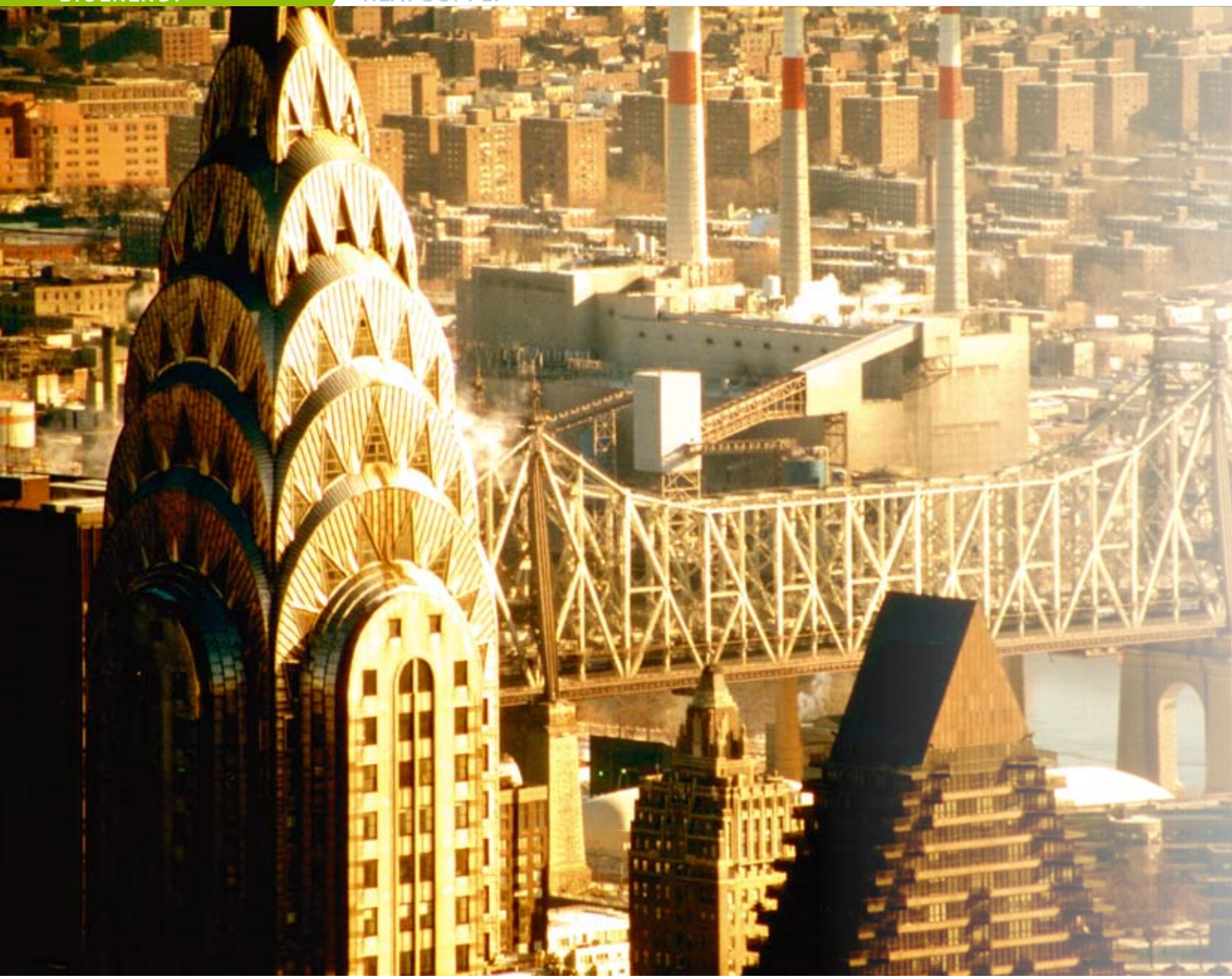

A view of New York City today. In 1882 a district heating network was installed using steam from power plants. Today, however, it is far from state of the art. Now small cities in particular are discovering district heat anew.

Photo: Rainer Sturm/pixelio.de

Renaissance of district heating in the US

District heating networks are not necessarily sustainable and environmentally friendly. In the US, Americans are now rediscovering such networks. In combination with biomass power plants they could become a part of the energy revolution Americans, with their wealth of forests, are striving for.

