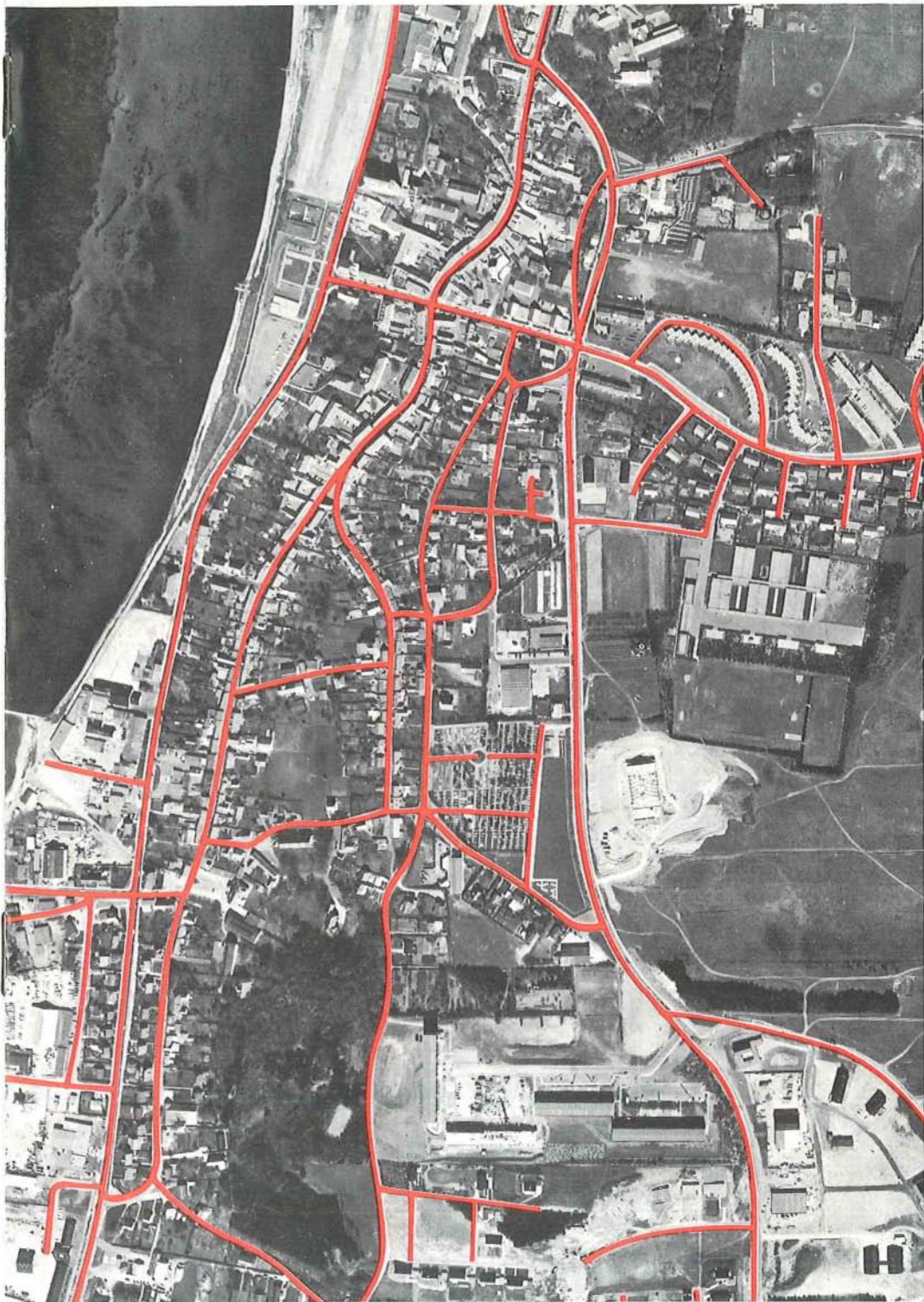


# District Heating



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# Facts about district heating in Denmark

District heating has made greater headway in Denmark than in any other country, supplying about one-third of the country's heat needs. Denmark started piping waste heat from power plants to homeowners back in the thirties, and by 1963, 15 per cent of the country was connected up to district heating lines.

