off-grid	On-grid	Total
(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
19	0	19	40	0	40	55	0	**55**

Country RES targets

Lithuania depends to a large extend on the Ignalina nuclear power plant which has been generating 75-88% of the total electricity over the period since 1993. In 2004, Unit 1 was closed, and the shutdown of Unit 2 is planned before 2010. The National Energy Strategy includes plans related to the start of operation of a new nuclear power plant which will result in a major rise of electricity generation output in 2016.
In order to provide alternative sources of energy and electricity in particular Lithuania has set a national target of 12% RES by 2010 (share of total energy consumption).
In Lithuania there is the national target to produce 7 % of electricity from RES by 2010.
The implementation of a green certificate scheme was however postponed for 11 years. The biggest renewables potential in Lithuania can be found in the **field of biomass,** with an
expected nine fold rise in electricity generation between 2006 and 2017. Furthermore, electricity from wind is expected to rise by 54 times between 2006 and 2017.
The renewables targets are calculated as the share of renewable consumption to gross final energy consumption. Renewables consumption comprises the direct use of renewables (e.g. biofuels) plus the part of electricity and heat that is produced from renewables (e.g. wind, hydro), while final energy consumption is the energy that households, industry, services, agriculture and the transport sector use.
The denominator for the RES share includes also distribution losses for electricity and heat and the consumption of these fuels in the process of producing electricity and heat.

Energy Saving Action Plan

Electricity from RES: In Lithuania, the RES-E market is dominated by hydro power. In 2004, this RES generated 421 GWh out of a total RES-E of 429 GWh. Small-scale hydro power is growing (average annual growth of 20% between 1997 and 2004), but the potential for hydro power in Lithuania is limited due to the topographical conditions. As an alternative, the Lithuanian government is promoting wind energy. The target capacity for 2010 is 200 MW from wind farms, 33 MW from biomass plants, and 132 MW from hydro power plants.

Legislative background

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LEGISLATION BASE

The major legal acts relevant to local and renewable energy sources (RES) have been selected and revised. These acts include:

- National Energy Strategy,
- Law on Energy,
- Law on Electricity,
- Law on Biofuel, Biofuels for Transport and Bio-oils
- Law on Heat, and others

Large cluster of environmental acts.

- The 21 January 1992 Law No. I-2223 (1996, 1997, 2000, 2001) of the Republic of Lithuania "On Environmental Protection";
- The 4 November 1999 Law No. VIII-1392 of the Republic of Lithuania "On Protection of Air";
- The 16 August 1996 Law No. I-1495 (amended in 2000) of the Republic of Lithuania "On Environmental Impact Assessment of Planned Economic Activities)";
- Ministry's of Environment Order No 387 on Setting Rules on Natural Resources Usage, Permitting and Setting Standards for the Pollutants of 30 11 1999 (LAND 32 – 99);
- The 22 November 1994 Law No I-671(amended in 2001) of the Republic of Lithuania "On Forests";
- The 13 May 1999 Law No. VIII-1183 (amended in 200, 2002) of the Republic of Lithuania "On Taxes for Pollution of the Environment";

FINANCIAL AND SUPPORTING SCHEMES

national energy efficiency programme

This is Special Programme as financing instrument for implementation of actions related to energy saving and utilisation of local and renewable energy sources.

There are such main goals of the programme:

1. Developing, revising and updating studies and programmes for utilization of local, renewable and waste energy resources and organizing their implementation.
2. Analyzing and assessing the implemented projects on utilization of local and renewable energy resources.
3. Implementing demonstrational solar and wind energy projects and continuing implementation of other projects on utilization of RES
4. Developing methods and schemes for collecting wood residue and straw for fuel, evaluating and implementing the methods and schemes.
5. Producing equipment that uses local and renewable energy resources while providing necessary assistance to the companies producing the equipment

The National Energy Strategy is renewed every five year

Main supporting policies

The core mechanisms used in Lithuania to support RES-E are the following:

- Feed-in tariffs: in 2002, the National Control Commission for Prices and Energy approved the average purchase prices of green electricity. The tariff levels will remain unchanged until December 2020.

- In September 2006, the procedure for promoting generation and purchasing of RES-E was updated to include wind, biomass, solar and hydropower plants with a capacity of less than 10 MW.

The National Energy Strategy provides for the improvement of the procedures for the promotion and purchase of electricity from RES to encourage competition among the producers and to introduce the system of green certificates or other systems beyond 2020.

In order to promote biofuels, the Law on Excise Taxes (2001) provides for excise tax relief. Besides this, the Law on Pollution Tax (2002, 2005) further stimulates the uptake of biofuels.

Through the Law on Heat (2003), municipalities encourage the purchase of heat fed into heat supply systems produced from RES. Investment subsidies and loans on favourable terms are also made available by the Lithuanian Environmental Investment Fund.

EU Structural Funds will be allocated for new boiler houses and CHP plants from 2007 to 2013 (approx. €36.8m). Through the Rural Development Programme, wind plants of less than 250 kW will be promoted if the electricity is to be used for agricultural production.

Purchase prices FOR RES USE IN LITHUANIA

According to legislation requirement the companies of electricity supply network must:
Purchase the electricity produced from RES in Lithuania.

There is fix purchase process according to quata up to 2010 years or sometimes for longer time. There is such price for:

- Wind energy - 22 ct LTL/kWh (6.37 ctEuro/kWh);
- Hydro energy- 20 ct LTL/kWh (Capacity of hydro power plants is less as 10 MW);
- Bioenergy - 20 ct LTL/kWh (5.79 ctEuro/kWh).

Without quota for wind turbine capacity less as 250 kW

- Later than 2010 year there will be market conditions.
  (1ct = 0.01 LTL, 1EURO = 3.45 LTL)

Programme for Support of REnewables sources

Title: The Order for Promotion Purchasing of Electricity, Generated from Renewable and Residual Energy Sources (2001, revised 2005)
Incentive type: purchasing and prices guarantees
Eligible renewable /other technologies: hydro, wind, biomass, solar, geothermal
Applicable sectors: physical and juridical persons, producing or having intention to produce electricity in power plant, using renewable and residual energy sources, and connect electricity generators to power grid and (or) purchase electricity, generated by power generators to distribution and transmission grids.
Terms, budgets and requirements: Prices and purchasing guarantee valid till December 31, 2020.
Biomass and biogas – the share of such fuel should be not less than 70% of fuel balance, for other fuels – RES and residual energy sources make not less than 90% of fuel balance. For wind energy zoning is applied.
System sizes: For wind plant – total installed capacity of all generators should not exceed 250 kW. For hydro - <= 10 MW. Scheme is applied according to defined quotas.
Authority: Decree of the Government of LR
Summary: Electricity generated at mentioned power plants will be purchased using prices defined by national regulator in the Decree no 7 from Feb.11, 2002 “Concerning prices for services in energy sector meeting public interests”.

The Ministry of Economy defines quotas for the following year for all electricity generators proportional to their installed capacity, which are based on actual electricity generating volumes in the current year and projections for the following year, provided by market operator by the type of renewable sources. Electricity, exceeding quotas is to be sold on the basis of bilateral contracts and in auctions. 40 % discount for connection to the grid fee is applied to such type of companies.

micro-CHP plants

Title: Concerning prices for services meeting public interests in energy sector (issued on annual basis)
Incentive type: quotas and prices guarantees
Eligible renewable /other technologies: combined heat and power generation
Applicable sectors: district heating (DH) sector
Terms, budgets and requirements: Every year national regulator – National Control Commission for Prices and Energy – defines purchasing prices for electricity generated in CHP plants.
System sizes: prices are defined for 3 sizes of nominal power capacity:

> 50 MW_{el} – large-scale
> 5 MW_{el} and <= 50 MW_{el} medium-scale
< 5 MW_{el} – small-scale

Authority: Decree and Regulations of the National Control Commission for Prices and Energy (Annual decree, Regulations from 2004)
Summary: On the basis of National Energy Strategy, Electricity Law, the List of Services meeting Public Interest the rules were established for defining legal and fair principles for purchasing prices of electricity, generated in CHP plants, which is purchased to meet public interests.
All generators are assigned to 3 capacity categories – large, medium and small scale.
According to defined rules Basic Price (electricity price of any alternative Electricity Only generator – condensing power plant using organic fuel) is estimated. It is used for estimating of weight average electricity purchasing price for each category of CHP generators.
In case CHP electricity generator, from which electricity is purchased, is District Heating operator, it's income from purchased electricity should be estimated using the price of thermal energy.

Barriers and market problems

The market for wood chips and other wood residues is growing.
The same is characteristic to straw.
The price of wood waste is expected to rise.
The probable import of cheaper wood chips from Belarus is deemed as stop the growth of price.
The investment to wood waste burning technologies is rather large and makes even the greater impact on utilisation of wood waste as price of fuel;
In Lithuania there is no good conditions for development wind energy, there are big environment restrictions for construction wind parks, also there must be used big funding for the reconstruction of the electricity network. The threshold is 200 MW capacities of erected wind turbines up to 2010 year and 500 MW up to 2020.
The real potential of hydro energy is reduced according to the environment requirements. In this moment the construction of the large HPP on big rivers is forbidden and the best small rivers for hydro energy are included into the protected environment zones.
There are not specific PV support, there are only 55 kW PV system off-grid.

CONCLUSIONS

The most efforts in Lithuania were aimed at developing biomass (wood, chips, wood waste, straw, biogas) and small hydro projects and their subsequent implementation. In 2005 the total capacity of installed wood-chip-fuelled boilers reached above 450 MW. No serious obstacles can be seen for

extension of wood fuel usage. Prices of fuel market depend on local conditions as well as of the number fuel consumers, capacity of installed of the wood burning boilers, etc. There is created local industry for production biomass combustion equipment.
Electricity production from local and RE sources is based on hydro energy. Lithuania has one large (105 MW) and a lot of small capacity (less as 10 MW) hydro plants. Installed total capacity of small hydro plants is above 24.8 MW.
There is only initial stage for production electricity in cogeneration utile from biomass, biogas and in wind parks.
In this moment according to Lithuanian government decision is done big progress for the installation of wind turbine. Till 2010 installed capacity of wind parks will encompass 200 MW.
The structural analysis of usage biomass shows that it is used mainly for heating energy production. At last time the biomass is begun to use into CHP for production of heat and electricity. In 2006 the reconstruction of Vilnius CHP-2 will be finished. There will be erected capacities
12 MW_{el}/ 36 MW_{heat}.

Sources
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Eurostat
Status of Photovoltaic 2007 in the European Union new member states, www.pv.pl

6.19. MALTA

INTRODUCTION

Energy Profile of Malta
The Republic of Malta is an archipelago of 3 islands and 4 islets right in the centre of the Mediterranean Sea. Malta joined the European Union in May 2004, and since then many of the EU Directives pertaining to energy and the environment have been transposed to national legislation. The Maltese Islands have a land surface area of 316 km^2 and a population density of 1,260 persons per km^2; one of the highest in the world [1]. The three inhabited islands are interconnected by a single electricity grid, with electricity generation coming from two fossil-fuelled power stations having a total combined nominal installed capacity of 571 MW [2]. Malta is fully dependent on oil imports to supply its energy needs. To date, no commercially viable indigenous oil discoveries have been made. However the Islands enjoy an abundance of sunshine with a mean daily irradiance of 5 kWh/m^2 and certain locations possess reasonable wind energy potential. 1. The National Energy Policy and the Renewable Energy Policy In August 2006, a draft proposal for a national energy policy was published for public consultation. It is built on three main pillars; namely security of supply, competitive pricing and environmental responsibility. To date, Malta fulfils the definition of a ‘small isolated system’, because of its geographic size and isolation as well as the level of electricity generation that does not exceed the 2,500 GWh mark. However, this situation may change since the draft energy policy is now proposing a DC cable link to the island of Sicily, Italy, which is about 93 km north of Malta, while Enemalta Corporation – the only power producer – is planning to install an additional 100 MW of generating capacity [2]. Almost concurrently, a draft Renewable Energy Policy for Malta appeared on the Department of Information website [3]. This policy is proposing targets for 2010 and beyond. It is predominantly focusing on photovoltaics, wind energy conversion systems and energy production from waste.
The Malta Resources Authority was set up in the year 2000 to regulate, among other responsibilities, the energy sector in Malta [4].

The Renewable Energy (RE) Situation

A few years ago, the percentage contribution of renewable energy technologies in the electricity generation sector was nil. In recent years there have been some changes, mainly attributed to installation of small grid-connected solar photovoltaic (PV) systems, but the percentage contribution of RE still remains below 0.001% of the total electricity generation by fossil-fuels.It is worth noting that the potential for PV electricity generation could reach 9% of the total generated electricity of 2003 [5]. Government is offering a subsidy – limited to domestic PV systems not exceeding 3.7 kWp – of 20% of capital cost with an upper limit of 1,150 € for the first 1 kWp, and at a lower subsidy rate for the next 2.7 kWp [6]. Enemalta Corporation is offering a 'net metering' policy for solar-generated electricity that is fed into the grid, provided that production does not exceed consumption within a stipulated period of time. Excess solar electricity would be bought by the utility at 7 € cents, which is about half the current price of electricity sold to consumers [2]. The potential for wind generation is appreciable (estimated to reach up to 9% of electricity generated, based upon 2003 figures) [5]. The draft Renewable Energy Policy for Malta states that Government declared the construction of large-scale onshore wind farms unjustifiable due to the various impacts and that no such installations will be authorized [3]. This document acknowledges the potential for medium scale wind turbines (defined as turbines rated between 20 kW and 500 kW), and that these could supply energy on a localized level. Planning aspects such as aesthetics and the potential impacts on the local landscape patterns are highlighted. Micro wind turbines (rated at <20 kW) have also been identified as potential contributors, albeit on a smaller scale. The document declares that there could be visual impacts on the local urban and rural landscapes, as well as other issues associated with this technology in the local context [3]. Government is offering a once-only grant of up to 25% on capital cost capped at 230 € for wind-generators for domestic use [8]. To date, there are no grid-connected wind medium or large-scale wind turbines on the islands. The Malta Resources Authority has recently published a tender for expression of interest for the development of deep offshore wind farms in areas off the Maltese coast [4]. Meanwhile, the potential for near shore wind farms in areas having sea depths of up to 20 m is subject to further investigation, although such systems will not be adopted if the deep water offshore wind farm project is successful. According to the draft Renewable Energy Policy, Energy from Waste projects are being developed with the first pilot project coming on line in 2008, followed by a plant in the northern part of Malta and another in Gozo It is envisaged that such plants would be of a limited size and distributed at suitable sites around Malta and Gozo. The "Sant' Antnin" Solid Waste Treatment Plant is the first candidate site [3]. The overall potential for generating electricity from waste could reach 5.6% [5]. Power generation from waste would reach 0.24% by 2010, according to Malta's report to the EU on the implementation of Directive 2001/77/EC [7].

Perhaps the most impressive development in the field of renewable energy is the application of domestic solar water heating systems that has increased by some 40% during the past year 2005. Although only 8% of households had an installed system in 2004 [9], sales are increasing due to escalating fuel surcharges on electricity bills. Since, the majority of homes in Malta use electric boilers to heat water, it is not surprising that consumers are now turning to solar water heating. In order to further encourage the use of solar heating, Government has introduced a once-only grant for first-time buyers amounting to 25% of capital cost with a maximum subsidy of 230 € per household [10]. It is estimated that if 75% of households install a solar heating system, this would translate to a saving of 5% of electricity generation of 2003 [5]. Moreover, Enemalta has an ongoing offer to waiver the installation fees of domestic new single-phase and three-phase electricity meters, up to a maximum of 161 €, provided that a solar heating system is installed beforehand [2]. Notwithstanding that, there is very little being done to promote the installation of larger heating systems that may be adapted for other sectors such as the tourist industry, industrial zones, etc….

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6.20. NETHERLANDS

INTRODUCTION

NATIONAL ENERGY POLICY

At the end of 2004, the General Energy Council (AER), the Council of the Ministry of Housing, Spatial Planning and the Environment (VROM Council) and the Innovation Platform ascertained that the Netherlands needs a national action plan for energy transition. In January 2005, the government gave the Energy Transition Task Force the mandate to develop such a plan.

This Transition Action Plan provides the main outlines of a national strategy that defines in concrete terms the role that sustainable energy can play in the transition to a desired future energy supply, the technologies that support this role, the opportunities this offers for Dutch companies and how these opportunities can be realized. The Transition Action Plan must be adapted annually to current developments and new insights. In addition to a technological component, this transition also has a strong societal component: an essentially different attitude of our society with respect to energy production and energy use, an attitude that will lead to different and new relationships.

The core of the Transition Action Plan comprises a coherent and flexible portfolio of transition paths that strengthen each other and are aided by supporting activities. The current portfolio comprises 26 transition paths. They have been selected from more than 80 possible paths based on three criteria: their contribution to the reduction of CO2 emissions, the opportunities they offer to Dutch companies and their technological feasibility.

NATIONAL ENERGY STRATEGY

The Dutch government is well underway towards meeting its Kyoto target of 6 % reduction of greenhouse gas emissions by 2012. However, the Kyoto targets will not be sufficient to prevent dangerous global climate change. Therefore the Dutch government has formulated ambitious new climate and energy targets for 2020 in order to become on of the cleanest and most efficient energy countries in the world. These targets are:

- to cut emissions of greenhouse gases by 30 % in 2020 compared to 1990 levels;
- to double the rate of yearly energy efficiency improvement from 1 to 2 % in the coming years;
- to reach a share of renewable energy of 20 % by 2020

With these ambitions the Dutch government follows the 2007 European spring Council which concluded that a reduction of greenhouse gas emissions of 30 % by industrialised countries by 2020 is necessary to limit global climate change to 2 degrees Celsius above pre-industrial levels. These ambitious first steps by Europe and individual countries are necessary as a step towards reaching a meaningful global climate change agreement, preferably by 2009.

At the same time, an ambitious climate and energy policy provides economic opportunities for companies. Dutch companies could become frontrunners in the development of clean and efficient new technologies, which are necessary for our future.