District heating networks bring different associations to mind. On the one hand, they are considered an energy-efficient way to supply defined residential areas with indoor heating and domestic hot water. Modern district heating systems enjoy a reputation for sustainable use of energy resources – a modern and environmentally friendly concept. In Europe, such heating systems are associated with the sight of gigantic heating pipes, usually in Eastern Europe, which slice through residential areas, are poorly insulated, and often leaking – a symbol of energy waste and obsolescence.

Underground pipes for a district heating system. In this case, the supply and return-flow pipes are individually insulated.

Photos (2): Bios Bioenergiesysteme GmbH

Another alternative is to run both pipes through an insulated tube.

The US, a pioneer in district heating

In general, these are also characteristics which the Europeans attribute to the energy supply in large American cities, if they speak of district heating networks at all in connection with the US. This attitude is not fair to the Americans. It is true that the first attempts at district heating networks were made in Europe 2,000 years ago under the Romans, and in the early modern era too, heat steamed through pipes into the houses of France's less fortunate. The true pioneers in the recent technological history, however, are the Americans. The first modern district heating network was created in 1853 at the US Naval Academy in Annapolis, Maryland. From there, district heating systems conquered the large cities – the first of which was Denver, Colorado, where the oldest continuously operated district heating network – in operation since 1880 – still serves 135 customers. New York got its start in 1882, initially installing a district heating network for lower Manhattan. Over the years, the New York city steam system has developed into the largest commercial district heating network in the world. The network boasts 2,000 customers in 100,000 commercial and private buildings, including laundry and restaurant chains, as well as indoor heating in public and private buildings. On the heels of the Big Apple, Boston installed a 40 km long district heating network in 1887. Shortly thereafter, Boston was followed by Cambridge and several dozen large cities on the east and west coasts of the United States. Another unique fact is that numerous universities have their own district heating networks.

Nevertheless, district heating in the United States in its current state is anything but future proof. Since the 1970s an increasing number of utility companies have lost interest in heating networks, investing less and less money in maintenance. "Some of these networks are energy wasting monstrosities," says Wulf Hohmann, a project engineer at Lahmeyer International, a German engineering company that counts energy systems among its specialties. As a result of the neglect, the district heating networks have lost customers.

That is set to change. District heating systems now enjoy political support in Washington. District heating is specifically mentioned in the multibillion-dollar programme that the Obama administration set into motion over the past year. Vice President Joe Biden referred to developing cogeneration plants and district heating systems in the same breath with renewable energy – yet another key project for Obama. District heating networks will not be able to make an impact in Obama's clean energy offensive, however, until their operators stop using fossil fuels and begin fuelling their heating plants with renewable energy sources – usually biomass.

An initial project in New Mexico

Because the discussion of heating networks is still relatively new, the number of projects concerned with linking biomass energy and district heating networks is highly limited. One of the first projects to be implemented since the rise of renewables is the biomass district heating plant in Santa Fe. In 2004 Austrian

company Bios Bioenergiesysteme GmbH concluded a comprehensive preplanning and feasibility study. It was concerned with four micro district heating networks in Santa Fe, the capital of New Mexico, population 65,000. The Austrian company worked together with a non-profit energy services organization called Local Energy. The US Department of Agriculture – comparable to Europe's agricultural ministries – provided support for the project within the framework of a biomass development initiative.

In this first phase, Bios studied possible concepts. For the project, Bios' engineers analyzed both a large centralized district heating plant for central Santa Fe, and an alternative plan using four micro networks. They collected data on heating requirements for the potential areas to be supplied, as well as the consumption behaviour of possible customers. At the same time, Bios generated a fuel study, in order to determine the requirements and the supply of biomass, which would ultimately be used to ensure the operation of the heating network. Feasibility studies rounded out the analysis.

