



It Works!

Bioenergy in Hesse



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The energy supply of the future will primarily be renewable. Considering global warming, the finite fossil fuel supply, the unforeseen dangers of nuclear power and our increasing dependence on imported fuels lead to a wide acceptance of this statement.

How and when this objective will be met is the topic of heated discussions. There is, however, consensus about the importance of saving and using energy more efficiently as well as increasing the development of renewable energy. This is not just about electricity, which in Hesse accounts for about a quarter of its combined energy requirements. All forms of energy like electricity, heating and gasoline must be considered.

To succeed in developing a more efficient renewable energy structure, Germany, as well as Hesse, must incorporate all suitable renewables into its energy-mix. Bioenergy will play an important long-term role in our energy future because it is renewable, versatile and to a large extent carbon neutral. It will be used increasingly during periods when other forms of renewable energy such as wind or solar power are not able to meet energy demands.

Nevertheless, bioenergy is not without controversy. Bioenergy production is not only based on organic waste, but also on energy crops grown on land that could be used for other purposes like feeding or food crops. There are also misgivings about the sustainability of crop cultivation overseas to be used as imported raw material. Increased transportation and inevitable processing plus occasional emissions from facilities are scrutinized. As any energy source, bioenergy must prove that its resources are being used efficiently.

In Hesse, bioenergy plays an important role in the regenerative power supply. The basis for Hesse's renewable energy production lies in its plentiful forests, abundant agricultural area and the improved usage of organic waste material. In the last few years, farmers have gained more importance as producers of sustainable raw materials and also as operators of their own bioenergy facilities. Recent research shows that at responsible extension rates only half of Hesse's bioenergy potential is presently being utilized.

Even if all of Hesse's remaining potential in agriculture and forestry was converted into bioenergy, there would still be ample wood available for use as building material or in

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furniture manufacturing, and the forest would not lose its ecological significance. Equally there would be sufficient agricultural area to grow food and animal feed.

This 45-minute DVD "It Works! – Bioenergy in Hesse" shows nine examples of how Hesse skillfully manages its prospects and utilizes bioenergy efficiently and extensively. The DVD also demonstrates the significance of bioenergy for all the parties involved as well as for the region. Our video introduces you to Hesse's diverse regions and the interesting and exemplary bioenergy projects that enhance the area and its overall energy efficiency. We hope they will inspire similar projects because climate protection and resource management will only work if we act.

The DVD was produced by the Bioenergy Initiative of Hesse in association with all institutions presently working in the field of bioenergy within Hesse. We would like to thank the director Michael Schlag, agricultural journalist, the Hesse Ministry of Environment, Energy, Agriculture and Consumer Protection as well as the Agency for Renewable Resources and the Viessmann group for their financial support. A special note of thanks goes out to all the producers of bioenergy whose projects are presented in this DVD.

Milk, Heat, Electricity Bioenergie Lempetal



The farmers Helmut Grandjot, Erhard Hofmeyer and Elmar Möcklinghoff from Hofgeismar (county Kassel) are among the pioneers to harness surplus heat from biogas-plants in Hesse. They have achieved a high standard of efficiency within their operations by networking their biogas facilities and establishing the company Bioenergie Lempetal (Bioenergie Lempetal).

When combustion engines are used to produce electric power from biogas, only half of the energy is transformed into electricity, the rest is expelled as heat. The electricity can be fed into the power grid without difficulty. However, utilizing the heat is more challenging. It requires a recipient in the immediate vicinity. Though some heat is used by the farmers themselves to heat the digesters and the homes and cowsheds, only a fraction of the heat can be utilized at the production-site.

Bioenergie Lempetal solved this problem by establishing a comprehensive system in the region. Two thirds of a mile away from the Möcklinghoff dairy farm is the Hofgeismar Lutheran Seniors Care Home. Their buildings are linked by underground heating pipes, which are connected to a central heating system. There is a high demand for heat energy the entire year, in part due to the therapeutic swimming pool.