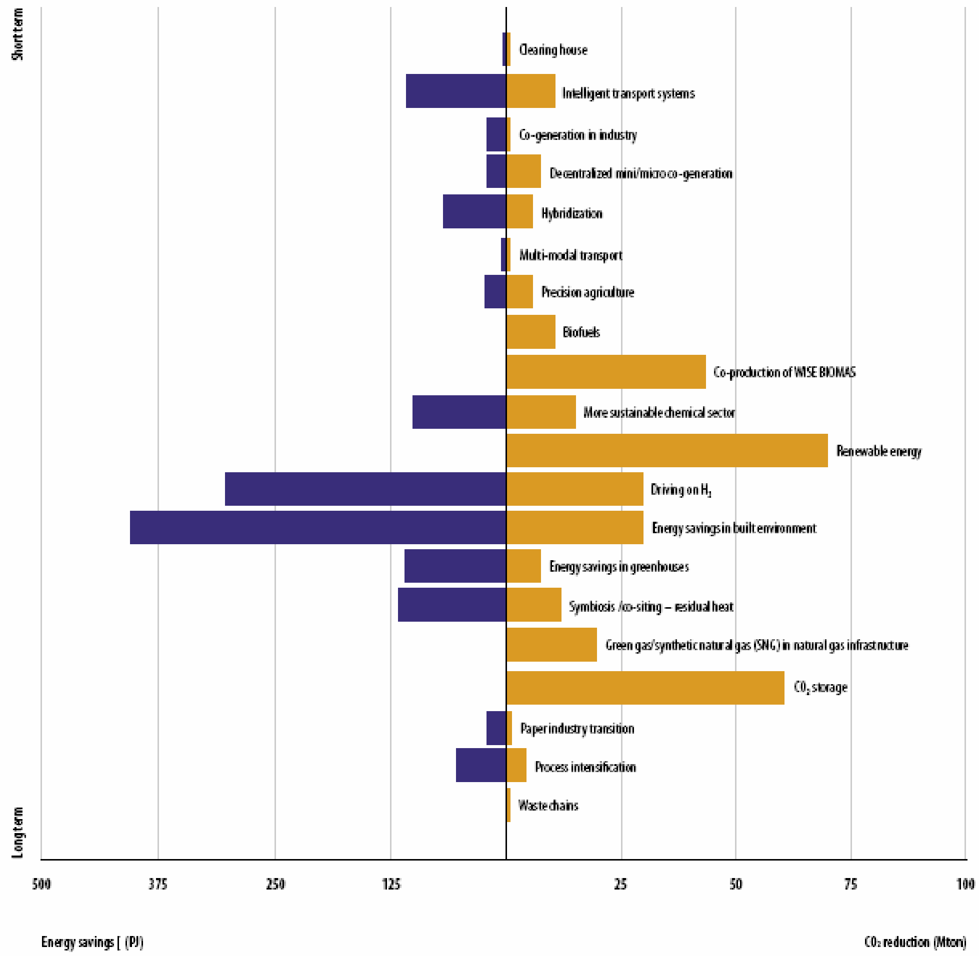
Because new technologies require a lead time before they show substantial effects, a temporary 'acceleration package' is necessary to achieve the short-term CO_2 reduction aims. In this package, transitional technologies such as clean fossil fuel (for example, coal gasification) and/or nuclear energy can contribute to the uncoupling of energy production and economic growth and in this way achieve an accelerated reduction of the CO_2 emissions.

The following platforms are active in the four themes mentioned above: Platform for Green Raw Materials (*PGG*), Platform for Sustainable Mobility (*PDM*), Platform for Chain Efficiency (*PKE*) and the Platform for New Gas and Clean Fossil Fuels (*PNG*). The Platforms for Sustainable Electricity Provision (*PDEV*) and for the Built Environment (*PGO*) are in the process of formation.

NATIONAL ENERGY EFFICIENCY

The platforms have selected and compiled a joint portfolio of 26 transition paths which is given by the figure bellow, as well as the achievable energy savings and emission reductions in 2050 for each path. The paths have been roughly sorted from top to bottom according to the period in which they can achieve substantial effects.

Figure 2.
Overview of the transition portfolio and maximum achievable effects per transition path



- The transition paths for ‘green gas’ (Platform for New Gas) and synthetic natural gas (SNG) in the natural gas infrastructure have been combined; the potential of H2 has not been taken into account.
- The transition path ‘adaptation of electrical infrastructure’ is a boundary condition for the production of sustainable electricity and decentralized generation; it has no effect of its own.
- Effects for the transition paths ‘production of biomass’ and ‘realizing biomass import chain’ have not been shown separately but calculated with other paths to avoid duplication.
- The CO_2 reduction from the ‘co-production WISE BIOMAS’ transition path has been decreased by the amount of electricity production in the ‘renewable energy’ transition path.
- Effects of the ‘electricity savings’ transition path are not shown separately but have been calculated with the transition paths for the chain efficiency and built environment themes; they were not calculated separately as effects in the electricity sector.
- The energy needed for storing CO_2 has not been shown.
- The built environment Platform is still being formed and has therefore not yet contributed.

Virtual power plant (Platform Green Raw Materials transition path Mini and Micro Co-generation)

Since 2005, fifty micro-co-generation installations of the 'first generation' have been tested in houses. Preparations are currently being made for a new test with 'second generation' micro-co-generation appliances that are more efficient and compact and have more intelligent heat storage and control systems.

This is the initial phase of a test with 1000 installations in 2007 that will also be linked together to become the first 'virtual power plant'. This will be an excellent opportunity for Dutch companies to introduce an innovative product on the national and European market as a successor to the successful high efficiency central heating boiler. Besides the product itself, the expertise concerning the technology (grid integration, metering, intelligent control of the virtual power

Energy grids (Platform for New Gas, Clean Fossil Fuels, transition path Mini and Micro- Co-generation)

Energy must be transported from the place of production to the place of consumption, during which it often goes through processing steps. To this end, a vast infrastructure has been developed that includes oil and gas tankers, oil and gas pipelines and the electrical power grid. Changes in the patterns of energy production, processing and consumption require timely adaptation of the infrastructure. If there is a successful energy transition, this adaptation will be enormous. It will apply to the implementation of new energy sources such as biomass and new energy vectors such as hydrogen. This will also apply to the implementation of efficient, small-scale energy production (both fossil and sustainable) as well as to the disposal of wastes such as CO2.

At the same time, the interaction between the infrastructure and the energy flows must be strengthened. This will result in improved usage and improved development of the infrastructure and the energy pattern. This aspect plays an important role in assuring the supply and provision of energy in the Netherlands, especially the import and export of energy.

Most of this infrastructure (tankers are generally the exception) is of such a nature that in practice virtually no competing grids can be built; the grids must therefore provide access to all relevant market participants. Moreover, the role of these grids is so fundamental that their absence could slow the

Financing the energy transition

At this time, more than € 1 billion is being spent annually on stimulating new applications in the field of energy and their further introduction in the market. This concerns the promotion of research activities, launching demonstration projects and the market introduction and largerscale application of proven technologies. The package of stimulation measures for mixing bio-fuels is also included in this amount. In addition, it is assumed that funds from the FES will become available as part of the so-called Borssele package. Most of this € 1 billion will be spent on the market introduction of new technologies and the support of new applications to promote their acceptance in the market, until reaching the point at which they can be supported entirely by the market. Examples include offshore wind power, co-generation and the introduction of bio-fuels.

Approximately € 200 million of these funds will be spent on the promotion of applied research, practical experiments and demonstration projects. The activities that are part of the Energy Research Subsidy (EOS), the Unique Opportunities Regulation (UKR) and the Demonstration Scheme are included in this amount.

A number of programmes will also be implemented to support this phase of research and demonstration, including feasibility studies, public relations and public information provision and the dissemination of expertise. This amount of € 200 million includes the one-time extra impulse as part of the Borssele package.

During this stage of the of the energy transition, the development and concrete definition of the energy paths primarily involves the demonstration of new technologies and the testing of new operational methods. In the years to come, there will also be a need for valorization of knowledge and its application in the market.

At the national level, the energy transition will lead to major effects and opportunities and will therefore require major investments. For the energy transition, an investment is required from existing forms of financing that will rise to about € 2 billion annually (approximately 1% of the national budget).

Theme New Gas

The energy transition in the natural gas sector means that the entire natural gas chain will become more sustainable. In recent years, in cooperation with interested parties, a portfolio of potentially promising routes has been identified that can provide direction and can be developed in parallel. They can be classified into two types:

1 Efficient use of gas, via the transition path, including mini and micro co-generation (de-central energy generation)

The ambition of the Platform for New Gas (PNG) is to work along these routes in an entrepreneurial and innovative fashion with the aim of becoming the most sustainable gas producer and user in Europe.

Energy savings in the Built Environment

A large percentage of the predicted energy use in 2030 will take place in existing buildings (houses and utility buildings). The ambition is therefore to achieve a reduction of 50%. This requires a significant effort. There are three important aspects to this process: technology, infrastructure and incentives. The Built Environment working group has not chosen a single technology; multiple routes are possible. This could involve measures with a gas solution (also green gas), heat distribution or an all-electric route. The approach focuses on the application of currently-available clean and efficient technologies and developing new technologies such as micro co-generation and new forms of thermal storage.

Mini and micro co-generation

In co-generation, electricity is generated locally from natural gas (in the future possibly from biogas or hydrogen). The residual heat from the generation process is used for space heating (in the future cooling as well) and producing warm tap water; this results in highly efficient energy production. By generating electricity close to the user, energy transport losses are limited and the load on the electricity grid is reduced.

The Platform New Gas focuses primarily on the micro co-generation installation, also known as the home power plant or 'magic boiler' with a capacity of around 1 kWe. Besides working on micro co-generation, the working group De-central Energy Generation – established by the Platform –is also trying to acquire an overview of the possibilities and ambitions with respect to mini co-generation. Based on the demand for heat and warm water of a household, a micro co-generation appliance can generate an average of 2500 kWh of electricity annually. The expectation is that micro co-generation will be introduced on a large scale primarily in existing construction due to the interchangeability with the high-efficiency boiler and the relatively high heat demand of older houses.

When micro co-generation facilities are controlled centrally, a 'virtual power plant' is created. This development can take advantage of the obstacles which may occur with a large-scale application of renewable energy sources (wind and solar) in the future and their effects on the electricity grid.

The Netherlands has an advanced liberalised market where distributed generation is well-established, principally because government policies have supported CHP and renewable energy sources. But the general policy thrust in Holland is to avoid using favourable grid policies or tariffs to subsidise the development of these technologies, and to rely instead on other methods. The substantial Dutch experience with DG has had some important advantages. Unlike the situation in the US, interconnection rules in the Netherlands are standardised.

Market rules were adjusted soon after their introduction so that CHP producers could more accurately predict how much electricity to supply to the grid. Power parks have been established where the main producer is the only customer with a direct connection to the grid. But CHP producers still faced difficulties because of rising gas prices and falling electricity prices. To help them cope, the Dutch government has increased direct subsidies to producers and has encouraged distribution companies to ensure that the network value of distributed generation is appropriately reflected in tariffs.

INTERCONNECTION TYPES AND REQUIREMENTS

Power range of individual systems covered by standard PV power plants

No power limits are specified. The only restriction is the connection to the low voltage power network. Special standards are applicable for generators connected to the medium or high voltage networks Interconnection voltage mentioned in standard Low voltage network only

Limitation of maximum PV generator power according to standard

The standard has no limitation for power. However the rated power determines the minimum required protections for the supervision of the point of connection with the low voltage network. Generators with a power electronic inverter and a rated power below 5 kVA have simple requirements for the protections.

Procedure for connection of larger PV systems to the grid

The connection of a generator to the power network has to be approved by the network operator. However, people forget to this requirement when dealing with small and medium sized PV systems on dwellings. Permission is asked for all large PV systems. By law, the network operator cannot refuse the connection of a PV system (or any other renewable energy source

Authorisation procedure

All PV systems have to comply with regular and special standards mentioned in this section of the document. Official procedures for commissioning are not available. Specialised Consultancy firms often assist owners of large and/or special PV system in authorisation and acceptance testing.

Legal situation

Utilities normally accept decentralised generators in their networks. The new Dutch legislation on electrical energy requires a zero-obstruction policy from network operators towards renewable energy. Pay back rates and the necessity of a net-export kWh-meter are subject to the contract between the network operator and the owner of the PV-system

Stimulation Scheme Renewable Energy Production (SDE)

In the period 2007 – 2011, an additional 326 million euros will be made available for the SDE (the successor to the MEP). From 2009 onward, the tax system will be vigorously greened every year with respect to the Coalition Agreement.

The new regulation SDE, opened early in 2008, will in any case be deployed for onshore and off shore wind, biomass and solar electricity. The SDE will be broadened with respect to the MEP, with the addition of sustainable (green) gas and the more effective stimulation of bio-cogeneration.

The design of the SDE means that it will be possible to enable installations that are stimulated by the SDE to switch to a mandatory system for renewably generated electricity in the long term.

Additional greening measures will be explored such as environmental effects, legal aspects, implementation costs, and administrative costs and economic and income effects are being examined. The following are a number of those possibilities:

- a broadening of the Energy Investment Allowance (EIA);
- equal tax handling for higher blends of ethanol;
- excise handling for hydrogen;
- the reduction of work-related mobility (including the stimulation of public transport); environmentally related taxes on mopeds;
- the differentiation of energy tax / increase in environmental effect (including the greening rate for greenhouse horticulture and handling of energy intensive industry);
- an increase in energy tax (1st taxation or 2nd and 3rd taxation);
- further tax differentiation of company cars according to environmental performance;

SUPPORT SCHEMES FOR RENEWABLE ELECTRICITY IN THE NETHERLANDS

- 1998-2003 energy tax exemption for consumption of RE.
- 3 million households (40%) on green power
- Huge imports (10 TWh)
- Tax money went abroad
- No extra RE-power in EU
- MEP scheme: kind of feed-in system
- Start in 2003, budget 2006: 700 mln €
- Funding: 50% households, 50% government
- Producers get a fixed contract for max 10 y
- Guarantees of origin are prove of production
- Every year publication of subsidies based on actual costs and benefits

OBLIGATIONS OF GRID COMPANIES REGARDING GRID ACCESS

A variety of incentives resulted in a particularly favourable investment climate for Combined Heat and Power generation (CHP). By 1995 CHP accounted for approx. 30% of the installed electricity generation capacity in the Netherlands.

The Electricity Act of 1989 created a separation between electricity generation and transmission on one hand, and electricity distribution on the other hand. Generation was concentrated in four generating companies. The generating companies together owned and operated the national transmission network. Distribution companies at that time were regional or municipal companies. The electricity produced by the four generating companies plus all imported electricity was sold to the distribution companies following a standardized tariff system.

The deregulation of the electricity market initiated by the Electricity Act of 1998 (to be discussed in more detail in Chapter 3) meant an end to all incentives mentioned above. Owners of CHP units, who did not consume all generated electricity within their own facility, had to sell the excess power on the market in competition with large generating stations. The market price was so low, in combination with rising prices for natural gas, that many of them could not cover their marginal cost and had to shut down. For many greenhouse owners heating their greenhouse with a conventional boiler proved to be more cost-effective than using a CHP unit and selling the electricity on the market.

PRESENT ELECTRICITY REGULATION IN THE NETHERLANDS

The electricity Act of 1998 implemented market reforms in order to comply with EU regulations. The transmission system was transferred to a newly formed state-owned company called TenneT. TenneT owns and operates the transmission system and manages the import/export interconnectors. The generating companies, having transferred their share in the transmission system to TenneT, were privatised. Three of them were sold to foreign utilities, one of which recently sold on its Dutch generating assets to one of the larger Dutch distribution companies. The fourth generating company was owned by regional distribution companies already and is now a full subsidiary of one large Dutch distribution company.

Distribution companies have been forced to implement an administrative separation between the ownership and operation of networks on one hand and the generation and supply of electricity on the other hand. In steps, the market for supply has been opened to full competition; starting with the largest customers (> 1 MW) from 1999, medium-sized customers (> 100 kW) from 2002; and the remaining customers now planned for July 2004. There is already a fully open market for green power.

All customers opting for green power can choose their own supplier. The Electricity Act of 1998 defines the electricity network as a regulated monopoly. In the definition of the Electricity Act, the network operator is the party that has the unique concession to operate the public electricity network within a specified geographic area. Operation of the network means making all strategic decisions with regard to the network; it comprises long-term and medium-term planning, providing new connections, setting standards for utilization of assets, setting maintenance standards and setting the network tariffs. The network operator is permitted to outsource the day-to-day operational activities to commercial parties.

The income of a network operator consists mainly of the network charges paid by the customers connected to his network. Such charges consist of:

- A non-recurring charge for establishing a connection; dependent upon the voltage level, the kVA rating of the connection and the distance from the nearest suitable interconnection point to the existing network of that voltage level. This applies for load customers as well as for generation;

- a monthly kW (for bigger customers a kVA) charge paid for the import rating of the connection;
- a kWh (and for bigger customers a kVarh) charge paid for the amount of electricity imported. For smaller customers there is no charge for exported electricity; net metering is not applied;
- a time-dependent tariff is possible.
- For bigger generators (10 MVA and up), a MWh charge paid for electricity supplied into the network.
- A system charge per kWh consumed. This is levied by the distribution companies and transferred to TenneT to pay for its activities as a system operator.

REGULATORY ISSUES RELEVANT TO MICROGRIDS

Of the regulatory situation described in the previous chapter, the following are particularly relevant for the creation of microgrids.

1.8.1 Commercial position of the network operator

The present regulatory context does not permit a network operator to treat similar customers differently. That means that, if a part of his network were to be operated as a microgrid, the network operator would not be in a position to offer the customers in that microgrid different connection attributes. This applies to the tariff system used, but also to technical conditions which may be applicable like improved local reliability or forms of demand side management required to operate the system in an islanded mode.