Interest grew rapidly thereafter, and by 1977 district heating was meeting

33 per cent of the heating needs. By 1982, according to energy estimates, approximately 40 per cent of the country will be served by district heating.

There are today about 450 district heating plants serving 700,000 of Denmark's two million households. About 16,000 kilometres of double piping link up power plants, district heating plants and municipal incinerators with households, office buildings, schools and other energy customers. Household waste plays an important part in the energy story. No less than 35 communities get heat from municipal incinerators.

In all, Denmark has invested about 15,000 million kroner (nearly \$ 3,000 million) in district heating, according to the Danish Board of District Heating.

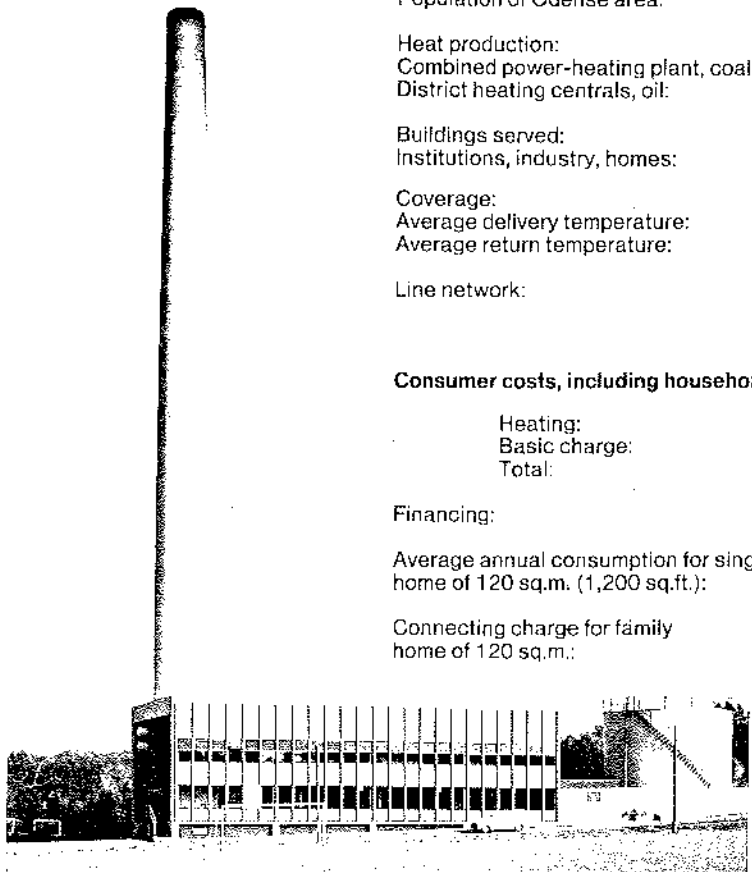
Odense Fjernvarmeforsyning (Odense District Heating) began supplying heating water from a centrally located power plant to nearby residents nearly 50 years ago. Today its operation is

one of the world's largest, with a yearly production of about 2,000,000 MWh, about 850 kilometres of heating mains and distribution lines, and roughly 30,000 customers – of these,

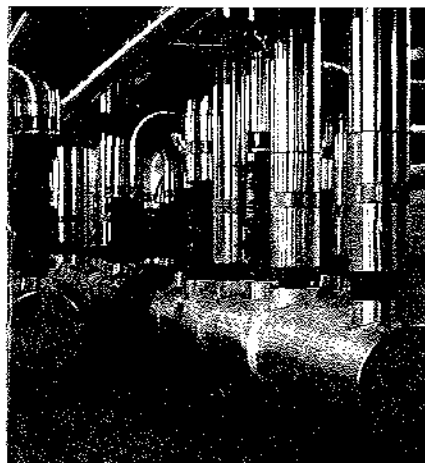
about 25,000 being households. Maximum load on December 31, 1978, was 525 MWh, equal to 9,700 tons of hot water per hour.

