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ASSESSMENT REPORT

on the Community Demonstration Projects in the fields
of Energy Saving and Alternative Energy Sources

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ENERGY SAVING

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ANNEX IBUILDINGS1. Housing projectsEE/038/79 - E.C.L. Maison Phénix - Rhône Alpes (Grenoble) - F

Experimental fitting of 18 houses with air/air heat pumps with back-up gas heating.

The particular advantage of this project is that any additional heat required (e.g. when the outside temperature is too low for the heat pump to operate effectively) is provided by LPG, which can be stored, so that no gas is required from the public network which is already faced with excess demand.

Energy savings are estimated at 4 406 kWh a year.

The measurement programme should be completed in May 1982.

EE/049/79 - Electricity Board of Ireland (Dublin) - IRL

Standard building techniques designed to save energy in Ireland (5 houses).

The aim of the project is to build standard low-energy houses as part of the Irish building programme which strictly comply with local planning restrictions and building regulations, with a view to building large numbers of such houses in the future. Energy savings have been estimated at 22 toe a year.

Building should be completed in August 1982.

EE/068/79 - Stichting Bouwcentrum en Ratiobouw (Rotterdam) - NL

Energy saving in 17 single-family dwellings in Haarlem.

The solar collectors used in these low-energy houses were developed by an R&D project partly financed by the EEC. Some other features of the project, like the recovery of heat from the air extracted, were abandoned for reasons which will have to be explained in the next periodical report. Energy savings are estimated at 715 toe a year. The project is to be completed by the end of 1983.

EE/231/79 - Officine Termomeccaniche Breda - I

This is a new type of domestic heating boiler called the BLUEFLAM 91, rated at between 27 000 and 350 000 Kcal/hour. The appliance has a number of very

important features: high efficiency (always higher than 91% and sometimes as high as 93%) because of proper internal recycling of flue gases; compact modular design; low pollution.

The aim of the project was to install 700 such boilers with different capacities throughout Italy, which is subdivided into six climatic zones. The measurement programme lasted two years so as to allow of comparison between two different heating seasons.

The demonstration project was convincing and BLUEFLAM 91 was shown to be technically superior to similar appliances already on the market. Fuel savings were in the order of 10% compared with the average of similar appliances.

This appliance is now being marketed, although there are a number of difficulties, principally because of the crisis in the building sector.

EE/290/79 - Novelerg (Paris) - F

Low-energy housing meeting the cost criteria of cheap rented accommodation (H.L.M.) (SOLPAC project) (12 houses).

The main aim of this project is to demonstrate the benefits of bioclimatic architecture and the storage of free heat. Differences of opinion with the H.L.M. offices have caused a series of delays and resulted in one of the two proposed sites being abandoned, cutting the number of houses from 24 to 12, (the Commission's share of the expenditure has been cut accordingly).

Energy savings are now estimated at 60 toe a year. Work is in progress.

EE/323/79 - Skive Kommune - DK

Energy saving in 53 houses and flats at Skive (53 housing units).

This project combines a number of the different insulation and heating techniques (solar collectors, heat pumps) known about in 1979 on one single site. A very intensive measurement programme should make it possible to assess the individual advantages of these techniques. The programme is to be completed in January 1983 and has already shown that the insulation measurements were as effective as expected. Energy savings are estimated at 387 897 kWh a year.

EE/213/80 - European Heatpump Consultors (Charlottenlund) - DK

A block of flats heated by a heat pump driven by a gas-fired diesel engine. This contract has still to be negotiated as the contractor is having trouble finding partners.

EE/250/80 - Stephen George & Partners (University of Leeds) (Leeds) - UK

Space heating using solar walls of the Trombe type (five houses).

Demonstration showing how the heat from the sun can be collected using a Trombe wall and a circulation and storage system in all the walls of the building.

Energy saving is estimated at 1 toe. The project should be completed in 1986.

EE/290/80 - South London Consortium (London) - UK

Low-energy housing: renovating three houses and converting them into 15 flats and building 20 new houses. Demonstration project in two parts:

- (i) the rational renovation of three Victorian houses so that they can be used as 15 low-energy flats;
- (ii) the building of 20 new houses using bio-climatic techniques and solar collectors.

Energy savings are estimated at 185 000 kWh a year for the 35 dwellings.

Work on the flats should be finished by mid-1982 and work on the new houses should begin shortly.

EE/111/81 - Centre de Recherche ELF (Saint-Symphorien d'Ozon) - F

Statistical and comparative experiments on 15 houses fitted with solar roofs and underground heat storage facilities. Heating by heat pump - with no back-up heating system - connected up to two heat sources: a solar roof and an underground storage system into which heat is fed from the solar collectors when not required to heat the house. Energy savings are estimated at 21 toe. The contract has just been signed and should run for two and a half years.

EE/213/81 - Cement Roadstone Holdings Ltd (Clondalkin) - IRL

Building and assessment of a low-cost low-energy house.

The aim of the project is to show that it is possible in Ireland to build low-

energy houses the additional costs of which are rapidly repaid by the savings made. The houses have high thermal inertia, good insulation, warm air heating backed up by solar collectors and a heat storage system. Savings are estimated at 330 toe a year. The project should be completed in 1984.

2. Projects in the tertiary sector

EE/215/79 - NV Nederlandse Gasunie (Groningen) - NL

Energy saving in respect of the artificial lighting of offices. Improving the design of lighting systems and their control systems. The project was completed in December 1981; its main features are described below.

Five different artificial lighting systems were fitted to five floors of an existing office block. A user reaction survey was then carried out, and the electricity consumption of each system was measured for one year and compared with that of one floor fitted with the old lighting system.

The five new lighting systems have the following features:

- (i) they use more efficient 26 mm fluorescent tubes, instead of the old 38 mm diameter tubes
- (ii) there is either overall lighting, or individual desk lamps with overall low-intensity background lighting
- (iii) the intensity of the overall lighting is adjusted in accordance with the intensity of the external illumination. There are separate controls for the inner and outer arrays and there may be either an on/off switch or a dimmer switch.

One of the systems also switches lights off after the occupants have left.

The aim is to save at least 100 MWh of the energy used each year for lighting the building under the old system, which represents an energy saving of some 50%. (Additional investment costs are amortized in three years for a new building and nine years for an existing building). The various systems tested saved between 63 and 84% of the electricity used for the old lighting system. The annual saving was 132 MWh for the whole building averaged over the five systems tested, so the 100 MWh target for annual energy saving was reached and improved upon. Total savings are calculated at 73%. The two systems which save the most energy are the individual desk lamp with background lighting and a system with lights suspended over desks.

The automatic systems for controlling lighting in accordance with external illumination proved difficult to perfect. There does not seem to be sufficient technological expertise on the market at the moment.

The user survey showed that:

- (i) occupants do not take to automatic systems for controlling lighting in accordance with external illumination;
- (ii) the most popular new lighting systems were actually those which produced the greatest energy savings;
- (iii) occupants may be satisfied with lighting conditions which, according to the theories, are considered to be bad (as regards uniformity of lighting, reflection on the working surface).

EE/238/79 - Borough of Darlington (Darlington) - UK

Energy saving by recovering heat and treating the water at the Darlington Sports Centre.

Use of different methods to reduce energy consumption (ozone treatment of swimming-pool water) and the recovery of energy (passing stale air through exchangers and dehumidifying the air using heat pumps). Energy savings are estimated at 2.7 GWh per year. The technical equipment is still being installed.

EE/281/79 - Solar 77 - AGIP SpA. Jacorossi SpA - I

This project is to install and test a new type of static emulsifier.

The chief advantage of emulsion is that it improves combustion, which in turn reduces the emissions of fluegases and the fouling of boilers and improves the average seasonal efficiency.

The advantages of the new type of static emulsifier are its simplicity of construction, reduced bulk and low cost and above all the fact that it can be fitted to existing burners with only slight modifications.

The measurement programme lasted two years. Emulsifiers were fitted to 50 existing boilers chosen because of:

- (i) the wide range of fuel consumption (between 20 and 4 000 kg/h);
- (ii) the wide range of uses (24 domestic heating boilers, 11 industrial heating plants, 7 hotel heating plants, 5 hospital heating plants, 2 sports centre heating plants and 1 school heating plant);

- (iii) the wide range of climatic regions;
- (iv) the wide range of fuels used: gasoil, liquid heating fuel (3-5°E), heavy heating oil (15-20°E and 20-30°E);
- (v) the wide range of types and makes of boilers.

The results were extremely convincing. Energy savings were in the region of 3.5% (in order to take account of the fouling of boilers when no emulsion is used, we have assumed a reduced efficiency of 6% for domestic boilers and 3% for industrial boilers). The emulsifier was found to be extremely reliable and easy to fit to existing systems. There was also a considerable reduction of flue gas emissions, which is a considerable environmental advantage. The standard maintenance operations were also much reduced.

All in all, the demonstration project can be considered totally conclusive, particularly as the use of emulsified fuel in boilers is rapidly becoming more widespread; the SOLAR 77 system makes it possible to use a small static appliance which can be rapidly fitted to an existing installation for very little cost. Even though the amount of fuel saved in a single installation is small, the number of existing installations which could be converted makes the system extremely attractive. Moreover, even disregarding the major additional advantages already mentioned, it should not be overlooked that emulsification makes it possible to cut the price of the fuel used and maintain the same operating conditions. At the same time, this will widen the range of uses for those oil-derived fuels for which there is least demand.

EE/079/80 - Department of Health and Social Security (London) - UK

Designing and building a low-energy hospital. Combination of a number of energy-saving measures in a new hospital (CHP, heat recovery, automatic control systems, heat pumps, heat storage, etc.). Savings are estimated at 900 toe a year. This is a long-term project and should be completed by 1990.

EE/131/80 - T.R. Freeman (Cambridge) - UK

Telephone monitoring of energy consumption in Essex schools.

The installation in 20 schools of control systems designed to optimize the operation of heating appliances and linked to a central remote control station by telephone. Energy saving is estimated in the order of 560 toe a year although the savings should be considered as indirect. The measurement programme should be completed in July 1982.

EE/201/80 - Emporio Ricambi Industriali (Udine) - I

Combined production of heat and power, solar collectors and heat recovery linked to a seasonal heat storage system in a commercial building.

The use of a number of different techniques in one office block: combined heat and power production, heat pumps connected to refrigeration plant, incineration and heat storage.

Energy saving should be in the region of 60 toe per year. The project is still under construction and is expected to be completed in March 1983.

HEAT PUMPSEE/035/79 - Kreis Warendorf - D

Gas-engine-powered heat pump for space heating with heat extraction from the soil. Heat output = 1 150 kW, heat exchange area in the ground = 9 000 m², energy saving $\hat{=}$ 50% as compared with a conventional installation.

The installation is in service; the project is progressing satisfactorily. It is based on research and development contract no EED 181-77. New projects have been launched (such as Everswinkel, and the hotel in Bad Reichenhall).

The soil is an extremely attractive heat source since it requires no maintenance. The gas engine and screw-type compressor are not from the Community, but henceforth the components will nevertheless be available throughout it. The energy targets will probably be achieved, while the anticipated investment expenditure has been exceeded. Payback problems are foreseeable. Annual energy savings : 133 toe.

EE/047/79 - MAN - Neue Technologie - D

Heat pumps powered by internal combustion engines (screw-type compressor) for space heating and domestic hot water production using heat extracted from the air. Heat output : 200 kW, compact sealed layout to optimize damping of noise and vibration.

The installation is being modified and will soon resume service. The technical aim has been achieved but so far the economic target has not, since the specific investment cost of the industrial installation has more than doubled compared with the forecasts (1 200 DM/kW heat output).

The sealed layout enables vibration and noise problems to be eliminated. The manufacturer's production structure yields major advantages in operating safety.

IC-engined heat pumps having low heat outputs are too expensive compared with other conventional, rational techniques but they may, nevertheless enable large quantities of energy to be saved for space heating purposes. Projects of this type are now the front runners for national subsidies in the Federal Republic of Germany. Annual energy saving : 64 toe.

EE/178/79 - Nieuwe Weerdjes - NL

Gas-engine-powered heat pump with a heat output of 550 kW intended for the economical production of heat for space heating and the production of domestic hot water (66 flats). The heat source is groundwater.

Groundwater is a very attractive heat source for heat pumps. However, certain important factors concerning water use have to be taken into account before groundwater can be used for heat pumps. For this reason and also for cost reasons, one large installation is preferable to a number of small ones.

As a general rule authorizations to use groundwater are subject to the reinjection of the cold water. The installation is not yet in service. One must therefore wait to see whether the technical and economic targets will be met. There are comparable installations in the Federal Republic and in other Community countries but they use electric heat pumps.

Annual energy saving : 87 toe.

EE/193/79 - Beghin-Say - F

Use of waste heat from industrial process (steam). The technique for producing clean steam by condensing dirty steam and recompressing it in a water-ring compressor is demonstrated by means of a paper industry process. Possibly effective at an (electric motor) output of 135 kW : roughly 1 350 kW in the form of steam.

Steam recompression is not a heatpump process in the conventional sense of the term. The principle is however similar.

This technique is in its infancy, but it seems to offer highly attractive energy-saving prospects in the industrial field and enables the recovered heat to be supplied at temperatures of more than 100°C. This project may be considered exemplary from the point of view of profitability and technology. As the project progressed the operating conditions proved to be better than originally forecast (maximum of 3 tonnes of steam per hour as against 2 tonnes). The payback period for the investment is thus reduced from 3.6 to 1.5 years despite the fact that actual investments are higher than forecast, in particular because the price of energy increased meanwhile.

Annual average energy saving : 800 toe.

EE/301/79 - Etablissements Bonnet - F

Electric heat pump used to recover heat from a communal dishwasher.

Temperature range : 30-60°C. Acquisition of additional experience to improve existing installations. Heat output of the heat pump = 31 kW.

The project is progressing as planned. The installation is in service and is apparently giving satisfaction. The project may serve as a model for industrial heat recovery via heat pumps with direct recycling of the heat recovered.

The industrial waste heat is discharged in large quantities at a low temperature. The scope for internal use of this heat is limited because of the mismatch between the lost heat and the heat requirements. The project shows that analysis of the thermal processes by specialists offers interesting utilization potential for heat pumps under marginal economic conditions. Annual energy savings : 15,5 toe.

EE/D15/80 - Nuffield College - UK

Replacement of a heatpump installation dating from the late fifties to heat the college by recovering heat from waste water from the city of Oxford. Installation fitted with two gas engines, one to drive the heat-pump compressor and the other to generate the electricity used to drive the circulation pumps and provide background electric heating. Heat output is 140 kW; the heat lost by the two engines is used to heat the hot water leaving the condenser. The installation is currently at the project and ordering stage.

The layout of this installation, which uses two gas engines in parallel apparently has the advantage of cutting electricity costs as compared with supplies from the public grid.

However, the use of surplus production in resistive background heating is not rational. The project will yield a return as energy costs are rising slightly. However, the results will not be absolutely representative since the existing heat recovery installation does not involve heavy expenditure.

Energy saving : 33 toe.

EE/043/80 - Spach & Fils - F

Replacement of oil to heat a hotel by using electric pumps recovering heat from surface waters. The electricity is generated by an existing hydro-electric facility. The heat output of the heat pump is 105 kW.

The project is progressing according to plan. The installation has been in service since the end of 1980. The target has more or less been met. As in other projects, difficulties have been caused less by the new techniques than by ancillary problems (fouling, modifications, corrosion). The installation is economically sound.

Annual energy saving : 41 toe.

EE/176/80 - Balcke-Dürr (Borsig) - D

Development of an advanced heatpump system using a compressor and an ammonia/water solution as the working fluid. For a given heatuse temperature this system enables the performance coefficient to be increased by a factor of 1.7 or, at an equal performance coefficient, enable the condensation temperature to be raised beyond 90°C. The heatpump compressor can be powered by either gas or electricity.

This concept embodies a known principle. A very recent patent furnishes proof of the practical feasibility of the theoretical principle. The various components of the set are at the design and ordering stage. If the operating capacity of this concept were demonstrated, we would have a new generation of heat pumps. Not a demonstration project, but a research and development project. Annual energy saving : 160 toe.

EE/205/80 - Energietechnik - D

Replacement of oil for space heating by using an electric heat pump with absorption exchangers ("energy wall" for a multi-family house). The installation entered service on time, encountered no problems, and is giving satisfaction. The heat pump is operated alternately with another system. It provides 60-70% of the annual heating energy. The use of this heat-pump system raises economic problems since the installation for extracting heat from the outside air is relatively costly compared with other installations for extracting heat from the heat source (these problems are independent of the energy needed to drive the heat pump).

The technical aim has been achieved perfectly. The economic target has not been met. A positive factor has been the suppression of ventilation blower noise. This has fired the imagination of several manufacturers.