These restrictions are so severe that the creation of a microgrid is economically feasible only if it is not operated by a network operator as defined by the Electricity Act.

1.8.2 The alternative way to operate a network

The Electricity Act provides an escape for the operation of networks which have special technical characteristics or which have been optimised in particular for reasons of energy efficiency. Such networks may be exempted from the requirement of being operated by a network operator as defined by the Electricity Act. This exemption, which is generally referenced as "Article 15" because it is described in Article 15 of the Electricity Act, is granted by the Minister of Economic Affairs upon an advice from DTe. Several dozens of applications are filed each year, mainly by operators of networks on industrial sites where a considerable part of the electricity is generated locally by one large CHP owner who trades his electricity directly to other companies on the same site. There is a considerable economic benefit by having only a single connection to the public electricity network and sharing the cost of the local network between the companies on that site. Pure economic benefit is not accepted by DTe as a valid argument for receiving an Article 15 exemption. However if this economic benefit is necessary to support the feasibility of the CHP unit, the energy conservation provided by the CHP is accepted as an argument.

ASSESSMENT AND OUTLOOK

The regulatory system in the Netherlands has caused a network tariff regime under which distributed electricity generation is much more attractive if the electricity is consumed "behind the meter" than if the electricity has to be exported to the public network. In order to share a DG unit between multiple users, the option of a private network is therefore in terms of economy an attractive and sometimes even the only feasible option. This creates a considerable business opportunity for microgrids.

The Dutch regulatory authority DTe has only unofficially expressed itself about the microgrid concept described in the preceding chapters. Off the record however there is great enthusiasm, in particular because it is believed that an innovative structure like a microgrid could be a platform for the development of new and market-responsive services. Protection of the interest of the individual customers remains a key parameter and proposals will be primarily checked against that parameter.

The legal position of the existing utilities as network operators is such that they are not the most obvious parties to participate in the establishment of microgrids. It should be noted that most of the operational experience available today in an existing utility is not embodied in the network operator (as a company), but has been placed in a services organisation which sells its services on a more or less competitive basis to the network operator. Such network management organisations are also in the market as subcontractors for the day-to-day management of a microgrid. In such a structure, although the utility does not own or govern the network, the expertise and economy of scale of the old utility can benefit microgrids as well.

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[3] Technical Report for Deliverable DG2, Evaluation of DG Regulatory Practices in Europe

[4] Experiences with policy instruments for the promotion of Renewable Energy in the Netherlands, Michel Verhagen, Ministry of Economic Affairs, Amsterdam, 13 Oct. 2005

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6.21. POLAND

INTRODUCTION

NATIONAL LEGISLATION and targets

In 2001, principally in response to international obligations such as the Kyoto Protocol, the Directive 2001/77/EC and the EU Accession Agreement, the Polish Parliament accepted the "Strategy for Development of Renewable Energy Sources until 2010." The share of electricity from RES in the total gross consumption of electricity in the country

Polish Council of Ministers accepted on 4 January 2005 National Energy policy – Energy policy of Poland until 2025. This document describes directions of energy sector, development, including renewables and puts forward biomass (*energy crops, firewood, wastes from agriculture, industry and forestry, biogas*), wind power and hydropower as the sources offering the greatest potential for use in Poland. **On the other side solar energy technology (PV plants) can use in heat generation or isolated electric power grids, which are not connected to the natioanal grid**. **Eligible renewable sources for homeowners are first of all rightly photovoltaic, which is not too support.**

The main Targets of Energy Policy until 2025:

- Maintaining the stable support mechanisms for the use of renewable energy sources
- The use of biomass in electricity and heat generation
- Intensification of use small-scale hydro power

- Increased of share of bio-components in the liquid fuel market
- Development of industry for renewable energy generation

In the Accession Treaty Poland adopted an indicative target saying that 7.5% of the country's total gross electricity consumption should come from RES by 2010. Therefore activities for promotion of increased use of renewable energy, with a view to achieve this target, are given priorities.

According to the Ministry of Economy due to economical and environmental issues in Poland the most perspective to growth are three kinds of RES technology – **biomass, wind and hydropower**, **especially small hydro power plants**.

Implementation of the European Union law in Poland

The obligations of Poland concerning the renewable energy sources arise from the country's membership the European Union and from other international agreements. The obligations are:

- achieving 6% reduction of carbon dioxide emission in 2008 – 2012 comparing to the level of 1988 – the obligation resulting from the ratification of the Kyoto Protocol in 2002
- achieving **7.5% share of electricity** produced from RES in the gross electricity consumption – the obligation resulting from implementation of the Directive 2001/77/EU in **2010**
- achieving 5.75% share of biofuels in liquid fuels market by 2010 – the obligation resulting from implementation of the Directive 2003/30/EU [12].
- The minimum share of RES energy defined in energy purchase obligation was increased –for 2010 – 2014 the required RES share is **10,4% (previously only 9 %).**

Renewable Energy Sources in Poland, barriers for PV plants

The share of electricity from RES in the gross electricity consumption in Poland increased from approx. 1.68% in 2000 to approx. 2.8% in 2006. Table shows the quantity of electricity generated from RES and its share in the gross electricity consumption for the period 2002–2006.

Share of RES in Poland´s Gross elektricity consumption

	2002	**2003**	**2004**	**2005**	**2006**
Electricity generation from RES (GWh)	2,767	2,250	2,893	3,761	4,203
Percentage electricity from RES (%)	**2,02**	**1,59**	**2,00**	**2,60**	**2,80**

Quantity of Electricity generated from different RES (%) in 2006

Type of RES	**(GWh)**	**(%)**
Biogas	94	2,2
Biomass	1821	43,3
Wind power	253	6,0
Hydropover	2035	48,4
Electricity generation from RES	**4203**	**100,0**

The pattern of the electricity generation in 2006 shows, that hydropower and next biomass has the largest share. Out of mentioned type of RES in Poland, (*which are more supported*) are not suitable for homeowners.
The most eligible RES for homeowners are probably photovoltaic systems.
Although current (2007) green energy purchase obligations upon Polish energy companies require significant annual RES share of **10,4% by 2010**, this quota system does not distinguish between the different renewable technologies and as a result it is not favourable for PV. Moreover, the green certificate scheme applied so far does not stimulate private investors' interest in PV development, contrary to the effectiveness of the feed in tariff-based system introduced in many European countries.
The installed capacity of PV systems by **2003 was around 120 kW and in 2007 around 600 kW** of total capacity, but all of them not connected to the grid. A growth of the installed capacity of solar cells has been observed, but due to the high investment costs any wide use is not foreseen except specific purposes. The Strategy set a national target of **1 MW of installed PV power until 2010**.
Despite progress being made in RES – related legislation (hardly PV – specific) there are still administrative barriers to PV investing, which require national administration action. Investors still face tardy approach and lack of interest from electrical energy distributors and have to overcome the bureaucratically administrative proceedings accompanying connection to the grid.
Although the reserves of solar energy in Poland are relatively high, their utilisation is not easy because of high irregularity of solar radiation. Solar energy is used to small extend in solar and photovoltaic installations. Solar systems (flat collectors, parabolic collectors or heliostats) heat the water for domestic purposes and the photovoltaic installations produce electricity used for supplying telecommunications devices, lighting road signs, and a few installations are used by individual users or by local societies.

Situation with solar energy technology (PV plants) in Poland

One from the most important eligible sources for homeowners is photovoltaic, which is not too supported. The green certificates exist on the market; there are some support mechanisms for RES in general, but not for photovoltaics.

The cumulative installed PV power in 2005-2007

2005			**2006**			**2007**		
Off-grid	On-grid	Total	Off-grid	On-grid	Total	Off-grid	On-grid	Total
(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
220	71	291	337	101	438	488	152	**640**

<u>Legislative background</u>

History and development of legislative

The new Energy Law, which came into force in January 1998, offers the opportunity to develop renewable energy technologies. The new Energy Law initiates substantial restructuring and regulation of electricity and heat markets. It introduces a free market for energy and rate diversification by region. The Law fosters energy-saving innovative methods, supports clean technologies, and recognises renewable energy sources as one option to achieve environmental targets in Poland.
The new executive regulation of the Ministry of Economy related to the Energy Law came into force in January 2001. Under this regulation, utilities are obligated to buy electrical energy and heat from

producers using renewable energy sources. This regulation obligates utilities to have a certain percentage of electrical energy sold to be from renewable energy sources (**2,0 % in 2001, increasing slowly each year up to 7,5% in 2010 (10,4 % in 2010 around new obligation from 2007)**. The electricity from small and large hydropower, wind, biogas, biomass, biofuel, photovoltaics, solar collectors, and geothermal energy is included. The regulation does not set a limit on the scale of the source. Heat and electricity from nuclear power plants, waste incineration, and imported energy are excluded from the quota system. This quota does not distinguish between the different renewable technologies, so PV has strong competition.

The above-mentioned regulation is due to Poland's need to increase its share of primary energy from renewables. First, environmental protection is one of the constitutional obligations of the State. Second, bound by international agreements such as the Kyoto Protocols, Poland is obligated to reduce its carbon dioxide emissions. Poland will also join the European Union in several years and must meet European standards on pollution and must significantly increase its implementation of renewable energy sources.

Unfortunately, there are no statements connected to the renewable energy technologies in the construction regulations. Of course, renewable technologies can be integrated into buildings if they comply with the general regulations. The Construction Law, which was brought into force in 1995, together with the later changes provides some indirect regulations that are useful for developing solar systems, i.e., emphasises that buildings should be designed, constructed, and used so as to ensure environmental protection and rational use of energy.

Another law important to implementing solar technologies is the Thermo-modernization (Retrofitting) Law, which came into force in January 1999. This law specifies rules that support thermal modernisation activities. One of the aims is a total or partial exchange of traditional fossil-fuels energy sources to non-conventional sources of energy. The law is oriented toward environmentally clean and energy-saving housing construction and technologies.

In August 2001, the Polish Parliament accepted the "Strategy for Development of Renewable Energy Sources until 2010." However, this Strategy mainly stresses the development of biomass and biogas, hardly mentioning solar energy. It plans to have installed 1 MWp of PV power until 2010.

Summary of history legislative

April 1997

Energy Law (Journal of Laws of 1997: No. 54 item 348; of 2003: No. 153 item 1504)

- Enumerates the main targets of the new energy policy:
    - security of energy and fuels supply,
    - efficiency in production, distribution, and use of energy and fuels,
    - development of competitive conditions in the energy industries.
- Initiates substantial restructuring and regulation of electricity and heat markets,
- Introduces a free market for energy and rate diversification by region,
- Defines Renewable Energy Sources

July 1999

Resolution adopted by the Parliament of the Republic of Poland concerning the development of utilisation of energy from renewable sources

December 2000

Ordinance of Minister of Economy concerning an obligation to purchase electric energy from unconventional and renewable sources and co-generated with heat, an obligation to purchase heat from unconventional and renewable sources as well as the extent of such an obligation (Journal of Laws of 2000: No. 122 item 1336)

April 2001

<u>Environmental Law</u> (Journal of Laws of 2001: No. 62 item 627; of 2003: No. 190 item 1865)

- Enumerates the main rules of the environmental policy:
    - prevention,
    - the cost of pollution is covered by the polluter
    - the complexity of the environment protection

August 2001

Development Strategy of Renewable Energy Sector

Provides for:

- increase of energy share from renewable sources in fuel- energy balance to 7,5 % in 2010,
- increase of energy share from renewable sources in primary energy consumption to 14% in 2020

May 2003

Ordinance of Minister of Economy concerning an obligation to purchase electric energy and heat from renewable sources and electric energy co-generated with heat (Journal of Laws of 2003: No. 104 item 971)

- utilities must include defined shares of renewable energy in their annual total sales:
    - 2,75% in 2003,
    - increasing each year up to 7,5% in 2010.

January 2007

In January 2007 changes in the Energy Law Act were made resulting in requirement of a licence for RES energy generation regardless of the power installed (previously required only > 50 MW).

INTERCONNECTION RULES

Eligible renewable /other technologies:

☐ biogas
☐ wood gas
☒ photovoltaic
☒ cogeneration
☐ oil
☐ steam power plant
☒ hydro
☐ wind
☐ incinerator
☐ gas
☐ others: ………………………………………………………………

Applicable sectors:

☒ housing
☒ services
☒ health and social facilities
☒ school and educational facilities

☒ small businesses

Limit on System Size/Overall Enrollment

In Poland the upper limit of generation capacity connected to the highest distribution voltage i.e. 110 kV is confined to 150-200 MW. This means that practically all DG is connected to grids lower than 110 kV. There are no special rules for DG connection. They are treated as the rest ofgenerators according to their power, voltage and other specific data of the sources.

Share of DG and RES technologies, Polish classification of DG

Criteria of classification of DG		**Power range**	**Examples of applied technologies**
Installed capacity	Micro	1 W - 5 kW	Gas turbines, Stirling engines, Diesel engines, Fuel cells
	Small	5 kW - 5 MW	
	Mid	5 MW - 50 MW	
	Large	50 MW - 150 MW	
Technology	RES	1 W - 5 MW - 10 MW	Small hydro, Wind, PV, Geothermal, Biomass, Landfill gases
	Modular CHP		Gas turbines, engines, Fossil fuel units

Licensing of renewable energy sources
All generators, producing energy in renewable sources are subject to licensing. At the end of 2006 the number of licensed sources reached 868, including 6 biomass, 74 biogas, 104 wind and 684 hydro, of total installed capacity 1 307,54 MW. The President of ERO granted also 36 promises of licenses, mostly for wind generators, of total capacity 692 MW.

Rules for net metering systems:
Website:
1. The Energy Regulatory Office, Poland (ERO)
http://www.ure.gov.pl/portal/en
http://www.ure.gov.pl/portal/en/1/17/Activity_Report_2007.html

2. PSE- Operator S.A. is a Polish Transmission System Operator
www.pse-Operator.pl

The Polish Power Grid Company -- Polskie Sieci Elektroenergetyczne (PSE) -- was created in August 1990 by the Polish Ministry of Trade and Industry as a joint-stock company, wholly-owned by the Polish state treasury. PSE is the owner of Poland's high voltage electricity grid and is responsible for grid operations and power dispatching. The distribution subsector consists of 33 distribution companies, all of which are joint-stock companies, and utilizes 110 kV, 15 kV, and 0.4 kV lines to supply electricity to customers. Distribution companies represent approximately 40% of all Polish electricity sector assets

Grid connection of DG and RES
Entities connected to the network are divided into the following connection groups:

- group I - entities connected directly to the transmission network,

- group II - entities connected directly to the distribution network, of rated voltage 110 kV, and the entities connected to the distribution network which require delivery of electric energy of parameters other than standard, or the entities that own generating units coordinated with the network,
- group III - entities connected directly to the distribution network, of rated voltage greater than 1 kV but lower that 110 kV,
- group IV - entities connected directly to the distribution network, of rated voltage not exceeding 1 kV and connecting power greater than 40 kW or the ‘before-the-meter’ protection rated current in the current circuit greater than 63 A,
- group V - entities connected directly to the distribution network, of rated voltage not exceeding 1 kV, and connecting power not greater than 40 kW and the up-the-meter protection rated current in the current circuit not greater than 63 A,
- group VI - entities connected to the network through a temporary connection which, according to the contract, will be replaced with a target connection, or entities connected to the network for a specified time period not longer than 1 year

Standard Interconnection Agreement:
In the case of RES article 7 of Directive 2001/77/EC shall be considered:
“Without prejudice to the maintenance of the reliability and safety of the grid, Member States shall take the necessary measures to ensure that transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from renewable energy sources. They may also provide for priority access to the grid system of electricity produced from renewable energy sources.
When dispatching generating installations, transmission system operators shall give priority to generating installations using renewable energy sources insofar as the operation of the national electricity system permits.”
In Poland rules that guarantee access to the transmission and distribution systems are in place and enable non-restricted trade of RES energy. Some restrictions may occur due to the safety requirements of stable system operation in the case of large wind farms with highly unpredictable production. These can be made more acceptable by new regulations and control systems of wind farms or assuring back power of adequate capacity.
The second provision of the art. 7 states that providing priority access to the grid system of electricity produced from renewable energy sources is obligatory. In Polish circumstances, according to the present Energy Law, all the entities must be treated equal regarding access to the grid. Therefore, granting any priorities for RES would require change in the Energy Law. To accomplish that a provision must be added to the Energy Law on ‘special energy sources’ e.g. RES or CHP for which special regulations are applied.

FINANCIAL AND SUPPORTING SCHEMES
<u>Main supporting policies</u>

Polish RES-E policy includes the following mechanisms:

- Tradable Certificates of Origin introduced by the April 2005 amendment of the Law on Energy (1997).
- The Obligation for Power Purchase from Renewable Sources (2000, amended in 2003) involves a requirement on energy suppliers to provide a certain minimum share of RES-E (3.1% in 2005, 3.6% in 2006, 4.8% in 2007 and 7.5% in 2010). Failure to comply with this

legislation leads – in theory –to the enforcement of a penalty. In 2005, these were not sufficiently enforced.

- An excise tax exemption on RES-E was introduced in 2002.
- The Energy Act of April 2007 incorporates a principal support mechanism of Certificates of Origin for RES-E: all energy companies selling electricity to end users have to obtain and present for redemption a specified number of Certificates or pay a substitution charge.
- A liquid biofuel quality requirement regulation entered into force in September 2006. Since January 2007, biocomponents for liquid fuels and liquid biofuels have been exempt from excise duty; preferential excise duty treatment was planned to increase under an Act of May 2007. An obligation to add a specified volume of bio-component to fuels was also introduced by two recent Acts (June 2006).

Various financing mechanisms are available in the context of RES-H&C. The Environmental Protection Bank provides soft loans, EcoFund is able to organise non-repayable grants (since 1992) and low interest loans (since 2002), and through the Act on Support for Thermo-Modernisation Projects (1998), investments in the modernisation of thermal installations have been facilitated as well.