At the end of 2009, Bioenergie Lempetal laid insulated pipes from the bioenergy facility to the Seniors Care Home, enabling them to connect the biogas heat to its central heating system. A second insulated pipe links the biogas facility of farmer Hofmeyer with the Möcklinghoff dairy farm. In this way, the hog farm utilizes its surplus heat too. With this concept, the bioenergy facilities are able to achieve a 90% efficiency rate from their biogas. Of course, they need energy themselves for crop cultivation, harvesting, transportation and facility operations. This accounts for 20% of the final energy produced.

Sustainable Forestry Hessen-Forst



The Hesse State Forest Enterprise (Hessen-Forst) with its headquarter in Kassel, manages a good 80% of all of Hesse's forests. This includes state forests as well as forests owned privately or by corporations.

The leading principle of the management of Hesse's forests is sustainability. In order to maintain diversity only a limited amount of wood may be harvested each year, but never more than the regrowth in that year. Sustainability can be compared to a savings account where you might want to withdraw the interest paid on your savings, but never touch the initial capital. As a result of such environmentally sound forest management, Hesse's available wood supply has steadily increased over the last decades.

Sustainable forest management rules out clear cutting. Only selected trees are harvested to ensure that the overall forest area may be preserved for future generations. The forest regenerates on its own. Seedlings take root and grow, allowing for a complex and diverse woodland. Sustainable forestry in Hesse not only includes natural forest rejuvenation, but also the development of mixed forests. Thus, conifer trees are occasionally planted in deciduous forests while broad-leafed trees are planted in conifer forests. As a result, Hesse's share of ecologically valuable mixed tree forests has increased over the years.

Still, none of these methods restricts the intensive utilization of the forest. Sustainable forest management produces wood for furniture and building needs, along with considerable amounts of firewood. Firewood is only harvested from the tops of trees and not from tree trunks. Beech wood is a favourite among people who collect their own wood from a patch of forest allocated to them by the local ranger. It is excellent firewood that is easily split and dried, and leaves little ash after burning.

Wood Fuel for Schools Forstbetrieb Holstein



The Holstein Forest Enterprise (Forstbetrieb Holstein), located in Bebra-Weiterode (county of Hersfeld-Rotenburg), clearly shows that bioenergy contributes to the regional economy and is able to create full time jobs. The company was founded by Frank Holstein, himself a forester, in 2005. The company removes forest residue, trims branches around electrical wires, keeps train tracks free of fallen trees or branches and clears wood from road construction.

Wood collected in this way can be a source of regional energy that is only being utilized recently. Today the Holstein Forest Enterprise, which employs eight full time staff members, offers a valuable service by recycling this bulky wood into fuel. At the centre of the company's operations is the portable wood chipper. It cuts every kind of wood into small wood chips. In this way, the volume is drastically reduced allowing for easy transportation as bulk cargo and trouble-free burning in automated combustion wood-fired boilers.

The wood chips are used in the large heating systems of schools, indoor swimming pools and biomass power stations. The business-model is "heat contracting": customers do not buy the wood chips but pay for the heat produced by burning them. Long-term supply contracts are agreed upon between the forest enterprise and the customer. The price is based on many factors including the current cost of heating oil. In 2010, energy from wood chips was sold for 5 US-cent per kWh (3.5 Euro-cent). Wood chips are an inexpensive source of fuel; its energy-costs are less than half compared to heating oil. Despite the higher start-up and operation costs, the use of wood chips in large heating systems is still good value. Moreover, they are energy-efficient; the energy used to harvest, transport and process the wood chips accounts for only 3% of total energy output.

Wood Fuel from Fields Viessmann Biomasse



Wood from the forests is limited. Wood fuel recycled from tree tops, especially from sustainably managed forests, cannot deliver the desired amount. One way to enlarge the resource of wood fuel is to grow wood as an agricultural product. Fast growing trees are grown on plantations and harvested every three years. Their wood is processed into wood chips. Large-scale cultivation of wood biomass on agricultural land is still in its infancy in Germany.