Annual energy saving :

- multi-family house : 8.6 toe
- single-family house : 1.3 toe.

EE/210/80 - Iona Cathedral - UK

Use of seawater (Gulf Stream) as a heat source in an electric heatpump installation for space heating and the production of domestic hot water.

Heat output : 310 kW. The project is behind schedule. Installation will take place during the summer of 1982. The provisional economic calculations confirm that electric heat pumps are economically sound under current price conditions. The replacement of oil is the basic aim, as in the other projects.

Annual energy saving : 32 toe.

EE/011/81 - Fichtel & Sachs - D

Heat pump driven by an internal combustion engine for space heating and the production of domestic hot water with extraction of heat from the air. Heat output : 20 kW, single-cylinder 4-stroke low-horsepower engine. Acquisition of operating and installation experience. Energy saving 50%.

Installation fully developed technically. The programme covering the production and operation of 40 units is progressing normally (several installations are already in service). To date, the noise problem has not been fully resolved. Significant prior research has been subsidized by the Federal Ministry for Research and Technology and by the Commission.

In practice marginal problems often play a decisive role and it is for this reason that the programme to improve operation and installation know-how is highly desirable. It shows how seriously the programme has been taken.

In actual service small heat pumps powered by internal combustion engines raise particular problems such as noise and pollutant emissions (diesel-engine-powered heat pumps) which have still not been completely resolved. The choice of a 20 kW heat pump is a good one. A serious contender in the electric heat-pump stakes owing to the acquisition of experience and costs which are attractive for commercial installations.

Annual energy saving : 124 toe (40 houses).

EE/146/81 - International Research and Development - UK

Heat pump driven by an internal combustion engine to recover heat from an exothermal process in the chemical industry. Condensation temperature sufficient to generate steam (600 kg/h). Heat output : 358 kW.

The heat pumps used in the sector referred to offer multiple prospects for use in industry if the payback period does not exceed three years. Since the project is still in its infancy it will be possible to assess it better only when we have some reproducible figures. In point of fact extensive research work subsidized by the Commission has already been carried out.

Annual energy saving : 69 toe.

DISTRICT HEATING, POWER STATIONS AND COMBINED HEAT AND POWER PRODUCTION1. District heatingEE/028/79 - AGAC Reggio Emilia - I

This plant is equipped with both diesel- and gas-powered motors along with compression and absorption heat pumps for space heating and air conditioning. The construction work has been completed, and the plant was opened on 3 April 1981. Test measurements are now being made. The initial technical results have been highly encouraging. The urban site has not created any special problems. Studies are now being made for similar projects elsewhere. Plants such as this will encourage further construction of new district-heating systems. An energy saving of 40%, or of 1 375 toe per year, as compared with conventional installations, has been achieved.

EE/120/79 - CEA - F

District heating from the Thernox nuclear reactor (Phase 1)

The preliminary plan for a district-heating system in Grenoble was abandoned in June 1981 for economic reasons specific to the Grenoble site. A new plan is now being drafted for the Saclay plateau, where the economic conditions seem more promising. However, no decision has yet been taken on the ultimate construction of the reactor, which will generate heat equivalent to 53 000 toe per year.

EE/121/79 - Svendborg Kommune - DK

Straw incinerator to supply a district-heating network.

Some 15000 tonnes of straw harvested in the Svendborg region are to be burned to generate 9 MW for the town's district-heating system during the cold season and thereby save 4 600 toe per year. Although the incinerator entered into service on 14 November 1980, it is not yet in full operation due to technical problems. The test measurement programme will not be run until they have been solved. Despite the difficulties - which are bound to be overcome - the project has lost none of its appeal. Similar plants have already been built - or are planned - elsewhere. This type of installation holds considerable potential.

EE/174/79 - Burmeister & Wain A/S - DK

Large-scale heat pump for district heating

A large-scale diesel-driven heat pump drawing heat from the municipal water-treatment works has been generating 11.5 MW_{th} for the Frederikshavn district-heating system. At the same time it generates electricity for the system's auxiliary equipment. Once the initial problems had been overcome, the installations were made over to the customer; they entered into operation in November 1981. Test measurements are now being made. The performance of the system has proved highly satisfactory, with energy savings of 56%, or 4 400 toe per year in comparison with conventional plant. Similar installations are now under construction.

EE/217/79 - Stadtwerke Saarbrücken AG and Fernwärme-Verbund Saar GmbH - D

Recovery of process waste heat for the Saarbrücken district-heating system (Part 1 of the "Saarschiene" project).

This project entails laying a regional pipeline to carry heat along the Saar valley between Völklingen and Saarbrücken. The process waste heat can be recovered from various industrial sources for the Saarbrücken district-heating system. The detailed preliminary plan has been completed, building permission has been obtained and the major equipment orders have been placed. At the moment the project consists solely of a demonstration programme to develop means of piping the heat over longer distances. Each year 11 500 toe of heat will be carried.

EE/330/79 - Azienda Servizi Municipalizzati - I

Remote-control of regulating valves for consumers connected up to a district-heating system.

This project aims at saving approximately 85 toe a year by selective reduction of the heat supply to a number of consumers connected to the Brescia district-heating system during peak demand periods. This method is similar to the electricity companies' method of regulating interruptible supplies. However, this is the first time that such a selective load-reduction system has been incorporated in a district-heating system. The main problem is to persuade the customers to tolerate certain limits to their service. However, the first public buildings have now been connected up to the remote-control system.

EE/003/80 - Comune di Modena - Azienda Municipalizzata Igiene Urbana - I

Raising steam and generating electricity by incinerating urban waste and sewage sludge.

The purpose of this project is to reuse the heat released during the incineration of domestic refuse from Modena to generate heat and power for a neighbouring industrial estate with a pass-out turbine. This will save 400 toe per year. The detailed preliminary plan has just been completed. One novel feature of this project is that a local authority has seized the initiative to supply an industrial estate with heat from the municipal incinerator.

EE/066/80 - Société Nationale ELF AQUITAINE and Commissariat à l'Energie Atomique - F

Underground storage of heat for a district-heating system in a confined aquifer.

The seasonal heat accumulator will be connected between the domestic waste incinerator at Thiverval-Grignon (Department of Yvelines) and the district-heating network in the Plaisir area. The heat will be stored approximately 500 m below the surface at 180°C. An annual energy saving of 2 000 toe is expected. The detailed preliminary plan is now being drawn up. Although this project entails considerable risks, it will open the way for exploiting many sources which produce energy all year round, even though there is no demand for it outside the cold season.

EE/100/80 - Azienda Energetica Municipale Milano and Società Pneumatici
Pirelli SpA - I

District heating in north-east Milan from the combined heat and power plant at Pirelli's Bicocca factory.

The plan is to tap the current excess boiler capacity at Pirelli's Bicocca factory for combined heat and power production. The heat will be supplied to the districts around the factory, saving 6 500 toe per year in the process. The detailed preliminary plan is now being finalized. This project demonstrates that industry too can seize the initiative to supply a neighbourhood with the heat which it needs and thereby provide the impetus for constructing a district-heating network.

EE/163/80 - Spie Batignolles S.A. - F

Heating of 15 000 dwellings in a Rouen neighbourhood from process waste heat.

This project will reuse process waste heat from a sulphuric-acid production plant in a new remote heating system in Rouen. The preliminary plans have now been completed and the construction work has just started. The project should save 14 500 toe per year. It is one of the largest heat-recovery projects in the Community.

2. Power stationsEE/118/79 - Walter & Co AG - D

Low-energy process for desulphurizing power-station flue-gases.

This is the first time that the new desulphurization process developed by Walter & Co has been applied in a large coal-fired power station (in this case the 475 MWe combined heat and power plant at Mannheim). The process leaves no waste, and there is no need to re-heat the treated flue-gases before they are discharged into the stack. The latter feature saves 8,300 toe per year even on the reduced project scale. Desulphurization in this plant produces ammonium sulphate, a fertilizer otherwise produced synthetically by a process with heavy energy consumption. The preliminary plan has now been completed and an application for building permission has been made.

EE/134/81 - Ruston Gas Turbines Ltd. - UK

Combined heat and power plant with a gas turbine driven by a heavy fuel-oil/coal mixture. The novel feature of this system is that a high-temperature heat exchanger separates the compressed gases entering the turbine from the exhaust gases emerging from the combustion chamber connected after the turbine. A ceramic (SiC) heat exchanger is employed. Unlike conventional gas turbines, which are generally fuelled by kerosene or natural gas, Ruston's turbine can be driven by a mixture of heavy fuel-oil and coal. This has considerable advantages in terms of energy consumption, with this project saving 1 050 toe per year.

3. Combined heat and power production

EE/156/80 - M.A.N. - D

"Total energy plant", with diesel motor, for a brewery.

Here a 600 kW diesel motor drives both an electricity generator and a steam compressor. The generator supplies the brewery with electricity, while the compressor recompresses the steam recovered from the wort boiler and then re-uses it to heat the boiler that it came from. The heat recovered from the diesel motor dries the malt. This project is a good example of successful integration of a "total energy plant" to an industrial process. The preliminary plans have now been completed. The project will save 1 015 toe per year.

EE/014/81 - CAMPBELL Nederland B.V. Groko Division - NL

"Total energy plant" in a frozen-foods factory.

Four 522 kW gas motors drive the electricity generators plus the compressors in the refrigeration units. This is the first time that this new type of cold accumulator (-10°C) with an eutectic mixture has been used. The project is a model of sound management of energy resources, making full use of the available methods of accumulating and subsequently re-using heat. It is now being implemented and will save 2 300 toe per year.

INDUSTRY: STEEL MAKINGEE/251/79 - Teksid - Italy

This project concerns the provision around a 150 t UHP electric arc furnace of an outer shell enabling the amount of air ingested by the fourth furnace orifice - and therefore the intake of fresh air - to be reduced. The shell was completed during the first half of 1980. Unfortunately, the first measurement results show that the reduction in fresh air intake is below forecasts. However, the shell has facilitated much more efficient furnace management (higher oxygen-blowing rate, quicker run-up to full electrical load, etc.) resulting in a drop in specific consumption of about 70 kWh/t (i.e. more than twice the original prediction), together with an improvement in working conditions. Energy savings are about 4 000 toe/yr. The project can therefore be considered successful in both technical and financial terms.

EE/014/80 - Estel Hoogovens - Netherlands

This project covers recovery of the heat contained in the combustion products of the blast preheaters in order to pre-heat the combustion air by means of a rotary heat exchanger. The energy saving is 6 000 toe/yr. The project is currently at an advanced development stage.

EE/074/80 - Usinor - France

In this case a system for recovering, storing and distributing LD converter gas is to be installed at the Dunkerque plant of Usinor. The recovered gas would be consumed within the plant itself. About 100 000 toe/yr could be saved. The installation work is under way.

EE/203/80 - Fulmer Research Institute - UK

The project is aimed at energy saving in the heat treatment of steels, by the use of fluidized-bed furnaces. The energy saving has been predicted at 6 750 kJ per kg of steel treated, which is equivalent to 230 toe/yr.

The furnace is being installed and it should be possible to start measurements shortly.

EE/228/80 - Italtractor - Italy

This project aims at saving energy in the manufacture of finished steel stampings by replacing the traditional hardening and tempering of steel. At the same time the simplified treatment enables at least the same quality to be achieved as for hardened and tempered products. The energy saving would be 930 toe/yr. The equipment is being installed.

EE/270/80 - Maximilianhütte - Germany

Project for recovering converter gas at the Maximilianhütte steelworks in Rosenberg. The technology used is not the same as in the Usinor project. In this case it forms part of a more general energy-saving programme and of the rationalization of the Rosenberg plant. Work has not yet begun. An energy saving of 6 500 toe/yr is expected.

EE/034/81 - British Steel Corporation - UK

The project involves pre-heating of the scrap charge for a 110 t electric arc furnace by recovering the heat extracted from the fourth exhaust orifice from the furnace. The foreseeable energy saving is 43 kWh/t of steel produced, which is equivalent to 990 toe/yr. Installation is virtually complete and the measurements will begin shortly.

EE/246/81 - Thyssen - Germany

In order to extract energy from the gas pressure in the furnace throat, the project envisages the installation of a four-stage by-pass turbine having variable guide vanes in the first-stage stator; these regulate the blast-furnace back pressure continuously. The turbines will drive two 13 000 kW generators, thus yielding a primary energy saving estimated at about 27 000 toe/yr. The turbo-alternator set is almost ready and the measurement programme should begin soon.

EE/253/81 - Danieli - Italy

Here the scrap charge for a 45 t electric furnace is to be pre-heated by the continuous heat flux in the hot gas exhausted from the fourth furnace orifice.

In the Danieli project, as opposed to project EE/034/81, the hot combustion

products will transfer their heat through a surface-type heat exchanger to an air flow which will heat the scrap.

An energy saving of about 50 kWh/t of steel produced has been forecast; this is equivalent to 1 500 toe/yr. The installation is at the project stage.

INDUSTRY : NON FERROUS METALSEE/147/79 - Electricity Council Research Center - UK

Improved Design of an Electric Induction Billet Heater

This project demonstrates an increased efficiency electric induction billet pre-heater by better utilisation of the available copper in the windings. Two applications are envisaged, one for aluminium billets (2 t/hour) and one for copper alloys (2.1 t/hour). Energy saving in terms of primary energy shall be 526 toe/yr. Predicted results are being realised on one of the demonstration models, the second one being under construction.

EE/251/80 - Norddeutsche Affinerie - D

Copper Melting Shaft Furnace for Refined Copper Anode Production

This project demonstrates the energy efficiency advantages of the shaft furnace over the more conventional reverberatory type. The throughput is 60 t/hour and the energy saving envisaged corresponds to 5,000 toe/yr. This project involves belgian and german companies having collaborated in R & D efforts and decided to finance jointly the investment for demonstration.

The payback of almost 8 years would normally be unacceptable. However, using only the furnace equipment costs this reduces to a more realistic 5 years.

EE/087/81 - Electricity Council Research Center - UK

Improved Design of an Electric Induction Furnace for melting Aluminium

This project demonstrates a new design of electric induction furnace whereby refinements in the channel and throat of the furnace will produce an increased power density and a vigorous stirring action in the molten metal. This should give rise to reduced metal loss and increased efficiency. A reduced metal loss of 1% represents 700 kWh/t and energy saving of 743 kWh/t should bring total energy saving of 1,443 kWh/t or 1.000 toe/yr. The envisaged payback period of 1.6 years is good. The project is still in the design stage so no operating experience is known.

INDUSTRY : CEMENT, BUILDINGS MATERIALS (BRICKS, LIME)EE/001/80 - Gebrüder Löhlein - D

Conversion of Brick Tunnel Kiln to Pulverised Solid Fuel Firing

This project claims substantial energy savings (60%) by converting an oil fired kiln to solid fuel firing i.e 1.310 toe/yr. Operating experience to date has revealed a higher average specific energy consumption than was first envisaged.

There is certainly a need to spread information regarding the solid fuel firing of brick kilns to encourage organisations to use pulverised fuel technology in this field.

It is a pity that the projected fuel savings were based on work carried out on another kiln. The true energy savings can only be known by analysis of past specific fuel consumption figures for this kiln. Despite these facts, the energy saving achieved are above 40%

EE/094/80 - Sauerlandische Kalk Industrie - D

Improvement in Specific Energy Consumption on Vertical Lime Kilns by use of Ring Burner System

This project demonstrates an improved burner system for vertical lime kilns. The system is claimed to reduce the specific energy consumption and improve product quality by improving combustion and heat distribution within the firing zone. The energy saving envisaged are 1.080 toe/yr.

If proved successful, the system could be readily replicated on other gas fired vertical lime kilns.

EE/171/80 - Creusot-Loire Entreprises - F

Rotary Cooler with Peripheral Blowing on a Cement Clinker Kiln

This project demonstrates an improved cooler for a cement clinker rotary kiln to produce clinker which is 300°C lower than the conventional grate cooler. Energy saving envisaged are 1.750 toe/yr.

The payback period of 3.25 years should encourage other users of such kilns to use the equipment. However, the maintenance costs charged against this project appear to be rather high and a reduction here would increase the commercial viability of the plant.

INDUSTRY: CHEMICALSEE/274/79 - Fertimont (Montedison) - Italy

The demonstration project is located in a plant producing urea - one of the main components of nitrogen fertilizers. The existing process consists of combining ammonia and carbon dioxide. Its efficiency is low and partly responsible for the high energy consumption. The project aims at modifying the unit in order to recycle the unreacted raw materials and thereby to increase reaction efficiency to 55-75%. This increase in efficiency would yield an energy saving of about 6 000 toe/yr. The programme has been delayed by longer delivery periods for the equipment. It was completed at the end of the first quarter of 1982 and the final report is in preparation.

