

## Energy and regions

## Besançon (FR)

**In the past 25 years, Besançon has reduced its energy consumption by 40%.**

### General aspects

Besançon (122,000 inhabitants) is the capital of the Franche-Comté region and the urban centre of the Greater Conglomeration of Besançon (176,000 inhabitants in 59 communities). An industrial network of SMEs and public activities in the third sector constitute the economic base of Besançon, a city with a long tradition of clock-making. The largest areas of activity today are mechanical engineering, electrical engineering, and electronics.

The city is located in a remarkable natural site: its historic centre is embedded in a meander of the Doubs River, with a towering fortified Citadel built by Vauban (XVII) and surrounded by hills and a vast forest on its northwest front.



### CONTEXT

In the 1970s, the City of Besançon became active in local energy management policy, with the support of ADEME, in a series of campaigns in various areas: district heating networks connected to HVAC equipment, public buildings, biogas, the use of waste to generate energy, cogeneration, etc. In 1983, this policy was strengthened when an adjunct mayor was appointed specifically to handle environmental and energy management issues; and in 1984, a centre for "energy management" was opened.

In 1990, this commitment to energy management led the City - along with a small group of other cities throughout Europe - to create its first network for the exchange of best practices. This network later became Energie-Cités.

## THE EXPERIENCE OF BESANCON

### Energy management in public buildings and services

The City directs a number of services that consume energy (public lighting, cleaning services, waste disposal, etc.) and also owns many buildings (roughly 300, ranging from schools to swimming pools, including a vehicle fleet). Energy management is under the direction of the Department of Industrial and Commercial Services, technical services, and has 62 officers with the following missions:

- The programming, operation, maintenance, control, and optimization of technical facilities related to energy in the urban services (heating, electricity, public lighting),
- The interdepartmental promotion of campaigns for energy management,
- The management of energy expenses and management contracts.

## Energy management in municipal buildings

Energy consumption in city buildings fell by 40% from 1978 to 2003. These reductions are primarily due to the work done on thermal systems, the better insulation of the buildings, the renovation of heating systems, and the implementation of a central management system.

### Energy audits

In 1983, when an adjunct mayor was appointed to be in charge of the environment and energy management, a more ambitious policy was put into effect, particularly with the implementation of energy audits for all buildings. In 2001, a new audit was designed for buildings considered "major energy consumers": Central administrations; the municipal technical centre; the Citadel, which houses a number of services and museums (nine buildings built at the end of the 17th century); the Mallarmé swimming pool; and the La Fayette swimming pool and skating rink. A complete list of the possible improvements was set up for each site, with an indication in each case of the costs, the energy generated, and the return on the investment. This audit represents a crucial instrument in decisions about what work should be done. In 2003, another audit was conducted on 10 other buildings - schools, sports arenas, and cultural centres - to allow a hierarchy to be created for the measures under consideration in terms of energy savings, costs, and environmental impact.

### The conversion of heating systems to natural gas

In 1985, most oil-fired heaters were converted to natural gas, a cleaner source of fossil energy. In 2003, natural gas remained the main fuel for heaters in city buildings, making up more than 87% of energy consumption for this purpose. In 2001, a new analysis of the heaters in these buildings showed that many of the systems were aging (33% of them being older than 21 years). Work to replace some of this thermal equipment had to be done to ensure mid-term returns on investments in heating systems.

### Management via PCs

At the beginning of the 1980s, the software *Territoria* and proprietary City software was installed for the monitoring and control of energy consumption in each building. The systems are used to manage energy for heating, electricity in buildings, and public lighting. This tool allows us to:

- Set up a table listing the energy consumption and technical & financial ratios in each building in order to compare one building to another,
- Rapidly activate control systems and repair services in order to prevent fluctuations,
- And set up an annual energy balance sheet for heating and electricity.

Besançon is one of four pilot cities - the other three being Villeneuve d'Asc, Mantes la Jolie, and Rennes - to pursue and test regularly the development of the software so it can be continually adapted to energy management in the 156 French communities that use *Territoria*.

### The central management system (GTC)

GTC is a technology that allows for the remote maintenance and control of the operation of all of the City's heating equipment. At Besançon, there is one GTC Centre for the management of heating, electricity in buildings, and public lighting. The system is based on a structure consisting of measurement and guidance substations connected by telephone lines or a fibre-optic network to the central unit, which controls the operation of all of the heaters and modifies their programming (activating heaters, cutting power, programming, regulation, etc.).

