

# The rational use of energy and Alternatives sources

## PRESENTATION

*This information note is devoted to*

### DEMONSTRATION PROJECTS IN THE FIELD OF GEOTHERMAL ENERGY

*It follows a first edition published in July 1981 devoted to demonstration projects in the field of energy saving.*

*Current Community activities relating to demonstration projects concern also the areas of the exploitation of solar energy and the gasification/liquifaction of solid fuels.*

## 1. Demonstration projects on alternative energy sources - Geothermal energy

In June 1978 the Council of the European Communities adopted Regulation (EEC) N° 1302/78 on the granting of financial support for projects to exploit alternative energy sources, followed in April 1979 by Council Regulation (EEC) N° 729/79 on the implementation of the 1978 Regulation in the geothermal energy sector. These stipulate, inter alia, that:

— the Community may grant financial support for demonstration projects to exploit alternative energy sources in the Community which by their nature may serve as examples and which prior studies and research have shown to offer prospects of industrial and commercial viability.

For the purposes of the Regulation alternative energy sources means any potential source of energy, with the exception of nuclear energy and fossil fuels exploited by conventional means.

— All projects must relate to the exploitation of alternative energy sources by means of new techniques or technologies which might encourage the establishment of other installations of the same type. With regard to geothermal energy in particular the Regulations state that:

— Support shall be granted to projects for exploiting geothermal fluids for the purpose of heating domestic, industrial or other premises, generating electricity, or industrial or agricultural applications of heat.

Support may be granted for projects for the exploitation of geothermal energy covering:

- the exploratory stage, or
- the exploratory stage and the fluid-utilization stage.

The exploratory stage shall cover the sinking of boreholes with a view to commercial exploitation of the reservoir. The fluid-utilization stage shall cover the other work and investment required for commercial exploitation of the reservoir. The commercial-exploitation stage shall be defined for each specific project.

- Such support shall constitute only a minority share of the total financing of the project.

Support may not in general exceed 40% of the total cost of the project and must remain within the set ceiling. Half of the support shall be repaid if the deposit is commercially exploited.

The repayable part of the support shall be repaid over a maximum period of eight years, starting from the second year of commercial exploitation of the reservoir. Arrangements for repayment shall depend on the nature of the project and shall be laid down in the contracts to be concluded with the recipients.

- Every project submitted for consideration by individuals or undertakings in the Community further to a call for submission of projects published in the *Official Journal of the European Communities* shall be examined by the Commission on the basis of the following information to be supplied by the applicants:

- a detailed description of the project and the timetable for its execution;
- a description of the preliminary work and research;

- the importance of the project for reducing energy dependence and increasing diversification of supply;
- the financial situation and technical capabilities of those responsible for the project;
- the nature and extent of the technical and economic risks involved in the project;
- the cost of the project, its potential economic viability and the proposed arrangements for financing it;
- the extent to which the execution of the project may encourage the exploitation of other geothermal reservoirs in the Community;
- whether at an earlier stage of research and development the project has been given financial support by the Community or by Member States;
- details of any other financial support for the project to be provided by, or expected from, Member States or the Community;
- any other information which justifies the Community support requested;
- how it is proposed to publicize the results.

— The Commission shall decide whether to grant or refuse support for projects after consulting the Advisory Committee on the management of the projects concerned, composed of representatives of the Member States.

## 2. Projects selected

Following the first three calls for submission of projects in June 1978, December 1979 and December 1980 respectively the Commission granted support totalling approximately 24.5 million ECU to the 39 projects that it had selected. In all roughly 257.68 million ECU will be invested in those projects over the next few years. As soon as funds are available, support will also be granted to 20 or so projects selected following the third call for projects. The list below gives a brief description of the projects for which Commission has signed, or intends to sign, contracts, the title of the project and the contract number along with the name and address of the contractor, all broken down by type of application.