EE/125/80 - Elf Aquitaine - France

The object of the demonstration is a device enabling liquid effluent from oil refineries to be concentrated, thereby reducing consumption of the energy needed to separate the water from the hydrocarbons. It involves a cylinder coated with a film enabling hydrocarbons to be separated out of water suspensions. The project has been completed and has enabled 2 500 toe to be recovered from the refineries where it has been installed. The contractual aim has thus been achieved and the project is a commercial success.

EE/129/80 - Agip Petroli - Italy

When filling station reservoirs or delivery lorry tanks are filled the vapours left over from the previous load are vented to atmosphere. In order to avoid hydrocarbon losses and pollution a condenser, followed by a refrigerated condenser, is located at one of the tank orifices. The residual vapours are thus recovered in liquid form. The project has been completed. Although the amount of hydrocarbons recovered is less than the target owing to the climatic conditions during the demonstration, the project has a good chance of commercial success.

EE/224/80 - Solmine - Italy

The aim of the project is to utilize the waste heat from the reduction process in the manufacture of magnetite sinter. The project is in two sections:

- (a) Recovery of heat from the sinter by means of a fluidized-bed cooler
- (b) Recovery of heat from the reduction of gases via incineration and an economiser.

The waste heat will be used to pre-heat the boiler feed water. The energy saving expected is 1 400 toe/yr. The project is at the design stage.

EE/022/81 - Union Chimique - Belgium

This is a new process for synthesizing ammonium nitrate which requires no external energy source since it generates enough heat to provide steam which can be used in other processes. This process also yields a higher yield and enables liquid effluents of sufficient purity to be produced which can either be re-used or discharged directly. One energy saving of 260 toe/yr is expected. The general application of the process would enable an energy saving of about 100 000 toe/yr to be made at Community level. The programme began on 1 January 1981 and should end on 15 September 1983.

GLASS INDUSTRYEE/246/80 - AKZO CHEMIE b.v. - NL

A countercurrent glass-melting furnace with heat recovery for sodium glass.

The melting furnaces usually used to manufacture glass from siliceous sand and sodium and potassium powder are of the "unidirectional flow" type in that raw materials are charged on the same side as the burners and the convection currents which develop at the bottom of the melt flow in the same direction as the combustion products.

Under the demonstration project, the firm has built a countercurrent furnace which is charged on the opposite side to the burners so that the convection currents in the melt flow in the opposite direction to those in ordinary furnaces. The experimental furnace which has a production capacity of 80 tonnes a day has been fitted with a heat recovery system which heats the combustion air with the residual heat from the flue gases, which are then discharged at only 600°C. When designing the system, the firm was expecting these modifications to produce a dramatic reduction in fuel consumption from 171 m³ NTP of natural gas per tonne - which is the consumption of an ordinary 80 tonne-a-day unidirectional furnace - to 124 m³ NTP per tonne, a saving of 27.5% which is equivalent to some 350 toe a year.

The experimental furnace began to operate in September 1981 but unfortunately there were a number of problems and the consumption of natural gas is therefore considerably higher than expected: between 140 and 150 m³ NTP per tonne instead of 124 m³ NTP per tonne. This is still a saving of 15% compared with the original consumption of 171 m³ NTP per tonne, which is by no means negligible, although not as high as 27.5%.

Basically, therefore, the project ended up achieving 45% of the success originally expected. Additional modifications - which would not necessarily be very expensive - could bring this success rate up to 85 or 90%.

The significance of these results is undoubtedly of very widespread benefit if one considers that just over 1 million tonnes of glass is produced in the Member States of the Community each year. Cutting natural gas consumption from 171 to 124 m³ NTP per tonne (i.e. by 47 m³ NTP a tonne) - the expected saving which can be applied roughly to all furnaces - would reduce consumption of natural gas by 47 million m³ a year, which is equivalent to some 40 000 toe a year. Even the saving of 26 m³ NTP per tonne already obtained would be equivalent to 22 000 toe a year.

INDUSTRY: TEXTILESEE/016/79 - Lanerossi - Italy

The aim of the Lanerossi project carried out on existing textile dyeing plant in their Schio factory was intended to demonstrate the technical feasibility and energy efficiency of a modification enabling a large proportion of the cooling and condensation water to be recovered as a result of a modified layout for the bath heating and cooling circuits.

The modification consists of separating the heating and cooling circuits and giving each its own heat exchanger, and rearranging the cooling circuit to accept both softened and hard water. With regard to the ratio "kg of bath water to kg of cloth" and to the techniques adopted: it is planned to recover 73 000 m³/yr of soft water at an average temperature of 45°C and 22 600 m³/yr of demineralized (distilled) water at 105°C, i.e. an estimated energy saving of 444 toe/yr.

The measurements are under way but are behind schedule owing to technical problems which have been dealt with in the meantime.

The initial measurements revealed very wide divergences in the amounts of water and condensate recovered as compared with the initial forecasts. The causes (coil porosity, valve life) have been pinpointed and eradicated. Consequently, the final results should coincide with the initial forecasts.

EE/133/80 - The Shirley Institute - UK

Project to demonstrate that very strict process control in the textile industry may enable management procedures to be formulated which could yield considerable energy savings.

The programme is under way in a textile dyeing plant having an annual cloth treatment capacity of about 4 000 t. Overall energy consumption would be about 270 TJ (6 500 toe/yr) of which 77% consists of fuel oil, 17% of gaseous fuels (methane and propane) and 6% of electricity.

The aim of the project is to reduce the above-mentioned consumption figures by 10% at the end of the demonstration period (equivalent to about 650 toe/yr) by installing suitable measuring instruments, analysing the data recorded and, finally, proposing on this basis suitable modifications either to the installation or to the running thereof.

The project is at advanced stage and the tests carried out so far foster the hope that the targets will be met.

INDUSTRY: DAIRY INDUSTRYEE/008/79 - Carbery Milk Products Ltd - IRL

This project has been installed and is operating in the premises of Carbery Milk Products Ltd., Ireland.

The project is now complete and the first set of tests have been carried out. The results show that for similar production runs, 23% of the primary energy input was saved on the production run with the heat recovery equipment installed. This is a little better than first estimates.

The testing organisations have carried out more work to finalise the savings in energy over long term operating and have performed another series of tests with the variables being maintained as constant as is practically possible. The results of these tests have not yet been published, but they are satisfactory.

In conclusion, the project has yielded positive results, the energy savings being estimated at about 430 toe/yr.

EE/008/80 - Cooperative Zuivelfabriek en Melkinrichting "DE EENDRACHT" W.A. - NL

This project has been raised to demonstrate the reverse osmosis technique as a pre-concentration unit to an evaporator. The aim was to increase the solids content of the skimmed milk from 6 - 8% to 18% by removing over 50% of the water in the original feed stock. The energy savings envisaged correspond to 330 toe/year.

The project is not yet completed but first tests have proved encouraging. The main energy saving from this project is claimed to be in the transportation of the end product from the pre-concentration plant to the evaporators. This would not necessarily be realised where both units are on the same site. The financial submission on the contract needs further examination since the cost of running the equipment appear to be higher than the value of energy saved.

INDUSTRY: MISCELLANEOUSEE/244/79 - Joseph Crosfield & Sons Ltd - UK

The project covers the use of gas continuously extracted from coal mines which, normally, is vented to atmosphere. The existing boilers have been modified so that all the coal gas extracted from the mine - and, if need be, natural gas and heating oil - can be used.

The measurements carried out over 12 months have been extremely convincing. The new three-fuel burner and the control system have proved that they operate excellently and are reliable. Boiler output has remained virtually unchanged, thus enabling fuel oil and natural gas consumption to be reduced by about 22 000 toe/yr.

EE/314/79 - Hermann Heye - Germany

This project demonstrates the use of mechanical energy made available by the expansion of natural gas from its supply pressure of 50bar to its working pressure of 2bar. The energy is used to drive a screw type air compressor and corresponds to an energy production of 806 toe/yr. The equipment installed has proved to be cost effective but its use will of course be limited to areas where gas is supplied at high pressure.

EE/167/80 - Compair Industrial Ltd. - UK

This project demonstrates a device by which screw compressors can be operated at part load more efficiently by utilising a two speed drive system. The energy saving envisaged are 20 toe/yr in primary energy. The project has reached the prototype build stage and first estimates of capital costs have been justified. This scheme should prove to be commercially viable when offered as an extra to the company's existing compressor range. Potential for replication is extremely good.

FLUIDIZED BEDS

EE/022/79 - Deborah Fluidized Bed Ltd - UK

Disposal by combustion of residual wastes from the spent lubricating oil reclamation industry, including usable steam production, without damaging the environment. The project is intended to provide a two-fold energy gain: the energy needed for incineration and recovery of the energy contained in the wastes.

The installation covered by the contract is a four MW entrained fluidized bed built at Avonmouth in the Tenneco Organics Ltd factory, which reclaims spent oils and produces an "inevitable" by-product in the form of a tarry residue at a rate of 2.5 t/h.

The work has been performed in line with the time-scale laid down both for the construction and for the testing and measuring stages. On completion of the programme the installation was acquired by Tenneco Organics Ltd and a repayment schedule for the repayable part of the subsidy was drawn up.

The development procedure was well suited to the disposal of harmful industrial residues without damaging the environment and yet saving energy. The advantages of the entrained fluidized bed using asymmetrical pulsed air at three levels were demonstrated perfectly by the project. The project also made it possible to demonstrate the reliability of the plant and its relative ease of operation. Its success was put to practical use by launching a commercial operation enabling 1 200 toe per year to be saved and offering prospects of a minimum saving of 150 000 toe/yr throughout the Community.

EE/027/80 - Metallurgie Hoboken - Belgium

An atmospheric-pressure fluidized-bed boiler was built to burn coal shale and mineral residues to produce steam in order to generate electricity in a back-pressure turbine. The energy thus obtained is to be used in metal-treatment processes within the company. The bed combustion temperature is regulated to permit better fixing of the sulphur in the lime and to reduce nitrogen oxide emissions. A particular feature of the project is that the fluidization air is pre-heated by means of heat from the ashes.

As provided for in the schedule, plant start-up took place in February 1982. The initial combustion tests will cover: metering of the constituents of the charge, the temperature regulation system, smoke filtration and the recovery of ash heat.

The demonstration proper remains to be carried out after plant assembly and initial testing. Its success depends, in particular, on the reliability of the measures to reduce the risk of plant corrosion and atmospheric pollution. If it is successful the project will yield savings of 8 000 toe/yr and will help considerably in making use of low-calorific value fuels such as coal shales.

EE/126/80 - Kalkzandsteenfabriek "DE HAZELAAR" - Netherlands

The project is located in a building materials factory and its purpose is to produce the energy needed to make bricks by burning coal having a large ash and sulphur content. The fluidized-bed technique enables the sulphur to be fixed in the furnace by injecting lime and to generate sufficient heat despite the high ash content. An original feature of the project consists of recycling the ashes by incorporating them in the brick making charge on leaving the furnace. Since the ashes are at a high temperature they help to reduce the amount of energy needed to heat the mixture to the required temperature and to avoid the expense of storing the ashes or carrying them to dumps. Installation is currently underway; the entry into service of the unit is planned for the end of the year.

The project is expected to yield a saving of 2 700 toe/yr. With similar facilities the process could yield a saving of almost 300 000 toe/yr at Community level.

EE/190/80 - Breda Termomeccanica Ansaldo - Franco Tosi - Italy

The project covers modification of the boiler in an oil-fired power station to burn low calorific value, high-sulphur coal mined close to the plant.

The planned modification consists in installing a 15 MWe fluidized bed. The particular feature of the plant would be its ability to recover heat from the ashes and use it to pre-heat the fluidization air. The power plant would produce about 80 t/h of steam to drive the turbines.

The design stage has been completed and site work has begun. The installation is due for completion by mid-1983. The fuel saving due to replacement of one fuel by another will be about 10 000 t/yr. If successful, the demonstration will prompt the use of low calorific value coal in power plants and large industrial boilers.

ENERGY FROM WASTEEE/160/79 - Esmil - NL

The aim is to build a plant for the combined treatment of household waste and sewage sludge. The household waste is burned in fluidized beds, the heat generated being utilised to dry recyclable paper and plastic and recover metals. The sludges from the waste-water anaerobic treatment station are fermented (also anaerobically) to produce biogas. The plant is now being built.

EE/192/79 - Intradel - B

The object is to demonstrate the industrial feasibility of recycling mixed municipal plastic wastes deriving from the threefold selective collection of paper, glass and plastics. The project is part of a large scheme for treating household wastes, comprising

- (a) the utilization of the products of selective collection, and
- (b) the automatic sorting of the remaining waste.

The energy saving to the community at large is put at 11 000 toe/yr. The installation will be built by the end of August 1982, i.e. with one year's delay.

The overall technical solution adopted for the treatment of household waste at Liège is based on a sensible approach, the activities involved being clearly divided into stages:

- paper, glass and plastic are collected on the same special round to reduce costs,
- the relatively unsoiled materials deriving from selective collection are recycled,
- a fuel is manufactured from the remaining waste collected in the normal way.

The plastics recycling project is an interesting attempt to recycle mixed wastes (mainly PVC and polyethylene).

The project's commercial success will depend principally on the market for the mixed waste compound.

EE/235/79 - Foster Wheeler - UK

There are two methods, at present, of utilizing waste tyres: retreading and

incineration (the latter with heat recovery). The aim here is to demonstrate a third possibility: pyrolysis, leading to the manufacture of marketable fuels. By subjecting waste tyres to high temperatures in furnaces the contractor plans to recover combustible oils by a distillation process. It may also be possible to use the residue (carbon black and fragments of steel).

Work, which began on 1 January 1979, was suspended at the end of that year on account of the financial difficulties of the first contractor, Batchelor Robinson; it was resumed, however, on 1 January 1982, after the latter's rights and obligations had been transferred to a new contractor, Foster Wheeler. The project will continue until 31 December 1983. To date, the equipment specifications have been drawn up and civil engineering works have begun on the site.

The project's programme provides for the treatment of 50 000 tonnes of used tyres per year, giving 16 000 tonnes of combustible oils, 14 000 tonnes of carbon black and 5 000 tonnes of steel fragments.

It is not yet possible to say whether the project will be viable, since there are risks of furnace explosions. If this risk can be obviated, the generalization of the process could save the Community as a whole 200 000 toe in liquid form, 100 000 tonnes of solid fuel and 80 000 tonnes of steel fragments.

EE/285/79 - IMAG - NL

The project consists in fermenting manure anaerobically at three farms raising pigs, cattle and poultry. The three digesters (ranging in volume from 100 to 1 000 m³) will work at temperatures lower than those normally used and have a shorter payback time; they will thus produce more gas and require less heat.

The biogas produced serves to heat the animal stalls and the water needed to clean them. One unit is in operation, having solved certain technical teething problems, and the two others are being constructed. It is hoped to produce eight toe/yr of biogas.

EE/033/80 - British Airways - UK

The object is to demonstrate the technical and commercial viability of using the waste produced on site at Heathrow Airport to provide all the energy needed in an airport service building. The energy generated by burning the waste is supposed to meet the heating and cooling requirements of a building by doing away with heating oil and reducing electricity consumption by more than 30%.

The annual saving is estimated to be about 1 000 tonnes of fuel oil and 2 300 MW of electricity. The novel aspect is the use of on-site waste for combined heat and cooling purposes.

The project includes the construction of an incinerator linked to a single control system which will allocate the heat produced to three functions: heating; hot-water production; cooling, with venting of the excess air to the atmosphere.

The preparation of the incinerator and the control system specifications started in July 1981, and the stage has now been reached when the specified equipment can be ordered. On-site assembly will begin in the first half of 1983, and the first trials are scheduled for the end of 1984.

EE/142/80 - E.Bi.A. - I

The aim of this project is to build a demonstration centre for the anaerobic digestion of animal, vegetable and municipal waste, with biogas production. This centre offers the possibility of meeting a major requirement which exists in Europe:

- i) summary and evaluation of the research effort dispersed among the Member States: substrates, fermentation techniques, nutrients, digester and storage engineering;
- ii) study of the conditions under which the biogas and the digestate can be used and which largely determine whether the installations will be economic;
- iii) on-site follow-up at various installations: training, information, assistance and experiments;
- iv) a place where scientists and others of different nationalities can meet.

The centre has now been set up. The trials conducted have shown that the best results are obtained from the following substrates:

- (i) sewage sludges + organic fraction of household wastes + pig slurry;
- (ii) pig slurry + cattle manure.

The risks attaching to the stage financed by the Community are commercial rather than technical, the objective of that stage being to sell six industrial-size installations. At the moment, an initial project in Modena with a 1 500 m³ digester to take pig slurry seems certain to go ahead; another project, under study, relates to the commune of Broni which is trying to find the best way of treating the household wastes from the district.