The Viessmann Group, a heating technology company located in Allendorf/Eder (county of Waldeck-Frankenberg), is the largest company in Hesse growing trees for fuel. Its subsidiary, Viessmann Biomass (Viessmann Biomasse), has been planting fast growing trees, mostly poplar, around its head office on about 500 acres of land for the last few years. The plantations are spread over eight different locations with transport distances of only a few miles. For small parcels of land to become economically viable, their boundaries had to be realigned. Yearly growth provides the company with about 4.5 tons per acre. That is the equivalent of over 500 gallons of heating oil for every acre per year. Half of the heat the company needs for its headquarters is obtained this way.

Poplar has proven best as an energy - tree in the area. In more limited amounts, Viessmann Biomass is cultivating willows. Test cultivation of Paulownia, a blue flowering tree native to China, and Igniscum, the Giant Knotweed, has been carried out as well. All these trees continue growing after being cut. This ensures the plantation's long-term use and maintains a balanced supply of wood fuel. Wood chips from these plantations are highly energy-efficient. Cultivation and processing takes less than 3% of the total energy output.

Fuel - Cold Pressed Bimbacher Ölmühle



Farming has been supplying itself with energy for centuries. Feed for draft horses or cows was obtained from arable land. This principle can work even in today's mechanized world, for example on farms which reduce their dependence on fossil energy by producing their own fuels.

The Bimbach Oil Mill (Bimbacher Ölmühle) in Großenlüder (county of Fulda) achieves this goal. Farmers Winfried Schlitzer, Dirk Döppner and Guido de Beisac operate a local oil press as a joint venture. The mill processes rapeseed from about 300 acres of land a year. The transportation distances between the fields, the mill and the customers are minimal. The fuel is produced and used locally.

Most diesel engines can run on rapeseed oil, but they require technical adaptations such as a change of gaskets or the installation of a fuel heater, because rapeseed oil becomes viscous when cold. The farmers run their combines and tractors on rapeseed grown on their own fields and processed into oil in their own presses. The oil mill is also contracted to produce rapeseed oil for a block heating station and delivers its oil to an agricultural contractor.

Rapeseed is planted in rotation with winter wheat and winter barley every three to four years on the same field. This maintains an environmentally-friendly crop rotation and protects plant health. Fuel is not the only product from the oil mill. By-products are oil used in animal feed and protein-rich rapeseed meal to replace imported soybean meal in hog feed. At last, cold pressed rapeseed oil and honey from the yellow rapeseed blossoms are specialties in the regional cuisine. The rape straw is chopped and becomes natural compost on the fields. Thus, the cultivation of rapeseed for energy serves the region's agricultural economy in many ways.

Natural Gas from Local Fields Biogas Homberg



The Biogas facility in Homberg/Efze (county of Schwalm-Eder) has managed to establish a remarkable agricultural energy project in a somewhat economically weak area of northeastern Hesse. It supplements earnings, adds economic value to the region, provides jobs and achieves outstanding energy use efficiency.

Despite the considerably high investment costs of over eight million Euros (11 million \$ US), it is still a regional project, owned half by the municipal energy supplier of the city of Kassel and half by both agricultural organizations and farmers in the Schwalm-Eder county. Regionally based savings banks and cooperative banks provided the financing.

The facility is capable of delivering electricity for 4,000 households and supplying 1,000 homes with heat.

Unlike standard biogas facilities, which convert their gas into electricity and heat on site, the biogas facility in Homberg transforms its raw gas into highly concentrated methane gas that is fed into the natural gas pipeline system. This process is technically sophisticated and with costs of two million Euros (about 3 m. \$ US) the biogas washer is the most expensive component in the methane facility. Feeding the gas directly into the natural gas grid decidedly improves energy efficiency. The heat generated by converting the gas into electricity directly on the production site could hardly be utilized because of the long distance to the next city. But when the gas is concentrated and fed into the national grid, anyone with a hook-up can purchase it. The Kassel municipal energy supplier uses it in its combined heat and power stations, in an indoor water park for example or in industrial companies, where the electricity as well as the heat is required.