## Facts and figures:

Population of Odense area:	167,000
Heat production:	
Combined power-heating plant, coal and oil:	1,785,000 MWh
District heating centrals, oil:	155,000 MWh
Buildings served:	
Institutions, industry, homes:	about 30,000
Coverage:	about 75 per cent
Average delivery temperature:	86°C
Average return temperature:	45°C
Line network:	about 810 km (including 28 km high pressure mains)
<b>Consumer costs, including household hot water:</b>	
Heating:	1.0 U.S. cent per KWh
Basic charge:	0.4 U.S. cent per KWh
Total:	1.4 U.S. cent per KWh
Financing:	15-year loan
Average annual consumption for single-family home of 120 sq.m. (1,200 sq.ft.):	29 MWh = \$ 406
Connecting charge for family home of 120 sq.m.:	\$ 760



Modern Danish district heating plant



Heat recovery installation

## Large industry heats the town

One of the most interesting district heating projects now under way in Denmark involves heat recovery from a large local industry, the Superfos chemical works at Fredericia in Jutland. The agreement calls for Superfos to deliver hot water to the municipal district heating company, which will then market it to its customers. Proceeds will pay investment costs, and whatever is left over will be divided between community and Superfos.

For consumers this means heat units costing one krone less than oil-fired units, an economy which is expected to double at a later stage, equivalent to 1,000 kroner annually for the average consumer.

The agreement yields not only economic but environmental benefits as well since the drop in the volume of oil burnt means a drop of 200 tons in the sulphur dioxide annually spewed over the town, even if the oil consumption of the Superfos plants goes up slightly.

Initial deliveries in 1978 enabled Fredericia to cut its heating oil consumption by 7,000 tons, with an appreciable reduction in individual heating bills. In 1979, Fredericia expects to save 12,000 tons of oil, and by 1982 the annual fuel savings will amount to roughly 30,000 tons.

The Fredericia-Superfos agreement is being studied closely by other Danish communities.

## The B&S incineration plants

Bruun & Sørensen A/S has delivered more than 45 complete incineration plants in Europe, while the company's Japanese licensee has built three plants since 1976. The biggest B&S plants can handle 384 metric tons of waste materials in 24 hours.

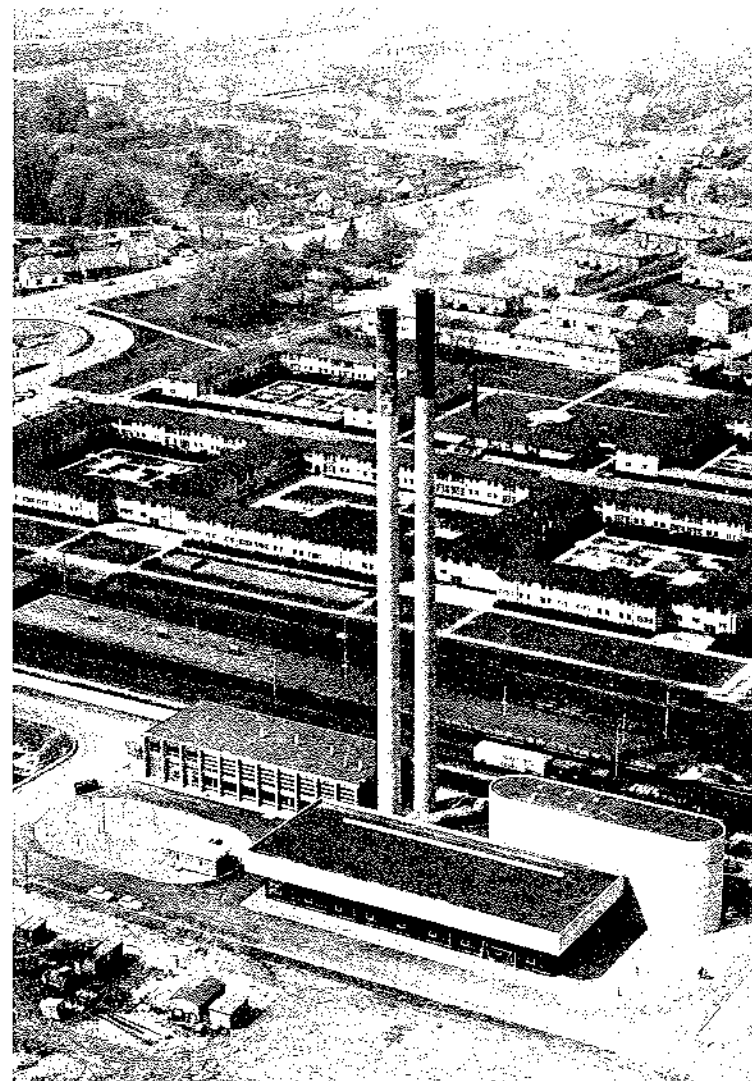
In Denmark, where about 70 per cent of all household solid wastes are burned in incineration plants, Bruun & Sørensen technology is involved in most existing installations. With few exceptions, these plants are hooked up to district heating systems and contribute about four per cent of the country's heat consumption.

