

Mureck turns into a source of energy what elsewhere is a headache for the local wastewater treatment authority.

From the frying pan to the tank

A city trades in used oil for biofuel



The Styrian capital of Graz offers a good example of how neglected sources of energy can be used: used cooking oil from Graz is converted in Mureck to biodiesel and returns as environmentally friendly bio-fuel in the tanks of the city's buses.

Initially, most private households used to dispose of their used cooking oil by flushing it down the sink while used cooking oil in industry was transported to the Netherlands and Belgium as feed to be used in pig-farming. So the search was on to find an alternative together with the government of Styria and the local authorities. Thus from the very start the collection of used cooking oil was tied in with the need to carry out a lot of work to convince the public why it should support the scheme. Here, the message that the sewerage system would not take everything that could be poured into it was at the heart of the public interest.

As well as the public information campaign a special logistics system also had to be devised for households and restaurants. A specially developed container called 'Fetty' was set up for practical and clean household collections (see picture). It was jointly introduced by the participating local authorities and waste management associations. Companies and restaurants can make

use of special containers at fixed sites, which are emptied whenever required.

SEEG is the only company in the world since 1993 to have taken used cooking oil and turned it into fuel that meets the quality requirements of EN 14214. 0.85 litres of quality biodiesel can be obtained from one kilo of used cooking oil.

10% of the participating local authorities buy back the biodiesel, which they can use as fuel for public and local authority transport. The local authorities benefit from the difference in price between fossil diesel and biodiesel made from used cooking oil, and the cost-savings from not having to dispose of the used cooking oil. The municipality of Leibnitz is the local authority with the most enthusiastic collectors. Cost benefits of over EUR 9,000 a year have been obtain-

ed from a very high collection rate and use of the biodiesel in the authority's vehicle fleet.

The potential is limited by people's average consumption of cooking oil, which amounts to 3 kg per person and year. Collection yields depend heavily on the activities of the local waste management associations. In this connection Styria still has enormous room for improvement, for while the waste management association of Leibnitz is way ahead with almost 2 kg per person, 0.47 kg per person and year is still considered an above-average result in the other localities. Consequently, the actual potential for development in this field is very clear.

Valuable raw materials in place of environmental pollution

Supply volume of biodiesel (RME)

Customer group	2004	2005	2006
Farmers	326	342	402
Local authorities	188	202	438
Graz City Transport Corporation	1,728	1,967	2,346
Private transport companies	1,165	1,114	3,929
Export	1,660	1,958	1,624
Total volume in t	3,067	5,583	8,739

From the frying pan to the tank – benefits for local authorities:

	Net costs
Processing costs (disposal + processing)	EUR 500/t used cooking oil
Re-delivery	EUR 850/lit bio-diesel
Diesel forecourt price/lit	EUR 0.80
Biodiesel re-delivery/lit	EUR 0.59
Savings per litre	EUR 0.21
Savings/average filled tank (e.g. 70 lit)	ca. EUR 15.00

The logistics of collecting used cooking oil - utilisation and use



1 kilo of used cooking oil
produces 0.85 litres of biodiesel

Biodiesel potential in Austria:

Crop-growing limits

	Relative yield
Rapeseed oil: approx. 345,000 t/yr (about 345.000 ha)	
Four-year planting interval	100
Three-year planting interval	97
Shorter planting intervals should be ruled out due to crop-growing limits!	

Potential collection of used cooking oil

	Relative yield
Used cooking oil	approx. 41,000 t/yr
of which from private households	approx. 24,500 t/yr

Disposal areas

At the current time used cooking oil is disposed of in very wide areas. In addition to the local authorities in Styria, collection partners also carry out proper disposal in areas in the Tyrol, Salzburg, Upper Austria and Carinthia. Clearly, however, not every region can adopt the strategy of transesterifying used cooking oil in establishing a sustainable energy supply. For SEEG a catchment radius of 200 km is useful and necessary at the present time.

As well as the collecting local authorities themselves, prominent AME diesel oil customers are the Graz City Transport Corporation, major road hauliers, the operators of vehicles collecting used cooking oil and some biodiesel filling stations. In addition, SEEG also exports to Slovenia and Germany.