EE/260/80 - Skive Egnens Erhvervsråd - DK

The object here is to build a power station which will generate energy from household and industrial waste, slurry, solar energy accumulated in the ground and energy from the outside environment.

After sorting, the solid household and industrial wastes are mixed with coal-dust and compressed into briquettes. Most of these are sold as fuel for solid-fuel stoves or boilers. The rest are burned in the power station, and the heat produced is sold. The liquid household and industrial waste, the slurry and the municipal sewage sludge are processed to produce biogas and compost. The biogas feeds the gas engines driving an electric generator and a heat pump system.

The reservoir of external heat for the heat pump is provided by tubes buried in the ground and panels which draw energy from the outside environment. The electricity, the heat from cooling the engines and from the heat pump are all sold; completing the power station are two wind pumps which drive air compressors used for producing hot water.

The various sources of heat (wind power, heat pump, cooling of gas engines, briquette-fired boilers) operate at different temperatures and are arranged in series. The aim is to produce an annual amount of energy equivalent to at least 6 000 tonnes of oil. The municipalities concerned are reviewing the preliminary studies at the moment, before taking any decision to commit themselves financially.

EE/287/80 - Friedrich Wahl - D

The wood scrap produced by sawmills consists of chips, sawdust and bark. A general outlet for the first two is the paper and board industry, or the manufacture of agglomerates. It has not so far been possible, however, to use bark, which contains a wide variety of organic matter, has a high humidity level and is soiled by vegetable remains or earth. The aim of the project is to gasify these wastes in closed furnaces and to use the gas to drive the turbines of a power generator. Four units of 120 kWe/hr are planned, the power from which will be used to drive the various types of equipment in a sawmill producing about 30 000 t/yr of building materials. The cooling water, whose temperature will be raised to 90°C, will also be used in the plant. The expected energy saving will be 230 toe/yr.

Shortly after the gas producers were started up at the beginning of 1981, it was apparent that the risks involved in using this type of waste had been underestimated. The gas produced contained water with a high phenol content, the discharge of which, after condensation, was not acceptable in terms of environmental protection standards.

To reduce phenol formation, the contractor tried operating the gas producers at a lower temperature, but this produced tars which blocked the ducts, and the installation was seriously damaged in a test run in May 1981. The contractor is currently busy modifying the installation, so that the bark can be gasified more completely using a fluidized-bed system. This will require further studies and development, and the contract programme, which was scheduled to end in April 1981, will thus be delayed by over a year.

EE/001/81 - E.Bi.A. - I

The object is to show that ethanol (96% to 99.9%) can be produced from low-value cellulose material, seeking the best energy balance in the process. The projected balance for 7 500 t/yr of processed cereal husks is as follows:

- ethyl alcohol	:	1 150 toe/yr
- available biogas	:	350 "
- nutrient meal	:	2 000 t.

The available biogas represents only 35% of the total produced: 65% is used as a source of energy for the installation.

The merit of the project resides in its advanced integration and particularly in:

- i) the favourable raw-material supply conditions (rice husks);
- ii) the optimization of the energy balance by various means:
 - . the anaerobic fermentation of the by-products of hydrolysis and alcoholic fermentation, giving more biogas than is required for system heat;
 - . the obtention of a 10%-strength liquor from a cellulose substrate, thus reducing the energy consumed during distillation;
 - . reuse of the distillation heat in the pre-hydrolysis and hydrolysis stages;
- iii) the use of the methane-fermentation digestate as a protein meal.

EE/179/81 - Comune di Modena - I

This type of operation, often carried out in the United States, involves drawing off the biogas that is formed spontaneously in tip strate and pumping it to a major consumer of thermal energy, in this case a briquetting works 1 200 metres away from the tip. Having peaked in the first year, biogas production will decrease rapidly over the following fifteen years. Mean production will be about 680 toe/yr. The plant is under construction.

ROAD TRANSPORTA. Road transport - Internal combustion enginesEE/262/79 - Thomson - CSF S.A. - FOptimization of the ignition and carburation of automotive petrol engines during the warm-up period

Since DEA-TH (the CSF company's automotive electronics department) has already put on the market an integral electronic ignition system and, as a cooperative venture with the Solex company, a carburation control device, Thomson - CSF S.A. has proposed a project to demonstrate a microprocessor-controlled integrated system for instantaneously optimizing the ignition and carburation of spark-ignition engines.

This system would be particularly attractive before the engine was properly warmed up i.e. during the first few kilometres following a cold start.

To provide adequate system flexibility the study would relate to three distinct vehicles having different engine capacities: a Citroen GY (the new GS), a Citroen Visa Super and a Peugeot 504, which would be fitted with adequate engine-parameter display systems (the most important being ignition advance) with a "binnacle" for the manual override and a printer.

The Company predicts that fuel consumption will be reduced by 5-15%, depending on the type of vehicle, or in other words about 0.5 toe/yr for the three vehicles in question. This prediction is theoretically feasible, especially for vehicles which, by definition, operate under stop-start conditions (taxis, vehicles driven in city centres etc). Predictions apart, it is however, not possible at present to say definitely how far the research has gone. We therefore feel that a visit is needed to assess just how much work has been done on the programme so far.

EE/178/80 - Alfa Romeo SpA - ItalyUse of a "cylinder cutout" engine incorporating electronic injection shut-off in a number of cars mainly used in urban traffic (taxis)

Alfa Romeo's EEC demonstration project consists in fitting 10 taxi versions of the Alfetta car with electronically and microprocessor controlled engines. Envisaged energy savings at project level of 2.5 toe/yr.

The on-board injection and ignition control unit has interchangeable memories so that it is possible for the engine to operate normally on either four or only two cylinders. In this case "modular" operation consists of being able to initiate combustion in either four or two of the engine's cylinders, depending on the driver's power requirement, with activation or disablement of the relevant injectors.

The vehicles were placed in the hands of a taxi company which used them for about six months.

All of the taxis were fitted with tachographs to record the number of kilometres travelled, the number of hours worked and the type of journey made. At the end of each working day the fuel tank was filled up to show consumption. The two cars having covered the greatest number of kilometres are undergoing a complete check-over. The average fuel saving can in any case be taken to be 10% as compared with an ordinary four-cylinder injection engine. However, if a comparison is made with an ordinary carburetted engine, an additional saving of about 10% can be anticipated, not only because of better fuel metering, but also because of the shut-off facility offered by injection engines, which cuts off the fuel supply when the foot is removed from the accelerator.

The saving from cars with a swept volume of more than $1\,700\text{ cm}^3$ - 15% - would be $2\,250\text{ m}^3$ per year i.e. 1 660 000 toe. The path followed by the company is, however, the simplest and most economical and therefore the most acceptable to the market. It can be applied to fuel-injection engines which will certainly be the most widespread before very long, in view of the advantages offered at low cost by the most recent electronic injection systems.

EE/221/82 - Renault Véhicules Industriels S.A. - France

Design, development, and demonstration on board vehicles of a Rankin-cycle system for recovering energy from engine exhaust gases

The aim of the programme is to use the considerable amounts of heat available from the exhausts of diesel engines used in commercial vehicles to generate further mechanical energy for feeding back into the engine (output) shaft.

Renault VI intends to link commercial-vehicle internal combustion engines with steam engines, using organic fluids and equipped with turbo expanders, whose power output will be fed into the engine output shafts by means of suitable mechanical transmissions.

The programme has only just begun and its state of progress is unknown. It is expected that the type of engine referred to above, fitted with the recovery system in question, will yield the very low specific consumption figure of 150 g/hp, which has never been attained hitherto. Over the speed range of 75-85 km/h of a maximum-capacity vehicle, whose current engine consumes 34.2 - 37.2 litres of fuel per 100 km, consumption drops to 30.5 - 33.5 litres per 100 km if the recovery system is fitted, which means 6.3 toe/yr per lorry. These are figures for motorway driving, whereas the fuel saving is much greater under give-and-take conditions. The turbine configuration in the Renault project is particularly economical, but on the other hand the payback period for the extra cost of the vehicle seems to be quite long despite the fuel saving (4 - 5 years). The demonstration which the Renault company is performing is extremely useful. Since the experiment is still in its early stages, its state of progress is unknown. The information provided will be very valuable in enabling the usefulness of this type of recovery to be determined.

B. Electric vehicles

EE/085/80 - Odense Elforsyning - Denmark

The contract which was signed by Odense Elforsyning on 16 December 1981 concerns the use of 5 Fiat 900 E/E2 electric vans in the service fleet of a Danish public electricity supply organisation. The Danish project can be regarded as an extension of the Italian project, since it involves the use of the same vehicles. However, three features, which are different, permit the collection of additional information and experience. These features are:

- climate - Denmark being the most northerly EEC-member country
- application within another public service sector in different traffic conditions
- electricity supply from a combined heat and power station.

The 5 electric vans will be delivered by October. One of the 5 vehicles will be fully equipped as a test vehicle and instrumentation in the remaining 4 vehicles will, as a minimum, include on board kWh meters. The energy saving shall be 30% or 2 toe/yr. The work on the measurement programme started on the 1st of December 1981. The contractor, together with the collaborating Energy Research Laboratory, is seen to have a very good capability for carrying out the required work in a professional manner.

In addition good contacts with related EEC research projects - in particular the DG XII-supported Anglo-Danish project "Advanced Battery Development", COST project 302 (electric vehicles) and AVERE - exist.

EE/130/80 - Fiat Centro Ricerche - Italy

The contract covering a demonstration with 10 Fiat 900 E/E2 vans to replace conventional vehicles in Torino (Turin) telephone installation and maintenance operations formally started on the 1 October 1981. The aim of the project is to demonstrate operational effectiveness regarding both energy and costs. In terms of energy saving, it should correspond to 4 toe/yr. In addition to the 10-vehicle fleet to be operated by the telephone company a test vehicle equipped with sensors and a magnetic recorder for complete dynamic performance monitoring will be operated by the Fiat Research Centre.

The activities are progressing well. During the first year of the four-year programme the following three phases will be completed:

1. manufacture and testing of the "test vehicle"
2. manufacture of the 10-vehicle fleet
3. start-up of fleet operation.

During the first six months the test vehicle has been manufactured and the procurement of materials and components for the manufacture of the 10-vehicle fleet has been prepared. The test vehicle shows excellent traffic compatibility with full payload. During the next six months the 10 vehicles for the fleet will be delivered.

The contractor is involved in a battery and charger research project under the EEC indirect programme (DG XII), and this offers an excellent opportunity for the establishment of real coordination of the two EEC programmes. In fact a field test of the on-board lightweight charger developed under the research programme is planned to be included in the demonstration programme. In addition, good contacts with COST project 302 (electric vehicles) and Association Européenne des Véhicules Electriques Routiers (AVERE) exist.

The initial proposal was for 70 vehicles but a 10-vehicle fleet is sufficiently large for the direct evaluation of the operational effectiveness in terms of performance, energy consumption and operational costs.

EE/161/80 - Electricity Supply Board - Ireland

A contract covering a demonstration project with 15 large electric vans to replace conventional vehicles in electricity supply, municipal, public transport and post & telegraph service, was signed by the Electricity Supply Board, Dublin on the 12th of November 1981.

In February 1982 two of the intended fleet owners - the Department of Post and Telegraphs and Dublin Corporation - announced their decisions to withdraw from the project for reasons of financial stringency. Consequently, the eventual fleet will total eight, four second generation Daily Electric IVECO 35F8s with a 890 kg payload and four Dodge 50s with a 2,400 kg payload. It is intended to put 4 Daily Electrics and 2 Dodge 50s in operation in the fleet of the Coras Iompair Eireann (CIE). The IVECO vehicle was demonstrated in Suzzara, Italy on the 29 March 1982. It displayed excellent traffic compatibility. The Dodge 50 has also good performance. The energy saving envisaged is 4 toe/yr.

AGRICULTUREEE/209/79 - PAGV - Netherlands

In this project waste heat from a small electricity generating station is recovered to heat the soil by means of buried pipework in order to speed up the growth of plants. The demonstration covers 1.5 ha of crops divided into plots which on a random basis are either heated to various temperature levels or remain unheated (reference plots). The plan had been to link the generating station with the crop fields by means of a buried pipe about 5 km in length. This pipe was to cross a dyke but in the event the competent Ministry did not authorise this. An amendment to the contract was accepted whereby the temperature of the condenser in the generating station is measured continuously and the values transmitted automatically to the demonstration site where a conventional natural-gas fired boiler reproduces exactly the temperature levels of the waste from the electricity generating station. The project is under way and the first results will be available soon.

EE/278/79 - ENEL - Italy

The aim of the project, by the Ente Nazionale per l'Energia Elettrica, is to use the low-temperature heat contained in the cooling water from conventional or nuclear power plants in order to improve the crops from market gardens or other agricultural holdings. The hot water will be used either to irrigate or to heat the soil by means of buried pipes, or to heat the air about the crops. It is above all expected that this project will enable production to be increased, germination to be speeded up and seasonal crops to be early. The purpose is to perfect this particular technique by assessing from a technical and economic standpoint the various ways of using hot water from power stations in agriculture and to determine which types of crop would derive most benefit.

Two installations are planned: the first near the Trino Vercellese nuclear power plant on the River Po near Casale Monferrato (Piedmont) and the second near the conventional power plant at Tavazzano near Milan (Lombardy).

The Tavazzano installation consists of seven tunnels, four greenhouses and three plots in an open field. The fields are being planted and completion of the measurements is anticipated for 1985.

The Trino Vercellese installation consists of 6.5 ha of crops in an open field. Experiments are planned using different irrigation techniques involving hot water, sprinkling, trickling, lateral infiltration or flooding. Completion of this installation has been greatly delayed as a result of an extended shut-down of the nuclear power plant for technical reasons.

EE/002/80 - AYLESCOTT DRIERS - UK

The hot air used for drying fodder is recycled instead of being discharged to atmosphere.

Before drying proper, the fodder is passed through a press to squeeze out the juice, which is then concentrated with assistance from the recycled hot air, then added to the cake. This process yields a two-fold energy saving:

- i) that of the heat recovered and
- ii) the lower consumption of energy needed to concentrate the juice as compared with the drying of fresh fodder.

The installation is complete and a saving of 200 toe was achieved during the first drying sequence involving 3 750 tonnes of fodder.

ALTERNATIVE SOURCES: SOLAR ENERGY

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SOLAR THERMAL1. Housing and BuildingsSE/043/79 - Tidcombe Lane First School - UK

Space heating and domestic hot water preparation by 70 m³ of flat plate collectors, 2 storage tanks of 9 m³ and 5 m³, and hot water cylinder of 1.2 m³. Space heating system: fan coil heaters and radiators. Construction was finished in September 1980. Monitoring is still going on until September 1982.

No monitoring results are yet available. The performance is expected to be good. The education value is outstanding and the potential for publicity good due to clear design and use for teaching pupils even from other schools. Energy produced per year: 5.4 toe.

SE/131/79 - Glaverbel SA - B

Domestic hot water for a factory.

Flat-plate glass collectors heat the water sufficient for 45 showers per day for the factory workers. The glass, which is preferentially transparent to visible light, was tested and then, after several breakages, partly replaced by ordinary glass.

The installation has been overdimensioned since requirements have proved to be almost three times below estimates and the (often saturated) storage reservoir has prevented the full recovery of all the energy collected.

Energy produced per year: 1.23 toe.

SE/149/81 - House at Mambour-Demeuse - B

Heating of an individual house.

Solar heating of an individual house by air-type collectors incorporated in the roof and by air/air heat pump. Storage in saline media using the latent heat principle (study of the composition and conditioning to overcome the problems of supercooling and ageing and to optimize the yield from the heat exchange). Estimated solar gain in kWh/year: 10 000. Roof-mounted air-type collectors considerably reduce the extra solar investment cost. The project is well designed; if properly implemented, a noiseless air-heating system is a viable proposition. Latent heat storage using an air-type system is highly

experimental and warrants the proposed study, the cost of which is insignificant when compared with the total estimated cost of the installation. It should be pointed out however that, assuming a payback period of 10 years and considering the estimated project costs, the overall cost is very modest.

Energy produced per year: 1.41 toe.

SE/151/82 - Era-Bertin - F

Communal heating.

Solar back-up for the electrical heating of a 23-apartment block by opaque air-type collectors covering the entire south-facing wall. Electrical underfloor heating and convector heaters in each room. Preheating of the fresh intake air by air collectors and by heat exchangers which extract heat from the exhaust air. Building is over-insulated with a low thermal mass ($G = 0.75 \text{ W/m}^{30}\text{C}$, including ventilation). Windowless, south-facing wall covered with absorber panels.