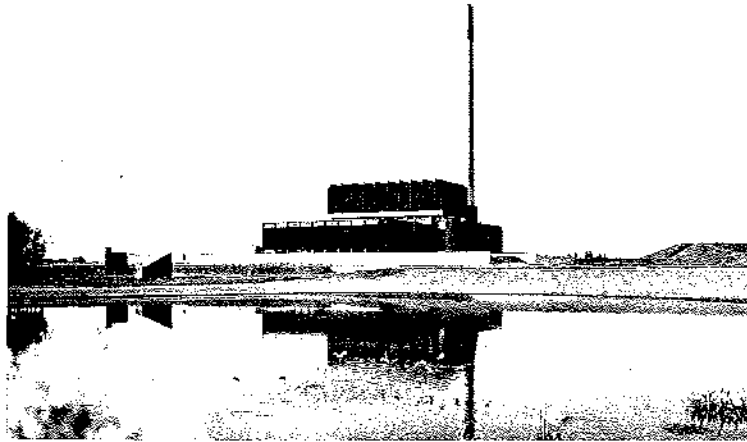
According to Bruun & Sørensen figures, the value of heat produced by incinerating plants can cover operating and maintenance costs, as well as

part of the interest payment and depreciation allowance. High environmental standards permit their erection within city limits, which means transportation savings.

Bruun & Sørensen A/S  
Aaboulevarden 22  
DK-8000 Aarhus C.

Bruun & Sørensen incineration plant





Vølund incineration plant built at the town of Alberisland near Copenhagen

## Hot water from household wastes

Household wastes may be a problem for city planners. But wastes also provide a solution to another problem: saving fuel and energy. Recycling waste materials will, at best, make use of only a small part of the daily wastes of a modern city. The rest can most profitably be turned into heat.

Vølund incinerating plants turn Copenhagen's household wastes into hot water for the city's district heating system. A rough rule of thumb equates about six tons of waste materials with one ton of fuel oil, so the huge stacks of city garbage mean considerable fuel savings.

The Vølund system, based on more than 40 years of development, uses a

combination of moving grates and rotary ovens to move waste materials downward from the inlet at the top. As wastes move along the grills, they are continually exposed to the flames, thus assuring maximum combustion. The first Vølund plant of this type has been serving a Copenhagen suburb for over 40 years. More than 45 Vølund plants have since been installed around the world.

After burning trash has made its contribution to district heating needs, the waste materials can be put to use as road fill or as a substitute for gravel. Slag containing iron can be sent to steel mills.

### An example:

Total quantity of wastes	: 330,000 t/year
Recycled material	: 30,000 t/year
Heat supplied for district heating, equal to	: 40,000 t oil/year
Gravel slag	: 40,000 m <sup>3</sup> /year
Chip slag	: 4,000 m <sup>3</sup> /year
Billets	: 5,000 t/year
Covering slag for use on supervised dumping ground	: 9,000 t/year

This type of waste treatment, involving direct re-use combined with combustion and leading to full exploitation of thermal energy and re-use of the slag, may be described as the 100 per cent re-cycling process.