The small American town Smethport is in the middle of the forest. In future, wood will serve as fuel for generating electricity and supplying heat through a district heating network. Photos (2): Smethport

"In phase 2 of the project, we decided for a biomass power plant on the campus of Santa Fe Community College with a nameplate boiler capacity of 1 MW," project engineer Klaus Supancic recalls. The decision, therefore, favoured the distributed solution with four micro networks. Bios then set to work on design planning, including fuel logistics; they concluded this phase in 2006 when construction offers were on the table. It was not until a year later, in 2007, that the plant actually went into operation. "Unfortunately, that is also where it ended," Supancic says. "For financial reasons, the other three micro-networks were not built. Additional heating pipes would have to have been built. That would have been expensive and no longer economically feasible."

Small town in the forest

The small town of Smethport, Pennsylvania, lays claim to having the first biomass-fired combined heat and power plant in the United States. The surrounding forests should offer adequate fuel. The fact that the first such power plant is located in a 1,700 resident community in the northern hills of Pennsylvania reveals the relatively low state of development of the biomass-for-district-heating-concept in the United States. "Smethport is considered a demonstration and pilot system," Lahmeyer engineer Hohmann confirms. The very fact that comparable projects are so rare makes the undertaking in Smethport all the more high profile. For instance, Pennsylvania State University is taking part in the project and in the town itself, "many people took part as volunteers," says Hohmann. The US Forest Service is also on board, as is the US Department of Agriculture.

It is no accident that Hohmann's firm was selected from a pool of 12 applicants. The US used to be a blank spot on the map for such endeavours. When it comes to renewable energy issues, European – and especially German expertise – is definitely sought after. To carry out a feasibility study for the Smethport project, a consortium was formed consisting of Lahmeyer, the American consultancy O'Brien & Gere, and two other German companies, district heating specialists GEF Ingenieur AG, and biomass specialists Seeger AG.

The district heating network is designed to supply 600 houses in the community via a new network of pipes. The community is reducing the cost for the network by combining the construction of the new pipe system with a renovation of the municipal water system.

Nevertheless, it still costs money. In an economic feasibility calculation Lahmeyer International put the investment at US$ 61 million. The two big pieces are the biomass power plant, at a cost of some US$ 23 million, and the district heating network at US$ 26 million. According to the analysis, specific heating costs will be 120 US$/MWh. Lahmeyer considers that "competitive with current heating costs," which are currently 100 US$/MWh. But this cost comparison, and thus the competitiveness of the biomass

district heating, depends on a number of factors. Hohmann lists these factors: the price for waste wood, the level potential feed in tariffs, support from market incentive programmes, capital costs, and finally the current price for gas or oil, which is currently used to power heating systems in Smethport. Fossil fuel prices are currently at very low levels in the United States. However, that will not necessarily be the case for the entire 20-year period under consideration for the project.

No alternative to a municipal biomass district heating network

Wood is the magic word spurring on development of new biomass district heating networks in the United States. Even Santa Fe, New Mexico, depends completely on private and commercial waste wood from gardens and sawmills – Europeans often like to associate this area with desert-like surroundings. That is only partially true, however; the surrounding mountains are up to 3,000 m high and densely forested. The Bios study revealed that within a 50 mile radius of the city – some 80 km – there was 1 1/2 times the amount of biomass needed to supply the large-scale 20 MW district heating plant under consideration.

One of the reasons for considering a biomass power plant in the project at all was to mitigate the risk of forest fires caused by amassed waste wood. That is one aspect that should interest other states as well – especially California. The Golden State loses hundreds of square kilometres of forest every year to uncontrolled wildfires which, among other things, are fuelled by the vast quantities of dry waste timber.

Americans discover their wealth of forests. The lack of alternatives to using a combination of commercial wood waste and deadwood, which elevates fire danger, in a biomass district heating cogeneration plant was also a decisive factor for the Grand Marais project in Minnesota. The location on Lake Superior is not connected to natural gas lines and heats its public buildings with propane and oil. Grand Marais now wants to replace this expensive and environmentally damaging energy approach with a district heating network, including a biomass cogeneration plant. Engineer Charles E. Hartley of LHB Corporation, which is heading up the project, comes to the conclusion in a feasibility study that, “There is a growing consensus that our carbon based economy has to evolve to renewables... wood-based district energy is the most practical and cost effective heating alternative for Grand Marais. We have studied and seen other wood based alternatives to combustion like gasification or pyrolysis oils that require dried biomass and extensive clean-up equipment. We do not believe that this technology will be ready for deployment in district heating applications anytime in the near future.”

Jörn Iken

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