Used cooking oil and fat which is not properly collected and disposed of usually ends up in the sink. From there it pollutes and clogs up the sewerage system and wastewater treatment plants, thereby incurring high costs. A study carried out in 2000 shows that additional costs for treatment plant operators amounted to EUR 0.44 per litre of oil.

Aspects of sustainability

- Awareness-raising among the population – not everything should be flushed down the sink. Waste is a raw material.
- Local authorities deliver a troublesome waste material to SEEG and receive precious fuel in return, enabling the cyclical approach to be experienced as a business.
- Improperly disposed of used cooking oils often end up being flushed down the sink. Collections enable maintenance and cleaning costs of the sewerage system to be minimised.
- Wastewater treatment plants are subject to less pressure, important in view of the increasingly stringent regulations on discharges for local authorities.
- The separate collection of used cooking oils and fats and their processing in Styria safeguards jobs in collection and processing.
- The upgrading of an otherwise cost-generating waste material into a fuel enables added value to remain in the local region and reduces reliance on energy imports.
- As producer of a renewable fuel SEEG contributes actively to climate protection (CO₂ neutral).

In 1993 SEEG was the first company in the world to produce biodiesel from used cooking oil

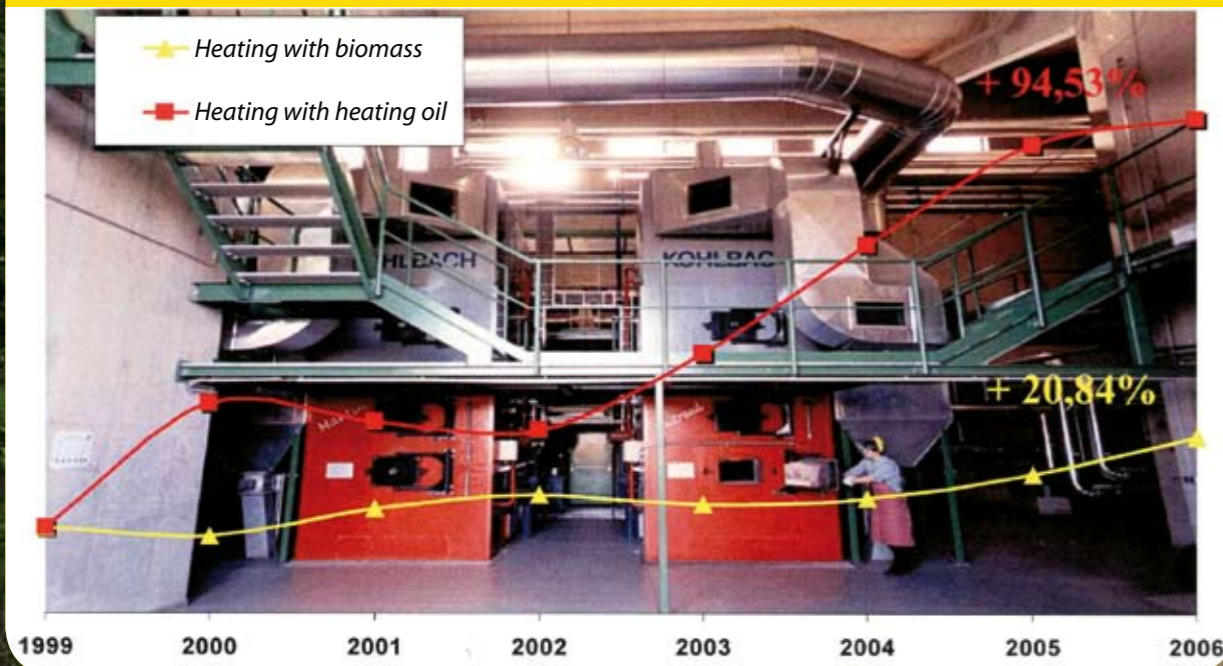
The desire to be independent from crude oil, the desire to keep added value in the region and the resolute determination to find a common and viable solution to the energy problem are the basis on which the activities of Nahwärme Mureck are founded.