A/S Vølund  
Abildager 11  
DK-2600 Glostrup

## Combatting corrosion

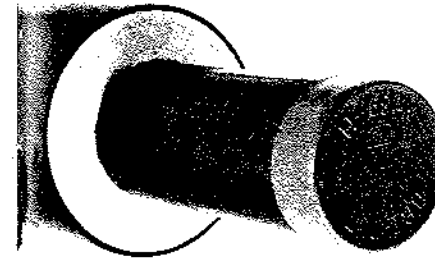
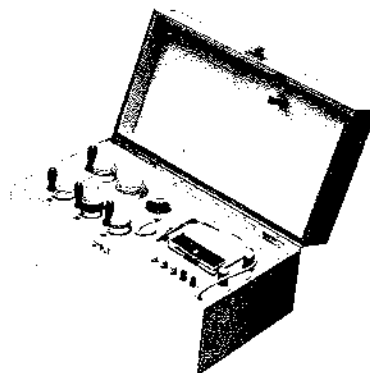
Danish homeowners and district heating authorities know the value of Hydro-X in combatting corrosion and scale in hot water tanks. Hydro-X, a fluid containing organic and inorganic chemicals, can be used equally well in any kind of hot water system.

A fully automatic dosing pump assures the correct dosage for each heating system. Periodic analysis of heating water is carried out with the Hydrotest, which was developed to record conductivity, alkalinity and water hardness.

Hydro-X A/S  
P. O. Box 30  
Tylstrupvej 50  
DK-9320 Hjøllerup



Hydro-X dosing pump and water analyser



## Distribution

No heating system is better than the pipes used to bring hot water from plant to user. Today's highly insulated heating pipes in their watertight jackets are easily laid, keep heat loss to a minimum and will last as long as the system itself. Advanced electronic monitoring systems sound the alarm if the lines are damaged or if corrosion sets in.

Pipe sections can be laid directly in sand-lined trenches, a far cry from installation procedures of earlier years, when pipes were manually insulated

## Mobile boiler facilities

Danstoker mobile boiler units eliminate delays in bringing district heating plants on steam, because they can deliver heat to neighbourhoods and local areas as the network is built up. Once a Danstoker unit has been linked up with local utility lines, it is ready to start delivering heating water for the mains.

Danstoker mobile boiler units are built into containers for easy transportation. Besides delivering heat during the building-up stage of a district heating system, they can also serve industrial users who want to spare the costs of a boiler plant.

Danstoker  
Industrivej 17-21  
DK-4700 Næstved



Insulated heating pipe sections prevent heat loss

on the site with mineral wool, concrete or other materials. Today's pipe-in-pipe heating mains have won Danish manufacturers a 58 per cent share of the European market.

I. C. Møller A/S  
Treldevej 191  
DK-7000 Fredericia

Løgstør Rørindustri A/S  
Danmarksvej  
DK-9670 Løgstør

Dürotan Rør A/S  
Brovadvej  
Erritsø  
DK-7000 Fredericia

Tjærskompaniet  
Slipshavnsvej 12  
DK-5800 Nyborg

A/S Dansk Rørindustri  
Nymarksvej 37  
DK-7000 Fredericia



Mobile boiler units bring plants on steam

## Energy-saving electronics

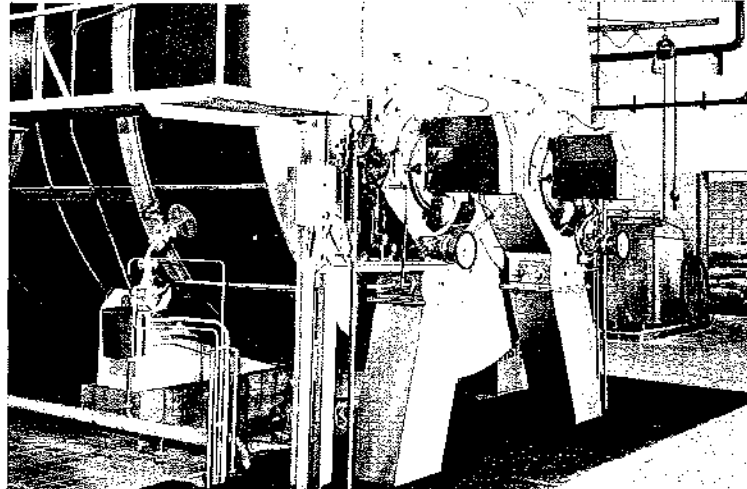
A broad range of heating equipment bearing the Euro-Therm trademark is now being marketed in a number of countries by Jydske Varmekedelfabrik A/S, a Danish company with over 30 years of heating experience.