Funds

Funds are available from a variety of sources, including EcoFund, the Environment Protection Bank, the National Fund of Environmental Protection and Water Supplies Management, the Fund for Thermo-Modernisation, European Commission pre-accession funds (Phare, Sapard, etc.), and funds arising from bilateral agreement with different countries (e.g., UK, Germany).

1. EcoFund (Ekofundusz) manages funds obtained through a conversion of a part of the Polish foreign debt to benefit the support of environmental protection and to stimulate the development of the Polish environmental protection industry. EcoFund was established in 1992. This was the first initiative in the world pertaining to the conversion of a part of the state-guaranteed debt for ecological purposes (the so-called “debt-for-environment swap”).

The agreement of all 16 creditor countries would make it possible to assign the sum of more than 3 billion dollars to environmental protection in Poland. This would constitute crucial financial support for the efforts to improve the condition of the Polish environment. Presently, about 400 mln USD is available. Financial support is in the form of non-returnable grants of up to 50% of the total cost of the project. Although EcoFund has financed several renewable energy projects, no PV project have been funded so far. However it may change soon.

The Environment Protection Bank provides up to 7 years of credit (at half the commercial rate) for energy renewable projects.

2. The National Fund of Environmental Protection and Water Supplies Management provides loans and non-returnable subsidies for environmental education, pilot projects regarding the implementation of technological advances and new technologies with a high level of risk or that are experimental in nature. Special provisions are made for local authorities.

3. The Fund for Thermo-modernisation supports retrofitting existing buildings, which includes installing renewable energy technologies. In essence, it provides State guarantees for loans taken out for investments in energy efficiency and renewables, and it assists borrowers in paying off these loans.

Furthermore, within one of the new Operational Programmes using Structural Funds 2007 - 2013, Poland plans to finance RES investments within the environmentally friendly energy infrastructure priority. Not only investments in energy generation but also RES equipment

Manufacturing will be supported.

Although good opportunities exist, most of the financed projects do not concern solar energy technologies, since they are considered expensive, especially PV. The development of solar energy sources is hindered by a lack of both direct governmental subsidies and low-interest loans. No incentives are offered for the manufacture and purchase of photovoltaic equipment by private investors. It is necessary to note that the tax systems for installation equipment and components applying to renewables are not appropriate. For PV modules and solar collectors, VAT is equal to 22%. This situation, which is a major obstacle to the wider use of solar systems in Poland, must be changed quickly.

The annual amount of funds spent on PV activities in Poland (including RTD, demonstration and dissemination) within the period of 2004 – 2006 amounted to ca 600 000 - 900 000 €, of which average 66% came from national sources.

The present low prices of energy obtained from fossil fuels, controlled by the government, squeeze potential profits of renewable energy installations. However, energy prices are increasing sharply. The government plans to allow energy prices to float.

Other obstacles are a low awareness and lack of knowledge of the potential of solar energy technologies, the risk of high unemployment in the coal industry, and the strength of the coal and gas lobby, which will prevent the rapid change of the structure of energy supplies.

Green certificates

The Energy Law imposes an obligation on certain electricity market participants to purchase electricity generated from renewable sources at a fixed price. At present, the obligation applies to suppliers of last-resort, whose grids are interconnected with specific renewables producers. The price to be paid to the operator of the renewable source is currently the average price of the sale of electricity on the competitive market in the previous calendar year (in 2005 the respective number is Pln134/MWh, or approximately Eu33/MWh).

Those entities that generate electricity from renewable sources are expected to recover the difference between their operating costs and the average market price payable by the last-resort suppliers by trading in certificates for renewable energy, so-called green certificates. A modified system of green certificates was brought into effect as of 1 October 2005. The certificates are issued by the President of the ERA at the request of the renewable producer and confirm the particulars of the green electricity concerned (i.e. ownership, location, capacity and other technical characteristics of the source, the volumes of electricity, and the period for which it was generated).

Under the Energy Law, the electricity generators and traders (irrespective of their capacity or their turnover from electricity sales) which sell electricity to end-users in Poland are under an obligation to obtain and present to the President of the ERA for cancellation such green certificates in a number proportional to the volume of electricity sold to end-users multiplied by the required minimum share of electricity from renewables in the total sales (to increase from 3.6% in 2006, to 9% in 2010).

The certificates are traded in electronic form only. The rights incorporated into the certificates are property rights tradable as a commodity. The Polish Energy Exchange is under an obligation to keep a register of the certificates and to cooperate with the president of the ERA in respect of the issuing, registering and cancelling of certificates.

In spite of the submission to the Polish regulator of green certificates for cancellation, the entities under the obligation may satisfy their statutory obligations by paying a fee. The fee is established by calculating the difference between the volume of electricity covered by the obligation in a given year, and the volume for which the certificates were submitted to the Polish president of the

ERA for cancellation, multiplied by a fixed sale price of Pln240/MWh (to be CPI-adjusted every year).

Conclusion

Poland Green power purchase obligation with targets specified until 2010. In addition renewables are exempted from the (small) excise tax. No penalties defined and lack of target enforcement.
PV tax incentives: no customs duty on PV and reduced VAT (7%) for complete PV systems, but 22 % for modules and components. Some soft loans and subsidies. A new law passed in April 2004 that tariff for all renewable energies have to be approved by the regulator (until now only for projects larger than 5 MW).

Resources

1) Centre of photovoltaics, Warsaw University of Technology, Warsaw
   http://www.pv.pl/Eng/PVCDataGl.php
2) Energy policy of Poland until 2025. Adopted by Polish Council of Ministers on 4 January 2005
3) Distributed Generation and Renewable Energy Sources in Poland, Józef Paska, Institute of Electrical Power Engineering, Warsaw University of Technology, Warsaw
4) The rules of green certificate register kept by Towarowa Gielda Energii S.A. aproved by virtue of Resolution of the Management Board of Towarowa Gielda Energii S.A. No 85/40/2005 of 18th October 2005
5) The Energy Regulatory Office, www.ure.gov.pl
6) The Photovoltaic European Research Area Network, www.pv-era.net

6.22. PORTUGAL

INTERCONNECTION RULES

Country: Portugal

Eligible renewable /other technologies: (PV, micro CHP, small wind)

Applicable sectors: Residential, Commercial, Schools, Government, industrial.

Breakpoint for Small System (Simplified Rules): max power < 150 kW

Rules for net metering systems: yes (If yes then)

Responsible Authority 1: EDP (Energia de Portugal)

Responsible Authority 2: REN (Rede Eléctrica Nacional)

Limit on System Size/Overall Enrollment: max power less than 150 kW higher than 16 A per phase (3,68 kVA single-phase and 11,04 kVA three-phase).

Standard Interconnection Agreement: Yes

Additional Insurance Requirements: Not allowed for systems eligible for net metering

External Disconnect Required: Yes

Website: http://www.erse.pt

Authority 1: ME (Ministery of Economy)

Authority 2: NA

Expiration Date: NA

Summary: (max 1000 words)

The figure of micro generation already exists in Portugal (actual legislation is based on the licensing of general micro generation installations up to 150 kW to be connected to the LV grid, consuming at least 50 % of the energy produced – DL 68/2002).

No specific guidelines exist in Portugal for the connection of micro generation systems to the electric grid. Small scale micro generation units are often treated in the same way as other conventional power plants.

The existing guidelines define some general technical conditions, focused on:

- Avoiding the deterioration of power quality in the public grid (for the LV public grid, power quality is defined according to the European Standard EN50160);
- Technical requirements associated to the electrical protection systems.

The kWh quotation is ~10 – 15 c€/kWh for the LV distribution in microgeneration.

Additional Resources: http://www.edp.pt ; http://www.erse.pt ; http://www.dgeg.pt

NET METERING RULES

Country: Portugal

Eligible renewable /other technologies: PV, micro CHP, small wind

Applicable sectors: Residential, Commercial, Schools, Government, industrial.

Limit on System Size/Overall Enrollment: max power less than 150 kW higher than 16 A per phase (3,68 kVA single-phase and 11,04 kVA three-phase).

Treatment of Net Excess: It is possible to add (sell) more energy into the net than the defined in the license since the producer establish a contract with the distribution company.

Interconnection Standards for Net Metering: Yes

Authority 1: (national legislation) Decreto Lei n. º 68/2002 of 25 of March, article 9. º (Measurement devices).

Website: http://www.dre.pt

Date Enacted: 2002

Effective Date: 25-03-2002

Summary: (max 1000 words)

For the purpose of invoicing the energy supplied to the entity that entailed the license of distribution of electric energy (LV) by the producer-consumer and the energy consumed for this and supplied by other one, the measurements will be made by independent counters, without damage of adoption of another solution waked up between the producer-consumer and the titular entity of the entailed license of distribution in LV.
The equipments and technical rules of measurement will be defined in the contract of selling and acquisition of electric energy (point b, of the article 6.° in the DL 68/2002).

FINANCIAL AND SUPPORTING SCHEMES

Title: NA

Country: NA

Incentive type: NA

Eligible renewable /other technologies: NA

Applicable sectors: NA

Terms, budgets and requirements: NA

System sizes: NA

Authority: NA

Summary: NA

SAFETY AND POWER QUALITY REQUIREMENTS

COUNTRY: (Portugal)

REQUIREMENT	**VALUE**	**REFERENCE STANDARD OR GUIDE** (including links)
PROTECTION REQUIREMENTS		
Is an external accessible disconnecting switch mandatory?	YES (description: visible disconnecting switch with safety in the isolation position)	NA
What is the acceptable range of AC voltage for operation?	+-10%	NP EN 50160
Is monitoring of voltage of each phase required?	NO	NA
What is the maximum allowed time for disconnection in case of a voltage out of range event	1 secs	
What is the acceptable range of frequency for operation of DER	+4 and -6%	
What is the maximum allowed time for disconnection in a case of a frequency out of range event	+-10 secs	
What is the minimum time for reconnection after a disconnection	5 secs	
Other protection requirements	NA	
IMPACT ON GRID-POWER QUALITY		
What is the allowable variation of voltage at LV side of LV/MV transformer, due to connection	+- 10%	NP EN 50160
What is the limit of harmonic current emissions	Individual Harmonic order, h max distortion (%) 2 h = 2,0 3 h = 5,0 4 h = 1,0	

	5 h = 6,0 6…24 h = 0,5 7 h = 5,0 9 h = 1,5 11 h = 3,5 13 h = 3,0 15 h = 0,5 17 h = 2,0 19 h = 1,5 21 h = 0,5 23 h = 1,5	
What is the limit of the voltage fluctuations and flicker	Pk ≤ 1 of 95% of the time	NP EN 50160
Requirements regarding power factor	0.9 leading<Power Factor<0.9 lagging	
Other requirements for impact on grid-power quality		NP EN 50160
SPECIFIC REQUIREMENTS		
Is an AC disconnecting switch mandatory for a microgeneration plant	YES	
What is the acceptable range for the settings of under-voltage disconnection	-10%	
What is the maximum allowed time for disconnection of a inverter in case of a voltage out of range event	30 secs	
What is the acceptable range of settings for under over frequency disconnection	+-15%	
What is the maximum allowed time for disconnection of a PV inverter in case of a frequency out of range event	10 secs	
What is the minimum time for reconnection after a disconnection of a inverter	+- 30 secs	
What is the limit of the total harmonic distortion of current of a inverter	NA	
Is an isolation transformer required for a inverter	YES	
What is the maximum allowable DC current injected to the grid	16 A	
Is any special protection required for transformer less inverters	Electric circuit breaker	

7.23. SLOVAKIA

INTRODUCTION

NATIONAL Policy and targets

In 2001, principally in response to international obligations such as the Kyoto Protocol, the Directive 2001/77/EC and the EU Accession Agreement, the Slovakia Parliament accepted the "Strategy for Development of Renewable Energy Sources until 2010." The share of electricity from RES in the total gross consumption of electricity in the country is 31 % (9,24 TWh from RES, appraisal value of generally consumption will be 29,8 TWh) in 2010.

Renewable Energy Sources in Slovakia

According to the National Energy Policy the technically exploitable potential of RES for the purpose of electricity generation is as follows:

- The main renewable energy in Slovakia is hydropower. The currently used hydro potential achieves about 2,500 MW (about 30% of the total installed capacity in Slovakia and more than 75% of technically exploitable hydro potential). Almost 5 TWh of electricity is generated by hydro power stations, which is about 15 percent in total generation. Some of such hydro power stations are used for the balancing of the electricity system. Installed capacity of small-size hydropower stations is about 57 MW, generating 36.6 GWh in 2001.
- Within the Development Programme of Hydro Power Stations 250 locations have been identified on several river flows in Slovakia that are suitable for the purpose of the construction of hydro power stations (< 10 MW).
- Of all renewables, biomass has the largest proportion of technically exploitable potential, however, mostly for the purpose of heat production (as a fuel). Large amount of biomass originates from the wood processing industry. Since such enterprises are large energy consumers, it would be appropriate to build the generating stations firing wood waste. Production of agricultural biomass will depend on the agricultural policy with respect to use of energy potential. Potential for electricity generation accounts for 1.27 TWh, though presently only about 85 GWh is in use.
- Geothermal energy is used only in two small-scale cogeneration units (about 44 kW). Further use is considered only in demonstration projects. There is one project with a larger potential (5 MW), however, it has not been implemented yet due to the extremely high cosi for geological exploration.
- Solar energy is used in a small extent due to high specific capital costs. The only active systems are solar collectors. Since the territory is almost fully covered by distribution network (98%) and the awareness of the public with regard to benefits of such systems is rather low, the current use of this type of renewable is about **104 kWp (in 2006)**.
- Regarding wind power, one project of the construction of a wind power plant with a capacity of 4 x 600 kW has been initiated in the western part of the country. Four turbines have been installed with some support provided by the PHARE programme. The annual production is expected to be 3,600 MWh. Nevertheless, Slovakia does not have suitable climatic conditions for more extensive use of wind power (surge wind, turbulent streams), besides national parks that are not suitable for ecological reasons.

  The construction of any renewable energy-based power plants is generally dependent on sufficient investment capital and compliance with environmental requirements.

According to the National Energy Policy the most perspective to growth are three kinds of RES technology – biomass, wind and hydropower, especially small hydro power plants.
<u>On the other side solar energy technology (PV plants) can use in heat generation or isolated electric power grids, which are not connected to the natioanal grid. Eligible renewable sources for homeowners are first of all rightly photovoltaic, which is not too support.</u>

Technologies, which have the biggest expectations for development:

- CHP for biogas,
- Combustion of biomasss,
- Small hydro power stations,
- Wind powers.

On the present time PV systems aren´t too use in Slovakia. There are use only thermal solar panels for solar water heating.
The current barriers for using PV systems are mainly high cost of PV panels. Majority of installed PV systems in Slovakia are off-grid - 64 kWp from total 104 kWp. There is fully covered by distribution network (98%) and they nearly don´t PV systems, which is on-grid.
Energy policy of the Slovak Republic estimates the technical exploitable potential in solar electricity production to 1 537 TWh. Current utilisation is only cca 100 MWh = 0,1 TWh.
For the energy policy of the Slovak Republic is the main advantage of PV systems decentralization supply. Photovoltaic systems have still too high investment costs and 98 % of Slovakia surface is covered by electricity grid. PV systém off-grid is prefer now.

The share electricity generated from RES in 2002-2005

Years / **Sources**	**2002** [GWh]	**2003** [GWh]	**2004** [GWh]	**2005** [GWh]
Hydropower - fully	5 483	3 671	4 207	4 741
From these peak load power station	215	192	107	103
Hydropower stations (without peak load stations)	5 268	3 479	4 100	4 638
Wind power stations	0	2	6	7
Biomass	159	84	3	4
Biogas	1	2	2	4
Electricity generation from RES (GWh)	**5 428**	**3 567**	**4 111**	**4 653**
Percentage electricity from RES (%)	**18,6**	**12,4**	**14,4**	**16,3**

Situation with solar energy technology (PV plants) in Slovakia
One from the most important eligible sources for homeowners is photovoltaic, which is not too support.

The cumulative installed PV power in 2005-2007

2005			**2006**			**2007**		
Off-grid	On-grid	Total	Off-grid	On-grid	Total	Off-grid	On-grid	Total
(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
20	0	20	20	0	20	64	40	**104**

Legislative background

National legislative

Legislative framework in energy sector of Slovakia is represented by 3 legislative acts which came in force at 1. January 2005:

- Act No. 656/2004 on Energy Management and on Amendments and Additions to Some Acts
- Act No. 657/2004 on Heat Energy Management
- Act. No. 658/2004 on Regulation in Network Industries

Another nationality documents:

- Decree of the Government of the Slovak Republic of 30.3. 2005 No. 124, Rules for effectiveness of the market with electricity.
- Act No. 276/2001 of 14.6. 2001, regulation in grid sector and change and completion of some acts
- National Strategic Reference Framework in 2007 – 2013. It sets out the national priorities to be co-financed from the Structural Funds (hereinafter the SF) and the Cohesion Fund (hereinafter the CF) during the 2007 – 2013 programming period in line with the Community Strategic Guidelines on Cohesion
- Proposal of strategy and higher usage RES in Slovakia- new version (april 2007)

A. INTERCONNECTION RULES

Eligible renewable /other technologies:

☐ biogas
☐ wood gas
☒ photovoltaic
☒ cogeneration
☐ oil
☐ steam power plant
☒ hydro
☐ wind
☐ incinerator
☐ gas
☐ others: ……………………………………………………………………

Applicable sectors:

☒ housing
☒ services
☒ health and social facilities
☒ school and educational facilities
☒ small businesses

Limit on System Size/Overall Enrollment

Rules for net metering systems:
Slovenská elektrická přenosová soustava
http://www.sepsas.sk

Úřad pro regulaci síťových odvětví (Regulatory Office for network industries)
http://www.urso.gov.sk

Operation rules distributions systems (ZSE, VSDS):
Utilities:
District system operator DSO 1:
Západoslovenská energetika - distribuce
Čulenova 6,816 47 Bratislava
www.zse.sk
District system operator DSO 2:
Východoslovenská distribučná a.s.
Staniční námestí č. 1, Košice
www.vsds.sk

General conditions

A founder who wants to establish own generation of power, has to comply with the conditions (e.g. valid rules and regulations). The generation of power must be acceptable for parallel operating with grid DSO, interference (current) incidence for grid and for next customers must be impossible.
For operation of electric devices are necessary to keep following rules:

- The valid rules and regulations for operating and for establishment of power generation, mainly [1], [2] a [3]
- Valid standards STN (Slovakai Technical Standard), PNE PDS [4], [5], [6], [7], [8], [9]
- Regulations and instructions DSO (ZSE a.s., VSDS a.s., SSE a.s.)