It is a pity to cover the entire south-facing wall completely in order to obtain a 33% saving on heating. The extra cost seems rather high compared with the modest solar gain. A building with its main wall facing south, of average thermal mass and with double glazing and insulating shutters would have achieved almost the same solar gain (20% of the energy consumption by direct gain alone and without an active system).

Energy produced per year: 7.2 toe.

SE/152/81 - Unerg - B

Office heating.

A building, part of an administrative complex, has been insulated and fitted with 80 m^2 of unglazed and insulated copper absorbers linked to two 16 kW heat pumps serving a 1 000 litre cold storage tank and a 1 000 litre insulated hot-water storage tank. Heat distribution via steel panel radiators (initial temperature = 65°C) located below the windows. Very promising system for two reasons:

- (1) the operating principle (heat pump + absorbers alone),
- (2) system retrofitted on an existing building.

The three other buildings in the complex will be fitted with monitoring instruments so that comparative energy balances can be drawn up.

Energy produced per year: 2.9 toe.

SE/154/81 - Bouwcentrum Techno - NL

10 Solar houses at Capell/Ijssel.

15 m² of air collectors on each home. Storage in a concrete column including a 140 ltr. domestic hot water tank. Gas-fired back-up heater. Construction will start in Spring 82. The estimated payback period is 60 years (lifetime 20 years, constant gas-prices). The design is simple. So the lifetime of the plant will be longer than 20 years (as assumed in the contract). Serial production will improve economy.

Energy produced per year: 5.2 toe (10 houses).

SE/155/81 - Bouwcentrum Techno - NL

10 Solar houses, Capelle/Ijssel.

3 elements of solar utilization in each house.

a) Greenhouse in front of the living room with triple glazing.

b) Wall-collectors (10 m²) on all the southern walls. Air circulation by gravity. Interesting wall-operated control system.

c) Active air-collectors (5 m²) for domestic hot water system. Storage 150 ltr. The project is still in the planning stage.

The project is an example for the systematic application both of active and passive solar-heating techniques. Long lifetime can be expected. Pay-back period 67 years at constant gas prices, 20 year lifetime. Economy could be satisfactory in serial production.

Energy produced per year: 4.5 toe (10 houses).

SE/156/81 - Centro Ricerche Macchine Tessili - I

The project is conceived for two operation modes:

Summer: Air conditioning and hot water production by an absorption heat pump, fed by solar concentrating collectors. Winter: Air-heating and hot water production directly by the solar panels. Supplementary heating by a conventional heating system. The project is still in the planning phase.

Estimated pay-back period: 25 years. The yearly operation time of the high temperature part of the plant will be short. Interesting application for hot countries.

Energy produced per year: 25.2 toe.

SE/160/81 - Usines Pernod - F

Heating and air conditioning of offices and industrial premises, using air-type collectors, greenhouses, storage of heat in concrete blocks, a heat pump; these systems serve various buildings (industrial premises, offices and restaurants) and supply domestic hot water to the restaurant. The Pernod plant is located near Lyon. The development of the heat storage system using concrete blocks should be monitored closely since it appears both simple and cheap.

Energy produced per year: 67.7 toe.

SE/163/81 - The Helix Multiprofessional Services - UK

2 semi-detached houses, one of them conventionally heated, the other:

- Construction as "home within a house" using the thermal mass of the wall
- Direct gains through southern front windows
- Active air collectors, storage in the walls
- Fresh air suction in summer by a gravity ventilation through the air collectors
- Conventional back-up heating system.

Construction is finished. Monitoring equipment will be installed in Spring 1982. The components are straightforward. Interesting comparison is to be made between conventional and the solar heated house.

Energy produced per year: 1.4 toe.

SE/179/81 - Solar Lodgings - UK

33 m² of collectors on each house, feeding 3 central heat stores: 1 for domestic hot water, 1 for space heating, 1 for excess heat. The project is not yet in construction, because the building site was not available.

Obviously there are no passive elements utilized in the design of the houses. All possibilities of passive solar utilization should be used before installing active devices. Advantage of the central heat stores: less heat losses. It will be very interesting to have a comparison between the results of a purely active solar house and an active - passive house.

Energy produced per year: 8.9 toe (9 houses).

SE/183/81 - Hotel Banghion - H

A period hotel has to be modernised. The central courtyard will be covered by a glazing thus serving as a greenhouse in winter and as a passive air conditioning

element in summer. Additionally, there will be an area of solar panels on the south-facing part of the interior side of the roof. The project is still in the planning phase.

The project is a very important effort to use passive solar elements in older properties in the Mediterranean. The design will be very difficult. Economy seems to be very favourable (payback period 15 years). The public impact will be high because of the great number of guests.

Energy produced per year: 14.2 toe.

SE/186/81 - Istituto Autonomo - I

Space heating of 5 houses (60 flats, 260 inhabitants) by passive solar utilisation. Greenhouses on the south-facing walls. Storage of the passive solar gains in the walls and in the floor. The houses are arranged on the site in such a way, that no house will be in the shadow of another one. The domestic hot water is prepared by flat plate collectors. The project is in the planning stage.

The project seems to be very well prepared and carefully designed. The payback period is estimated with less than 20 years.

Energy produced per year: 44.9 toe.

SE/199/81 - Bourneville Village Trust - UK

Two existing houses for old age pensioners are retro-fitted with two different types of flat-plate collectors for domestic hot water production. Surface areas: 44 m² and 113 m². Both of the houses have different heat storage systems.

The comparison between the two houses will be interesting, because the two projects are slightly different.

Energy produced per year: 3.0 toe.

SE/207/81 - Terme Etrusche - I

A new thermal bath centre will be built. The utilization of solar energy is foreseen for: - heating of domestic hot water; - heating of the water for the swimming pool; - mud heating for medical applications; - clay drying. Technical data: - 1 200 m² of flat plate collectors divided into 3 independent systems. The project is in a planning stage.

The design is made on the basis of well-proven technology. The necessary temperature is between 50° - 60°C. The investment costs are relatively high. The public impact will be high, corresponding to the great number of guests expected to use the centre.

Energy produced per year: 54.7 toe.

SE/216/81 - Three Solar Heated Houses - UK

Combination of passive and active solar utilization elements in three houses:
 - 30 m² of solar air collectors on each house - 4 m³ rock-stone consisting of bricks: - greenhouse elements for passive heat gains.

Domestic hot water preparation by the solar installation.

The plant is a well designed combination of greenhouse elements in front of the south-facing living-room, and of active air collectors at the walls of the rarely used second floor room. The payback period is estimated to be reasonably shorter than the plant's lifetime.

Energy produced per year: 1.43 toe (3 houses).

SE/228/81 - Unione Piemontese - I

The use of active and passive solar technology will reduce energy consumption in buildings by up to 60%. The project is the first step in developing large scale solar technology for residential buildings. Passive part: Careful arrangement of the buildings on the site with respect to the shading effects between the buildings. Careful design of windows and insulation. Greenhouse elements.

ii) Active part: air collectors to preheat ventilation air.

It is very important to develop a solar technology for large scale buildings.

The project seems to be very carefully designed. The payback period is estimated to be shorter than 15 years.

Energy produced per year: 263.7 toe.

SE/235/81 - GEC Power Engineering - UK

250 m² of evacuated tube collectors are providing hot water for kitchen use in a factory. The collector circuit is connected with the factory's high pressure water system. (100% solar rate in summer). Collectors are currently being tendered for.

Well-proved technology, medium payback periods. Good example for consequent integration of solar energy.

Energy produced per year: 11.9 toe.

SE/237/81 - "Sol og Vind" - DK

27 single family houses and a communal building are using passive energy conservation elements as far as possible. The active system consists of 640 m² of solar collectors of two heat-stores with a volume of 45 m³ and 28 m³ and of a wood-furnace. The storage tanks are situated in the centre of the "Village".

Construction was finished in September 1981. The project is one of the first centralized applications of solar energy for a great number of houses. The thermal storage losses will be low because of using only two great storage tanks, but the heat losses will increase due to the long distances between collectors and storage. The pay-back period is estimated to be 25 years.

Energy produced per year: 12.5 toe.

2. Agriculture

SE/04/79 - Azienda Floreale Diem - I

A greenhouse for seedling growing of pot plants is heated with solar energy. The air collectors are mounted above a pebble stone bed which is used for energy storage. The greenhouse was additionally insulated with double glazing (polyacryl). The installation is almost 100% self sufficient. The project is partially finished, namely the small demonstration (271 m² greenhouse) and the planning of the 800 m² greenhouse. Very well designed application of solar energy for greenhouse heating. Short pay-back period. Insulation of greenhouse has to be done before applying such a system.

Energy produced per year: 24.4 toe.

SE/14/79 - Sassari - I

Agricultural by-products are chopped, ground, dried and processed into pellets. The electric and heat energy for the drying process and the pellet production is provided by two different solar installations:

- 60 m² of flat plate air collectors heat the air for the drying process. Heat can be stored in a pebble stone bed. Collector outlet temperature is 60-80°C.

- Electric energy is produced by a turbine-driven 5 kW generator. The turbine is part of thermodynamic circuit, which is heated by 48 m² of concentrating (Fresnel Lens) collectors.

The construction of the plant was finished in October 1981, but some parts of the electric generator section are still missing or defective. The drying section of the plant is in satisfactory operation. There are reasonable economic results to be expected. The power generation section demands very high investment costs.

Energy produced per year: 10.9 toe.

SE/15/79 - Adelskam Wine Farm - I

200 m² of concentrating collectors are generating process heat for the following processes:

- Wine cooling by means of an absorption chiller (required temperature 120°C)
- Wine pasteurizing (required temperature 120°C)
- Bottle washing (80°C)
- Space heating (80°C).

The project is not yet in construction because of problems with the purchase of a suitable absorption chiller. The plant is designed on a high technological level and therefore careful planning and a well-trained maintenance staff is necessary. The pay-back period is long (26 years), because the plant is designed to provide almost 100% of the process energy demand. Under conditions of a lower solar percentage a better pay-back could be expected.

Energy produced per year: 7.1 toe.

SE/123/79 - IMAG - NL

Solar-heated water for livestock rearing.

Air-type solar collectors linked to an air/water heat exchanger produce hot water to dissolve the milk powder used to feed 600 calves. Anticipated solar gain: 42 000 kWh/yr, i.e. 54.5% of requirements. In view of the poor efficiency of air/water exchangers, the use of air collectors for water heating is not the best solution. The solar panels were poorly dimensioned and had been damaged by a storm. Considering also the economic difficulties in rearing calves, the investment seems to have been misplaced. Nevertheless, in view of the significant energy requirement, an installation using water-type collectors could have yielded good results.

Energy produced per year: 3.6 toe.

SE/125/79 - IMAG - NL

Solar heating of a methane digester.

Glazed flat-plate collectors produce hot water which is used to maintain the optimum temperature in a tank producing methane from pig slurry. Solar gain: 125 000 kWh/yr for a total collector surface of 600 m². The tank "digests" 10 to 15 m³ slurry per day.

The operation of a biodigester is fairly complex, involving the interplay of several parameters. It may well be that a solar installation with a variable output will further complicate a system which is still at a somewhat experimental stage. Generally, part of the gas produced by the digester is used for reheating purposes which reduces investment cost. Since the installation is still being developed, its cost-effectiveness cannot be assessed.

Energy produced per year: 10.8 toe.

SE/188/81 - University of Perpignan - F

Solar-heated crop drier.

A fruit-growing cooperative in the Eastern Pyrenées uses 22 m² of air-type collectors to heat the air in a fruit and vegetable drying tunnel. Output: 5-10 tonnes per day. Back-up heating system: variable resistance elements totalling 10 kW. The University of Perpignan designed and provided the instrumentation for the unit.

The method uses a fairly abundant local resource, (i.e. the sun) to provide low-temperature warm air. Crop drying accounts for 10% of the total direct energy consumption by agriculture in France, i.e. 500 000 toe in 1980 (source: Agence pour les Economies d'énergie).

The University of Perpignan project will provide more detailed information about the behaviour and efficiency of such systems.

Energy produced per year: 1.2 toe.

3. Industry

SE/09/79 - "Multi-Flash" Desalination Plant" - I

Parabolic trough collectors are used to generate pressurised water at 90-100°C.

The multi-flash desalinator was tested before being installed on the Island of Lampedusa, to the south of Italy. The plant did work for testing during several months in 1981. It has to be redesigned for future use. The field of application of desalination with solar energy has a high potential.

Energy produced per year: 21 toe.

SE/176/81 - AGIP Nucleare - I / MAN - D

1 728 m² of parabolic concentrating collectors are heating a thermal oil circuit. Steam production by means of a heat exchanger. Collector outlet temperature: 280°C. Two axis suntracking system. Supplementary heating by an oil-fired steam boiler. The project is in the engineering and manufacturing phase.

The technology of the plant is very complicated. The mirrors are very sensitive to dust. High maintenance. Poor economy. Economy may improve slightly under conditions of serial production.

Energy produced per year: 108.9 toe.

SE/182/81 - Tecnotessile - I

100 m² of evacuated tube trough-type collectors are producing steam for a textile factory. Collector outlet temperature: 220°C. Two heat stores of a relatively small capacity, because the solar-produced steam is continuously used to supplement the conventional heating system. The project is in the engineering phase.

The technical concept is good. Solar gains can be used immediately without great storage volumes. Long payback period.

Energy produced per year: 6.9 toe.

SE/185/81 - La Metalli Industriale - I

Treatment of industrial effluent. Oil-in-water emulsions - polluting residues from the engineering industry - are heated, via a heat exchanger, by hot water produced by glazed flat-plate collectors. The emulsions are then passed to an evaporation column where they are concentrated and their volume considerably reduced, producing an oil which is sufficiently concentrated (99%) to be used as a fuel. The plant is designed to treat 400 m² emulsion per year. The contract is being negotiated.

The principle is interesting and deserves more detailed technical study. The

industrial uses for low and medium-temperature heat are numerous, disparate and poorly understood. They represent a significant proportion of a country's energy consumption.

Energy produced per year: 1.4 toe.

SE/222/81 - Production of process heat - I

Production of thermal energy by the conversion of solar energy collected by 48 trough-type collectors with a total surface area of 168 m². The value of this installation, which is incorporated in an operational industrial plant, is that it will enable the true efficiency of this system to be assessed.

Energy produced per year: 10.4 toe.

SE/227/81 - Voldadige Brick Factory - I

A new brick drying plant is planned with a wide integration of energy conservation and solar energy: 700 m² of air collectors will preheat the air (max. 80°C) for the brick drying and brick kiln process. Heat storage by the clay depository itself. The project is in planning stage.

The project is an excellent example for the possibilities of industrial energy conservation, combined with an efficient low-temperature utilization of solar energy.

Energy produced per year: 66.6 toe.

4. Swimming Pools

EE/61/79 - Uchaud Swimming Pool - F

Heating of a swimming pool and sports facilities.

Solar heating of an open-air swimming pool and a gymnasium. Production of hot water for the showers. Glazed flat-plate collectors, 15 m² hot water storage tank, anti-freeze/water exchangers, gas back-up heating.

Gymnasium (with roof-mounted collectors) due to be completed at the end of 1982. Work on the swimming pool due to begin at the beginning of 1983 as soon as municipal funds received. Total investment (collectors plus storage facility) is FF 2 541 per square metre of installed collector. A systematic attempt should be made to harness the same installation for two complementary uses (heating of

the swimming pool in summer and of the gymnasium in winter) in order to get a better return on the water-type collectors. It is planned to cover the swimming pool at night. The payback on this project may make it a test case since it involves the optimum use of glazed flat-plate collectors (year-round use, fairly large scale facility, sunny area, proven techniques).

Energy produced per year: 25.5 toe.

SE/126/79 - Bundesinstitut für Sportwissenschaft - D

Rational use of energy in the construction of swimming pools.

Various energy saving concepts are demonstrated in three different public swimming pools (Stadtsteinach, Unna, Ahaus). Pool cover, heat recovery and solar energy. The collector's surface is equal to the pool's surface. Four different solar systems are demonstrated, glazed, closed loop, unglazed with heat pump, glazed open loop and unglazed open loop.

The fitting of the solar systems will start in May 82.

Advanced overall technology, rather expensive, collector surface to pool surface rather large. Extensive monitoring system should yield exact results for pool's energy consumption and supply.

Energy produced per year: 147.8 toe.

SE/P/3/81 - Indoor Swimming Pool - B

Heating of one of two indoor swimming pools and hot water for showers; surplus heat is fed into the air system. Two fields of single glazed collectors with selective copper absorber. Closed loops with heat exchangers. Comparison between solar and conventional energy for pool heating is possible.

Energy produced per year: 16.4 toe.