Energy from Organic Waste Kompostierung Wetterau



Since the beginning of the 1990s, the Compost Plant in Niddatal-Ilbenstadt (county of Wetterau) has been handling green waste from private gardens and organic waste from the households' bio containers of around 300,000 residents in the county of Wetterau, north of Frankfurt. The compost facility was enlarged in 2007 to include a fermentation process. Since then, the Wetterau Composting Plant (Kompostierung Wetterau) produces more than four million kilowatt hours of electricity from biogas per year. This amount can meet the needs of 1,500 households. The county of Wetterau with its waste company is the majority shareholder alongside with regional agricultural organizations.

The facility's digester operates at a temperature of 131° F (55° C) so that the bio waste is sanitized in order to ensure that the produced compost will contain no pathogens and/or weed seeds that can germinate. The necessary heat for this thermophile fermentation is supplied by the block heating station, which converts the biogas into electricity. The system runs on its own energy. The quality of the compost derived from fermentation residues is even better than regular compost; its salinity is measurably lower. The salt is passed over to the liquid fertilizer, which is separated from the fermentation residue. Compost and liquid fertilizer supply about 1,200 acres of regional farmland with plant nutrition and humus. It is an economically self-financing process. Earnings from the energy project cover approximately all operation and fermentation costs, and the project has had no effect on waste disposal fees.

The energy gained in a composting plant adds an additional use to the exploitation of organic waste material; it leads to the ecologically efficient so-called cascade utilization. Incidentally, it demonstrates a recycling oddity, because it takes place in the reverse order. Energy gain, for example burning wood, is normally the last possible use of the resource. Here it is the other way round. After energy has been extracted, materials continue to be utilized as fertilizers and soil conditioners.

Saw Mill's Power Plant Holzenergie Odenwald



The Odenwald Wood Energy Company (Holzenergie Odenwald, HEO) in Grasellenbach (county of Bergstraße) is a merger of six sawmills from the area. Together they market their wood off-cuts and by-products. The company was founded in 2004 and its headquarters are located at the "Monnheimer" Saw Mill. Wood pellets are HEO's most important product making up 70% of its sales. HEO also delivers wood chips to schools and produces wood briquettes for wood stoves and fireplaces.

Easy to transport and store, wood pellets are a form of bioenergy that is usable in any private home. Not much different from heating oil, they are delivered to the customer by a tank wagon. Due to their high energy density, a homeowner will get along with one or two deliveries a year. Pellets are an inexpensive fuel. In 2010, their energy was 40% cheaper compared to heating oil.

Unlike split logs or wood chips, wood pellets are a highly processed energy product. They are a by-product of sawmilling and are made from sawdust and wood shavings. The drying and the pressing of the pellets are procedures that require an energy input. About 140 KWh of electricity is needed to press one ton of wood pellets. That amounts to about 3% of their energy content. The energy needed to dry damp wood shavings and saw dust is supplied by low-grade wood, which has almost no other use and doesn't qualify for pellet production. Besides, the boiler not only produces energy for drying, but also electricity. Drying sawdust could therefore be seen as an energy transfer from low-grade scrap wood into high-grade pellets.

In addition to deliveries in tank wagons, pellets are also offered in small quantities. They can be packed into sacks and sold to private homeowners who run a wood pellet stove. Pellets have beneficial burning properties and low emission levels because they are free of bark, very dry and energy dense.

Elephant Grass in Southern Hesse Miscanthus Gersprenztal



Werner Germann, a heating technician from Brensbach (county of Odenwald), became familiar with the cultivation of Miscanthus during a trip to Austria in 2006 and brought the idea back to southern Hesse. Miscanthus, also known as elephant grass or Chinese silver grass, should become the material to heat his company building, by growing it in the region. Mr. Germann found seven farmers willing to cultivate this new plant and together they established the Miscanthus Gersprenztal Company. Today, he manages the company along with farmer Timo Böck. The area under cultivation has increased to 100 acres. Miscanthus offers a new possibility to obtain energy from agricultural land and enlarge the source of raw materials for bioenergy.