Specialized firm must carry out the process of project development, engineering, building and connecting electrical power plant to the electrical grid. The connecting to the electrical grid must be discussed and approved with distribution system operator (DSO). The distribution system operator can request changes and completion of energy equipment. The reasons for changes are safety and trouble-free operation and also the capacity of the grid.

Enrolment procedure

Enrolment procedure is very similar as in the Czech Republic. The reason is common state Czechoslovakia, The Slovak Republic and the Czech Republic were the same country with common electrical grid and rules.

Part A: Generally data

The electricity producers must give information about power generation and termination point to distribution network operator. Required information for every category of producers:

b) Power generation data

- Rated output voltage
- Rated apparent power kVA
- Rated active output (power) kW

- Maximum supplied active power or requirements for idle power (kVAr)
- Kind of generator – synchronic, asynchronous, etc.
- Drive
- Operating mode of electricity production, (e.g. continuous (permanent), discontinuous)
- Contribution to short-circuit current
- Operating tension
- Transformer data
- Requirements for self consumption protection
- Ability of isolated-network operation and black start
- Results of metering in energy source
- Method of line from generator to transfer point

b) Resolution of transfer point

- Method of synchronization between distribution network and producer
- Detailed data about transfer point method solution
- Method of connection and disconnection from distribution grid
- Data on network (grid) protection

Part B: Technical data

- Situation plan of plot boundary and location of production unit
- electrical unit scheme, rated levels of electrical units,
- Shunt off resistance delivery station
- Electrical data on transformer feeding, which means power, transfer, short circuit voltage, etc.
- Description of protection with exact data on kind, producer, connection and function
- Self production contribution to opening short-circuit current in transfer point
- Description and method of gear and generator operation
- Invertors, frequency transducer and synchronous generator have to have test report
- Wind power plants: certificate and test report concerning reverse impact (rated power, fluctuation of active and idle power, inside angle of source, limits for driving of power factor)

Application for connection

Documents necessary for connection decision:

- agreement of neighboring owners touched by building up
- agreement of municipality and appropriate building office with realization of power generation

If application doesn´t contain all the requested data, operator of distribution network is going to request completing of application. The term of application completion is considered as term of assumption application.

Connection statement application

Operator of distribution grid determines if an applicant has to elaborate attest studies of connection to distribution grid.
In case that the attest studies are not necessary or an applicant supplied attest studies with acceptance results, obligation statement is produced during 30 days from application delivery. The obligation statement contents:

- place, method and date of connection
- place, method and type of take-off measurement
- eligible costs of operator distribution grid, which are evoked by connection to grid

Next parts of the obligation statement are requirements for obtaining of a valid spatial planning permission and building permission and project documentation of power generation. Validity of statement is 180 days.

Project documentation

Requested operational project documentation has to contain following foundations:

- Realization according to requirements of distribution grid operator
- Lengths, kinds and diameters of lines between power generation unit and district grid transfer point, parameters of disposable transformer
- Situation solution of connection to district grid
- Kinds, parameters and proposal values of extension electric protection of power generation in continuity with distribution grid
- Proposal of commercial measurement performance

DSO gives statement to project documentation during 30 days from request. Parts of the obligation statement are requirements for put in:

- a revision report of generation power,
- a revision report of connection to district system,
- a revision report of protection related with connection to district system,

In case, that connection to district grid is going to evoke eligible costs of distribution grid operator, eligible costs will be on applicant's account. DSO concludes contract with an applicant.

Connection to the grid

DSO determinates method and transfer point with regard to existing net conditions, power and method of operating of own power generation, according to competent interest of producer. Reason is security against trouble effect and protection of the other customers.

Connection to grid takes place in switch point with separation function. This switch point is available to the staff of distribution network operator at any time.

The examples of connection are presented below. Simplification of connection to the district grid is possible in these cases:

- the sources (power generation units) have low period exploitation
- service (operating) is not joined with production technology
- producer does not request usual secure connection (e.g. wind power)

The applicant has to submit to follow papers before setting in operation:

- **report on technical expertise and technical test of electrical equipments (auditorś report),**
- **protocol on source setting in operation (report on technical acceptance of electrical equipments),**
- **local operational regulation of source**

B. NET METERING RULES

Electrometer, measuring and directive devices

The net metering rules and interconnection rules are the same as in the Czech Republic.

Kind and number of necessary metering devices (electrometer of distribution system operator = DSO) and controlling devices (commutator rate) according to the contract conditions for commissioning and supply of electricity appropriate DSO.
Electrometers and next controlling devices are located in appropriate points, which DSO determined.
Measurement is designed according to tension level, where generation power works and separately from power.

- low tension: by power generation direct (to 80 A) or half direct
- high tension: to power transformer 630 kVA including – measuring on side low voltage, half direct from power 630 kVA – measuring on side HV – half direct
- 110 kV: measuring on side 110 kV, half direct

DSO provides supply and montage, electricity producer pay eligible costs and installation.

Measuring and controlling devices and transformers are parts of equipments power generation. Measuring and controlling devices have to perform requested technical parameters.

Costs for metering devices

Authorized DSO provides:

- Electrometer verification costs
- Operational verification of measuring devices costs, finding rightness, linkage and methods
- Operational costs of verification and data providing, including operational long-distance transmission values

Producers and authorized customers provide:

- Purchase and installation costs of measuring transformers and costs for office verification, purchase costs for connective cables, cable terminal box or switchgear, short circuit protection
- Purchase and operational costs of telephone line

Installation measuring devices (electrometer, chart recording instrument)

C. SAFETY AND POWER QUALITY REQUIREMENTS

REQUIREMENT	**VALUE**	**REFERENCE STANDARD OR GUIDE**
PROTECTION REQUIREMENTS		
Is an external accessible disconnecting switch mandatory?	yes	www.vsds.sk
What is the acceptable range of AC voltage for operation of DER?	±10 % for U_n = 230 V or 400 V	STN EN 50160 STN 33 0120
Is monitoring of voltage of each phase required?	No, measured is only power	www.vsds.sk

What is the maximum allowed time for disconnection of DER in case of a voltage out of range event	During DSO, individual time 0,1 s – 0,05 s	www.zse.sk
What is the acceptable range of frequency for operation of DER	±2 Hz with frequency 50 Hz	STN EN 50160 ČSN 33 0120
What is the maximum allowed time for disconnection of DER in a case of a frequency out of range event	Immediately 0,1 s – 0,05 s	www.vds.sk www.zse.sk
What is the minimum time for reconnection after a disconnection of DER	1 min.	
Other protection requirements	Tension and under-voltage, watt protection	Individual during DSO
IMPACT ON GRID-POWER QUALITY		
What is the allowable variation of voltage at LV side of LV/MV transformer, due to DER connection	±10 %	STN EN 50160
What is the limit of harmonic current emissions of DER	According to regulations	STN EN 61000-3-2 STN EN 61000-3-12
What is the limit of the voltage fluctuations and flicker for DER	**±10 % U_n** for U_n= 230 V or 400 V	STN EN 50160 STN 33 0120
Requirements regarding power factor	cos φ= 0,95-0,97	-
Other requirements for impact on grid-power quality	-	-
PV SPECIFIC REQUIREMENTS		
Is an AC disconnecting switch mandatory for a PV plant	YES	
What is the acceptable range for the settings of under-voltage disconnection	Max. 70 % U_n	
What is the maximum allowed time for disconnection of a PV inverter in case of a voltage out of range event	0,05 s	
What is the acceptable range of settings for under- over frequency disconnection	± 2 Hz for explicit frequency 50 Hz	
What is the maximum allowed time for disconnection of a PV inverter in case of a frequency out of range event	0,05 s	
What is the minimum time for reconnection after a disconnection of a PV inverter	To 1 min.	
What is the limit of the total harmonic distortion of current of a PV inverter	-	
Is an isolation transformer required for a PV inverter	-	

What is the maximum allowable DC current injected to the grid		
Is any special protection required for transformerless inverters	YES, surge guard	
Is an anti-islanding protection for the PV inverter mandatory	-	
What method of anti-islanding protection is acceptable	-	

D. FINANCIAL AND SUPPORTING SCHEMES

the purchase price - price setting

The Regulatory Office for network industries determines amount of purchase prices for electricity from renewable sources in the Slovak Republic in decree No. 2/2007 on support for the electricity production from renewable energy sources.

Following tables show purchase prices for electricity produced from renewable sources determined by the Energy Regulatory Office for year 2008.

Slovakia's household electricity prices are the highest in the EU based on purchasing power parity, according to the Gas and Electricity Market Statistics published by Eurostat on November 14. In absolute numbers, the electricity prices for households and industry are among the 10 most expensive in the EU.

Purchase prices of electricity generated by small hydroelectric plants

Date of commissioning	**Purchase prices of electricity supplied to the network, in**	
	Sk/MWh	**€/MWh**
Small hydroelectric power stations refurbished after 1st January 2005	2520	82,35
Small hydroelectric power stations commissioned after 1 January 2005, installed capacity 1-5 MW	2820	92,15
Small hydroelectric power stations commissioned after 1st January 2005, installed capacity max. 1 MW	2420	79,1
Small hydroelectric power stations commissioned before 1st January 2005	2000	65,35

1 EUR (euro) = 30,6 SKK

Purchase prices and green bonuses of electricity generated by PV plants

Date of commissioning	**Purchase prices of electricity supplied to the network, in SKK/MWh**	
	Sk/MWh	**€/MWh**
Electricity generation using solar radiation	8 410	274,8

Purchase prices for electricity generated from combined heat & power plants (CHP)

In next table aren´t all category of CHP, which are supported in Slovakia, there are only possibilities technology for homeowners.

Date of commissioning	Purchase prices of electricity supplied to the network, in Sk/MWh	
	Sk/MWh	**€/MWh**
Gas engine, fuel is gas	2500	81,7
Gas engine, fuel is gas, commissioned after 1.1. 2007	2680	87,6
Gas engine, fuel is mix air and methane	2150	70,2
Micro – turbine, fuell cell, Stirling engine	3750	122,5

Summary barriers

Market barriers

- Lack of long-term stable economic conditions – currently feed-in tariffs defined from year to year .
- No promotion of RES use for households – the bill for Energy Efficiency Fund on RES Promotion subsidise households, Bills are going to Parliament this year (2008)
- Information lack of possibilities, how and where used RES, especially PV system

Legislative barriers

- Absence of long-time stability conditions, which definated redemption price generated from RES

Absence of obligation purchase electricity from RES

Resume

Goal in production of RES without large hydro plants is 4% in 2010 and 7% in 2015. Production of PV is not mentioned in 2010, as for 2015 it is 10 GWh (during Strategy of Energy Security in Slovak Republic submitted in October 2007). On the other hand, Strategy of Energy Security predicts 6 MW of installed PV power in 2010.

The current feed-in tariff **(0,27 €/kWh)** is not sufficient for PV development. There are not guaranteed longer period time, just for one year.

Resources

Úřad pro regulaci síťových odvětví (Regulatory Office for network industries)

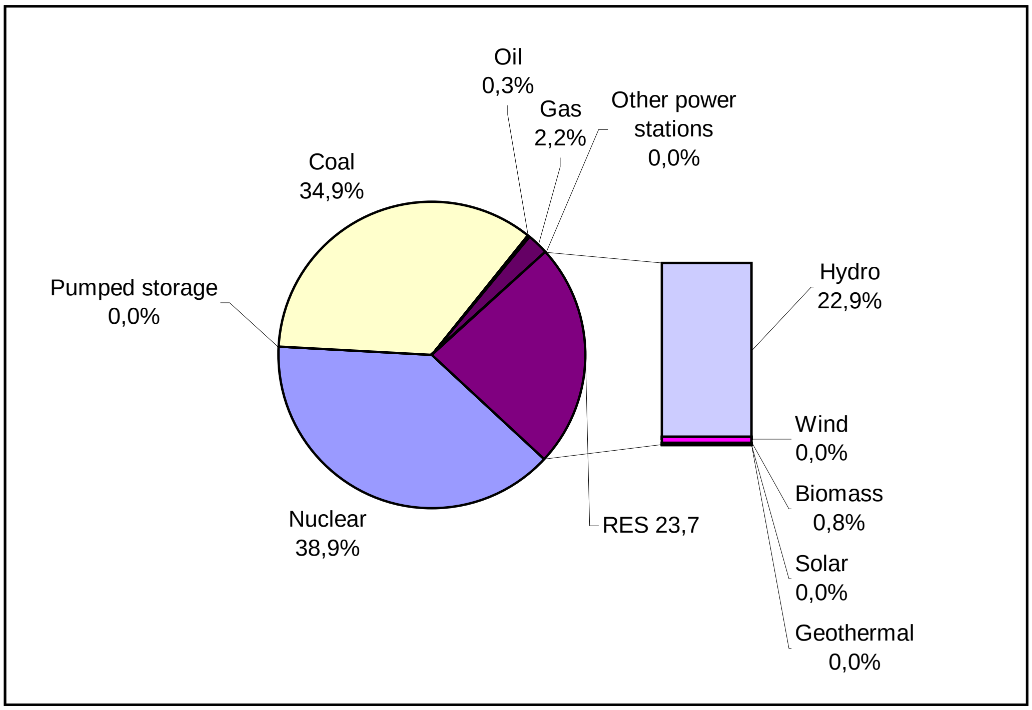
http://www.urso.gov.sk

Czech RE Agency www.czrea.org

7.24. SLOVENIA

INTRODUCTION

The Republic of Slovenia is a coastal Alpine country of 20,274 km² located in Southern Central Europe with a population of 2 million inhabitants. As a member of the European Union, Slovenia adopted European legislation part of which is also Directive 2001/77/EC. Below is a profile of the gross electricity generation by fuel (2005) and the generation by renewables.



Gross Electricity Generation by fuel in Slovenia in 2005 (Source: EUROSTAT)

The share of RESs in the total energy consumption was 10.6% in the year 2005. The share of RESs in total electricity production is 23.7 % (2005). The national target for electricity generation from renewables according to Directive 2001/77/EC is 33.6% including big hydro (till 2010) or 4.2% excluding big hydro (2010). The situation regarding individual RES technologies of electricity production in particular for wind and PV is presented below:

- *Wind turbines:* There is only one wind power plant operational on Kredarica, but the electricity generated is not being fed to the national grid. In the year 2004, a plan to build 47 wind turbines on Volovja Reber was adopted. Their installed capacity will be 40MW and the expected annual electricity generation will amount to 120 GWh. In the short-term the installation of a 40 MW wind park is foreseen.
- *PV:* The first grid-connected Slovenian solar power plant for electricity production was built in Ljubliana and has a peak capacity of 1.1 kW. Another 5.5kW solar power plant was installed on the faculty of electrical engineering and computer science in Maribor and started

to operate in the year 2004. The largest grid-connected solar power plant in Slovenia (100 kWp) became operational in the year 2007. The total installed PV capacity in Slovenia is nearly 0.5 MW.

<u>National strategy regarding RES</u>

The national target regarding RES can be found in two national strategic documents: Resolution about National Environment Protection Program 2005-2012 from 2005 and National Energy Program from 2003.
Main targets in the Resolution about National environment protection program 2005-2012 are developed according to the Kyoto protocol obligation (reduction of greenhouse gas emissions by 8% according to the year 1986). The reduction of greenhouse emissions will be achieved by:

- increasing of RES share in total energy supply up to 12% until 2010
- increasing of RES electricity form 32% in 2002 to 33.6% until 2010
- increasing the share of electricity production by cogeneration systems up to 16%
- decreasing of energy consumption in new buildings by 30%
- decreasing of energy consumption in public sector (public buildings) by 15%
- replacement of the fossil liquid fuels by RES fuels by 5,75% to the year 2010
- decreasing the energy intensity by 30% up to the year 2015 (according to the year 2000)

On the basis of the abovementioned documents, different regulations designed for the promotion of RES were developed and adopted:

- Regulation for the conditions to acquire the status of qualified electricity producer (Official gazette of RS, 29/01)
- Regulation of rules for definition of prices and for purchase of electricity from qualified producers of electricity (Official gazette of RS, 25/02)
- Decree on prices and premiums for purchase of electricity from qualified producers of electricity (Official gazette of RS, 75/06)

Financial and supporting schemes

The national policy for the promotion of electricity from renewables is a combination of several instruments. Apart for soft measures like public awareness campaigns and demonstration projects, direct support for renewable energy producers is given by a system of feed in tariffs, soft loans and subsidies.

Feed in tariff

Electricity production from RES in Slovenia is supported trough a feed-in tariff system. The system is designed to support independent qualified producers and allows them to choose between fixed feed-in tariffs or premium feed-in tariffs from the distribution companies. If a producer sells electricity on the free market, he is eligible to receive the standard annual premium, while if the producer is connected to the distribution or transmission grid he receives the standard annual price by the grid operator. The terms of the feed-in tariffs are set in the Decree on prices and premiums for purchase of electricity from qualified producers.

The prices for the purchase of electricity from qualified producers and the premiums for electricity that the producers are selling individually to the end consumer or via distributor are shown in the table below. The prices are changed annually with a government decree, taking into account the inflation and other relevant factors like expected future price of electricity and changes in fuel prices.

Table 1: **Feed-in tariffs for wind and PV.**

RES capacity up to 50kW and above	Standard annual Price (€ct/kWh)	Standard annual Premium (€ct/kWh)
Wind	5.863 – 6.072	2.107 – 2.316
Solar	37.419	33.663

The fixed feed in tariff and the premium are paid for a period of 5 years from the commencement of electricity production onwards. After 5 years, the annual premium and the annual price are reduced by 5% each, after 10 years by 10%.