The Euro-Therm name covers furnaces operating on oil, gas, coal, wood and waste materials, rotary oil burners, oil ore-heaters, water emulsion units and the electronic controls needed to assure efficient operation.

The Euro-Therm I control panel provides complete electronic operation of the burner. The Euro-Therm II regulates burner r.p.m., and the Euro-Therm III maintains a check on heat production, temperatures and smoke colour. The various Euro-Therm control panels can be mounted individually or together with the power supply cabinet.

More than 1,200 Euro-Therm boilers are now in service.

Jydske Varmekedelfabrik A/S  
Edw. Rahrsvej 32  
DK-8220 Brabrand



Two K.B. Rotary Burners in use at municipal heating plant

## Rotary burner

Starting point in any heating system is the heater itself. Designed for easy maintenance, K. B. Rotary Burners are particularly suited for power stations, district heating plants and other industrial installations.

K. B. burners are delivered for burning oil, gas or both, and changing from one fuel source to another is easily accomplished. An important accessory is the water emulsion unit which in-

creases fuel efficiency and reduces solids content of flue gas by 90 per cent. A gas recirculation unit will also help reduce wastes, as well as improve performance.

The water emulsion unit can serve several burners at a time.

Dansk Olie- & Stokerfyring  
Sct. Jørgensgade 108-110  
DK-5000 Odense C.

## Heating panels

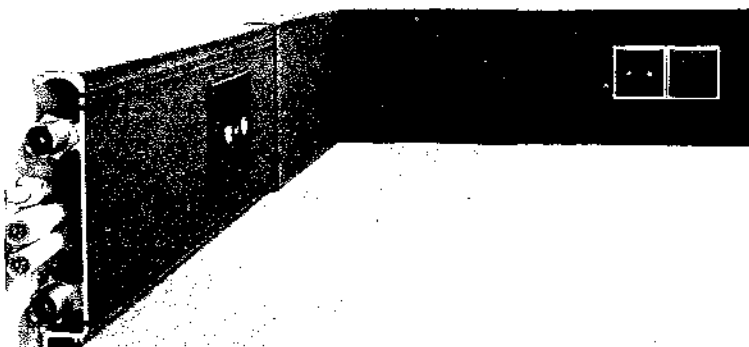
Something new has replaced the old hot-water radiator - the Wanpan heating panels that replace skirting boards around the room. Unobtrusively placed at floor level, the Wanpan hot water panels blend with the fittings of the room and leave wall space free for other purposes.

Placing the radiator at floor-level provides heat where it is needed, and because the Wanpan encircles the entire room, there will be no temperature variations from one side to the

other. Thermostat controls and a clock-operated on-off switch keep heat consumption to a minimum.

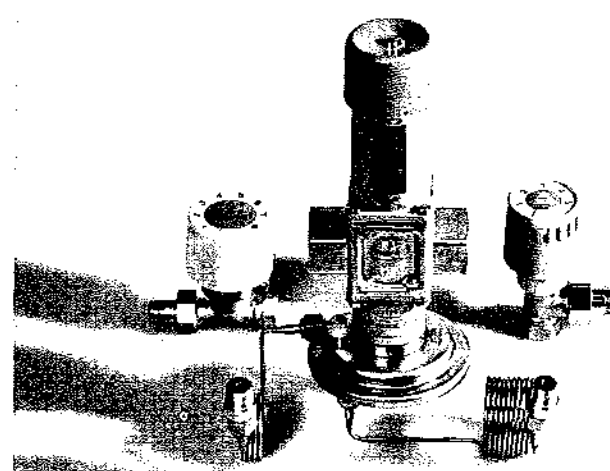
Wanpan panels are easily installed and require little maintenance. They can also be provided with outlets for telephone and electrical appliances.