### Electricity generation: high-enthalpy reservoirs

Drilling of about ten wells in Quaternary volcanic formation north of Naples. Now that the first four wells have been drilled to 1500 m, long-term trials are to be run with a 3.5 MW mobile unit and an initial 10 MW unit is to be installed. It is hoped that the full project will generate several times that amount.	AGIP S.p.A. C.P. 4174 I-20100 MILAN
Drilling of three 2000 m production wells in sedimentary formations — flysch and limestone — in a volcanic complex north of Rome. Following long-term trials on a 1 MW pilot installation, a 3.5 MW double flash unit and a boric and potassium salts recovery unit are to be installed.	MOFETE I GE 01/79-I Drilling of two production wells MOFETE II GE 18/80-I Surface installations
Drilling of three 2000 m production wells in sedimentary formations — flysch and limestone — in a volcanic complex north of Rome. Following long-term trials on a 1 MW pilot installation, a 3.5 MW double flash unit and a boric and potassium salts recovery unit are to be installed.	ENEL 3, via G.B. Martini I-00198 ROME
Exploitation of a deep reservoir in metamorphic formations at between 3000 and 5000 m, since the main reservoir is beginning to run out. Following analysis of the results of a production measurement programme on an experimental unit linked to the first borehole, a 10 MW production unit drawing on production wells is to be installed.	CESANO I GE 03/79-I Drilling of two production wells CESANO II GE 63/81-I Surface installations
Exploitation of a limestone reservoir in a volcanic complex north of Rome. The project will entail sinking six wells and installing an 8 MW power plant drawing on four 2000 m production wells once tests on the fluid have been completed.	ENEL 3, via G.B. Martini I-00198 ROME
Exploitation of a reservoir in the metamorphic formations on the Island of Milos, to the south of Athens. Drilling of three or four 1000 m production wells and repair work on existing exploratory wells. Commissioning of a 3 to 10 MW power station.	LARDERELLO GE 04/79-I
Exploitation of a limestone reservoir in a volcanic complex north of Rome. The project will entail sinking six wells and installing an 8 MW power plant drawing on four 2000 m production wells once tests on the fluid have been completed.	ENEL 3, via G.B. Martini I-00198 ROME
Exploitation of a reservoir in the metamorphic formations on the Island of Milos, to the south of Athens. Drilling of three or four 1000 m production wells and repair work on existing exploratory wells. Commissioning of a 3 to 10 MW power station.	LATERA GE 29/80-I
Exploitation of a reservoir in the metamorphic formations on the Island of Milos, to the south of Athens. Drilling of three or four 1000 m production wells and repair work on existing exploratory wells. Commissioning of a 3 to 10 MW power station.	Public Power Corporation 30, rue Chalcocondyli H-102 ATHENS
Exploitation of a reservoir in the metamorphic formations on the Island of Milos, to the south of Athens. Drilling of three or four 1000 m production wells and repair work on existing exploratory wells. Commissioning of a 3 to 10 MW power station.	MILOS GE 31/81-H
Supplying heat to offices and dwellings in an urban district of Milan by means of a two-stage process using heat exchangers followed by heat pumps. The reservoir is situated at 2500 m and consists primarily of detrital and marly rocks. It will be tapped by a pair of wells.	AGIP and SNAM C.P. 4174 I-20100 MILAN
Drilling of a pair of geothermal boreholes in the sandy layers of the Upper Triassic (3500 m) in order to supply the district heating network which is already in operation in Aars (northern Denmark).	METANOPOLI GE 02/79-I
Drilling of a pair of geothermal boreholes in the sandy layers of the Upper Triassic (3500 m) in order to supply the district heating network which is already in operation in Aars (northern Denmark).	Dansk Olie and Naturgas Dr Tvaergade 30 DK-1302 COPENHAGEN
Drilling of a pair of geothermal boreholes in the sandy layers of the Upper Triassic (3500 m) in order to supply the district heating network which is already in operation in Aars (northern Denmark).	AARS GE 05/79-DK

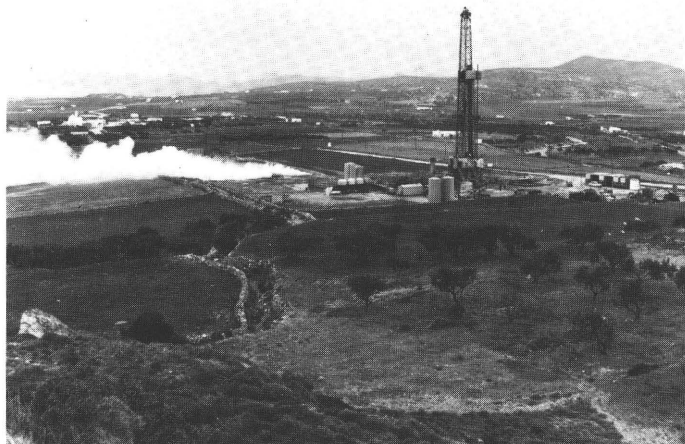
### Space heating

Supplying heat to offices and dwellings in an urban district of Milan by means of a two-stage process using heat exchangers followed by heat pumps. The reservoir is situated at 2500 m and consists primarily of detrital and marly rocks. It will be tapped by a pair of wells.	AGIP and SNAM C.P. 4174 I-20100 MILAN
Drilling of a pair of geothermal boreholes in the sandy layers of the Upper Triassic (3500 m) in order to supply the district heating network which is already in operation in Aars (northern Denmark).	METANOPOLI GE 02/79-I
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Drilling of a pair of geothermal boreholes in the sandy layers of the Upper Triassic (3500 m) in order to supply the district heating network which is already in operation in Aars (northern Denmark).	AARS GE 05/79-DK