Subsidies

Electricity production from RES in Slovenia is eligible for subsidies. The funds for the subsidy come from the national budget and are awarded by the Agency for Energy Efficiency and Renewable Energy (AURE) through public calls for applications.

The subsidy is designed to cover the additional costs that are related to the use of renewable energy compared to traditional energy sources. Its maximum size can amount to 40% of eligible costs of the investment project. For small and medium-sized enterprises the subsidy could reach 50% and in rural areas or when a whole region is supplied by renewable energy the subsidy could go up to 60%.

Soft loan from ecological fund

The Ecological Fund of the Republic of Slovenia provides soft loans to renewable energy produers. The loans are funded by the national budget and voluntary donations by national or international natural persons or legal entities. Data on the allocation of the loans from the fund can be obtained at www.eckosklad.si. In 2007, several loans were awarded.
Below is an example of a PV project that has received funding from the Ecological Fund:

Project capacity: 6.3 kWp
Total investment 33,200 €
Eko fund loan 23,300 €
Own assets 9,900 €
Specific production: 1000 kWh/kWp
Estimated total production: 6300 kWh/year
Constant sale price: 37,41 €/kWh
O&M annual expanses: 10% of sold energy

Interconnection

There are several important stages before the connection of the producer of renewable energy to the electricity grid is completed. The following table illustrates a list of the activities, which need to be undertaken as well as the entities that are responsible and need to be consulted for the implementation and final realisation of a renewable energy project.

Activities and responsibilities in the project development process (adopted from www.pv-platforma.si)

STEP	ACTIVITY	RESPONSIBILITY
1	DECISION FOR CONSTRUCTION	Responsible: INVESTOR Collaboration: ARCHITECT
2	PROJECT CONDITIONS FOR CONNECTION TO THE ELECTRICAL GRID	Applicant: INVESTOR Issued: DISTR. COMPANY
3	ELABORATION OF THE PROJECT DESIGN FOR CONNECTION TO THE GRID	Commission: INVESTOR Performed: PRO. DESIGNER
4	CONSENT FOR CONNECTION TO THE GRID	Applicant: INVESTOR Issued: DISTR. COMPANY
5	SELECTION OF THE INSTALLER	Commission: INVESTOR Collaboration: PRO. DESIGNER
6	INSTALLATION OF THE PLANT	Applicant: INVESTOR Performed: INSTALLER
7	CONTRACT FOR CONNECTION	Applicant: INVESTOR Issued: DISTR. COMPANY
8	CONNECTION OF THE PLANT TO THE GRID	Applicant: INVESTOR Performed: INSTALLER + DISTR. COMPANY
9	ACQUISITION OF THE STATUS »QUALIFIED ELECTRICITY PRODUCER«	Applicant: INVESTOR Issued: Ministry for environment and spatial planning
10	CONTRACT FOR SELLING THE ELECTRICITY	Applicant: INVESTOR Issued: DISTR. COMPANY

Summary – institutional, technical and financial requirements

At the moment issues are divided among several ministries – Ministry of environment and spatial planning, Ministry of the economy and Ministry of finance. To achieve successful solar thermal energy policy, an institution which would coordinate energy related activities should be established. This will also reduce the time necessary for procedures such as granting the subsides etc.
Large investors expect pay back time as low as 7 to 10 years. Despite the fact that energy price is lower (15-20 %) comparing to more economically developed EU countries, it could be expected, that this difference will disappear, this will not be enough to persuade investors.

Conclusions

Slovenia has limited energy resources of its own. The main sources for electrical energy production in Slovenia are conventional energy carriers. To this moment, renewable energy sources (excluding big hydro power plants) have a small share of the energy consumption in the country. Mostly, retrofitting of old hydro power plants and construction of a few new ones are foreseen, whereas the large potentials for independent distributed energy producers from wind and solar PV plants are overlooked. To support the production of electrical energy from renewable energy sources, a feed-in tariff system as well as subsidies and soft loans have been introduced. It is expected that those instruments will attract investment in renewable energy and produce a vibrant market, where both large and small-scale installations will benefit.

7.25. SPAIN

INTRODUCTION

For the first time in the last 20 years, the upward tendency has been inverted in Spain, which will yield an improvement in the country competitiveness. A direct saving of 1.3 tons of oil equivalent has been achieved, that is, the equivalent energy to the total primary energy consumption in a city of 350.000 people; or a softening of 1.12% of the tendency in consumption, which yields a lessening of emissions amounting to 3.5 CO2 million tons.

In 2007, a package of 21 legislative measures were put into practice on building energy certification, energy labelling of vehicles, efficient street lighting, improvement of the cogeneration framework and regulations for thermal installations in buildings.

The Spanish Government approved in 20 July 2007 the National Energy Efficiency Plan for the period 2008-2012, involving an additional effort with regards to the previous period, and consistent with the Spanish National Allocation Plan of Emission Rights.

The Plan will generate energy savings of 87.9 Mtep, that correspond to 60% of primary energy consumption of Spain in 2006) and will avoid the emission of 238 millions tonnes of CO_2. it is concentrated in 7 sectors (industry, transport, buildings, public services, home appliances, agriculture and energy generation).

For the period 2008-2012, Public Administration will provide a financial contribution to the Plan of 14.5 millions euros, which corresponds to more 20.2% than forecasted in the E4 Programme (Strategy for Savings and Energy Efficiency in Spain). In order to implement the Plan, it had been identified 59 measures, being 36 through economic incentives, 3 related to promotion (including a general communication campaign) and 4 targeted to consumers and market actors. Furthermore, a package of legislative measures will be prepared.

NATIONAL ENERGY STRATEGY

With this new Energy Efficiency Energy Plan, the Spanish Government consolidates the efforts made under the Plan 2005-2007 and reinforces the measures that had been very well proved and permitted to improve the energy efficiency.

The main strategic objectives are as follows:

- To recognise the savings and energy efficiency as tool for economic growth and social welfare.
- To create the adequate conditions in order to extend and to spread knowledge about savings and energy efficiency, as well as establishing and introducing these issues in all national strategies, namely in the Spanish strategy for Climate Changes.
- To improve the market competitiveness tacking in account savings and energy efficiency principles.
- To consolidate Spain position as a front runner of savings and energy efficiency.

NATIONAL ENERGY EFFICIENCY

Besides the above mentioned regarding the National Energy Efficiency Plan, special focus for the Royal Decree that puts the basic procedure for the Energy Efficiency Certification into action. This regulation will oblige, from next November on, to certify newly built house energy point of view and will not affect the existing ones for the time being. The approval of this Royal Decree is one of the development measures of the Action Plan of Energy Saving and Efficiency for the building sector in Spain, and it is a partial transposition of Directive 2002/91/EC on Building Energy Efficiency. Moreover, it completes the new regulatory framework on building energy efficiency started some months ago, with the approval of the Technical Building Code.

When the buildings are devised, built, sold or rented, a certificate of energy efficiency should be pit at the disposal of the purchaser or tenant, as appropriate, to allow them to compare and assess the energy efficiency of the building.

LEGISLATION AND REGULATION FOR MICROGENERATION SYSTEMS

Electricity producers in Spain are subjected to different legislation depending on the producing technology and energy source used (see list bellow). Producers are classified in two main groups; special regime and ordinary regime. Renewable energy sources are included in the special regime while the ordinary regime consists of conventional power plants such as nuclear power stations and is therefore left out of this study.

The special regime has been regulated by different royal decrees named in the following. Royal Decrees in Spain are legal orders proposed by the government, instead of being proposed by the parliament as in the case of laws, and have a lower range than laws.

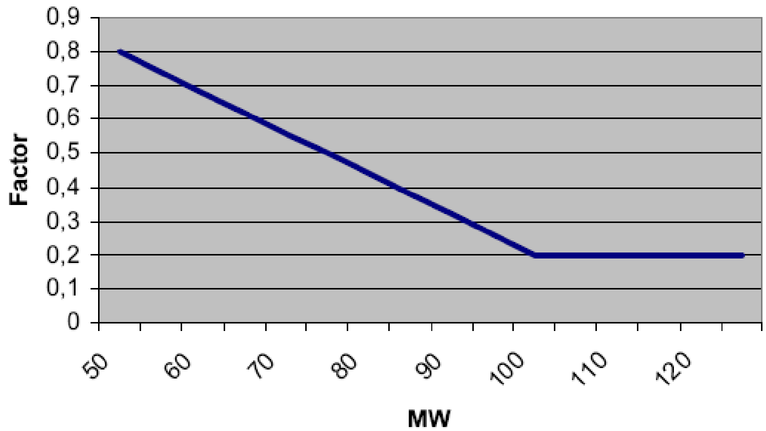
Royal decrees regulating the special regime are Royal Decree (RD) 2366/1994 which was modified by the RD 2818/1998 in order to adapt the legislation to the Law of the electricity sector 54/1997. The RD 2818/1998 was modified by the RD 436/2004 and recently, May 2007, by the RD 661/2007. Aspects related to the connection of the production installations are regulated in the RD 1955/2000 partially modified by the RD 661/2007, by its annex XI regarding connection and by its "disposición final segunda" regarding deposits for licensing. There is specific legislation, RD 1663/2000, for the connection to the low voltage grid of solar photovoltaic installations with an installed capacity lower than 100 kVA.

There have been some changes in the different royal decrees regarding the groups in which producers in the special regime are divided.

The RD 436/2004 established for the first time a division of the solar category into solar photovoltaic and thermal solar and of the wind category into on-shore and off-shore. The RD 661/2007 reduces the number of groups of the special regime from four to three. The three groups are: electricity producers using cogeneration (CHP), renewable energy sources, and waste.

The group with producers using renewable energy sources is called group b and is divided into 8 subgroups: solar energy, wind energy, waves, geothermic, tides, hydropower, biomass and biogas

Installations with an installed capacity larger than 50 MW are not included in the special regime. However, when these installations use renewable energies, except for hydro power, they receive a premium equal to the premium obtained by a similar installation with a capacity below 50 MW multiplied with a factor. That factor decreases linearly with the installed capacity from 0.8 for 50 MW to 0.2 when the installed capacity is larger than 100 MW (see Figure 1). Due to this limitation there are no installations using renewable energies with installed capacity larger than 50 MW.



Source: Grid Issues for Electricity Production Based on Renewable Energy Sources in Spain, Portugal, Germany, and United Kingdom
(*Annex to Report of the Grid Connection Inquiry*)

List of legal /legislative documents

a. Order ITC/3860/2007, of 28 December, that revises the electric tariffs from 1 January 2008.
b. Royal Decree 661/2007, of 25 May, that regulates electricity production (special regime).
c. Royal Decree 436/2004, of 12 March, that establish the methodology for the update and systematization of legal framework of electricity production (special regime)
d. Legislative Resolution of 31 May 2001, which defines the contract model and invoice template for grid connected photovoltaic plants.
e. Royal Decree 1955/2000, of 1 December, that regulates transport, distribution, selling, supply and authorisation of electric energy plants.
f. Royal Decree 1663/2000, of 29 September, on photovoltaic power plants connection to low tension grid.
g. Royal Decree 2818/1998, of 23 December, on electricity production by renewables and cogeneration power plants.
h. Act 54/1997, of 27 November, on Electric Power Sector.

The main objective of Royal Decree (661/2007 of 25th May 2007) is to improve the remuneration of less mature technologies, such as biomass and solar thermal energy, so as to reach the objectives in the Renewable Energies Plan 2005-2010, as well as the objectives engaged by Spain at EC level.

With the development of this renewable energy, Spain will cover 12% of the energy consumption in the year 2010.

The new regulation will guarantee a profitability of 7% to the wind and hydraulic installations that will opt for providing distributors with their production, and between 5% and 9% if they take part in the electricity power production market.

Photovoltaic installations with a high capacity virtually double their remuneration. The remuneration for low capacity installation is maintained in general terms. The profitability of 7% in Photovoltaic installations will be granted.

The technologies needing some impulse for their limited development such as biomass, biogas or solar thermoelectric will benefit from 8% profitability if they choose to supply distributors, and between 7% and 11% if they take part in the market.

Tariffs will be revised every four years, taking into account the accomplishment of the set objectives. This will enable to adjust tariffs according to the new costs and the extent of achievement of the objectives.

The revisions of tariffs to be done in the future will not affect the installations under way. This guaranty provides legal security to the producer and gives stability to the sector, enhancing its development.

The new regulation will not be retroactive. The installations to be implemented up to 1st January 2008 will be able to stick to the former regulation all along its operational life if the fix prices system is chosen. When these installations take part in the market, they will be able to keep their former regulation until 2012.

REGISTRATION AND LICENSING OF MICROGENERATION UNITS

The Electricity Act 54/1997, dated November 27th, has been the regulatory framework for a phased liberalisation of the electricity system since January 1st 1998. The new regulation of the electricity system includes the following aims:

- Make electricity supply cheaper.
- Improve the quality of the electricity service.
- Broaden the range of energy services on offer and tailor them to consumer needs.

The restructuration and regulation are based on:

1. The creation of two coordinating bodies for the electricity system (Market Operator and System Operator).
2. The liberalisation of electricity activities or of the use of electricity installations:
3. The legal separation or unbundling of regulated activities(transmission and distribution) as monopolies from the liberalised activities (production and supply sales). They must be owned by different legal persons or corporations although they may be part of the same business group or holding company.
4. The creation of a wholesale electricity market, with an organised market or pool and a free market. The pool works on the basis of purchase bids and sale offers for energy that are submitted by the market agents (generators, distributors, traders, external agents and qualified consumers). The free market works on the basis of physical bilateral contracts entered into by producers or external agents and qualified consumers, as well as external agents.

5. The creation of the status of qualified consumer, meaning consumers who are free to choose their supplier/trader or who can go directly to the market to purchase their electric power, quite independently of the distributor in the electricity area where the supply is located. Qualified consumers must pay the distributor a regulated toll included in the so-called access tariffs for the use of transmission grids and distribution networks.
6. The actions of an independent regulatory body, the National Energy Commission (Comisión Nacional de Energía or CNE), set up under the Hydrocarbons Act 34/1998, dated October 7th, whose task is to ensure there is effective competition in energy markets and the objective, transparent functioning of those markets for the benefit of all the agents operating in the system and that of consumers (e-mail contact address: dre@cne.es).

INTERCONNECTION TYPES AND REQUIREMENTS

OVERVIEW OF THE TRANSMISSION SISTEM

The typical voltage levels for the transmission grids in Spain are 400 kV and 220 kV. The international connections are also considered as a part of the transmission system. Red Eléctrica de España, REE, is the Transmission System Operator (TSO) and owns about 99.8% of the 400 kV power lines and 98.5% of the 220 kV power lines.

OVERVIEW OF THE DISTRIBUTION SISTEM

The typical voltage levels for the distribution grids in Spain are 132 Kv (very high voltage), 66 kV, 45 kV, 30 kV (high voltage), 20 kV, 15 kV, 13.2 kV, 11 kV (medium voltage) and 380 V (400 V in the latest regulation, RD 842/2002, low voltage).

In Spain the main distribution companies are Iberdrola, Endesa, Unión Fenosa, Hidrocantábrico, and Viesgo with a market share of 40%, 39%, 15%, 2.5%, and 2.5% each, which represent 99% of the total distribution activity. During the last years the number of distribution companies has increased considerably even if they have a negligible market share.

PAYMENT SCHEME FOR RENEWABLE ELECTRICTY PRODUCTION

After the Royal Decree 2818/1998 was approved electricity producers based on renewable energy sources with a capacity below 50 MW have the possibility to choose between two different payment options since. These options are:

- Fixed regulated feed-in tariff
- Market option (combination of the electricity market price together with a fixed premium)

However, solar producers have only the possibility to receive feedin-tariffs. Producers in the special regime can freely choose payment option but the decision taken is for at least one year.

Payment scheme for renewable electricity production according to RD 661/2007.

Group	Subgroup	Capacity	Period	Feed-in Tariff c€/kWh	Premium c€/kWh	Cap c€/kWh	Floor c€/kWh
b.1 Solar (871 MW)	Photovoltaic (371 MW)	P≤ 100 kW	First 25 years	44.0381	---	---	---
			Thereafter	35.2305	----	---	---
		100 kW<P≤ 10 MW	First 25 years	41.7500	---	---	---
			Thereafter	33.4000	----	---	---
		10<P≤ 50 MW	First 25 years	22.9764	---	---	---
			Thereafter	18.3811	----	---	---
	Thermal (500 MW)		First 25 years	26.9375	25.4000	34.3976	25.4038
			Thereafter	21.5498	20.3200		
b.2 Wind (20155 MW)	On-shore		First 20 years	7.3228	2.9291	8.4944	7.1275
			Thereafter	6.1200	0.0000	---	---
	Off-shore			----	≤ 8.43	16.40	---
b.3 Waves, tides			First 20 years	6.8900	3.8444	---	---
			Thereafter	6.5100	3.0600		
b.4 Hydro power P≤ 10 MW (2400 MW)			First 25 years	7.8000	2.5044	8.5200	6.5200
			Thereafter	7.0200	1.3444		
b.5 Hydro power10<P≤ 50 MW			First 25 years	=6.60+1.2*((50-P)/40)	2.1044	8.0000	6.1200
			Thereafter	=5.94+1.080*((50-P)/40)	1.3444	---	---
b.6 Biomass	b.6.1 energy crops	P≤ 2 MW	First 15 years	15.8890	11.5294	16.6300	15.4100
			Thereafter	11.7931	0.0000		
		P>2 MW	First 15 years	14.6590	10.0964	15.0900	14.2700
			Thereafter	12.3470	0.0000		
	b.6.2 biomass from residues in the agricultural sector and gardening	P≤ 2 MW	First 15 years	12.5710	8.2114	13.3100	12.0900
			Thereafter	8.4752	0.0000		
		P>2 MW	First 15 years	10.7540	6.1914	11.1900	10.3790
			Thereafter	8.0660	0.0000		

Source: Grid Issues for Electricity Production Based on Renewable Energy Sources in Spain, Portugal, Germany, and United Kingdom (*Annex to Report of the Grid Connection Inquiry*)

The values of the feed-in tariffs, premiums, incentives, caps and floors to be paid to power producers included in the special regime will be actualized annually with the consumer price index, IPC, minus 25 units up to December 2012 and minus 50 units thereafter.