Elpan ApS  
Billedskærervej 8  
DK-5230 Odense M.



Euro-Therm control units

Wanpan heating panels along



Danfoss control components

## Automatic controls

Danfoss, an international company with production in six countries, ranks among world leaders in development of automatic controls for heating systems of all kinds, including district heating. Danfoss products are sold in over 100 countries.

Danfoss, which is a major producer of refrigeration equipment and refrigeration controls, began working with heating systems in the mid-50s and

thus has about a quarter century of experience in this field. Production includes automatic controls for district heating systems as well as for furnaces and radiators, and electronic speed regulators for AC motors used in ventilation and air conditioning systems.

Danfoss A/S  
DK-6430 Nordborg

## Heat measuring

A district heating service with thousands of customers needs a dependable heat measuring system to assure correct customer billing. In Denmark as well as in a number of other countries, this service is provided by ISS Clorius Industri A/S, which uses a measuring device developed in 1926 and since improved for greater accuracy.

The Clorius heat measurer resembles a thermometer. It is mounted on a radiator, where heat evaporates a

liquid inside a glass tube at a predetermined rate. The gradually falling level of the liquid in the tube will be measured in heat units that can be easily read at the end of the heating season by a Clorius representative. A new tube is installed at the start of each heating season, and a wire seal prevents tampering.

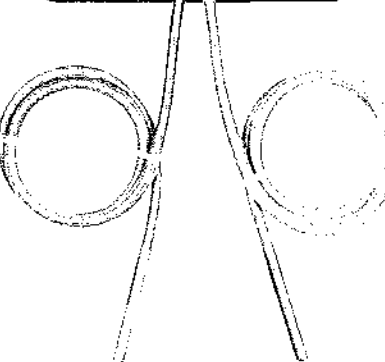
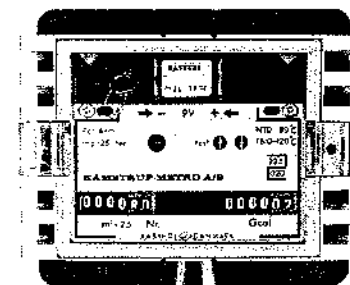
ISS Clorius Industri A/S  
Literbuen 16  
DK-2740 Skovlunde

## Battery-operated heat register

Kamstrup-Metro A/S uses a battery-operated heat register to record heat consumption. This electronic device is operated by a 9-volt standard battery or by a lithium battery with a lifetime of up to five years. The device is mounted directly on the water meter installed in the heating system, where it measures the difference in temperatures of water input and outflow. The result is a precise record of home heat consumption.

Kamstrup-Metro A/S was established in 1946 and today ranks as one of Europe's leading producers of all kinds of measuring and regulating equipment for temperatures, pressures, and other variables.