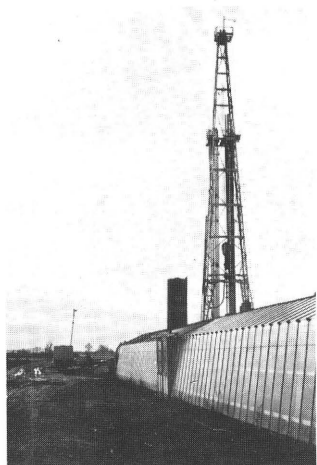
Heating several residential blocks to be built north of Rotterdam. A pair of wells will tap the geothermal reservoir formed by detrital deposits at around 3000 m. Seasonal storage in a shallow aquifer is also being contemplated.	T.N.O. Centrum voor Energievraagstukken Postbus 342 NL-7300 AH APELDOORN
Heating an estate of 3400 new dwellings to the north of Paris. A pair of wells will tap the Triassic sandstone at 1900 m or, if this fails, the Dogger limestone at 1500 m.	ROTTERDAM I GE 07/79-NL Production well ROTTERDAM II GE 22/80-NL Reinjection well
Heating an estate of 3400 new dwellings to the north of Paris. A pair of wells will tap the Triassic sandstone at 1900 m or, if this fails, the Dogger limestone at 1500 m.	Établissement public d'aménagement de la ville de Cergy-Puiseux BP 47 F-95012 CERGY CEDEX
Supplying the district heating network at Jonzac, a town to the north of Bordeaux. Heat pumps are to be used. A single well will tap the reservoir, which lies 1800 m down in the Triassic sandstone and dolomite.	CERGY GE 08/79-F
Supplying the district heating network at Jonzac, a town to the north of Bordeaux. Heat pumps are to be used. A single well will tap the reservoir, which lies 1800 m down in the Triassic sandstone and dolomite.	The municipality of Jonzac F-17500 JONZAC
Heating of 4200 existing dwellings in the outskirts of Strasbourg. A pair of wells is to exploit the Bunter sandstone 3000 m down in the Rhine graben.	JONZAC GE 10/79-F
Heating of 4200 existing dwellings in the outskirts of Strasbourg. A pair of wells is to exploit the Bunter sandstone 3000 m down in the Rhine graben.	SOCALMIG 14, place des Halles F-6700 STRASBOURG
Heating of 4200 existing dwellings in the outskirts of Strasbourg. A pair of wells is to exploit the Bunter sandstone 3000 m down in the Rhine graben.	STRASBOURG GE 11/79-F
Heating of 1500 new and existing dwellings and of public buildings by means of heat pumps. The Dogger limestone at around 1250 m is to be tapped by a pair of wells.	Oise office of public works and construction 1-3 Cours Scellier F-60006 BEAUVAIS
Heating of 1500 new and existing dwellings and of public buildings by means of heat pumps. The Dogger limestone at around 1250 m is to be tapped by a pair of wells.	BEAUVAIS GE 12/79-F
Heating of dwellings from two sites in the Freiburg region. At Bremgarten, the Dogger limestone at 1700 m is to be exploited once vibroseismic studies have been completed, while in Weingarten the Muschelkalk limestone at around 700 m will be tapped once three shallow exploratory wells have been drilled. Reinjection will depend on the salinity of the fluids.	GEWERKSCHAFT WALTER Am Handelshof 1 - Postfach 570 D-4300 ESSEN
Heating of dwellings from two sites in the Freiburg region. At Bremgarten, the Dogger limestone at 1700 m is to be exploited once vibroseismic studies have been completed, while in Weingarten the Muschelkalk limestone at around 700 m will be tapped once three shallow exploratory wells have been drilled. Reinjection will depend on the salinity of the fluids.	FREIBURG GE 13/79-D
Heating of 800 dwellings soon to be built. With cascading the geothermal energy can be used in heat exchangers, heat pumps, swimming pools and glasshouses. The reservoir rocks at between 1500 and 2000 m are to be tapped by a pair of wells.	Stadtwerke Viernheim Industriestrasse, 2 D-6806 VIERNHEIM
Heating of 800 dwellings soon to be built. With cascading the geothermal energy can be used in heat exchangers, heat pumps, swimming pools and glasshouses. The reservoir rocks at between 1500 and 2000 m are to be tapped by a pair of wells.	VIERNHEIM GE 14/80-D
Supplying a district heating network which is now under construction. The fluid is to be cascaded through heat exchangers and heat pumps. The Viséan karstic limestone at around 2000 m is to be tapped by a single well.	I.D.E.A. 74, rue de Pâturages, B-7300 QUAREGNON
Supplying a district heating network which is now under construction. The fluid is to be cascaded through heat exchangers and heat pumps. The Viséan karstic limestone at around 2000 m is to be tapped by a single well.	BORINAGE GE 15/80-B

**MILOS: GE 31/81-H: electricity generation**

Between 500 and 1100 m, the first production well struck a 300°C geothermal reservoir in fractured metamorphic rocks capped by impermeable volcanic formations. This well exhibited a temperature of 300°C and a pressure of 115 bars at 1100 m. Production tests on the steam/water mixture suggest that yield could be as high as 100 t/h at 260°C with 10% salinity. Provided the other two or three wells planned confirm these promising results, a 10 MW generator could be installed.