Renewable energy producers receive an incentive for consuming reactive power during low demand periods in which the circulation of reactive power, and therefore the losses in the lines, increases. At the same time they have to pay a penalization if they consume reactive power during peak load hours. The incentive or penalization is calculated as a percentage of a reference value that is updated every year. The RD 661/2007 established a reference value of 7.8441 c€/kWh and a percentage (annex V) that goes from -4% (penalization) to +8% (incentive).

Producers using renewable energy sources without storage capabilities such as wind power or solar will no longer receive capacity payment according to the RD 661/2007. Year 2006, the average capacity payment for wind power producers, amounted to 4.81 c€/kWh. Other producers included in the special regime can receive capacity payment but only when choosing the market option.

As mentioned before, currently, most of the producers included in the special regime are regulated by the RD 436/2004. However, no later than year 2012 they have to change to the payment scheme defined by the new RD 661/2007.

DEVELOPMENT OF PAYMENT SCHEMES

By comparing the payment schemes on the special regime the following conclusions can be drawn:

- Solar photovoltaic power production has experienced a great increase regarding payment. Installations with a capacity below 5 kW have almost the same payment as 10 years ago but large installations have got a much higher payment according to the new legislation. A solar photovoltaic installation with an installed capacity of 150 kW received according to the RD

2818/1998 a payment of 21.6 c€/kWh and according to the new royal decree, RD 661/2007 a payment of 41.8 c€/kWh is received.

- Wind power producers choosing the feed-in tariff option receive slightly higher payment than 10 years ago but since 2004 the number of wind power producers choosing the market option has increased tremendously and during 2005 and 2006 they have received very high payments. However, the payment has been limited by the new legislation published on 2007 by a price cap of 8.5 c€/kWh which is 30% higher than the feed-in tariff wind power producers received 10 years ago.
- Electricity production from energy crops and biogas receive much higher payment according to the new legislation. An installation using energy crops with an installed capacity of 1.5 MW earlier received according to the RD 2818/1998 a payment of 6.5 c€/kWh and according to the new legislation, RD 661/2007 will receive a payment of 15.9 c€/kWh.

APPLICATION PROCEDURE FOR ACCESS AND CONNECTION TO THE GRID

The application procedure for the connection to the grid is defined in the Royal Decree 1955/2000 in its Title IV. There are two different procedures depending on whether the production installation is to be connected to the transmission system or to the distribution system. The procedures are outlined below.

Procedure for connection to the transmission system (RD 1955/2000 article 53 and 57)

1. The project developer sends the access application to the transmission system operator, TSO. The application has to include the information defined in the operating procedure 12.1 published by the TSO.
2. The TSO sends a report with the eventual anomalies or mistakes to the project developer so that those are corrected.
3. The project developer corrects the anomalies or mistakes within a month from the reception of the report of the TSO.
4. After receiving the correct access application, the TSO has two months to communicate the project developer on the access license depending on whether there is available capacity for the connection or not. If the TSO does not inform the project developer on time, then the project developer can appeal to the regulatory body CNE. If the project developer does not agree with the proposed connection point by the TSO then he can appeal to the CNE who has a period of three months to decide on the conflict. The TSO´s report on available capacity has a validity of six months.
5. The project developer sends the basic project and the program of execution to the transmission company in order to get the connection license.
6. The transmission company has to send within a month a report to the TSO regarding the fulfilment of the technical requirements as well as a copy of the basic project and the program of execution.
7. The TSO will write a report within a month.
8. The access and connection licenses can be processed at the same time but to get the connection license the project developer has to have the access license.

Procedure for connection to the distribution system (RD 1955/2000 article 62, 63 and 66)

1. The project developer sends the access application to the operator of the distribution system, DSO, in the area. Each distribution company has an application model.
2. The DSO sends within 10 days a report with the eventual anomalies or mistakes to the promoter so that those are corrected.
3. The promoter corrects the anomalies or mistakes within 10 days from the reception of the report of the DSO.
4. After receiving the correct access application, the DSO has 15 days to communicate the project developer on the access license depending on whether there is available capacity for the connection or not.
5. The project developer sends the basic project and the program of execution to the distribution company in order to get the connection license.
6. The distribution company, in case the connection can affect the transmission system as defined earlier in point 4, has to send within a month a report to the TSO regarding the fulfilment of the technical requirements as well as a copy of the basic project and the program of execution.
7. The TSO will write a report within a month.
8. The access and connection licenses can be processed at the same time but to get the connection license the project developer has to have the access license.

OBLIGATIONS OF GRID COMPANIES REGARDING GRID ACCESS

Access and connection to the grid are regulated by the Royal Decree 1955/2000. According to its article 20 the only reason to deny access to the grid is the lack of capacity. The lack of capacity will be justified exclusively according to criteria of security, regularity and quality of the supply.

Moreover the general criteria of security, regularity and quality of the supply, there are also other specific criteria for the producers included in the special regime when deciding on access to the grid.

These specific criteria were already defined in the RD 436/2004 and are stated again in the RD 661/2007 with some modifications:

1. The capacity of a generating installation or group of installations included in the special regime connected to one power line of the distribution grid cannot exceed 50% of the capacity of the power line at that point.
2. The capacity of a generating installation or group of installations included in the special regime connected to one substation or transformer cannot exceed 50% of the capacity of the transformers installed for that voltage level.
3. For producers without storage capabilities, such as wind power and solar photovoltaic producers, it is also established that the capacity of the producer or group of producers sharing connection point, will not exceed 1/20 of the grid short-circuit capacity at that point.

COSTS AND OBLIGATIONS RELATED TO MEASUREMENT

In Spain measurement points are classified in different types and there are different requirements for the different types.

Measurement points of type 1 regarding generation are defined as those points where the energy flow during the year is equal or larger than 5 GWh or where the installed capacity is equal or larger than 12 MVA. For measurement points of type 2 the corresponding limits are 750 MWh and 1,800 kVA. Measurement points of type 4 and 5 are defined as those points with a voltage lower than 1 kV and a production capacity larger respectively lower than 15 kW.

NET-METERING

The Law defining the measurement requirements for installations connected to the low voltage grid, i.e. measurement points of type 4 and 5, establishes that when a generating installation also consumes electricity, then the installation will be considered as a generating or a consuming installation depending on whether the installed generating capacity is larger than the retailed consuming power or vice versa. In that case net-metering is used. However, it is possible to have two measurement equipments to measure the produced and consumed energy separately. Solar photovoltaic producers typically choose two different measurement equipments since the tariff they receive for their production, 44 c€/kWh, is much higher than what they pay for their consumption, approximately 17 c€/kWh.

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[3] Spanish Electric Power Act, Spanish Energy Commission (CNE) www.cne.es

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7.26. SWEDEN

INTRODUCTION

The output of hydropower production—which is the main contributor to the generation of electricity from renewable energy sources (RES)—may vary from approximately 51TWh in extremely dry years (such as 1996) to 78.5TWh in wet years (such as 2001). In an average year, large-scale hydroelectric output reaches approximately 63.8TWh. Hydropower and nuclear power are the dominant sources of domestic electricity production. In 2005, hydropower accounted for 72.1TWh and nuclear power for 69.5TWh, whereas various forms of combustion generated 12.1TWh (60 per cent biofuels, 22 per cent coal, 14 per cent oil and 5 per cent natural gas). Wind power accounted for less than 1TWh, but it should be pointed out that this output is steadily increasing.

In 1997, gross consumption amounted to 146.66TWh, and in 2005 to 147TWh, after a small decline during 2002–03. Consequently, the growth in electricity consumption is considerably slower than the present GDP growth.

The single most important Swedish body of law for the attainment of the national targets under the Renewables Directive, is the quota-based system of ‘‘green certificates’’ – in Sweden called ‘‘electricity certificates’’ – adopted by means of the Certificate Act.

The value for the fixing of the Swedish indicative targets for electricity produced from renewable energy sources (RES-E) are 46.0 per cent in 1997 and 52.0 per cent in 2010. In addition to this relative target regarding the increase of the RES-E share of the gross electricity consumption, Sweden has also issued an absolute target, consisting of a 10TWh increase in RES-E production between the years 2002 and 2010. Under an average hydroelectric output, the latter increase would correspond to a 55.3 per cent RES-E share of the gross electricity consumption in 2010. The absolute

target has now been extended until 2016: by then, the increase in the RES-E production should have reached 17TWh compared to 2002.
The previous government stated goal to become "independent" of fossil fuels by 2020 has led to strategies to phase-out oil in the transport sector and to phase in biofuels. In Sweden, biofuel use has progressed in privately owned vehicles and transport fleets.

INTERCONNECTION RULES

Electricity cannot be stored and so, at all times, there must be a balance between demand and production. To ensure this, there must be a party responsible for overall operation of the system. In Sweden Svenska Kraftnät is responsible for maintaining this balance. It is also responsible for operation and maintenance of the country's bulk power transmission grid.
The regional grids, which consist of about 36 000 km of lower-voltage lines, are owned mostly by the three larger electricity utilities. They carry electricity from the national grid to the local distribution networks and, in some cases, directly to larger electricity users. The local distribution networks, amounting to about 477 000 km of lines, are owned primarily by the large power companies and by local authorities. Security of supply over the various grids and networks has become increasingly important in step with the growing dependence on electricity.
A condition for proper operation of the competitive electricity market is that all parties should have unrestricted access to the power grid, which is regarded as a natural monopoly. The Swedish Energy Agency is the network authority, whose duties include responsibility for surveillance of the tariffs of the grid owners, ensuring that they comply with regulations concerning metering and that they provide good security of supply. A special unit, the Energy Market Inspectorate, was set up within the Agency on 1st January 2005 to take over these duties. On 1st January 2008, the Inspectorate has become an autonomous public authority. It applies the Grid Benefit Model as one means (among several) of assessing the fairness of tariffs.

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FINANCIAL AND SUPPORTING SCHEMES

As a market-based support system, electricity certificates have to a large extent replaced earlier public grants and subsidy systems for wind power, combined heat and power production (CHP) and small-scale hydropower. However, other support mechanisms still exist.
RES that are eligible for electricity certificates, and thereby promoted, are wind power, solar energy, geothermal energy, wave energy, certain biofuels and, to some extent, hydropower. It should be observed that peat production facilities (generally CHP plants) are also supported, which means that the electricity certificate system in practice has an additional purpose besides solely supporting the production of electricity from RES. As far as hydropower is concerned, it should be pointed out that the large-scale plants already in use are not under support. On the contrary, supported hydropower facilities include: (i) any smallscale hydropower plant (with a maximum output of 1.5MW) which came into use before April 1, 2003 and (ii) any hydropower plant built after the end of 2002, or any increase in the capacity of an existing hydropower plant, irrespective of its output. It should be

remembered that since most of the remaining unexploited rivers in Sweden are legally protected, construction of any further large scale hydropower plants is unlikely.

The electricity certificate system introduced in 2003 is the State measure par excellence when promoting RES-E in Sweden. For the moment, only domestically produced electricity is promoted through the system, but a review scheduled to begin in 2012 will consider the opportunities of taking the international market into account. When a generator has obtained an electricity certificate, it is the aim of the system that the certificate is sold in order to provide additional revenue, subsequently improving the economics of RES-E and encouraging the construction of new plants. On the demand side of the market, the legislator has placed certain undertakings under a quota obligation, namely an obligation to purchase certificates corresponding to their electricity sales or use in accordance with a table in the Certificate Act. According to the table, the number of certificates needed for each sold or used MWh increases over time, from 0.074 certificates per sold or used MWh in 2003 to 0.169 certificates in 2010. If no purchaser can be found for a certificate, the generator holding the certificate is entitled to have the latter redeemed by the State. This has not yet occurred, as the market price of the certificates is generally significantly higher than the sums guaranteed by the State.

The fact that electricity-intensive industries are exempt from the electricity certificate system, while the certificates have led to significant price increases for domestic consumers, has generated criticism. Nonetheless, the certificate system has been described as a success story, and is estimated to have contributed widely to the generation of an additional 5TWh of RES-E in early 2006 as compared to 2002. A similar system is currently under discussion as regards energy efficiency gains.

Funding support for the promotion of RES-E is also provided by the Climate Investment Programme, through which municipalities and other entities may apply for funding of energy related measures intended to reduce effects on the climate. The programme, which also lends support to CHP, production of biogas from waste, transition to biofuels and increased energy efficiency, is estimated to reduce energy use by 215GWh and greenhouse gas emissions by 203,000 tons, on an annual basis. The 2006 distribution of funds amounted to a total of approximately € 34.3 million.

The Climate Investment Programme is managed by the Swedish Environmental Protection Agency.

Electricity efficiency is promoted through a number of subsidies. For example, there is the Energy Efficiency Gains Programme, which is directed at electricity intensive industries. Furthermore, conversion from direct electricity to other forms of heating for residential purposes is subsidised. Additionally, the Swedish Energy Agency manages a system of regional energy guidance offices, where information on electricity efficiency, for instance, is provided.

Other support schemes are

- Energy and environmental taxes
- Labelling of “Good Environmental Choice”
- Green Tax Change
- Support for technical innovations

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7.27. UNITED KINGDOM

Production of Electricity from RES and CHP in UK

UK Renewable Energy Strategy

The UK is firmly committed to increasing renewable energy use, as an integral part of wider strategy to tackle climate change and ensure the UK's energy security. UK has ambitious domestic targets (e.g. an aspiration for 20% of electricity to come from renewable sources by 2020) and measures (e.g. the Renewables Obligation) to contribute to delivering this. The 2007 Energy White Paper: meeting the energy challenge set out proposals to further expand and accelerate renewable deployment, including through reform of **the Renewables Obligation and reducing planning and grid-access barriers.**

The details of how the EU 2020 target is to be implemented – including the contribution that each Member State is to make - have yet to be agreed. The Commission issued on 23 January 2008 proposals, in the form of a draft Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources, and this will be subject to negotiation between Member States and the European Parliament. However it is clear that a step change will be required in the level of renewable deployment across the EU, including in UK.

Network Connections

Renewable energy projects that generate electricity normally connect to either the transmission grid or the distribution grid. The difference between these grids is normally the voltage: transmission grid voltages are normally 220 kV and above (132 kV and above for offshore wind and Scotland); distribution voltage levels are normally 11 kV, 33 kV, 66 kV and 132 kV (except offshore wind and Scotland).

Business Enterprise and Regulatory Reform (BERR) co-ordinates activity in this area through two sub groups: the Transmission Committee (formally the Transmissions Issues Working Group or TIWG) and the Distribution Committee (formally the Distribution Generation Coordinating Group).

Transmission Committee

TIWG was established by BERR to initiate preliminary studies into the scope of work required to upgrade the transmission system to accept increasing amounts of renewable generation. The Renewable Energy Transmission (RETS) and England and Wales Transmission (EWTS) studies both identified the costs of installing up to 6 gigawatts in England and Wales, and 6 gigawatts in Scotland. It was clearly recognised that the provision of this infrastructure was crucial in ensuring that the generators can meet Government 2010 targets for renewable energy generation.

The role of the Transmission Committee is now to monitor the rate of progress of the implementation of the infrastructure, and to identify, well in advance, the issues required to be resolved in order to meet the needs of the expansion of renewable energy generation.

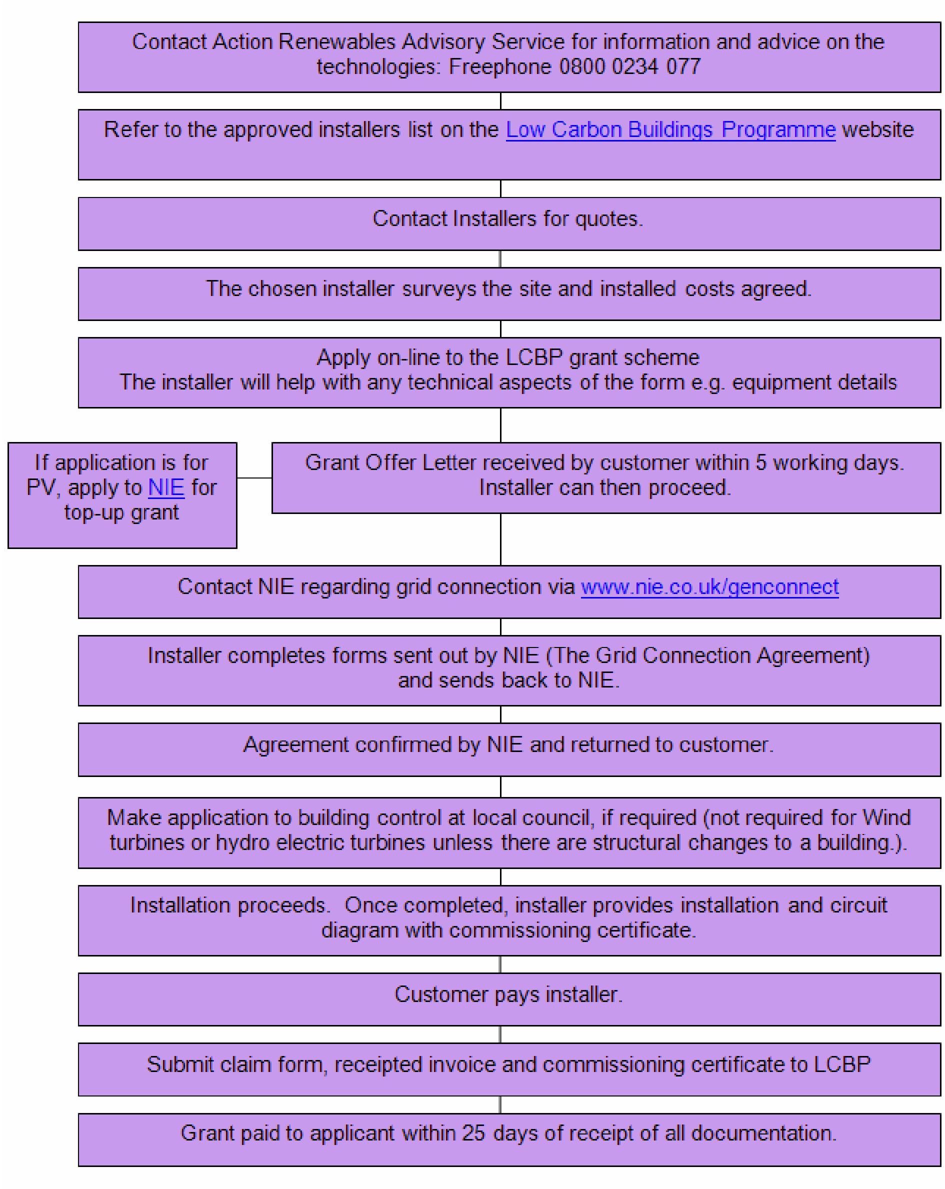
Distributed Generation

Along with the expanding community of independent electricity producers, renewable energy accounts for an increasing proportion of installed electrical generation capacity. As the whole industry shifts to a wider range of generation sizes and technologies, the transmission and distribution network structures and the commercial trading systems will change.