Implemented between 1985 and 1988, the system has solved problems in the use of a major array of heating systems in a wide variety of applications (schools, gymnasiums, administrative buildings, cultural centres, social centres, etc.). It is also applied to all new equipment.

This technology improves the operation, programming, and regulation of heating systems. The slightest anomaly is quickly detected. The system can analyze and sometimes even directly regulate such anomalies, for instance remotely via a simple laptop. Staff continually take part in trading measures to ensure that they know how to use this tool.

### Switching to energy-saving lamps

All of the City's buildings are equipped with fluorescent lamps. Since 1997, technological progress has allowed us to increase the quality of light as well as reduce energy consumption by installing electric ballasts in fluorescent tubes. Since 2004, the new generation of fluorescent lamps has been installed; their stronger luminance allows for a smaller number of lamps to be used in certain equipment.

### **Programs to save energy in public lighting**

Since 1990, the City has been involved in programs lasting several years to replace mercury vapour lamps with high-pressure sodium lamps. More than 70% of the lamps have already been replaced. In addition, remote management has been expanded to cover the network of public lamps in a program lasting several years. In 2003, more than 70% of the network was remote-controlled, with the program scheduled to be completed in 2005. The main savings came from the reduction in maintenance costs due to the sustained initial performance of materials. At the same time, data on the costs and power consumption of the public lighting system have been recorded since 1990 using the *Territoria* software, which allows an annual balance sheet of consumption to be drawn up. In addition, in 2002 the *Maximo* database for the City of Besançon has been used for the management and cartography of the City's lighting network. Finally, contracts have been entered into with the French electricity provider EDF based on subscribed power; sound knowledge of consumption is thus a prerequisite in renegotiating rates. In 10 years, the modernization of the grid has allowed the number of control panels to be reduced by 60%.

### **Energy efficiency in vehicle fleets**

The City also manages and services a municipal fleet of all kinds of vehicles. Since 1990, the City has made the acquisition of low-emission vehicles running on electricity, natural gas, or LNG a priority. In compliance with the Clean Air Act of 1996, which calls for 20% of the vehicle fleet to be low-emission, the City Council of Besançon resolved in 1998 to have 80% of its vehicle fleet switched to low-emission vehicles and passed a budget for the next 10 years for this purpose.

In 1998, the City signed an agreement with ADEME and EDF to promote electric vehicles; in 2003, 33 such vehicles were purchased, and charging stations were installed in the main parking lots of Besançon.

In 2004, the building that houses the City's technical workshops installed some 350 m<sup>2</sup> of photovoltaics on the roof to ensure that as much clean electricity was produced as the electric vehicles consumed. In 2004, more than 50% of the City's vehicle fleet was clean.

### **Distributed power generation**

In 1995-96, the City worked with Energie-Cités in the European project APAS to come up with reliable figures on the potential of renewable energy within the metropolitan area. The report was updated in 2002 in a study that covered each type of renewable energy, evaluated the technological potential of each type, and proposed feasibility studies for the development of the six types of renewable energy studied on sites or equipment managed by the City. Renewable energy has not, however, yet been the focus of a global policy, but rather of a series of experiments that nonetheless provide a sound basis for more ambitious developments; the projects already undertaken include:

- 1980, solar heating for the swimming pool in the summer,
- 1992, a geothermal plant was installed that constantly pumps water from an aquifer in an underground parking garage to heat the City's administrative centre using a heat pump; the water that has been cooled off is then used to cool the nearby data centre,
- 1992, photovoltaic panels on the City's roadworks vehicles to power the signal lamps without having to leave the motors running.
- After launching the use of biogas at the wastewater purification plant starting with small cogeneration units in 1985, a 450 kW cogeneration units was installed in 1995. This large unit covers all of the heating needs and 30% of electricity demand at the wastewater purification plant, which serves 145,000 inhabitants.

Wood energy is used to a great extent throughout the region of Franche-Comté thanks to the policy ADEME has been pursuing for more than 15 years. The City of Besançon is also committed to using wood for energy purposes in its forest management, for example:

- In 1999, the City installed an automated wood-fired heating system (150 kW) to provide heat to a small group of houses in the forest of Chailluz as part of the national program launched by ADEME under the title "Wood energy and local development". At the same time, people can not only take walks in this forest and learn about the environment, but also witness this technology in action, which uses wood from the forest,
- In 2004, the City began construction of one of the largest wood-fired heating systems in France (see box).