SE/P/4/81 - Indoor Swimming Pool "De Thermen" - NL

Solar heating of an indoor swimming pool during the warm season. Plastic unglazed collectors (FAFCO USA). Two fields 45° and 60°. Total area 578 m². The back of the panels is covered with corrugated plastic sheet, as support and wind protection. The collector's surface is appr. 90% of the pool's water surface. The solar plant is installed, the monitoring campaign will start in May 1982.

An adequate technique for heating a swimming pool is used. The investment costs are relatively high due to the collector's subconstruction.

Energy produced per year: 27.8 toe.

SE/P/13/81 - University of Exeter - UK

Data-logging at a solar-heated swimming pool. Open-air pool measuring 10 x 25 m, operating since 1978 and open from May to September. Polypropylene tubes sunk in the asphalt of a tennis court represent an original type of solar collector, the efficiency of which is to be measured. The swimming pool, which, for 1 140 hours of the year is heated by gas to a temperature of 24°C, consumes 180 000 kWh per season (no insulating pool cover).

It is planned to cover the pool in order to reduce heating requirements. The payback period for the solar installation should be between four and five years. The request for EEC financing relates only to the instrumentation and experimental monitoring of the system over two years by the University of Exeter. Several swimming pools go to make up the sports centre, which also includes tennis courts. If the collector monitored under this project functions properly and at reasonable cost, it would provide a neat solution to the problem of the amount of land needed for water-type collectors used to heat open-air pools.

Energy produced per year: 2.5 toe.

SE/P/17/81 - Piscine de Plein Air - B

Single glazed flat-plate collectors are used in a closed loop to heat the pool water supply, hot water to the showers and to a 100 m³ storage tank. This tank can be used by a heat pump as a source of low temperature energy. Total solar surface 2 100 m². The extensive monitoring system should yield good results. The solar field is installed. The monitoring system will run from May 82 onwards.

The high quality collectors used may be too expensive to be economically viable for this kind of application.

Energy produced per year: 86.4 toe.

SE/P/18/81 - Project by the General Secretariat for Sport of the Greek
Government - H

Three solar-heated pools in Greece.

Three outdoor olympic pools (25 m x 50 m), open throughout the year and built between 1974 and 1978 and heated by oil, are in future to be heated (showers included) by between 1 800 and 2 600 m² glazed flat-plate collectors operating in an open system.

Solar energy contribution: 590 264 to 820 030 kWh/yr (70 to 87%).

Back-up heating: electricity (pump) and existing boiler - all the pools are fitted with a wind-break during the winter and will have an insulating cover at night. Basic payback period is between 6 and 7.6 years. This project is the first example of EEC aid being requested by Greece. If the project is successful, the fact that it has received EEC support should have a considerable impact on the future pattern of aid applications in Greece.

Energy produced per year: 176.9 toe.

SE/P/19/81 - Commune of Verona - I

Heating of the pool water, showers and general space heating of the indoor pool at Verona by means of a total of 750 m² of Pirelli solar collectors. A number of energy-saving devices have been linked to this solar installation, i.e.: heat recovery units, heat pumps, radiant heaters. The feasibility study has been completed and is in the ready for signature. Work should begin shortly.

This is an excellent and well-designed project and those responsible (CREAIES) appear fully to have overcome the difficulties. The extensive data-logging programme planned should yield vital information on the true viability of the system.

Energy produced per year: 41.8 toe.

SE/P/20/81 - Robinson - UK

Eight solar-heated swimming pools.

Eight pools are to be fitted with Robinson unglazed collectors to heat the pool water primarily during the summer. The total insolation between April and September is 713 kWh/yr (KEW weather station). The annual solar gain is 808 MWh for a total collector surface of 1 704 m² (total volume of the pools is 4 782 m³; each year, 870 000 visitors will use at least one of the eight pools).

Low-cost unglazed collectors are particularly suitable for the summer-time heating of swimming pool water. The average payback period is six years (2.7 - 11 years) which is satisfactory.

Energy produced per year: 69.5 toe.

SE/P/22/81 - Eton College Swimming pool - UK

The project concerns the instrumentation and experimental monitoring of a solar-heated pool which is covered during the school year and is already equipped with a solar-heating system. Solar gain: 32 000 kWh/season, i.e. 14.5% of the pool's heating requirements (approximately 9% of total requirements); the pool has an insulating cover over it at night.

Energy produced per year: 2.8 toe.

SE/P/23/81 - Albertslund "Badesøen" - DK

Solar heating of outdoor swimming pool with unglazed plastic collectors (ROBINSON, UK). The pool will not be covered by night (circular pool with an "Island"). The collector area of 1 612 m² will be approx. 60% of the pool's area. The collectors will be mounted on nearby roofs at an angle of 25° facing East/West. Extensive monitoring system planned. Unfortunately, the shape of the pool is such that it can not be covered.

Energy produced per year: 51.6 toe.

SE/P/25/81 - Electricity Supply Board - IRL

Indoor pool.

The pool, located in Dublin, measures 10.5 x 25 m and is open throughout the year; since 1979, it has been heated by an air/water heat pump operating on exhaust air. Electrical back-up heating for showers, pool and space heating. It is planned to save 8% on the total energy consumption by installing flat-plate solar collectors in series to heat the incoming water supply.

Energy produced per year: 3.7 toe.

SE/P/26/81 - Horsens - DK

Heating of an open-air swimming pool with unglazed plastic collectors (ROBINSON UK). Outside the swimming season the pool serves as an energy source for a heat pump. The latter will supply an indoor swimming pool with energy during October, November and March, April.

The system is not optimized concerning pool's surface (1 050 m²) and collector's surface (300 m²) which is 3/10, it should be 5/10 - 7/10.

Energy produced per year: 8.6 toe.

SE/P/29/81 - Stichting Sportfondsenbad Amersfoort - NL

The water of a large indoor swimming pool (200 m³/d) is preheated by unglazed polypropylene collectors. As the water temperature from the mains is 9-10°C, the energy gain is boosted if the ambient air temperature is higher (April-October).

A simple and useful application for preheating large quantities of cold water. Potentially high public impact (600 000 visitors per year).

Energy produced per year: 18 toe.

SE/P/30/81 - Stichting Zwembad Gouderak - NL

Solar heating for an outdoor swimming pool. Unglazed plastic collectors (ROBINSON UK). The pool is covered by night. 344.6 m² collector surface is equal to 50% of the total pool area. Simple monitoring system planned. The adequate technic for summer swimming pool should yield economical results.

Energy produced per year: 24 toe.

E/P/31/81 - Agip petroli - I

Heating of the water for an indoor pool and showers by means of 229 m² of solar collectors (with selective surface). Priority is given to the heating of the pool water. The feasibility study is nearing completion.

The project is well designed but the choice of selective surface collectors seems inappropriate in view of the temperature requirements of the pool.

Energy produced per year: 10.3 toe.

SE/P/32/81 - Ronciglione swimming pool - I

Solar heating of the two pools and showers at a new indoor swimming pool by means of 330 m² of liquid-type flat-plate collectors linked to a water-to-water heat pump and heat-recovery units which extract heat from the waste water. Space heating is provided in equal proportions by a heat pump which extracts heat from the exhaust air and by the direct solar gain from skylights in the roof.

A complex but well-conceived installation. The use of an auxiliary heat pump is very promising. The data-logging programme is very extensive and will be carried out by a competent centre.

Energy produced per year: 13.6 toe.

SE/P/33/81 - COMES - F

24 swimming pools.

COMES is acting as Contracting Authority on behalf of 24 French communes in response to the calls for submission of projects concerning the solar heating of swimming pools. The pools are divided up as follows: 17 open air; 3 mixed and 4 indoor pools. All the preliminary studies have been carried out by the Technip Consultancy Bureau; the Veritas Bureau is responsible for the data-logging programme. The solar-heating method used for open-air pools involves the use of low-cost, unglazed plastic collectors which offer an excellent economic return. For the indoor pools, glazed collectors have been used; even here, the economic return is good in view of the low operating temperatures and the simplicity of the systems used (the pool acts as a heat store). The design of the installations and the robust technology involved make the project highly suitable for demonstration purposes. The five and a half year payback period (of the solar installations alone) ensure a high economic return on the project. Since the majority of the pools are open to the public, the impact on the public at large is likely to be very effective.

Energy produced per year: 215 toe.

SE/P/35/81 - Torvecchia swimming pool - I

School and public swimming pool with recycled supply; roof and southern facade retractable. Three pools (1 111 m²; 24-26°C) are heated by 450 m² of Yazaki selective surface solar collectors. The annual heating requirements of 1 705 MWh for the pools are met as follows: 31% by heat exchangers located on the filtration circuit; 16% by the solar collectors and the remainder by an oil-fired boiler. In summer, the collectors supply 28 MWh for the showers, i.e. a total solar gain of 280 MWh/year.

The stated overall payback period of seven and a half years is accurate.

The covering of the pool and the recovery of heat are highly efficient devices which may mask the poorer returns on the expensive and fragile selective surface collectors.

Energy produced per year: 23.8 toe.

SE/P/41/81 - Bundesinstitut für Sportwissenschaft - D

Rational use of energy in the construction of swimming pools.

Various energy concepts are demonstrated. (see SE/126/79). Two additional pools are chosen, Uelzen North; Ihringen South-West.

The estimated costs for heat recovery systems are high. In reality they might come down at least for the solar part.

Energy produced per year: 520 toe.

SE/P/43/81 - Commune of Urbino - I

Heating of the pool and shower water in an existing indoor pool measuring 25 x 10 m (306 m²) by means of a solar heating installation comprising 234 m² of glazed solar collectors. Supplementary heating provided by an oil-fired boiler. There are two storage tanks for domestic hot water.

The feasibility study is nearing completion. The design of the installation is satisfactory and the overall payback period should be about 10 years which is normal for the type of technology involved.

Energy produced per year: 16 toe.

SE/P/46/81 - Naples Municipal Swimming Pool - I

It is planned to install 2 100 m² of Pirelli rubber absorber collectors, 1 300 m² of which are unglazed, to heat the indoor municipal pool at Naples. The solar gains more than cover the total heating requirements of the pool. The excess heat gain could be used to heat the shower water at a nearby sports centre. The collector array is too big, which reduces its efficiency and hence its economic viability. No details have been given as to whether other effective measures to reduce consumption have been taken (covering of the pool, exchanger to recover heat from exhaust air, etc) which would have allowed of the use of a smaller collector surface area.

Energy produced per year: 105.6 toe.

PHOTOVOLTAIQUESE/017/79 - Officine Galileo - I

The objective is to demonstrate how a 30 kWp photovoltaic generator embodying concentrating devices can provide power for an agricultural cold store for cut flowers and heat for a greenhouse.

The generator consists of 28 1.1 kWp modules, each comprising 7 plano-parabolic reflectors of 2.5 m aperture x 1 m long, giving a theoretical concentration of x 25. The photovoltaic receivers are modular elements 2.1 m long, each consisting of two parallel series strings of 40 specially designed solar cells bonded to an actively cooled heat sink, to maintain them at a temperature of 75-80°C. Each 2-module unit is rotated during the day about an inclined N-S axis to follow the sun. The system includes 1-day battery storage, a dc/ac inverter and monitoring equipment.

Initial design of all generator components and sub-systems completed.

Other than the solar cells, all components are ready for the construction of 4 kWp prototype for design qualification. But only 1 kWp of solar cells are available and Ansaldo, the suppliers, do not wish to manufacture any more.

Because of the difficulties of solar cell procurement and serious technological problems with the concentrating system, it is unlikely that the project as it stands can be brought to a successful conclusion. In retrospect, a flat-plate array would have been a better choice. Such an array providing power for an agricultural cold store, would be a good demonstration, having the necessary elements of innovation, good publicity impact and good market potential in the near future. Energy produced per year : 22.3 toe.

SE/028/79 - Katholieke Universiteit Leuven - B

The objective is to demonstrate the use of photovoltaic solar energy conversion to charge the batteries of an electric car.

A 1.8 kWp flat-plate photovoltaic array installed at a test site on the University campus charges the batteries of a 5-seat electric car throughout the day.

During the night, the car is used for security patrol purposes on the campus, travelling a total distance of about 35 km. The system includes a simple battery charge control unit, a facility for switching automatically to the grid supply when there is insufficient solar energy and a comprehensive data monitoring system.

About three-quarters of the solar cells have been made by the University but no modules have yet been assembled. The car has been delivered, the array structure and the shell of the control room built and the monitoring equipment is available. Delays have been due to problems with cell development and manufacture, the withdrawal of ENE, who were to have assembled the modules, car procurement difficulties and planning delays. The expected completion date is now 1 June 1982.

Despite the delay, this could be an interesting and successful demonstration of the use of solar energy in electric vehicles which are not in use during the main part of the day. The concept is far from commercial viability at present but could find future application in sunnier countries, provided solar cell costs continue to fall, fuel cost to rise and the performance and range of electric vehicles are improved.

The solar cells have many innovative features, designed for high performance and low cost. Energy produced per year : 0.5 toe.

SE/077/79 - Elf Aquitaine - F

The objective is to demonstrate the use of a photovoltaic solar water pump with microjet distribution to irrigate a plot of land in southern France and evaluate its effects on water consumption and crop yields in comparison with conventionally irrigated and non-irrigated plots.

A 924 Wp flat-plate photovoltaic array supplies current to a dc electric motor driving a 5-stage centrifugal pump, which transfers water from a borehole to a 30 m³ overhead storage tank. Water from the tank is fed through manually operated valves to an experimental micro-irrigation network, which waters a 6.000 m² plot of land, divided into four sections. The experimental plot is adjacent to a 7.400 m² conventionally irrigated plot and two 400 m² non-irrigated plots. Data from all the plots are transmitted to a centre in Toulouse by satellite.

The installation was completed in 1979 and was monitored with maize crops in 1979 and 1980. For economic reasons, a change was made to asparagus in 1981. Because this takes two years to mature, no data were gathered in that year. It is proposed to continue monitoring until 1985. The project has aroused interest among agricultural research centres in France and has been visited by authorities from developing countries.

The plant has worked well, except for a single failure in 1980 (breakage of the pump drive shaft). Which caused a week's shut-down. Had it not been for this, the solar pump would have supplied about 80% of the 1.012 m of

irrigation water required during the growing season. It has been shown that irrigation increases crop yields by a factor of more than 3. The preferred microtube system produces more maize and uses only about one fifth of the water consumed by the conventional sprinckler system. A well conceived, well executed project, which is demonstrating an application of photovolatics which may soon be economically viable, particularly in developing countries. The investigation and development of more efficient irrigation techniques is an important element of the project.

Energy produced per year : 0.3 toe.

SE/146/81 - Rijksuniversiteit Gent - B

The objective is to investigate the technical, economic and safety aspect of operating a 5 kwp grid-connected photovoltaic generator, supplying a simulated domestic load. To demonstrate the system to the public.

A 5 kwp flat-plate photovoltaic array, installed in a public place near the centre of the town, connected to an artificial load simulating the electrical requirements of an average 4-person Belgian household and with facilities for taking back-up power from the grid and feeding excess power to it. The system includes a 3-day storagd battery, a dc/ac inverter and data monitoring equipment. The array voltage and tilt angle are adjustable for experimental purposes.

Work is in the early stages, the contract having been signed only three months ago. The electrical design of the system is complete. Modules and batteries have not yet been ordered, although suppliers have been selected. The array structure has yet to be designed and two experimental types of inverter, PCR and PWM, are still under development. The system, complete with monitoring equipment, is not expected to be fully operational until the end of 1983.

If well executed, a good demonstration project, providing an excellent opportunity to study the technical, economic and safety aspects of small, on-site, grid-connected solar generators. Has many innovative features, notably the low-cost solar cells developed by the Catholic University of Leuven and the Gent inverters. Inclusion of such features incurs a certain risk and it reamains to be seen whether the hardware will prove to be reliable.

It will probably be many years before roof-top solar cell arrays become economically viable for grid-connected residences and in Europe there are many non-technical obstacles to overcome before a market can be established.

Energy produced per year : 1.1 toe.

BIOMASSSE/054/79 - Plessis Belleville - F

This is for the installation of a new type of fluidised bed gasifier using flax waste. Use of the large quantity of material available could save up to 364 t/y conventional fuel, making the plant self-sufficient in electricity and oil and allowing a considerable off-site sale of electricity. Gasification as an alternative to combustion is applicable to a very large dry crop residue resource in the Community. The technology is well developed, and commercial plant is available and highly appropriate for demonstration in this context.

The scheme has good economic prospects in the french agricultural-industry context with a substantial potential national and Community market for the equipment. There is a possibly larger overseas market in developing countries and part of the research supporting this project has been promoted with that prospect in mind. Energy produced per year : 364 toe.