Understanding how small generators interact with the electricity supply industry has formed an important part of BERR's New and Renewable R&D Energy programme since 1995. Renewable energy projects generate electricity and need to be integrated into the electricity system. This is not only a matter of engineering a physical connection, but also of helping to ensure access for small generators. **This access must be fair in commercial terms, not restricted by unnecessary regulations, not subject to inappropriate technical restrictions, and based on cost-effective technologies**.

The connection of renewable energy generators, which will mostly be of a modest size in terms of their electrical output, is therefore not straightforward. A considerable amount of work needs to be done to improve conditions for developers if Government targets on greenhouse emissions and renewable generation are to be met. The Distribution Committee has the responsibility to take forward this work and, through the activities of its subordinate project groups, aims to identify rational solutions to problems that may now, or in future, impede the deployment and connection of renewable energy generators to the network.

Application for PV, Wind or Hydro Installations in Northern Ireland



Small-Scale Wind Turbines

The use of wind power in the UK is growing at a rapid pace and the number of small-scale wind turbines installed is increasing as costs fall, energy prices rise, and planning policy changes take effect. With this growth of the small wind market and more rapid growth predicted as government policy encourages more micro generation, it is important to establish the current baseline of installed capacity. To do this, a gap analysis survey of small-scale wind turbines was undertaken in 2005/6, which included turbines up to 100kW in size.

For the purposes of this study, small scale wind Power is split into 3 categories:

• Tiny wind turbines (Up to 100W)

• Micro turbines, including building mounted turbines (from 100W to 6kW)

• Small-scale turbines (from 6kW to 100kW)

In the cases where generation data was not available an estimate was made using the capacity factor calculated from known metered data from onshore wind farms. This was applied on a country basis to the schemes with no generation data. The capacity factors used are displayed in the table below:

Country	**Capacity Factor**
Northern Ireland	0.34
Scotland	0.29
England	0.27
Wales	0.25

A summary of the results is presented below.

Category	Size Range	Number of turbines	Installed capacity (MW)	Annual Generation (MWh)
Tiny wind turbines	≤100W	22,000	2.20	4,730
Micro wind turbines	>100W - ≤6kW	808	1.56	3059.56
Small wind turbines	>6kW - ≤100kW	123	3.63	7973.57
Total		**22,931**	**7.12**	**15,763**

This analysis of small-scale wind turbines has been a valuable exercise (2005/6) and it is recommended that it be repeated fully in five years time when it is expected that micro-generation uptake and the number of small turbine installations will have increased.

CHP Development Trends

CHP market growth in the UK since the early 1990s has been significant but not dramatic. In the ten years between 1993 and 2003, installed capacity increased by 64%, with almost half of this growth taking place in 1999. Since 2000, the market has been flat. Indeed, since 2000, 800 MWe of capacity has stopped operating because of unfavorable market conditions.

In terms of installed capacity, over 90% of CHP is located in the industrial sector, with 75% accounted for by chemicals, oil refineries, paper/publishing and food/drink. 1,236 of the total number of 1,539 projects are in the commercial/residential sectors (including agriculture). There are only a handful of district energy/CHP schemes. Fuel use for CHP is dominated by natural gas, which holds a 74% share of the market.

The development of CHP in the UK has taken place firmly in the context of privatization, market restructuring and changing regulations, all of which have been overseen by the Department for Trade and Industry (DTI). Against this dominant background, direct policy responsibility for CHP has resided with the Environment Department, now known as the Department for Environment, Food and Rural Affairs (DEFRA), which has set three CHP targets since 1990.

As a specific measure for support of the development of small-CHP it has to be mentioned the VAT reduction for domestic CHP. In the 2002 Budget the Government announced a reduction in VAT for certain grant-funded domestic installations of micro-CHP. This may be extended following proposals made by the Chancellor in April 2004.

Climate Change Agreements. These were established with 44 industry sectors to provide an incentive to achieve energy saving targets. For sectors with little experience of CHP, targets were initially set on the basis that CHP could not be applied. When market conditions improve, targets will be revised to take account of the potential for CHP application.

PV System in UK

Installed capacity of Building Integrated PV (BIPV) in the UK = 747.546 kWp.
The total installed renewables generating capacity for UK is 961 MW. The electricity generating capacity that BIPV contributes towards the renewable generating capacity is less than 0.1%

Laws & Regulations

As with all developments in the UK, PV installations have to adhere to planning regulations. This involves submitting plans to a local planning authority who bases its decision on Planning Policy Guidance, namely Planning Policy Guidance Note 22: Renewable Energy and in particular the annex with respect to photovoltaics. There are three main categories of building types that have to be assessed.

New buildings

With a new construction which intends to incorporate PV the planning authority will have to determine what visual impact the technology will have on local amenity. The planning authority may wish to impose planning conditions to reduce such effects that are deemed to have such an impact. In effect this may involve scaling down the amount PV paneling installed.

Existing buildings

Planning decisions for adding PV technology to existing buildings will determine by whether it is deemed to be a “material alteration”. If this is the case then planning permission may be required and as above certain restrictions may be required.

Listed Buildings

In the UK certain buildings have a designation set out by the Heritage authorities to reserve and protect their distinctive character. Quite often a building is listed due to its appearance either architecturally or historically. Therefore the addition of a technology such as PV paneling is likely to detract from such an appearance. If such an effect is considered unacceptable then planning permission is unlikely to be granted, however the planning authority should again judge each case for its own merit.

A final planning consideration is due to the location of the building, i.e. whether it is in an area protected for its visual characteristics such as an Area of Outstanding Natural Beauty (AONB). Again the planning authority must establish whether such a development will conflict with the area’s character.

Grid Connections

Connecting PV systems to the grid must get permission from a local Distribution Network Operator (DNO) of which there are a total of 14 operating in UK. The equipment being used must also be approved and reliable.

The size of the installation is also important. If a developed intends to grid connect a system of a capacity lower than 5kW then guidance document "Engineering Recommendation G77" should be consulted. This document encourages the use of standard equipment and connection procedures and although only a recommendation (therefore not compulsory) it is recognized that companies who adhere to G77 are less likely to encounter problems with their application for grid connection. If an installation is to exceed 5kW then a different document "G59/1: Recommendations for the connection of embedded generating plant to the Regional Electricity Companies distribution systems" should be consulted.

Subsidy schemes

Investments

Currently the Dept of Trade & Industry is running a 20 million pound PV demonstration program. Grants are available which can save up to 65% of the installation costs of qualifying schemes. It is hoped that this scheme will pave the way for sustainable growth in this area and ultimately reduce costs for future projects by stimulating the industry.

Promotion and dissemination

The Energy Savings Trust provides substantial aid (up to 50% of project costs) for BIPV applications in the UK, as part of the UK government Kyoto commitments to achieve 10% of renewable generation by 2010. DEFRA and the DTI government departments have additionally supported and promoted the use of PV technologies. A number of non-profit organizations promote the use of PV (amongst other renewable energy technologies) including PV-UK, National Energy Foundation, MRETT, CAT and Energy 21.

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7.28. LUXEMBOURG

INTRODUCTION

Luxembourg is the smallest IEA country, but its population of 430,000 inhabitants in 1998 is the richest of all International Energy Agency countries (IEA). Energy consumption per inhabitant is high because of the country's iron and steel industry, the large sales of transport fuel and the overall wealth of the country. Domestic energy resources are limited to renewable energies. Therefore, Luxembourg has the highest dependence on imported energy (more than 99% of total energy in 1998) of all IEA countries. Also, because of its small size and lack of indigenous sources, Luxembourg's energy market is greatly influenced by the energy policies and energy markets in surrounding countries.

Electricity generation from renewable energy and co-generation has expanded rapidly because of the generous buy-back tariffs and direct subsidies. The government should ensure that support for renewable energy does not put too heavy a burden on electricity consumers. This could be achieved by improving the cost-effectiveness of support schemes. The best way to ensure that energy production from renewable forms of energy is sustainable in the long term is to ensure that their cost decreases to a level which makes them competitive.

The Luxembourg is totally dependent on oil products imports. Its oil sector is strictly retail. The government sets price ceilings on the most important oil products to avoid inflation. This system may also prevent abuses of dominant position if competition does not work properly. Since effective competition encourages companies to decrease costs of supply, allowing them to reduce sale prices, the government should rely on market forces to keep oil product prices low. Energy efficiency policy in Luxembourg received a welcome boost in 1993, when a new framework law on energy efficiency was adopted. Several Grand Ducal regulations (decrees) have been issued to implement this law and the government needs to start assessing their cost-effectiveness. Implementation of the energy tax will also encourage energy savings.

National Energy Policy

The Energy Efficiency Law of 5 August 1993 established a legal framework to adopt a wide range of regulations focused mainly on energy efficiency measures and also on the promotion of renewable energy. The 1993 law has five targets (see box) and at the end of 1999, several Grand Ducal regulations described below were issued to implement the law.

In 1998, the National Plan for Sustainable Development, setup a strategy for sustainable development in Luxembourg's different economic areas as described bellow:

- To achieve significant energy savings.
- To introduce the best available technology.
- To balance environmental protection and economic growth in choosing the most cost-efficient solutions.
- To promote human behaviour compatible with the above objectives.
- To work for the adoption of these objectives at international level.
- To promote balanced development of the territory.
- To optimise the environmental management of the land.

The National Plan sets objectives and proposes measures as guidelines in meeting the following objectives:

- To ensure security of energy supply.
- To diversify energy supplies.
- To develop highly efficient co-generation.
- To improve energy efficiency in all consumption sectors.
- To increase the use of renewable energy.

Interconnection and National Regulations

Neither the Law of 24 July 2000 relative to the organization of the electricity market, nor the Grand-Ducal Regulation of 30 may 1994 concerning the production of electrical energy based on renewable energy sources and cogeneration deal with the issue of interconnection standards.

For small generation units (rated up to 1000 kVA), the distribution network operators active in the Grand-Duchy, together with the SEE, have developed specific technical prescriptions.

On August 2003, the dispositions of the "*Règlement ministeriel concernant les prescriptions de raccordement aux réseaux de distribution de l'énergie électrique B.T. au Luxembourg*" of 8 August 1989 were replaced by the "*Prescriptions de raccordement pour les installations à courant fort disposant d'une tension nominale inférieure ou égale à 1000V au Grand-Duché de Luxembourg*".

These prescriptions are to be followed together with the rules set in the Distribution Code and the requirements of the German VDEW. Section 13 of the document states that: "The developer, installer, owner of the connection and the (network) operator negotiate with the VNB (utility) the technical elements of the connection and the installation on a case-by-case basis for the following installations:

- Auto-producing installations operating in parallel to the VNB 's low voltage network.
- Back-up emergency stand-alone generators for electricity supply during public network breakdowns."
- In February, the launch by ERGEG of the Regional Electricity Initiatives with the aim of speeding up market integration at a regional level so as to end up with a single European Union market. France belongs to four of the seven regions defined by the European Commission and ERGEG:
    - Central-West (with Germany, Belgium, Luxembourg and the Netherlands);
    - Central-South (with Germany, Austria, Greece, Italy and Slovenia);
    - South-West (with Spain and Portugal);
    - United Kingdom and Ireland.
- In December, the entry into force of the new guidelines for Regulation (EC) No 1228/20033. While the Regulation set out the general principles for congestion management, the new guidelines explain precisely the improvements to be made to the current mechanisms. In particular, they require a coordinated approach at regional level for the calculation and allocation of interconnection capacities.

Renewable Energy

The National Plan for Sustainable Development of 1998 sets the following targets:

- To increase the share of renewable energy in the public system (electricity distributed by CEGEDEL) from 2.5% in 1997 to 5% in 2010.

- To increase the share of co-generation in electricity consumption from 7% in 1997 to 15% in 2010.
- To increase the share of electricity auto production in total electricity consumption in the public system from 10% in 1997 to 45% in 2005.
- To double the share of wood in final energy consumption from 0.5% to 1% in 2010.

In 1994, a ministerial regulation provided support for co-generation and renewable energy and a grant to non-industrial co-generators of LUF 6,000 per KW for the installation of the first 5,000 kW. This ended in 1997, when the ceiling was reached.

Industrial co-generators are eligible for special depreciation allowances in the framework of the 1997 law. Wind turbines with a capacity of less than 50 kW have received a direct subsidy of 25% of the investment cost. There is a limitation of LUF 60,000 per turbine.

For wind turbines with a capacity above 50 kW, a subsidy of LUF 3,000 per kW with a maximum of LUF 6 million was granted to the first five projects.

Projects involving solar energy, biomass, biogas and heat pumps in the residential sector have received a subsidy of 25% of the investment cost with a ceiling of LUF 60,000 per house.

In the non-residential sector, projects have received 25% of the investment cost with a ceiling of LUF 1.5 million for each installation.

Until the end of 1999, a ministerial regulation of 1997 provided a subsidy of 25% to the costs of the connection of existing houses to the heat grid. In addition to these direct subsidies, the Grand Ducal regulation of 1994 sets the buy-back tariff for electricity from non-industrial co-generation and renewable sources. CEGEDEL (but not SOTEL) has a purchase obligation. The buy-back tariff for co-generators with a capacity of 1 to 150 kW averages LUF 2.95 per kWh; from 151 to 1,500 kW, the tariff averages LUF 2.3 per kWh for day supplies and LUF 1.2 per kWh for night supplies. There is an annual subsidy of LUF 4,500 per kW installed if electricity is supplied during peak load. Electricity plants using renewable sources receive the same payments as co-generators. Electricity from wind energy and solar PV receives an extra bonus of LUF 1 per kWh.

CEGEDEL purchases hydro-electricity from SEO at a price which allows SEO to cover its costs of production and to make a profit. Electricity from state and private micro power plants is purchased at a price set by the Grand Ducal regulation of 1994, which also allows the plants to recover their costs.

The production of renewable energy remained a major political issue. The Minister of Economic Affairs and the Minister of Environment jointly presented a study on national renewable energy production, identifying a potential up to 8.9% of energy consumption. Further on, were presented new draft regulations on the rational use of energy and measures to for the promotion of renewable sources.

Accordingly environmental organisations, only two companies, CEGEDEL and EIDA, are offering electricity generated from renewable energy sources.

The "*Réglement grand-ducal du 8 Février 2008*"

The Decree Law Grand Duchy of Luxembourg of 8 February 2008 defines a set of long term objectives and tariff rules to be applied to related to the electricity production from renewables. Accordingly the studies carried out by the Ministry of Economy and External Trade the production and targets of electricity production from RES in Luxembourg is as indicated din the table bellow.

Electricity production from RES in Luxembourg

Technology	1997 (GWh)	2005 (GWh)
Biogas	0	27
Biomassa	0	0
Biocombustíveis	17	18
Small hydro	82	102
Photovoltaic	0	19
Wind energy	3	53
Total	102	219
RES share	2,0 %	3,45%

The commitment of Luxembourg in framework of EU Directive 2001/77/CE is to reach a RES share of 5,7 % in 2010.

Main characteristics of the new legislation

- Definition of all feed-in tariffs;
- Differentiation at technologies and power levels;
- Definition of 15 years duration period for plants installed after 1 January 2008;
- Regression of the established tariff;
- Introduction of bonus for the heat;
- Limitation to a 15 years period during which the installations can benefit from a extra remuneration;
- Introduction of a guarantee system.

Tariffs

Wind energy

Technology	Power	Investment	Tariff
Wind parks		20 – 25%	82,7 €/MWh

Solar photovoltaic energy

Technology	Power	Investment	Tariff
Photovoltaic	0 – 30 kW	30%	420 €/MWh
	31 – 1,000 kW	30%	370 €/MWh

Small hydro energy

Technology	Power	Investment	Tariff
Hydroelectricity	0 – 1 MW	20%	105 €/MWh
	1 – 6 MW	20%	85 €/MWh

Biogas

Technology	Power	Investment	Tariff
Biogas	0 – 150 kW	50%	150 €/MWh
	151 – 300 kW	50%	140 €/MWh
	301 – 500 kW	50%	130 €/MWh
	501 – 2500 kW	50%	120 €/MWh

Biomass

Technology	Power	Investment	Tariff
Solid biomass	0 – 1 MW	20%	145 €/MWh
	1 – 5 MW	20%	125

			€/MWh

INFORMATION SOURCES

[1] Ministère de l'Economie eu du Commerce Exterieur

[2] Rapport Annuel de L'institut Luxembourgeois de Regulation 2006

[3] Agence de l'Energie (website)

[4] European Energy Review 2008

[4] Energy Policy of IEA Countries