## **A unique district heating system and one of the largest wood-fired heating systems in France**

Besançon's urban heating system and district piping network were set up back when the urban zone of Planoise was being developed just west of the City. This district heating system continues to be gradually further developed today as residential and commercial areas are improved.

### Urban heating

The thermal energy used in the district network comes from:

- (33%) waste heat from the incineration of waste at a plant near the heating system,
- (67%) a central heating system that burns heating oil, coal, and natural gas.

Since 1994, the heater has been modernized with the addition of a cogeneration gas turbine that produces 7.8 MW of thermal power and 4.5 MW of electricity. Cogeneration provides some 30% savings of primary, non-renewable energy: 2,500 tons of coal and 2,300 tons of heating oil have been replaced by natural gas.

In 2004, a wood-fired heating system with a rated output of 7.3 MW completely automated for hot water was constructed next to the heating system to replace the oil-fired generator. Put into operation in 2005, this new heating system will cover some 20% of the demand for heat in the City's heating system. In addition to the direct effects on the quality of air, the project itself was conceived according to High Environmental Quality standards, particularly in terms of the energy efficiency of some of the equipment, the selection of procedures and products, lower noise pollution, and ease of operation and low maintenance.

### The district heating system

Thermal energy from the central heating unit is transported by water at a maximum temperature of 180° in a network of insulated pipes 15 km long. This piped-heat network connects to heat exchangers in the HVAC rooms of buildings, where connections to all the other networks are made: water, wastewater, electricity, telephone lines, and cables. This technical set up is unique in France. In 2002, the district heating system met the demand for hot drinking water in the equivalent of 12,520 apartments: social apartments, offices, administrative buildings, schools, the regional hospital, a clinic, etc.

## **Water management**

The solutions implemented to reduce the loss of water in the pipes have improved the return on investments in the water supply, among other things by lowering the energy consumption of the equipment needed to purify the water, for example

- by running pumps when there is low demand for electricity, and hence lower rates,
- by cutting pumps off when power is expensive in winter: the water pumps are stopped (to the extent that this is possible) when rates are high,
- electricity contracts that are systematically reviewed along with EDF if one of the demands needs to be modified.

# EVALUATION and PERSPECTIVES

## Participation in the project Interreg IIIA "REVE Jura-Léman"

In taking account of sustainable development and implementing Agenda 21, the City of Besançon and the Greater Conglomeration of Besançon decided to take part in the project "REVE Jura-Léman" along with six other French communities (Echirolles, the Metropolitan Area of Grenoble, the Communities of Jura Dolois, the Communities of the Montbéliard Region, Evian-les-Bains, and Montmélian) as part of a community interest program called INTERREG IIIA France-Suisse 2000-2006 (sponsored by the European Union to encourage international cooperation.)

This project was coordinated by Energie-Cités and will be terminated at the end of 2004. It aims to mobilize local communities in the Jura and Léman regions to launch a true sustainable energy policy based on three campaigns:

- The implementation of the project, the certification project for the management of energy called the European Energy Award®/Cité de l'énergie®<sup>1</sup> in eight French communities. The City of Besançon began this process with a day of preparation for audits on 6/29/2004.
- The involvement of the eight French communities in the project and of the 14 "energy cities" in Switzerland as well as 59 partners of SuisseEnergie in the communities involved in the European campaign Display to improve energy use and lower emissions of CO2 in public municipal buildings. The objectives of the Display campaign obviously correspondent to the objectives of the City of Besançon in terms of raising the awareness of the public at large about energy management and CO2 emissions and to encourage city officials to monitor their consumption of energy.
- In each of the eight French communities involved in the project, an investment in the amount of 200,000 euros to implement several specific energy management measures.

## A local Agenda 21 in preparation

In May of 2003, the City of Besançon and the Greater Conglomeration of Besançon made sustainable development the only way of development in these areas by launching a coordinated definition of a local Agenda 21 along with the public and socio-economic factors for Besançon and by launching a Charter for the Environment for the Greater Conglomeration of Besançon.

## FOR MORE INFORMATION

### The City of Besançon

Rita CORONA

**DGST - Services industriels et commerciaux et environnement**

25 rue Mégevand

25034 Besançon

Tel: +33 (0)3 81 61 52 28

E-mail: [rita.corona@besancon.com](mailto:rita.corona@besancon.com)

Web site: [www.besancon.com](http://www.besancon.com)

This case study was completed by Energie-Cités with the participation of the City of Besançon.



<sup>1</sup> [www.energiecite.ch](http://www.energiecite.ch)