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Renewable energy in agriculture and forestry

Prognoses over future energy supply agree on a strongly increasing importance of renewable energy [1].Agriculture and forestry should increase the application of environmentally neutral energy in their production systems and offer renewable energy as a market product. In this report, important renewable energy sources are identified, the new renewable energy law (EEG) explained, as is electrical energy in the power supply network. Renewable energy is to a great extent accepted by the population, the supply is infinite, useful in many areas and, through the necessary technology, creates many working places world-wide.

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The comparatively less intensive production of renewable energy against fossil fuel production means that large areas are required for the production of the former. Because of this, large technological production plants for biomass, hydro power, wind power, solar electricity or solar heating require considerable investment. Currently the limited number of such plants means that the individual cost is still too high. It must be underlined however that the costs for fossil fuel and nuclear energy do not include the social/financial costs for environment and health damage. If these were taken into account then the environmentally neutral renewable energy sources would be economically competitive. The energy politics of the federal government are aimed at the realisation of the solar era through financial support measures in the next decades.

Solar architecture

The required architectural lay out of a buildings determines to what extent the design allows solar energy can play a role. The passive utilisation of the sun's energy takes place via the radiation which penetrates buildings and warms the interior, but also from the radiation that warms outer walls, floors and inner walls. The active utilisation in the form of solar collectors is applicable for heating of living and working quarters and use of the heat for working systems, the simplest example being the warming of household water. Solar electricity (photovoltaic module) for the transformation of solar energy into electrical energy is more complicated and more expensive. Already presented has been an example of a building designed as a future-oriented cow house with full recognition of animal and energy demands [2].

Global solar radiation comprises direct rays that can be easily concentrated via a lens, and indirect rays. Concentrated collection systems are practical where there's a high proportion of direct radiation – such in southern regions – and because of this the collector or focal point has to be readjusted. In our northern European latitudes where the solar radiation is mainly more diffuse, it is preferable to use solar collectors or photovoltaic modules. South-facing surfaces for this purpose should have an angle of 30°. Movable systems are technically complicated and are therefore not worth the effort as a rule. The loss of radiation energy through the sun's movement across the sky is more economically compensated for by extending the solar panel area.

Through the planning of the building, its surfaces in relationship to volume, the seasonal sun position with consideration of shadows and wind shelters, solar architecture works-out the best possible position of a building towards the sun. According to required use, it also allows for optimum optimised insulation of wall and window surfaces.

Wind and water power

Wind and water power sources are traditionally those that have been used for hundreds of years by agriculture and forestry and their associated trades (mills). Nowadays, the favoured use for these sources is in electricity production. The long-term reliability of hydro power plants is impressive. Their degree of efficiency in the transformation from primary energy to useable energy is the highest of all. Individual windmills or wind parks have already developed into a new income source for farmers. Although, according to the German planning and construction statute book, research, development or use of wind or water energy (BGB §§ 35, § 1.7, since 1.1.1997) is permitted in the countryside, control of wind energy developments is localised at community level through regional planning permission programmes through identification of preferred sites – often with restrictive construction rules. Outwith such areas, wind energy plants or wind parks of any size are generally not permitted. Agricultural and forestry enterprises are permitted in outside areas as a matter of course. However, permission in planning areas outwith the sites with preferment for wind energy – for instance on farm steading sites – comes under the individual judgement of the building authorities. The height of the planning permission depends on the total height – that is the height of the tower plus the rotor blades. To what extent exemptions may be allowed for future renewable energy production plants remain, because of the different state building regulations, to be clarified. Helpful for small wind energy plants can be the antennae regulations that permit a height of up to 10 m.

Building approval for new hydro power plants are as a rule awarded according to the existing water rights. Approval and granting of hydro power plants in the increasing number of flora-fauna-habitat areas (FFH) certified by the state ministries of environ-

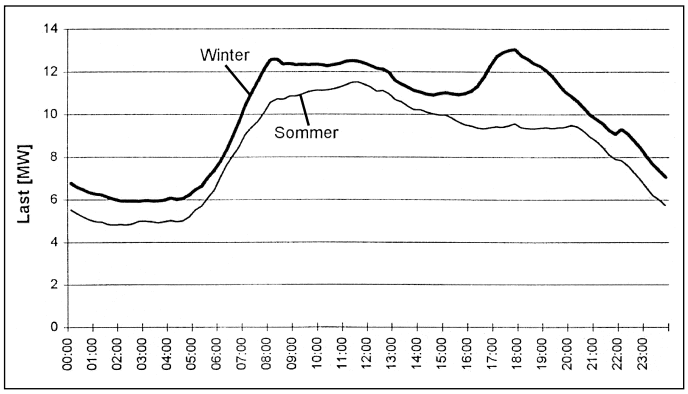

Fig.1: Typical load of 24 hours current supply from Monday to Friday in Eckernförde; Source: Energy Foundation Schleswig-Holstein, Kiel. 10/1997

ment make more difficult the utilisation of hydro power. Innovations in turbine technology could lead to technology that would more acceptable for gaining planning approval.