*Geothermal field of Milos*



*Production drilling at Melleray*

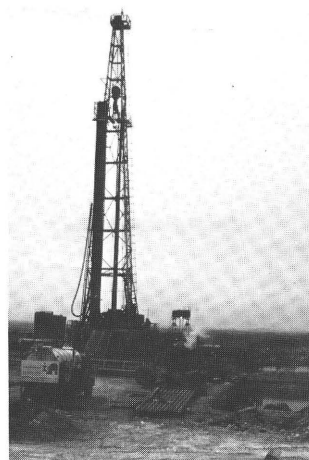
**c) MELLERAY: GE 09/79-F: heating glasshouses**

Drilling of both wells was completed in December 1980. A Triassic sandstone reservoir — 180 m thick — was struck at about 1450 m. The vertical production well can yield between 160 and 170 m<sup>3</sup>/h at 70°C and with 38 gr./litre salinity, while the directional reinjection well which is 1000 m away at the reservoir level, can handle a maximum of 90 m<sup>3</sup>/h at 64 bars and 45°C. Although the production flow rate is slightly lower than expected, this is compensated by the higher temperature. On the other hand the reinjection rate is much lower than the production rate and this limits exploitation of the geothermal loop. It is hoped that yield can be increased by stimulating the Triassic formation to accept reinjection. Geothermal energy would then supply 85% of the heat required by 16 hectares of glasshouses.

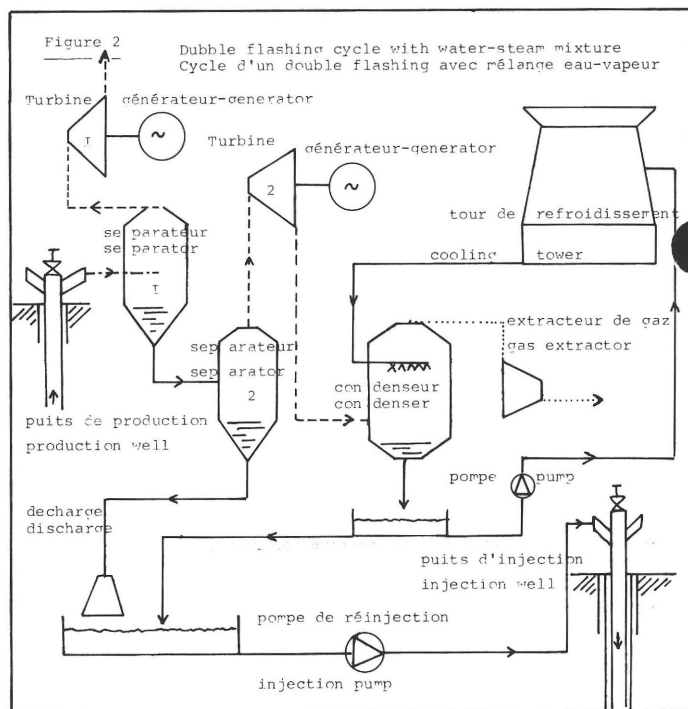
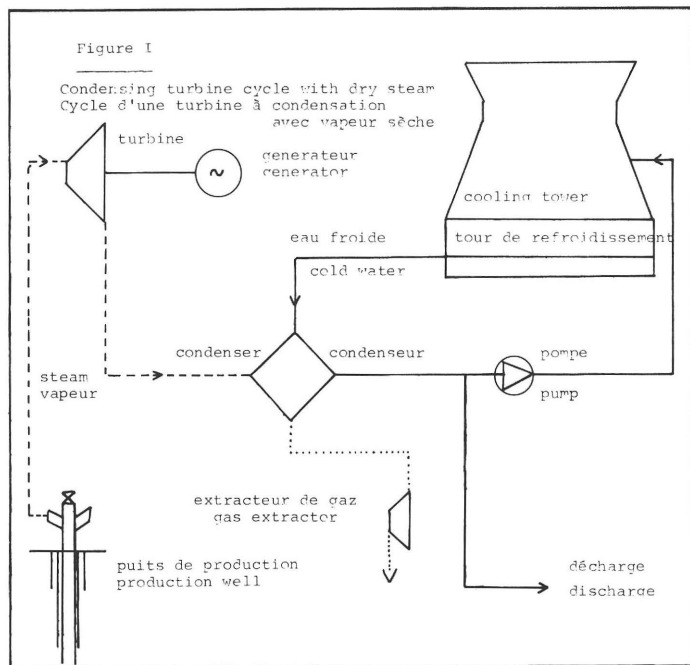
**d) CERGY: GE 08/79-F: heating new dwellings**