Kamstrup-Metro A/S  
Jacob Knudsenvej 12  
DK-8230 Åbyhøj



Kamstrup-Metro's heat register measures heat variations

Clorius device measures radiator's heat

## Installations for homes

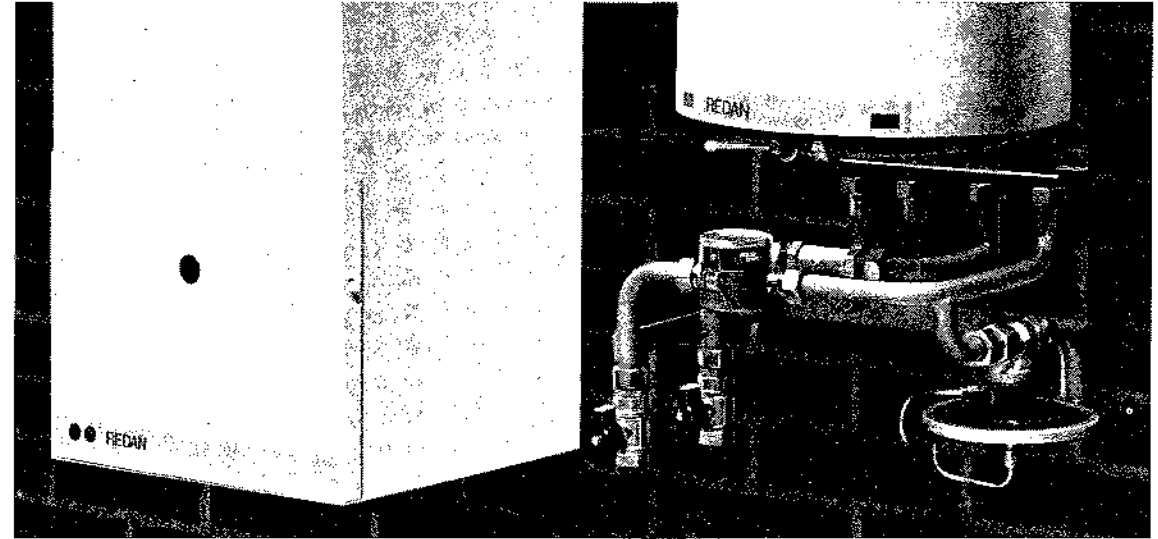
Redan A/S has acquired a reputation in Denmark as a manufacturer of highly advanced equipment for home heating and district heating systems. Among other things, Redan turns out heat exchangers, automatic water heaters and automatic controls for

district heating. It also manufactures heating installations for home use.

A particularly successful product has been the Redan water heater. This is built on the principle of a gas-operated water heater, using hot water from the district heating system as its

energy source. This efficient heat exchanger eliminates the need for large hot water tanks.

Redan A/S  
Sindalsvej 35  
DK-8240 Risskov



## Danish Board of District Heating

The Danish Board of District Heating represents a group of companies actively involved in development of Denmark's district heating programme and which also deliver equipment and components to district heating authorities in Europe. Danish expertise covers heat production, boiler plants, solid waste incineration, in-

dustrial waste heat recovery, and establishment of distribution systems.

Danish experience can offer you better district heating efficiency, energy savings and total energy utilisation through efficient heat recovery from incineration and industrial waste heat production.

*For further information write to:*

Danish Board of District Heating  
Rugaardsvej 274  
DK-5210 Odense NV

### The group includes the following members:

Bruun & Sørensen A/S, Aaboulevard 22, DK-8000 Aarhus C.

ISS Clorius Industri A/S, Literbuen 16, DK-2740 Skovlunde.

Danfoss A/S, DK-6430 Nordborg.

Dansk Olie- & Stokerfyring, Ser. Jørgensgade 108-110, DK-5000 Odense C.

A/S Dansk Rørindustri, Nymarksvej 37, DK-7000 Fredericia.

Danstoker, Industrivej 17-21, DK-4700 Næstved.

Dürotan Rør A/S, Brovadvej, Erritsø, DK-2800 Lyngby.

Elpan ApS, Billedskærervej 8, DK-5230 Odense M.

Svend Hjelmqart ApS, DK-8900 Randers.

Hydro-X A/S, P. O. Box 30, Tylstrupvej 50, DK-9320 Hjallerup.

J. Ib Production ApS, Gravene 18, DK-5620 Glamsbjerg.

Jydsk Varmekedelabrik A/S, Edw. Rahrsvej 32, DK-8220 Brabrand.

Kamstrup-Metro A/S, Jacob Knudsensvej 12, DK-8230 Aabyhøj.

Harry & Mogens Larsen I/S, Consulting Engineers, Skolevej 8, DK-5270 Odense N.

Lebit A/S, Hovedgaden 20, DK-2970 Høved.

Løgstør Rørindustri A/S, Danmarksvej, DK-9670 Løgstør.

I. C. Møller A/S, Treldevej 191, DK-7000 Fredericia.

Rambøll & Hannemann A/S, Consulting Engineers, Lavsensvænget 8, DK-5200 Odense V.

Redan A/S, Sindalsvej 35, DK-8240 Risskov.

Scan-Technic Ltd., P. O. Box 139, DK-2610 Rødovre.

Tjærekompagniet, Slipshavnsvej 12, DK-5800 Nyborg.

A/S Vølund, Abildager 11, DK-2600 Glostrup.