SE/100/79 and SE/205/81 - Bord na Mona - Phases I and II - IRL

This very large project is for the establishment of 600ha of short rotation forestry, development of management and harvesting systems, and the conversion of a power station to utilise the material. The project target is for the supply of 15,000 t/y of short rotation forestry and supplementary material to supply a 5 MW generating system forming an element in the national electricity supply. The project is largely based on the unique opportunity presented in Ireland by very extensive peat-lands, but it will be an crucial demonstration of the concept of energy plantations, applicable to other land-types in the Community and elsewhere.

It is supported by extensive long-term research and development which is now being scaled up to a commercial-sized operation. The main demonstration is of the overall concept as the component techniques do not involve

any drastically new developments. Economic prospects are in-line with those of comparable peat extraction schemes, which, in the long-term, short rotation forestry is expected to replace. Energy produced per year : 1040 toe.

SE/111/79 - S.E.S. - I

This is a demonstration of renewable energy systems, of which the main elements are a biogas plant and solar collectors, integrated into farm production systems to provide a large proportion of the energy requirements. The biogas digester uses cattle waste and electricity and hot water are provided for drying units, aquaculture and greenhouses as well as for general farm requirements. Total contributions of about 50 toe/y are obtained for a reasonable investment cost and repayment time.

The demonstration uses commercially available equipment to utilise what are major potential sources of alternative energy for Community agriculture. Both digester and solar thermal technologies are at a suitable state of development for demonstration and of reasonable pay-back times will assist the expansion of the market for commercially available equipment. Energy produced per year : 53.4 toe.

SE/145/81 - A.I.R.D. - B

The scheme is to carry out trials of digester technology using new materials and methods and to extend this work to the construction and operation of six, relatively small-size, digester installations in working environments using a variety of animal wastes as feedstocks. This will assist in the demonstration of cost-effective biogas technology applied in different situations, some having considerable additional environmental and waste disposal benefits. The proposers have long experience in this work.

The scheme is concerned with a key area of bio-energy development and, in animal waste, with a major energy resource in the Community. As such it should promote biogas technology in general and the associated market for equipment and engineering services. Energy produced per year : 180 toe.

SE/177/81 - Baring-Asperup Co-operative - DK

The project is for a community energy scheme the main item of which is a district heating network supplied to a large extent by a biogas digester

and solar collectors but including other alternative energy techniques including wind and combustion of wastes. It could supply 700 to 800 toe/y; it exploits the large European biomass energy opportunity in animal and crop wastes, and is particularly appropriate to Danish conditions.

The state of art in component systems is well developed and they are appropriate for scaling-up to this level. The low temperature distribution system may be a considerable innovation. Prospects for economic operation are good and a successful demonstration will considerably boost the market for the various alternative energy system components and systems engineering. In the wider context the demonstration of a large measure of self-sufficiency at a community level will have important implications to energy policy both nationally and in the Community. Energy produced per year : 619 toe.

SE/194/81 - Société d'Énergie Électrique de l'Est - F

The project is for the installation of a very large generating capacity based on the combustion of sugar cane residues (bagasses). By utilising the large bagasse resources available, not only will the energy requirements of the processing factory be met, but a large contribution can be made to the public electricity supplies of the island of Réunion. The substitution of over 10,000 toe/y of fuel is proposed by the application of well-proved technology and short pay-back times are envisaged. There is considerable scope in the developing countries for this kind of approach and energy supply strategy, using cane or other crop waste at a large scale. Energy produced per year : 11.750 toe (47.000 MWh el.).

SE/200/81 - Ansaldo Impianti - I

This is a large digester utilising cattle waste contributing fuel savings of 160 toe/y or so and supplying most of the farm needs for hot water and electricity. Surplus electricity in the summer months is used for irrigation in this way removing some of the problems of imbalance of supply inherent in digester technology in Europe. In cattle waste the scheme uses one of the largests and most immediately promising biomass energy resources in the Community and is of a size which should guarantee economic feasibility. Investment costs per prospective toe saved per year are low and there is a good pay-back time.

As is the case with other digester programmes the state of art of the technology is appropriate for it to be applied in practice at large scale. There is a large number of cattle units in the Community of sufficient size to justify installation of digester units which also have waste disposal advantages. Developments of equipment and systems are expected to reduce the minimum economic size of the units for which digesters can be justified, thus rapidly expanding the market for equipment and systems engineering. Energy produced per year : 49.9 toe.

SE/220/81 - Marshall - UK

The scheme will burn poultry litter in a specially adapted boiler to produce the heating requirements for 20 per cent of the units of a large chicken-rearing enterprise. It is projected to save 1500 t of conventional fuel a year in this way. This large energy contribution is for a relatively low cost and consequently a short pay-back time of less than 4 years is projected. The state of technical development gives little cause for concern as modified standard equipment is to be used. With poultry waste the project addresses a more limited resource base than cattle waste, but there are numerous opportunities for extension throughout the Community. Such a practice could have a considerable impact on the profitability of the poultry industry and expand the market for specialised boiler equipment. Energy produced per year : 1500 toe.

SE/226/81 - Azienda "Il Prato" - I

This is a demonstration of a digester system using poultry waste with the biogas used for electricity generation supplying most of the farm needs. Hot water from the total energy modules will also supply a proportion of farm needs for this, including for heating greenhouses that are included in the system. Total energy contributions could be as much as 125 toe/y. The project is in the high-potential area of digester technology, though poultry waste is a relatively small component of total Community waste resources. The extensive R & D base in anaerobic digestion includes work on chicken manure and the technology is ready for demonstration at farm-scale. Successful demonstration could lead to considerable cost-saving in agriculture in general, and this is particularly important in this and other regions of Italy. Energy produced per year : 760.5 toe.

SE/231/81 - Reveninge Co-operative - DK

This is a large, multi-unit biogas system established on a community basis with its own gas distribution system. Over 300 toe/y are expected to be generated contributing towards the self-sufficiency of a 300-strong community. The scheme shows an original feature in proposing to be inter-connected with the national natural gas distribution network for back-up purposes. The scheme will use part of the large supply of digestible farm and other waste available in the Community. R & D in digestion is well advanced in Denmark and demonstration at this particularly large scale, using mixed materials in modular units is particularly appropriate.

There are good prospects for economic viability as oil prices rise and there are major implications to national and Community energy strategies if a high degree of self-sufficiency can be demonstrated. Energy produced per year : 322.5 toe.

SE/234/81 - B.M.A. - D

This demonstration is of a new form of pigsty utilising the animal wastes, solar heating, and heat recovery and exchange technology to supply a large part of its own needs for temperature control and electricity. The lightweight construction closely integrates all elements necessary for pig-rearing and optimises energy aspects. The total energy production from biomass is small, partly due to the low energy needs inherent in the system. Pig slurry is one of the most amenable materials for digestion and represents a considerable and readily useable resource in the Community. There are unique features in the project in combining the biogas system with other energy conservation techniques. The energy conservation aspects are just one of the elements of this new approach to pig-rearing which could lead to a major new market if the demonstration is successful. Energy produced per year : 19.5 toe.

SE/240/81 - C.E.A. - F

The project aims to develop techniques for the production of potential energy crops using industrial waste heat and solar heating in double-wall greenhouses, with most of the facility already provided. The techniques require close climatic control with air temperature regulation and soil heating with closed ventilation and heat recovery.

There is considerable potential in Europe for the development of low-grade industrial waste-heat sources and combined with solar heating this makes an interesting prospect. The energy conservation aspect is in the saving of conventional fuel in the conduct of the trials, and in the longer term in the possibility of producing economically feasible energy crops by these methods. Markets may arise for the new system in horticulture in general if the demonstrations are successful. Energy produced per year : 3.13 toe.

ALTERNATIVE SOURCES: GEOTHERMAL ENERGY

<u>CONTRACT NO</u>	<u>PROPOSER</u>	<u>SECTOR</u>	<u>PAGE</u>
GE/01/79	AGIP	Electricity	80
GE/02/79	AGIP	Space heating	76
GE/03/79	ENEL	Electricity	81
GE/04/79	ENEL	Electricity	80
GE/05/79	DANSK OLIE AND NATUR- GAS A/S	Space heating	76
GE/06/79	GOM/ANTWERP	Heating of glasshouses	79
GE/08/79	EPA VILLE NOUVELLE DE CERGY PONTOISE	Space heating	76
GE/09/79	GEOVAL	Heating of glasshouses	79
GE/10/79	VILLE DE JONZAC	Space heating	76
GE/11/79	SOCALMIG	Space heating	77
GE/12/79	OFFICE PUBLIC D'AMENA- GEMENT ET CONSTRUCTION DE L'OISE	Space heating	77
GE/15/80	INTERCOMMUNALE IDEA	Space heating	77
GE/16/80	SOGECLER	Space heating	77
GE/17/80	SBRU	Space heating	77
GE/18/80	AGIP	Electricity	80
GE/19/80	CAGG	Heating of glasshouses	79
GE/21/80	AGIP	Space heating	78
GE/29/80	ENEL	Electricity	80
GE/31/81	PPC	Electricity	80
GE/46/81	SAHLM "LA GIRONDE"	Space heating	78
GE/63/81	ENEL	Electricity	81
GE/64/81	SEDMA	Space heating	78
GE/67/81	SAULGAU	Space heating	78
GE/69/81	SOUTHAMPTON CITY COUNCIL	Space heating	78

(a) Space heatingGE/002/79 - AGIP - I

The production and reinjection wells are now complete. Although the flow-rate and temperatures have proved lower than forecast, the deposit is nevertheless exploitable. The extremely high salinity could cause unexpected corrosion and erosion problems. A way must also be found to recover the substantial amounts of methane dissolved in the fluid and the reliability of the submersible pump under those conditions also remains to be assessed. In conclusion, the initial results have been relatively satisfactory, even though certain problems remain to be solved.

The field is expected to be exploited at 60 m³/h and 66°C. Expected yield: 850 toe/year.

GE/005/79 - Dansk Olie and Naturgas A/S - DK

The production well is now complete. Technical and geological problems have ruled out exploitation of the primary target; however, a secondary, less promising, reservoir closer to the surface is suitable for exploitation. Consequently, the best results which can be expected will fall short of the initial highly optimistic targets.

The geothermal fluid obtained has proved highly saline.

The secondary reservoir is expected to be exploited at 80 m³/h and 74°C once the reinjection well has been completed. Expected yield: 1 720 toe/year.

GE/008/79 - EPA Ville Nouvelle de Cergy Pontoise - F

The production and reinjection wells have now been completed. Although the primary target cannot be exploited, a promising exploitable reservoir has been struck in a secondary target area closer to the surface. Results to date have been encouraging. Partial exploitation has already commenced and the possible benefits of installing heat pumps to increase the energy savings are also to be assessed.

The field is expected to be exploited at 175 m³/h and 55°C. Expected yield: 2 800 toe/year.

GE/010/79 - Ville de Jonzac - F

The production well has struck exploitable reserves, though with a lower flow-

rate than forecast. This slight setback has been counterbalanced by exploiting the field without reinjection but with a heat pump coupled with other renewable sources of energy instead. Initial exploitation without a heat pump started in 1981. The field is now being exploited at 40 m³/h and 65°C.

Expected yield: 910 toe/year.

GE/011/79 - SOCALMIG - F

The production well has now been completed. It proved impossible to tap the primary target for technical rather than for geological reasons. No assessment could be made of the exact potential of the reservoir because the drilling operations were badly conducted. The field is not expected to be exploited.

Possible yield: 550 toe/year.

GE/012/79 - Office Public d'Aménagement et Construction de l'Oise - F

The production and reinjection wells have now been completed. The results obtained are appreciably higher than forecast. Despite the addition of a hospital to the grid, the potential still exceeds current requirements. Further studies into ways of stimulating consumption have led to slight delays in the construction of the supply lines. The well is expected to be exploited at 130 m³/h and 47°C. However, it has the potential for up to 250 m³/h.

Expected yield: 2 300 toe/year.

GE/015/80 - Intercommunale IDEA - B

The reservoir is closer to the surface than expected and has far surpassed the forecasts. From both the technical and economic point of view, this puts the project in an even more favourable light than the encouraging forecasts in spite of certain delays in the construction of the surface plant.

The field is expected to be exploited, without reinjection, at 350 m³/h and 68°C. Expected yield: 6 700 toe/year.

GE/016/80 - SOGECLER - F

The production well is now complete. The primary reservoir has failed to live up to the forecasts and has proved virtually impossible to exploit. Unfavourable local geological conditions were to blame for the poor results. The well is unlikely to be exploited. Flow rate: 25 m³/h at 75°C. Possible yield: 550 toe/year.

GE/017/80 - SBRU - F

The potential of the primary reservoir has exceeded the temperature and flow-rate forecasts. This integrated project has proved a viable proposition from both the technical and economic points of view. Initial exploitation, to supply almost half of the network, has already started. The well is expected to be exploited, without reinjection, at 150 m³/h and 53°C. Expected yield: 2 400 toe/year.

GE/021/80 - AGIP - I

The production well is now complete. The primary reservoir has reached the very high target set. Subject to confirmation from the reinjection well, this reservoir appears to have great potential with the water temperature being particularly favourable. Once the reinjection well has been drilled, the field is expected to be exploited at 250 m³/h and 101°C. Expected yield: 3 400 toe/year.

GE/046/81 - SAHLM "La Gironde" - F

The production well has now been completed. The reservoir has revealed a greater potential than forecast. The project appears promising and a success from both the technical and economic points of view. The reservoir is expected to be exploited, without reinjection, at 200 m³/h and 50°C. Expected yield: 1 600 toe/year.

GE/064/81 - SEDMA - F

The production well is now complete. The primary target has fallen short of the forecasts and proved virtually impossible to exploit because of the unfavourable local geological conditions. Given the current yield, the field is unlikely to be exploited, even without a reinjection well. Flow-rate: 20 m³/h at 40°C. Possible yield: 150 toe/year.

GE/067/81 - Ville de Saulgau - D

The production well has now been completed. Production tests have revealed exceptional potential, which should be particularly easy to tap since no reinjection is needed. The surface plant is now being made ready. The geothermal water with its low mineral content will replenish a surface reservoir whose

current output is inadequate. The well is expected to be exploited, without reinjection, at $180 \text{ m}^3/\text{h}$ and 40°C . Expected yield: 1 300 toe/year.

GE/069/81 - Southampton City Council - UK

The production well has struck a reservoir with the forecast potential, but with high salinity. Although drilling of the reinjection well has yet to confirm the nature of the reservoir - and hence the success of the project - the geothermal potential has been established and the project can therefore be considered a success. The field is expected to be exploited, with reinjection, at $75 \text{ m}^3/\text{h}$ and 74°C . Expected yield: 2 400 toe/year.

(b) Heating of glasshouses

GE/006/79 - GOM - B

Drilling of the production well has now finished, without, however, striking the reservoir, which is considerably deeper than forecast. Nevertheless the geology of the region is still promising, particularly at the southern tip where the reservoir is at a more accessible depth. No exploitation is possible as yet.

GE/009/79 - GEOVAL - F

Work on the production well, the reinjection well and the surface plant has now been completed. The potential of the reservoir has lived up to expectations. Full exploitation has already commenced, though it has been somewhat delayed by the unreliable pumping gear. Since the production well currently has greater capacity than the reinjection well, a further study is to be made to increase the maximum possible reinjection rate. On the whole, the project can be considered a success despite the problems encountered. The well is now being exploited at $165 \text{ m}^3/\text{h}$ and 70°C . Yield: 2 900 toe/year.

GE/019/80 - GACG - F

The production well has struck a reservoir with the forecast potential. The project has therefore achieved its objective. The plan now is to tap those resources in two consecutive stages. The first phase of the construction work on the surface plant is about to start. Although the final phase is slightly behind schedule, the project as a whole has been a success. The field is

expected to be exploited, without reinjection, at 175 m³/h and 58°C. Expected yield: 3 200 toe/year.

(c) Generation of electricity from wet steam and brine

GE/001/79 }
GE/018/80 } AGIP - I

The two production wells have now been completed. Production tests are now being conducted, without reinjection. Long-term production tests with reinjection are planned for the near future, before a 3 MW set is installed on an experimental basis. The very fact that an exploitable reservoir has been struck is reason enough for continuing the project, which holds out promise of successful commercial exploitation; it is expected that the field will be exploited. Capacity of the two wells: between 4 and 5 MW. Expected yield: 8 000 toe/year.

GE/029/80 - ENEL - I

The two production wells have now been completed. One of them has struck an exploitable reservoir, but the other is dry. The next phase of the project will be to carry out long-term tests before installing an 8 MW unit. The entire project has proved a technical and commercial success, which gives every reason to carry it on. The field is expected to be exploited. Capacity of the productive well: 4 MW. Expected yield: 7 000 toe/year.