The two production and reinjection wells have now been finished. The production well (CGY1) traversed 31 m of Trias at 1900 m; an air-lift test produced a flow rate of only 45 m<sup>3</sup>/h at 69°C and 95 gr./litre salinity. The reinjection well (CGY2) struck 100 m of Dogger limestone at 1400 m. Air lift assistance here produced a yield of between 150 and 170 m<sup>3</sup>/h at 56°C and 14 gr./litre salinity. On the basis of this data, it was decided to abandon the Trias — the main target — and to exploit the Dogger rocks only. Directional drilling was resumed with CGY1 until the Dogger formation was struck between 1200 and 1400 m; air-lift produced 200 m<sup>3</sup>/h at 56°C at well head.

It is planned to start exploiting the geothermal loop in October 1981, the target flow-rate being 50 m<sup>3</sup>/h in the first year and 120 m<sup>3</sup>/h in the second; boosted to the maximum possible of 150 to 200 m<sup>3</sup>/h, depending on the prospects for reinjection (planned at 35°C). Ultimately the project could save 3000 toe a year. A provisional geothermal station is being built and will probably be finished in June 1981.



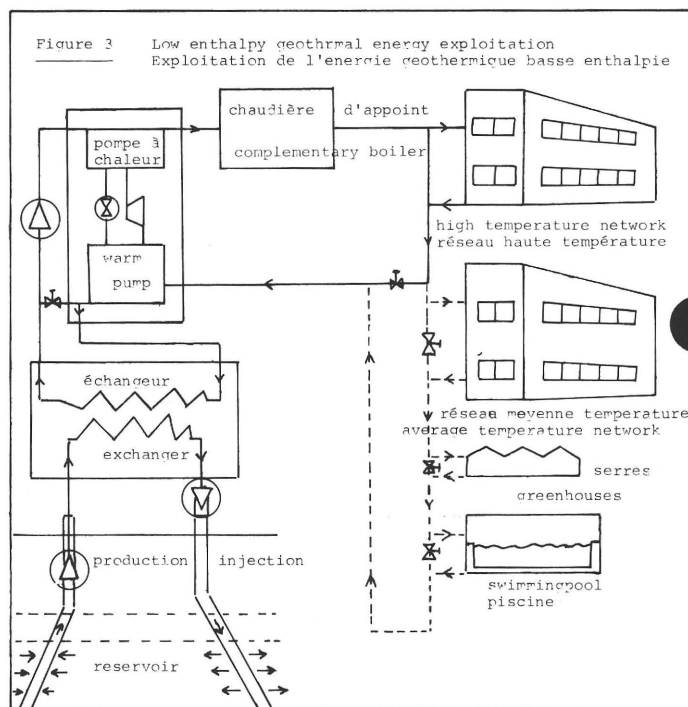
*Production drilling of Cergy*



sure steam from the first separator drives a back-pressure turbine, while the liquid passes on to a second separator which produces flash steam for a condensing turbine. The water discharged usually has to be reinjected, even after treatment or salt recovery. Pressurized hot brine or medium-enthalpy sources normally contain large quantities of salt likely to cause corrosion and scaling; experiments are now being carried out on binary fluid installations using an intermediate fluid with a low vaporization point, for instance one of the Freons or isobutane.

#### B. Low enthalpy (below 90°C) (Figure 3)

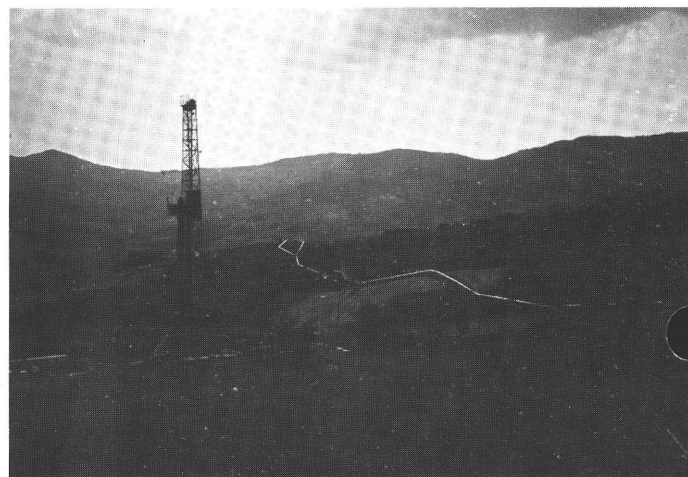
Hot water fields of this type are sometimes very large and are usually located in sedimentary beds with a more or less normal temperature gradient. They usually lie at a depth of between 1000 and 3500 m, and the fluid often has to be reinjected because of its salinity and of pressure losses in the reservoir. Since there is no means of transmitting the heat gathered from these reservoirs, they are normally tapped at sites close to the users. In most cases they supply heat for dwellings, glasshouses, industrial plant and certain industrial processes. Since drilling costs are high, optimum use must be made of the heat. Cascading is normally used to reduce the reinjection temperature to the minimum possible level. The use of heat pumps makes it possible to use fluids at relatively low temperatures or to resort to reuse of the residual heat should the high-temperature system give reinjection temperatures that are too high.