From the forest to the living

Environmental relief through the reduction of dust emissions

Heating costs comparison from 1999 – 2006



Before the launch of Nahwärme Mureck, the district of Radkersburg was dependent on fossil energies to a horrifying extent: 55% of the heating systems ran on crude oil, 7% on coal and 12% on electricity. So the idea of having a local heating utility for Mureck – Nahwärme Mureck – was extremely attractive. For over three years, the town of Mureck, local residents and farmers looked intensively at the benefits of a local heating system before coming up with an overall concept. By integrating all of the parties involved and providing open and honest information the scheme was launched in 1998 with an immediate take-up of 50%, despite the additional 25% costs of conversion over a conventional oil-fired heating system. Today, local heating has achieved a take-up of just over 85%, which has brought great benefits to the citizens of Mureck.

In 2006 the annual heating costs for a detached house were EUR 750 less than one equipped with conventional oil heating (based on a heating oil price of EUR 0.65 per litre). Due to the sharp increases in the price of heating oil the vision of Nahwärme Mureck and the risks invol-

ved had paid off. The procurement of raw materials at Nahwärme Mureck meets the criteria of sustainable development in full. Approx. 40% of the wood chips are provided by 23 farmers of the cooperative from their woods, with the rest sourced from the region's sawmills.

In addition to securing a renewable source of energy for the town of Mureck, the reduction of emissions was a priority matter of concern right from the start. Despite the extra costs we voluntarily opted for hose filter technology as our preferred solution for cleaning flue gases. This enabled us to reduce dust emissions by a far greater extent than would have been the case with cheaper technologies. Dust emissions in particular have become a highly important issue in recent years and are a further justification for the decision which was taken.

The local energy guidance agency calculated the emissions for Nahwärme Mureck in 1997. It contrasted the emissions from the Nahwärme system with those it had replaced. The results in the table below have been extrapolated to a supply output of 7.5 MW.

Aspects of sustainability:

Growth in the size of Austria's wooded areas. The forest in particular performs central functions for everyone in terms of water management, recreation, protection and the living environment. Thanks to the energy cycle system, some 750 ha of forest in the region is managed on a sustainable basis. Simple switch to local, renewable energy without a lot of effort and expenditure and with added convenience for local residents now possible. More stability and direct control of local energy prices. Reduced exposure to turbulences on the international oil market. Clear cost savings for users due to the high oil price (EUR 750 per household and year in 2006). Reduction of local emissions (dust, soot, etc.). Cooperation and close interplay of local heating, local authority and the citizen forges deeply shared identity with the region. Added value for forestry companies and sawmills.

Pollutant emitted from combustion	Annual reduction of pollutants through Nahwärme Mureck (supplying 7.5 MW)
SO ₂	3,843 kg/yr
C _x H _y	1,813 kg/yr
CO ₂	4.714,583 kg/yr

Thinking differently is good for the environment and helps cut costs.

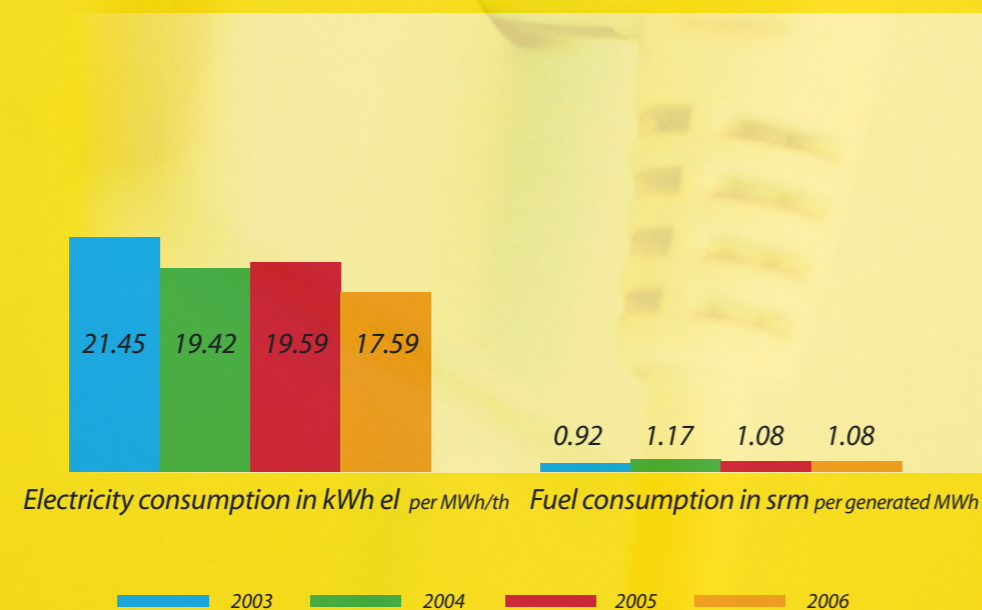
The biogas unit is a cornerstone of Mureck's drive towards self-sufficiency using renewable sources of energy, particularly eco-electricity.