GE/031/81 - PPC - H

The three production wells have now all been completed. They have shown exceptional potential; the initial results have been extremely encouraging. The incentive to take advantage of the energy savings and to tap the available potential in future will be all the greater since facilities for consuming some of the energy generated on the island itself and for transferring any surplus to neighbouring islands are also to be constructed. Both the technical and economic prospects are favourable. The field is expected to be exploited. Aggregate capacity of the three wells: between 5 and 8 MW. Expected yield: 9 000 toe/year.

(d) Generation of electricity from endogenous steamGE/004/79 - ENEL - I

The production well at the roof of the potential reservoir has run up against many of the problems associated with drilling in extremely hostile, very hot and highly corrosive environments. It looks as though they will be hard to overcome with today's technology. Although the technical and commercial prospects are, therefore, inauspicious, it nevertheless seems worthwhile continuing the field studies and field work with a view to defining methods of tapping the resources, which offer great potential once the necessary techniques have been mastered. It is uncertain whether the field will be exploited.

(e) Power generation combined with other uses

<u>GE/003/79</u>	}	<u>ENEL - I</u>
<u>GE/063/81</u>		

The pair of production wells has now been completed. One struck an exploitable reservoir, the other cannot be exploited because the fluid is too saline. The reservoir struck is, however, large enough to ensure the success of the project, although not all the exploitation problems have yet been overcome. Finding answers to them would be a major technical advance since this well contains precisely the type of geothermal fluid found in most of the reservoirs left unexploited today on technical grounds. Consequently, approval must be given to continuing this project, which also incorporates a major innovation in its approach to the recovery of mineral salts. It is expected to lead to commercial exploitation. Capacity of the productive well: 3 MW. Expected yield: 5 000 toe/year plus the mineral salts recovered.

ALTERNATIVE SOURCES: LIQUEFACTION AND GASIFICATION OF COAL

<u>CONTRACT No</u>	<u>PROPOSER</u>	<u>SECTOR</u>	<u>PAGE</u>
LG/02/1/78	IDGS	Underground gasification	85
LG/02/2/78	GEGS	Underground gasification	86
LG/03/1/78	NCB	Liquefaction	86
LG/01/2/80	FIAT ANSALDO	Gasification	83
LG/01/5/80	AGIP	Gasification	83
LG/01/6/80	BGC	Gasification	83
LG/01/10/80	VEBA OEL	Gasification	85
LG/01/13/80	KLOECKNER STAHL- FORSCHUNG GMBH	Gasification	85
LG/02/1/80	GEGS	Underground gasification	86
LG/03/1/80	NCB	Liquefaction	87
LG/03/2/80	RHEINISCHE BRAUN- KOHLENWERKE A.G.	Liquefaction	87
LG/03/3/80	HALDOR TOPSØE	Liquefaction	88

1. Gasification of solid fuels

LG/01/2/80 - FIAT ANSALDO - I

Fluidised bed coal gasification demonstration plant for the generation of electric power in a gas/steam combined cycle

The aim of the project is the design, construction and operation of a gas/steam combined cycle power plant (140 MW, 55 t/d coal) using two fluidised bed gasifiers (Westinghouse Electric Corp.).

The project is still in the beginning of the engineering phase. Thus no evaluation is yet possible, but technical problems with low rank coals in a fluidised gasifier can be expected. Nevertheless, if successful, the project would provide a useful means of upgrading such types of coal. Combined cycle operation does offer the prospects of increased efficiency with full environmental protection.

LG/01/5/80 - AGIP CARBONE - I

Coal gasification demonstration plant

The subject of this project is a gasification plant (Texaco entrainment gasifier) having a coal throughput of 200-400 t/d to produce synthesis gas from high ash and high sulphur coal (Sulcis, Sardinia).

The project is in the middle of the engineering phase. Gasification trials with Sulcis coal have been carried out at the Montebello (US) and Oberhausen (Germany) plants and have shown that the Texaco gasifier can gasify such types of coal successfully. Even if no detailed evaluation is yet possible, the results of the gasification trials are promising. On the other hand, the project's feasibility depends, apart from technology and economics, on the development of the Sulcis mine itself which will have to provide the coal.

LG/01/6/80 - BGC -

Demonstration of a commercial scale slagging gasifier

The project aims at extending the application of the Lurgi fixed-bed gasifier by converting it to slagging operation and increasing the fines content of the coal feed, in order to prove its commercial viability for SNG production (600 t/d coal throughput per unit).

The work is well underway and has led to some very promising results with the injection of fine coal in the tuyères of the gasifier. With a view on the whole project, the process plant development and performance are eminently satisfactory. The first generation Lurgi gasifier can now be transformed into a flexible unit capable of matching the performance claimed for newer second generation processes which still have to be proven. In the remaining programme, data will be acquired to assess the full commercial advantage of this important development. Success with proposals to gasify run-of-mine coal could further enhance the technical and economic advantages of the gasifier.

LG/01/10/80 - VEBA OEL - D

Production of hydrogen for the hydrogenation of heavy oil and coal

The construction and operation of a full-scale unit is foreseen for the gasification of solid fuels or residues (360 t/d throughput) to produce synthesis gas for further processing to hydrogen needed for coal liquefaction.

The contract covers the feasibility studies, which are completed, and the basis engineering which is well advanced. Based on trials on an existing 1 t/h pilot plant, a novel device has been developed and shown to be satisfactory. This new pressurised coal feed system, CONTINUA, incorporates a double screw extruder which works well with the materials to be gasified. As this process to make hydrogen has some novel engineering features and uses cheap residues among other fuels, it has potential for lowering the cost of making liquid fuel from coal and oil processing. The project is well conceived, is making good progress and shows every prospect for a successful conclusion to the basic engineering phase according to schedule.

LG/01/13/80 - Klöckner Stahlforschung GmbH - D

The aim of the project is long-term trials for the gasification of 400 t/d coal in an existing OBM molten iron bath reactor (Oxygen-Bodenblasen-Maxhütte, originally a novel steelmaking process developed by the contractor) with a view to the construction and operation of a demonstration plant (3.600 t/d coal throughput).

The project was terminated on 30 September 1981. The work carried out in an existing converter at the Maximilianshütte showed that different types and sizes of coal can be gasified successfully, particularly with regard to the low content of harmful substances in the gas. The work contracted for has been satisfactorily completed. The installation performed well and much valuable information was obtained from the instrumentation. The data obtained should be carefully evaluated in terms of energy and mass balances, costs, etc. in order to assess the full economic potential of the process. As a means of gasifying coal, it has many advantages, some of which are : high degree of coal conversion, good quality gas, low environmental impact. It also has decided advantages in steel plants in processing, as a ready supply of gas on site and in replacing mineral oil often used in this connection. The chances of large-scale application of the technology are good.

2. Underground coal gasification

LG/02/1/78 - IDGS -

Belgo-German experiment on in situ gasification

The aim of the project is the large-scale test of a new process for underground gasification of coal, characterized by alternating pressure (20-60 bar) of the gasifying agent (air and oxygen) and the depth of the seam to be gasified (900 m and below). Initially, it is planned to produce a gas of medium c.v. which will be burnt in a combined cycle power station (including a gas turbine).

The work on the project started in 1979 at the test site of Thulin (near Mons). After the completion of a first borehole to discover the geological conditions, three additional boreholes have been sunk, around the first one, at a distance of 35 m. All boreholes reached the seam to be gasified (Léopold-Charles) at a depth of about 670 m.

Subsequently, several trials were carried out to improve the natural permeability of the seam by injecting water, nitrogen or helium under pressure. A considerable increase in permeability was obtained, particularly in the direction of natural coal fissuration.

After having reequipped the site, the trials to establish a channel between two boreholes (linking by reverse combustion), began in April 1982 and ignition was accomplished.

The results obtained so far in improving the seams' natural permeability should allow the establishment of a sufficient linking between the boreholes by reverse combustion, which is a decisive step for the process. But even

if this is successfully carried out and gasification itself takes place, a large number of problems remain to be solved before commercial application.

LG/02/2/78 - GEGS -

Underground coal gasification at great depth I

The project aims at the application of the pressurized underground gasification process at great depth for the production of different gases and, thus, exploitation of coal reserves which cannot be mined by conventional means. For economic reasons, the preliminary trials are to be carried out starting from existing mine roadways.

The project was terminated on 31 March 1981 and achieved its targets: establishment of a linkage between 2 boreholes by hydrofracking, ignition and reverse combustion. The tests of linking boreholes, ignition and retro-combustion and gasification made at Bruay I and II have provided interesting and promising results. While this is an encouraging beginning, and by any standards can be regarded as a success, it is only a beginning. There is still a long way to go, and many obstacles to overcome.

LG/02/1/80 - GEGS -

Underground coal gasification at great depth II

This is the large-scale continuation of the previous project. It is planned to drill boreholes from the surface, to establish the linking between the boreholes and to proceed to gasification.

The sites for large-scale trials have been chosen. No technical evaluation is yet possible, in view of the early stage of the project. Nevertheless, the results of previous work (see evaluation of GEGS I, above) gives hopes that the project will reach its target to make successful use of large coal deposits which cannot be mined by conventional methods.

3. Liquefaction of solid fuels

LG/03/1/78 - NCB -

Supercritical gas extraction pilot plant

This project aims at the design, construction and operation of a pilot plant (25 t/d) for the liquefaction of coal by supercritical gas extraction and the conversion of extracts to high-grade liquids.

The design has been completed (February 1982). The project was then

merged with the new project "Coal liquefaction demonstration facility" (LG/03/1/78) in view of a temporary concentration on the liquid solvent extraction technology. Thus, the design and experience will be available for application as necessary in the following project.

LG/03/1/80 - NCB -

Coal liquefaction facility

The aim of the project is the design, construction and operation of a coal liquefaction plant (25 t/d coal) using the technique of solvent extraction. The coal extract is converted to distillate oils suitable as feedstock for aromatic petrochemicals, transport fuels, etc. It is provided to include at a later stage, also the supercritical gas extraction process (see above).

The design phase has been completed (February 1981). Construction work will not start before the financing of the whole project is secured. At the present stage, no evaluation is possible, but it is expected that the coal extraction technology can successfully be used to produce high-rank liquid products (chemical feedstocks, transport fuels, etc.) from coal.

LG/03/2/80 - Rheinische Braunkohlenwerke AG - D

Hydroliquefaction of lignite

The design, construction and operation of a demonstration plant for the hydrogenation of lignite (360 t/d lignite, 72 t/d products) is foreseen to obtain high-rank products (motor fuels, chemical feedstocks, etc.). The basic engineering phase is completed and was partly financed by the Federal Government whilst the detailed engineering phase started on 1 October 1981. The work was concentrated on the dimensioning of apparatus and machinery, the pretreatment of coal and the hydrogenation reactor. A technical evaluation is not yet possible since the project is still in a very early stage. Nevertheless, the project seems to be promising because the technology chosen is not very high-risk and the raw material (lignite) is cheap.

LG/03/3/80 - Haldor Topsøe - DK

Demonstration project for selective hydrocarbon synthesis

The aim of the project is a mobile plant (1 t/d products) for the manufacture of gasoline from coal-based gas by a novel selective synthesis process.

The contract covers phases 1 and 2 of the project and the engineering and design work (phase 1) is completed. Ordering of equipment is underway so that the unit can be assembled and tested in Denmark during 1982. Then, the plant will be dismantled, shipped to Houston (USA) reassembled (phase 2) and operated (phase 3). No technical or economic evaluation is yet possible but the process will probably find its place in several applications, particularly because a significant reduction of pressure in the synthesis stage is envisaged.

<u>NAME AND ADDRESS</u>	<u>TECHNOLOGICAL FIELD</u>
Soc. NIFES Consulting Engineers National Industrial Fuel Efficiency Service Ltd Malvern House Mapperley Road <u>UK - NOTTINGHAM NG3 5AQ</u>	Industry
Prof. Carmelo CAPUTO Direttore dell'Istituto di Macchine Università degli Studi di Roma Via Eudossiana <u>I - ROMA</u>	Road Transport (except electric vehicles) Agriculture Industry : boilers
M. GAGNOT METRA 16-18, rue Barbès <u>F - 92126 MONTROUGE</u>	Energy from waste
Mr. MARQ Marq & Roba 221, Boulevard Léopold II <u>B - 1080 BRUXELLES</u>	Buildings
Dr. J. GIBSON National Coal Board Stoke Orchard <u>UK - CHELTENHAM GL52 4RZ</u>	Fluidized beds Gasification and Liquefaction of Coal
Dipl. Ing. P. MUELLER VEW-Hauptverwaltung Abtlg. Energieanwendung <u>D - 4600 DORTMUND 1</u>	Heat Pumps
Mr. JENSEN Director of Research Energy Research Laboratory Odense University <u>DK - 5230 ODENSE</u>	Electric vehicles
Prof. NANCETTI Direttore dell'Istituto di Chimica Applicata Università di Pisa <u>I - PISA</u>	Geothermal energy
M. BELLANGER SOREIB 27, rue Longchamps <u>F - 92200 NEUILLY-SUR-SEINE</u>	Solar energy

(Annexe II)

I.S.T.

Solar energy

D - 7842 KAUDERN-WOLLBACHGENERAL TECHNOLOGY SYSTEMS LTD
Forge House
20 Market Place
Brentford

Solar energy

UK - MIDDLESEX TW8 8EQ

FIGURES FOR THE COMMUNITY DEMONSTRATION PROGRAMME

Table (a) : Energy savings (situation at 10 May 1982)

Investment (ECU)	First call for projects	Second call for projects	Third call for projects	Total
Proposals received	326	303	362	991
Total investment for proposals received	976.756.000	502.704.000	883.839.000	2.363.308.000
Projects selected	53	60	73	186
Projects withdrawn by the proposer	14	15	1	30
Contracts signed	39	42	8	89
Total investment for projects selected	78.960.000	88.300.000	105.840.000	273.100.000
Financial support granted	21.425.000 (1)	27.130.000 (2)	32.217.762 (3)	80.772.762 (4)

- (1) dont 4.938.670 ECU relatifs aux projets retirés
(2) dont 5.042.555 ECU relatifs aux projets retirés
(3) dont 408.525 ECU relatifs aux projets retirés
(4) dont 10.389.750 ECU relatifs aux projets retirés

Table (b): Solar energy

Investment (in ECU)	First call for projects	Second call for projects	Third call for projects	Total
Proposals received	135	105	47	287
Total investment for proposals received	108	99.2	29.2	236.4
Projects selected	26	36	22	84
Projects withdrawn by the proposer	8	1	2	11
Contracts signed	17	21	2	40
Total investment for projects selected	26 582	38 406	13 229	78 217
Financial support granted	6 354 (1)	13 229 (2)	3 332 (3)	22 915 (4)

(1) of which 2.31 m ECU are for projects that have been withdrawn

(2) of which 0.95 m ECU are for projects that have been withdrawn

(3) of which 0.18 m ECU are for projects that have been withdrawn

(4) of which 3.44 m ECU are for projects that have been withdrawn

ANNEX III

Table (c): Geothermal energy (situation at 10 May 1982)

Investment (m ECU)	First call for projects	Second call for projects	Third call for projects	Total
Proposals received	36	33	50	119
Total investment for proposals received	140	163	241	544
Projects selected	13	17 (a)	18 (b) (5)	48 (c) (5)
Projects withdrawn by the proposer	1	6 (d)	0	7 (d)
Contracts signed	13	11	4	28
Total investment for projects selected	70	132	99	301
Financial support granted	9.026 (1)	10.047 (2)	9.17 (3) (5)	28.243 (4) (5)

(1) of which 0.6782 m ECU are for projects that have been withdrawn
(2) of which 4.207 m ECU are for projects that have been withdrawn
(3) of which 0 m ECU are for projects that have been withdrawn
(4) of which 4.8852 m ECU are for projects that have been withdrawn
(5) excluding a series of eight projects where a decision is pending

(a) of which 3 are continuations of projects already selected
(b) of which 1 is continuation of projects already selected
(c) of which 4 are continuations of projects already selected
(d) of which 2 are continuations of projects already selected

ANNEX III (continued)

Table (d): Liquefaction and gasification of coal (situation at 10 May 1982)

Investment in ECU	First call for projects	Second call for projects	Total
Proposals received	12	23	35
Total investment for proposals	276 819 000	723 824 000	1 000 643 000
Projects selected (1)	4	9	13
Contractual stages selected (1)	4	16	20
Contractual stages withdrawn by the proposer	1	-	1
Contracts signed	3	9	12
Total investment for projects selected (1)	107 560 000	443 079 000	550 639 000
Total investment for contractual stages selected	39 517 000	186 744 600	226 261 600
Financial support granted	22 404 000 (2)	52 579 000	74 983 000 (2)

(1) In this field, given the size of the investment involved in each project, it has been possible to grant Community support only to certain stages and not to the whole project.

(2) Of which 4 340 000 ECU are for stages that have been withdrawn.