## 4. Progress reports on some of the selected projects

### a) CESANO: GE 03/79-I (two production wells) and GE 63/81-I (surface installations) - Electricity generation

The first well (C7) was drilled between December 1979 and April 1980. The geothermal reservoir (221°C) was struck at a depth of more than 2000 m in Lias limestone formations, with a flow rate of up to 500 t/h at 180°C and not more than 70,000 ppm salinity. The second borehole (C8) was drilled to a depth of 960 m in the Caldera Baccano between May and August 1980. Extensive gas reserves were discovered in the volcanic formations, together with a fluid with extremely high salinity (400,000 ppm), a temperature of 150°C and a pressure at the bottom of the borehole of 130 kg/cm<sup>2</sup>. Well-inspection requirements prevented any more extensive exploratory drilling, but flow rates between 50 and 90 m<sup>3</sup>/h at 116°C were achieved for short production tests. Although there is no conclusive evidence of an extensive, deep reservoir, results to date justify the installation of the first 8 MW double flash unit in Europe, to run on the output — predominantly water — from the two wells. The fluid will be reinjected via an unproductive well nearby.



Geothermal field in exploitation - Central Italy



Heating a complex of new and existing buildings. The reservoir formed by detrital deposits at around 1700 m will be tapped by a pair of wells. The fluid contains large quantities of dissolved CO <sub>2</sub> .	Société géothermique de Clermont-Ferrand F-63000 CLERMONT-FERRAND	Saulgau town hall Postfach 31 D-7968 SAULGAU
	CLERMONT-FERRAND GE 16/80-F	SAULGAU GE 67/81-D
Heating of a redeveloped urban neighbourhood including existing public buildings and dwellings currently under construction. A single well will tap the Cenomanian sandstone/limestone reservoir at around 1100 m.	Société Bordelaise mixte de réalisation urbaine 9, Terrasse du Front du Médoc F-33006 BORDEAUX	Southampton City Council Civic Centre UK-509 4WZ SOUTHAMPTON
	BORDEAUX-MERIADECK GE 17/80-F	SOUTHAMPTON GE 69/81-UK
Supplying a district heating scheme for 30 000 flats in Ferrara. The Jurassic dolomite reservoir at around 2000 m is to be tapped by ten production and six reinjection boreholes.	A.G.I.P. S.p.A. Piazzale Mattei I-00144 ROME	Dansk Olie Naturgas A/S Agern Alle 24-26 DK-2970 HØRSKOLN
	FERRARA GE 21/80-I	THISTED GE 78/81-DK
Supplying heat for a residential district north of Rome, comprising 2500 dwellings, some already standing, others yet to be built. Two production wells will draw from the limestone reservoir about 2200 m down in the Lias. If results are favourable, a 3-5 MW generator is to be installed.	ENEL 3, via G.B. Martini I-00198 ROME	
	ROMA-OLGIATA GE 23/80-I	
Supplying a district heating network for public buildings and dwellings, by means of both heat exchangers and heat pumps. A single well will tap the Triassic limestone and dolomite reservoir at a depth of about 2400 m.	AGIP S.p.A. Piazzale Enrico Mattei, 1 I-00144 ROME	Gewestelijke Ontwikkelings- maatschappij Desguinlei 12 - bus 13 B-2000 ANTWERPEN
	VICENZA GE 24/80-I	HOOGSTRATEN I GE 06/79-B Production well HOOGSTRATEN II GE 20/80-B Reinjection well
Heating for existing seminary and municipal buildings, and for a sports centre and glasshouses which are about to be built. A pair of wells will tap the Muschelkalk limestone at 1000 m and the Bunter sandstone at 1300 m.	Séminaires des Jeunes F-67630 WOERTH- WALBOURG	Association syndicale libre des propriétaires de Melleray 196, rue des Montaudins F-45560 SAINT-DENIS-EN- VAL
	WALBOURG - GE 26/80-F	MELLERAY GE 09/79-F