Biomass

Biomass is organic substances produce by plants and animals. The use of this in energy production is being codified in a currently developed biomass statute. This will regulate which fuels, technologies and environmental demands will apply for systems used in the production of electricity from biomass within the scope of the EEG law. There will be a wide field of action as far as agriculture and forestry are concerned. Energy crops, waste from agriculture and forestry, as well as horticulture, waste from timber processing and manufacturing and landscaping cuttings, biogas from anaerobic fermentation, gas from the gasifying of biomass – and ethanol or methanol will belong here too, as long as they have been created through the use of biomass.

Renewable energy law (EEG law)

The law for the precedence of renewable energy from March 29, 2000 [4] was passed by the German Lower House with the agreement of the Upper House with the aim, in the interests of climate and environmental protection, of encouraging a sustainable development of energy supply and to substantially increase the contribution of renewable energy in electricity production, in line with the targets of the European Union and the Federal Republic of Germany which are to at least double the proportion of renewable energy within total energy consumption by 2010.

Within the scope of this law, the acceptance and payment for electricity coming only from water, wind or solar power, from geothermic sources, from refuse heap gases, sewage gas, mine gas or from biomass will be regulated by electricity supply organisations responsible for the common power supply network. The network suppliers are duty bound to accept renewable energy production into their supply networks and to pay for it according to the law. Plants accepted as suppliers of electricity will, however, only be supported for a period of 20 years by the EEG law.

Reduction of environmental stress through optimisation of the production and use of electrical energy

With the exception of small energy storage units, electrical energy must be used at the same time as it is produced. What isn't used is lost and represents stress on the environment without any recompense. Ideally, electrical power should be available to all consumers at any time of the day but this could only be attained through overcapacity. This fact is only given limited attention currently in politics and the economy. This is an attitude that will change when the consumer is invoiced for the real costs of energy transformation. It is advisable that this subject should be given some preliminary attention in research institutes.

The encouragement of renewable energy through the EEG law comprises minimum payments per kWh supplied and not of higher prices for supply at peak periods. In a study on the possibility of cost-oriented electricity price creation, prepared by the research society for environment protection in energy transformation, Kiel [3] it was investigated whether, through additional information on actual electricity price at that moment of use from an instrument on the plug, there would be a reaction in the consumer behaviour creating an improved utilisation pattern for electrical energy from the mains network. A gauge sited on the plug and indicating the value of the electricity depicted nine price variations via red, yellow and green light diodes. *Figure 1* shows a typical utilisation of the power supply in Eckernförde from Wednesday to Friday outwith the experiment. Here, the consumer was willing to use equipment preferably in cheaper periods.

Electricity sold at peak periods is paid for at a higher rate by the network operator. This could represent a market niche for agricultural and forestry producers. However, the plant has to then supply a guaranteed amount of electrical energy to the public network during peak utilisation periods and this amount must be defined by contract. Encouraged here is the polyvalent combination of preferred renewable energy sources, also in combination with conventional fuels for the bridging of unavoidable periods of low supply. If no electrical energy storage is built into the system – these are generally expensive and require a high degree of servicing – then potential energy is the way that remains for supply of energy from agriculture and forestry. Such systems, which still have to be developed, could be based on the example of pump storage power stations. Outwith the contract-regulated peak periods with their substantially higher payments, the stored electrical energy would then paid for according to the EEG law minimum price. In that agriculture and forestry enterprises are decentrally distributed, they can also play a role in the stabilisation of the network current at the end of the electricity cables. This in itself is already an argument for the availability of electrical energy in peak periods outwith the main population centres and thus is the countryside.

Outlook

It is possible that agriculture and forestry can play a role in energy supply not only as individual enterprises but in their totality. Current economic models, developed in a time of power oversupply, have to be re-inspected because of this, as to whether they are still applicable for the coming 50 years. An ecologically-oriented agriculture with sustainable production methods through minimal energy use and supplying energy from renewable energy sources appears to be a variant suitable for the future. With this in mind there is a real case for every agricultural production unit adopting a system of optimal utilisation of renewable energy within the first decades of this century [1]

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