From nature to the socket

Bio-gas provides multiple benefits for all involved

Local heating: comparison of electricity and fuel consumption 2003 – 2006



The idea of adding a biogas system to Bioenergie Mureck first arose in 2000. Liquid manure, maize and green forage harvested within a radius of 6 km are fermented in the biogas unit to produce biogas which in turn is converted into electricity and heating. The plant with an output of 999 kW can generate some 8,000 MWh of eco-electricity a year, which covers the annual consumption of about 7,700 people. Waste heat is fed straight into the local heating grid of Biowärme Mureck and the fermented biogas manure is a stand-alone farming fertiliser, enabling a further step to be taken in the region's drive towards greater self-sufficiency with regard to energy and materials.

The Mureck biogas system is quite unique in the whole of Austria. This is true of the way the system itself has been devised to include raw materials flexibility and of course the high degree of interlinkage between Nahwärme and SEEG. Biogas systems in particular tend to stir up a lot of opposition, so the aim right from the start was to inform and include local people in the decision-making process. Hence the choice of location was made jointly with the local residents. A further contribution to cementing good relations with local residents was the voluntary decision to build a biofilter. Emissions are to a certain extent inevitable especially when the raw materials are delivered and mixed. By extracting and cleaning the air in a biofilter it is now possible to deal with this problem. This raft of measures

has managed to win over the trust of local residents and citizens in the region. The fact is that good cooperation and open communications pay dividends. Thus work on the biogas unit was able to begin in May 2004 and the system was commissioned in February 2005.

Gaining greater acceptance:

A member of staff has been put in special charge of liquid manure deliveries. By liaising with local residents and restaurateurs the company is able to set delivery dates and times that cause minimum inconvenience. This, too, underpins the systematic measures Bioenergie Mureck has put into place to ensure greater quality of life in the region. As well as generating energy, the biogas system also provides considerable benefits to many other sectors of industry in the region. It upgrades the liquid manure to produce a more crop-friendly fertiliser and also improves crop rotation on a sustainable basis. Initial trials using Sudan grass have already taken place to enhance crop rotation still further. The spreading of the fermented biogas manure on the fields has now clearly reduced the former, highly unpleasant smell: again, this is a highly important matter for the local tourism industry, for local residents and restaurant-owners. The tourist trade and local residents benefit from the biogas system because tourism can continue to develop unimpaired. If in future the glycerine accrued from the production of biodiesel is fed into the biogas system, the gas yield of the remaining substances in the biogas unit

will increase by up to 25% and the addition of glycerine will also create a stand-alone fertiliser: farmers will no longer be forced to use mineral-based fertilisers. This is a further step to genuine cyclical farming.

Aspects of sustainability:

Independence of the region through generation of its own eco-electricity and local heating. The biogas system impacts positively on crop rotation. The fertiliser produced is more friendly to crops. Underground water and soils enjoy greater protection because the exchange of liquid manure prevents a further round of fertilisation. Glycerine is also fermented to produce a stand-alone fertiliser, making local farming independent and completely self-sufficient. Considerable reduction of unpleasant smells during the spreading of liquid manure improves the overall situation for tourism.



In terms of energy technology and logistics, the benefits derived from using the region's natural resources are immeasurable when compared with the global transfer of energy.



Visions & strategies

Upgrading the existing modules

Visions:

To make the region self-sufficient in sourcing all its energy requirements from the region. In other words, complete independence from the vagaries and confusion of the global market for oil and gas. Everything which grows in the region should be processed, refined and whenever possible used there in order to create and reinforce a regional ecological, social and economic cycle.

The project also aims to act as an exemplary model for the viable development of rural space and become a centre of excellence for bioenergy in South-Eastern Europe. The bioenergy celebrations enable us to establish a common basis.