Supplying the existing Ravensburg district heating network. Heat pumps will be used to back up the heat exchangers. Either the sands at 1300 m, the Jurassic limestone at 1800 m or the dolomite at around 2500 m could be tapped. Reinjection will be necessary only if the dolomite reservoir is tapped.	Stadtwerke RAVENSBURG 25, Georgstrasse D-7980 RAVENSBURG	Compagnie d'Aménagement des coteaux de Gascogne Chemin de l'Alette - Route de Pau B.P. 215 F-65001 TARBES CEDEX
	RAVENSBURG GE 27/80-D	LAMAZERE GE 19/80-F
Heating of a group of 1200 dwellings, school buildings and glasshouses some already constructed, others yet to be built. The Lusitanian limestone at around 1600 m is to be tapped by a single well. If that fails, the Dogger limestone at 1800 m will be tapped by a pair of wells.	Compagnie générale de Chauffe and Elf Aquitaine 37, avenue du Maréchal de Latre de Tassigny F-59350 SAINT-ANDRE-LEZ-LILLE	Malteries Franco-Suisses et Grande Malterie du Berry F-36100 ISSOUDUN
	PROVINS - GE 28/80-F	ISSOUDUN GE 25/80-F
Heating a group of 1600 dwellings in the Bordeaux region by means of a series of parallel heating networks. A single well will tap the Cenomanian/Tungnian limestones at around 1000 m and the prospects for exploiting the Jurassic dolomites at around 1300 m will also be explored.	« La Gironde » Avenue de la Jallère Quartier du Lac F-33075 BORDEAUX	Société civile R.J. MARCHAL Route de Spada - MAIZEY F-55300 SAINT-MIHIEL
	PESSAC GE 46/81-F	MAIZEY GE 30/80-F
Heating a group of 4000 Council flats, school buildings, a hospital and a swimming pool. A pair of wells is to tap the Jurassic limestone at around 1800 m.	Avignon municipal authorities Place de l'Horloge F-84000 AVIGNON	
	AVIGNON GE 55/81-F	
Heating a complex comprising 1400 Council flats, one hospital, a water-sports stadium and municipal installations. The fluid might be treated for use in the industrial or domestic hot water supply. The Jurassic limestone at about 2000 m is to be tapped by a single well.	Béziers municipal authorities Place Emile Zola F-34505 BEZIERS	
	BEZIERS GE 62/81-F	
Heating a complex of flats connected to a district heating network in a Reims suburb. The Dogger limestone layer at about 1300 m is to be tapped by one or more pairs of wells.	Société d'équipement des Deux Marnes 5, rue Piper F-51100 REIMS	
	REIMS-MURIGNY GE 64/81-F	
Heating a residential area now being redeveloped, including a hospital and a schools complex. Heat pumps are to be used. Two production wells are to tap the Jurassic karstic limestone reservoir at 900 m. Following treatment the fluid could also be used as drinking water and for refilling the surface reservoir.		
Heating a civic centre which is now being built and which will include a shopping centre, offices, a leisure centre, hotel, swimming pool and a factory. Storage reservoirs are to be employed. A pair of wells will tap the Permo-Triassic sandstone reservoir at around 2000 m.		
Supplying the district heating network at Thisted. A pair of wells will draw from the Triassic sandstone formations between 1500 and 3200 m.		
<b>Heating for glasshouses and other applications</b>		
Supplying heat for approximately 40 glasshouse sites in northern Belgium. The Viséan karstic limestone reservoir at about 2000 m is to be tapped. Since the geothermal fluid is highly saline, a reinjection well will have to be drilled.		
Supplying heat for 1 hectare of glasshouses in the Orléans region. A pair of wells is to tap the Triassic sandstone formations at around 1800 m.		
Supplying heat for 15 hectares of new glasshouses. A tank will be provided for storage, salt recovery and gas removal. A single well will extract fluid from the inframollasic sandstone formations and the Palaeocene limestone at approximately 1500 m.		
Supplying heat for industrial barley drying, mainly for the pre-drying stage. The Triassic sandstone at 800 m will be tapped by a single borehole.		
Heating 10 hectares of glasshouses with storage installations. Triassic sandstones at about 1300 m are to be tapped by a pair of wells.		