From the view of crop production, Miscanthus is considered a low-input plant. Once planted as a permanent crop, the soil requires no further treatment and as a rule, no further pest control. With regards to energy use for cultivation, Miscanthus is good value. It dries on the fields over winter and because of its low moisture residue amounting to only 15%, it needs no additional drying after harvesting. In winter, Miscanthus transfers its nutrients from its leaves and stems into the roots and requires no additional fertilizer after the first year. Being harvested at the end of March, Miscanthus is one of the few crops remaining on the fields over winter. It offers wild animals a retreat from an otherwise bare landscape. Miscanthus is planted as a rhizome, this is the horizontal stem of the plant found underground, which sends out roots and shoots from its nodes. These rhizomes are either dug up or started in green houses and then planted in the spring.

While Miscanthus is easy to grow, it is difficult as a fuel. Based on its weight, one pound of Miscanthus has the same heat value as woodchips. However, Miscanthus is – like straw - of low density and it requires a lot more storage volume than wood. During burning, higher emissions and dust can be expected. Miscanthus therefore needs special boilers.

Additional Information

Additional information about the different facets of producing and using bioenergy can be found on the following websites.

(All websites are in German, some offer an English version, too.)

General Information

Biomassepotenzialstudie Hessen	www.biomasse-hessen.de
Energieland Hessen (HMUELV)	www.energieland.hessen.de
Fachagentur Nachwachsende Rohstoffe e.V.	www.fnr.de
Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit	www.erneuerbare-energien.de
Bundesverband Erneuerbare Energie e.V.	www.bee-ev.de
Deutsche Energieagentur	www.thema-energie.de
Bundesverband Bioenergie e.V.	www.bioenergie.de
Agentur für Erneuerbare Energien	www.unendlich-viel-energie.de

Biogas

Fachverband Biogas	www.biogas.org
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Wood Fuel

Hessen-Forst	www.hessen-forst.de
Deutscher Energieholz- und Pellet-Verband e.V. (DEPV)	www.depv.de

Fuel from Vegetable Oils

Union zur Förderung von Oel- und Proteinpflanzen e.V.	www.ufop.de
Verband der Deutschen Biokraftstoffindustrie e.V.	www.biokraftstoffverband.de
Bundesverband Dezentraler Ölmühlen	www.bdoel.de

The Bioenergy Initiative of Hesse



The Bioenergy Initiative of Hesse (Bioenergie Hessen) informs and provides professional advice free of charge about the use of bioenergy in agriculture and forestry.

www.bioenergie-portal.info

Institutes Participating in Bioenergie Hessen



The Witzenhhausen Institute focuses on facility planning, education programs, professional development and public relations in the areas of bioenergy.

www.witzenhausen-institut.de



The Hesse Agricultural Advisory Service (Landesbetrieb Landwirtschaft Hessen) is a competent contact for agricultural research, advisory services and education in all areas of bioenergy.

www.llh-hessen.de



The Hesse Renewable Energy Production Association (Erzeugergemeinschaft für Nachwachsende Rohstoffe) responds to questions about growing and marketing energy plants.

www.ezg-nawaro.de



The Machinery Ring of Hesse (Maschinenring Hessen) deals with technical questions involved in the production and use of renewable energy.

www.mr-hessen.de



The Hesse Resources Competence Center (Kompetenzzentrum Hessen-Rohstoffe) is a network that advises, informs and educates about growing raw material and bioenergy.

www.hero-hessen.de

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Bioenergy Lempetal // Hofgeismar

Viessmann Biomass // Allendorf

Biogas Homberg // Homberg (Efze)

Forest Enterprise Holstein // Bebra

Bimbach Oil Mill // Großsülde

Sustainable Forestry // Weilrod

Compost Plant Wetterau // Ilbenstadt

Elephant Grass Gersprenztal // Brensbach

Saw Mill's Power Plant // Grasellenbach



The state of Hesse intends to substantially increase the use of renewable energy.

The efforts will be largely focused on developing energy from biomass.

In the medium term, it has the largest potential among all renewables and it will play a leading role in future developments.

The film presents nine bioenergy projects in Germany's federal state of Hesse that are operating today and already contributing to Hesse's way to renewable energy production. The film is a production of the Bioenergy Initiative of Hesse.

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