Strategies:

A primary aim is to open up an international information, consultation and training centre for renewable energies and industrial raw materials pitched at primary, secondary and tertiary education as well as teacher-training programmes and visitors in and to the municipality of Mureck.

This is a comprehensive programme to supply information and make people aware of the planting and processing of raw products and of their use in regional cycles.

The 'international information centre' has to cover a wide spectrum of issues; in Mureck it intends to act as a pivotal force of change to accelerate the switch from fossil-based fuels to renewable sources of energy and to speed up the use of agricultural products as raw materials for industry.

1. Systematic further development of biofuel production:

Here, new scientific findings are intended to be integrated into practical applications through a series of pilot phases in Mureck. In addition to rapeseed oil and used cooking oil, a pilot project on the use of complete plants as a raw material for biofuel production is set to begin in 2008. In a few years this highly promising technology will then be used to produce biofuel for practical applications and enable three to four times the amount of liquid biofuel to be obtained per hectare compared to biodiesel derived from rapeseed oil.

2. Biogas as fuel:

As well as generating eco-electricity, the intention is also for biogas to be processed for use as a fuel in gas-driven vehicles and to be supplied at filling stations. To this end a network of biogas filling stations is to be set up in Styria. Regional vehicle dealers are currently being encouraged to switch from diesel and petrol-driven cars and vehicles to biomethane gas.

3. The electricity filling station – electricity as fuel:

The electricity filling station is a community project of Mureck residents. A photovoltaic system will be supplying electricity in future so that hybrid vehicles can fill up 'electricity' at the pumps.

4. The potential of the local heating system:

With its two 2 MW biomass heating boiler, min. 1 MW waste heat from eco-electricity generation and a 2 MW biogas peak load boiler the potential of the local heating system should be fully used in the winter months. This means that further new connections will have to be set up in Mureck and neighbouring areas also have to be supplied all year round with space heating. There are also plans to integrate drying processes for various products in the summer months, thereby enabling the 100% utilisation of waste heat during the hottest time of the year.

5. Use of cascades:

The idea behind using complete plants is to deploy biomass even more efficiently. Biomass is increasingly in demand as a primary source of energy and industrial raw material for a range of applications in the constructions materials and vehicles industries. New crops and forms of crop rotation are also being studied with a view to optimisation and the efficient production of raw materials.

6. Glycerine phase as a biogenic raw material in biogas production:

Glycerine is a by-product in the manufacture of biodiesel and should also be put to good use. The aim is to utilise the glycerine phase obtained in the region's biogas production plants. Glycerine has many benefits: as a precious source of energy in biogas production and when used with other substrates, it raises yields by up 25%. In addition, glycerine enhances the composition of biogas liquid manure to create a fully fledged fertiliser. Mineral-based fertilisers no longer have to be used. Consequently, this would also make local farming production extensively independent of imports. The feasibility study on glycerine additives (carried out by the division of agricultural engineering with the department of sustainable agricultural systems at Vienna's University of Natural Resources and Applied Life Sciences [Boku]) has produced positive results in terms of gas yields and fertiliser quality. An amendment must be made to current legal provisions (i.e. the downgrading of glycerine phase from materials group 3 to materials group 2) in

association with the authorities (Federal Ministry of Economics and Labour, Federal Ministry of Agriculture, Forestry and Water Management, and the Chamber of Agriculture) in order to permit the addition of the glycerine phase in biogas production plants without a markdown of the feed-in tariff.

7. Thermal cooling:

As well as commercial requirements for refrigerated systems (among butchers, for example) offices and private households are displaying an increased demand for cooling systems. Even though sustainable construction methods in the latter case should of course be a priority in meeting this demand, the fact remains that sales of electrical cooling appliances have shot up. So the intention is to offer a viable, sustainable alternative in the form of the local heating supply. Cooling will be supplied to commercial establishments (such as butchers) and offices (e.g. banks) as well as detached houses by means of the Nahwärme flow pipe (heated at 80-90°C). The aim is to replace electrically powered cooling appliances using a sustainable source of energy. Here, Nahwärme Mureck intends to focus its special attention on buildings which cannot meet the required degree of cooling through enhancements to the structure alone (as required by Austrian low-energy house standards). To this end further field research projects are required.