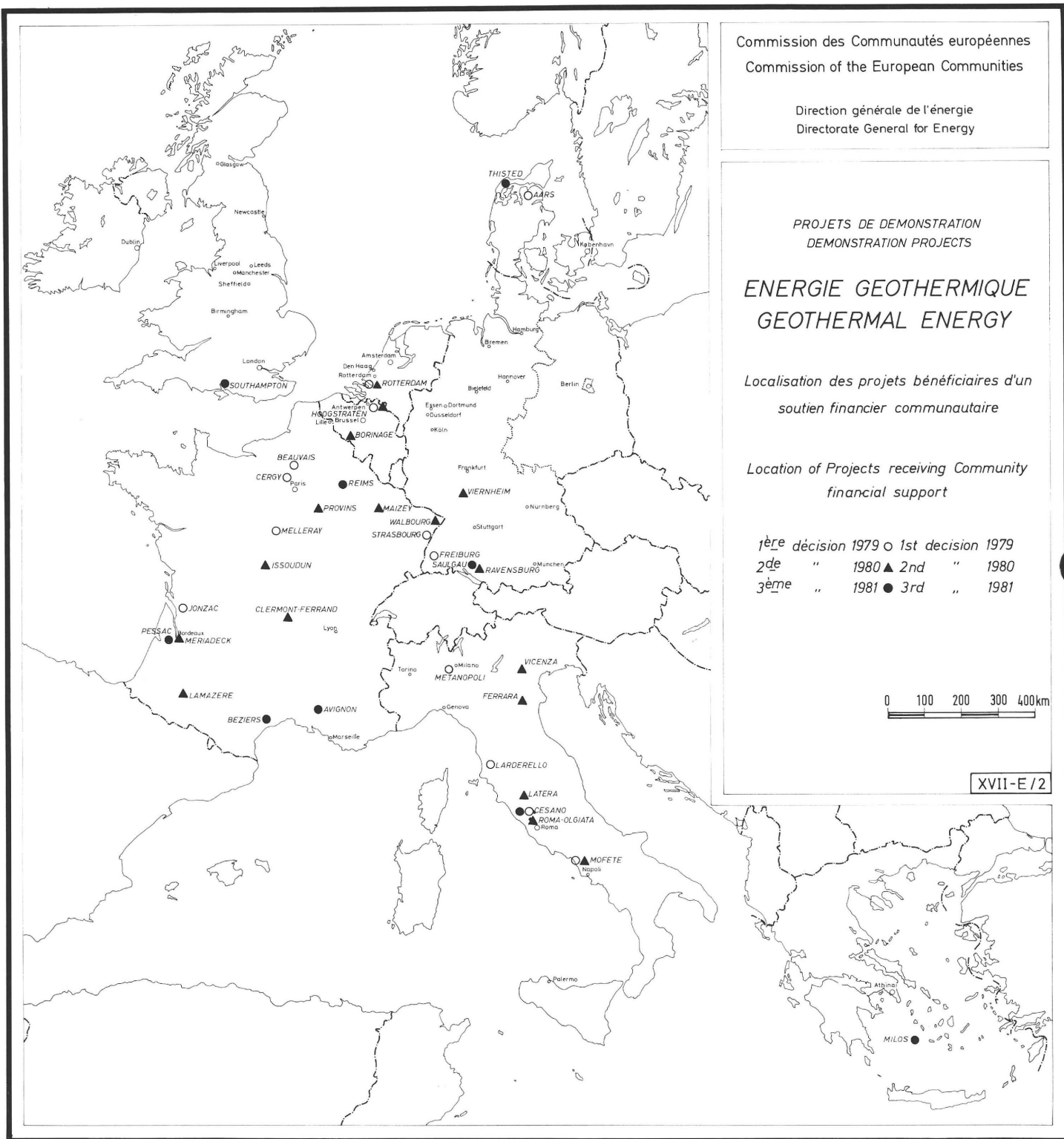
### 3. Exploitation of geothermal energy

#### A. High enthalpy and medium enthalpy; temperatures over 90°C

High-enthalpy reservoirs are found in permeable rocks where temperatures are far higher than the local temperature gradient would lead one to expect. They are rare and are often far from where the heat is required. Consequently, the energy has to be converted into electricity for transmission. The conversion process requires steam at sufficient pressure to drive a turbine. The form in which the geothermal fluid reaches the surface depends on the thermodynamic conditions in the reservoir and on the way in which the field is exploited, the three most common forms being dry steam, wet steam and hot water.

**Figure 1** shows the normal method of using dry steam, the steam flowing straight into a direct-intake condensing turbine.

Steam/water mixtures from geothermal boreholes are first passed through a separator, where steam is drawn off usually to drive a condensing turbine. Output can be increased by using the double flash process (see **Figure 2**). The high-pres-



Commission des Communautés européennes  
 Commission of the European Communities

Direction générale de l'énergie  
 Directorate General for Energy

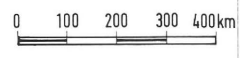
PROJETS DE DEMONSTRATION  
 DEMONSTRATION PROJECTS

**ENERGIE GEOTHERMIQUE  
 GEOTHERMAL ENERGY**

Localisation des projets bénéficiaires d'un  
 soutien financier communautaire

Location of Projects receiving Community  
 financial support

1<sup>ère</sup> décision 1979 ○ 1st decision 1979  
 2<sup>de</sup> " 1980 ▲ 2nd " 1980  
 3<sup>ème</sup> " 1981 ● 3rd " 1981



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