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NEWS LETTER

IEA heat pump center

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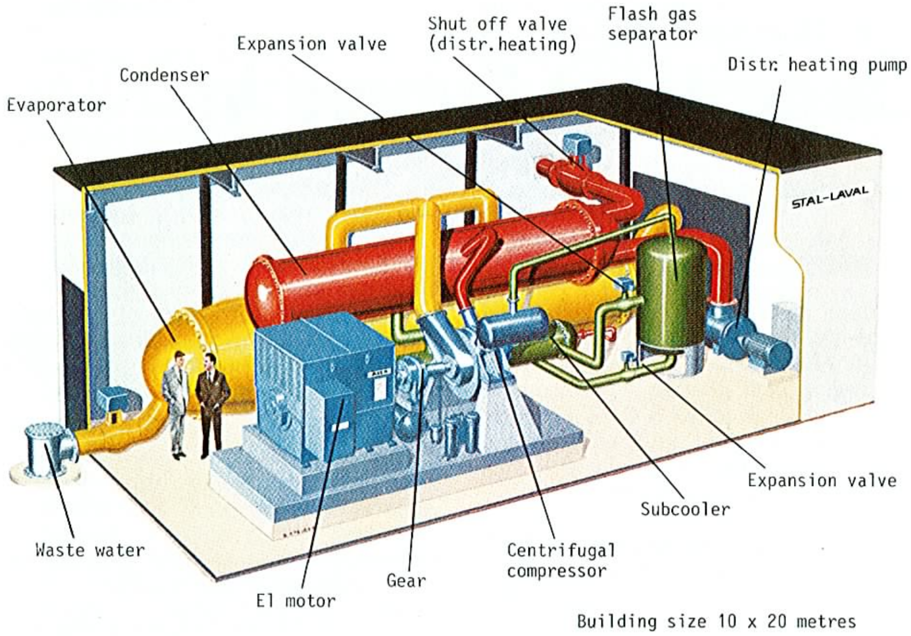

10 MW Waste Water Source, Electrically Driven Heat Pump for District Heating in Vasteras, Sweden (ref. to page 2)

EDITORIAL BY P. V. GILLI*

R, D&D in the Field of Heat Pumps:

The heat pump is one of the two classical processes to "generate" large amounts of low and medium temperature energy by means of relatively small amounts of exergy (available energy), the other process being the cogeneration of heat and power. The implementation of the heat pump process requires mechanical (or thermal) equipment, increasing first cost but decreasing energy cost. It is not surprising that increased cost of conventional fuel and decreasing first cost of heat pumps (by mass production) has greatly improved the economy of the heat pump and led to worldwide sales figures of 1.5 to 2 million reversible (heating/cooling) units per year. The sales figures of heating-only heat pumps are lower by an order of magnitude; their breakthrough will require improved cost-effectiveness and therefore continued R, D&D.

R, D&D in the field of heat pumps concerns heat pump systems as well as heat pump units. Systems R, D&D in many countries is at least partly sponsored by public funds, units R, D&D is mainly borne by industry.

Topics of **systems R, D&D** are concentrated on COP/SPF improvements of reversible as well as heating-only heat pumps in the bivalent or monovalent mode by: lower supply temperatures; separation of heat load and domestic hot water; higher minimum heat source temperatures using short- or long-term heat storage; higher average heat source temperatures using solar radiation, latent heat of condensation or of freezing, and waste heat recovery; reduction of cycling losses, for instance by buffer storage and improved defrosting control; proper utilization of refrigerant superheat and subcooling; and improved and standardized control equipment. Refined modelling techniques will help to recognize the weak spots of the various systems and to concentrate on energy-effective and cost-effective areas of development.

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Main topics of R, D&D on **heat pump units** are technical improvements of the units on the one hand, and, on the other hand, reduction of their production cost by large-scale, partly or fully automated production and by a design geared to it. Generally, technical improvements will cause higher production cost, but the actual cost increase may be small if modern production techniques are applied. Some of the many ways to improve the heat pump units are: increased motor efficiency, lower heat losses, speed control by pole changing and by thyristors, new improved compressor types, double cycle, economizers, non-azeotropic refrigerant mixtures, improved heat exchangers and expansion valves, use of waste heat from the compression side for superheating suction gas. The technical development potential is large, even if it cannot be fully utilized for economic reasons.

However, the heat pump market is not restricted to the standardized heating/cooling or heating-only small and medium-sized, electrically driven compressor unit: It encompasses a broad spectrum of sizes, working fluids, compressors and drives, processes and standardized as well as tailor-made applications. Accordingly, specialized R, D&D is necessary and is being performed for a large number of different heat pump systems.

Unit sizes presently span a wide range: from about 0.5 kW or 1.0 kW power input (for heat pumps supplying domestic hot water to single-family houses or dwelling units) to units of several hundred kW as used for large residential, commercial, and institutional purposes, up to the MW range for industrial heat pumps, and presently to about 8 MW drive power (30 MW heat output) for large units in district heating networks.

Apart from the conventional reciprocating compressor there is a large number of rotary compressor types on the market or under development such as the scroll compressor for small, the screw compressor for medium-sized, and the centrifugal compressor for large units. Drives other than the electric motor include the gas engine and the diesel engine. For very large sizes, even the steam turbine - driven by steam from a coal-fired plant - has been suggested.

There is also a multitude of basic heat pump processes in use: the closed compression steam cycle with conventional refrigerants such as R-12 and R-22, with refrigerant mixtures such as R-502 and other non-azeotropic mixtures, the open-cycle with steam as working medium as utilized for industrial purposes, the thermally-driven sorption cycles (the chemical heat pump) and combinations of the compression and the sorption cycle. The sorption cycle is of particular use if waste heat of sufficient temperature or free (say, solar) heat is available as drive energy. The process has been developed as a simple heat pump process, upgrading ambient heat to supply temperature level by means of high temperature, and also as heat transformer for industrial purposes, producing high-temperature heat by means of a medium-temperature heat source and a low-temperature heat sink.

The cost-effectiveness of the heat pump has been demonstrated in many instances. However, ongoing and future R, D&D will improve the competitive position of the heat pump in a broader spectrum of applications, including the heating-only heat pump for hydronic heating systems as presently required for most European locations. This will help to realize the large potential of the heat pump for oil substitution and for replacing energy consumption by investment, that is, by creating and maintaining jobs.

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Bemt Baeckstroem*

Large Heat Pumps in Sweden

Background

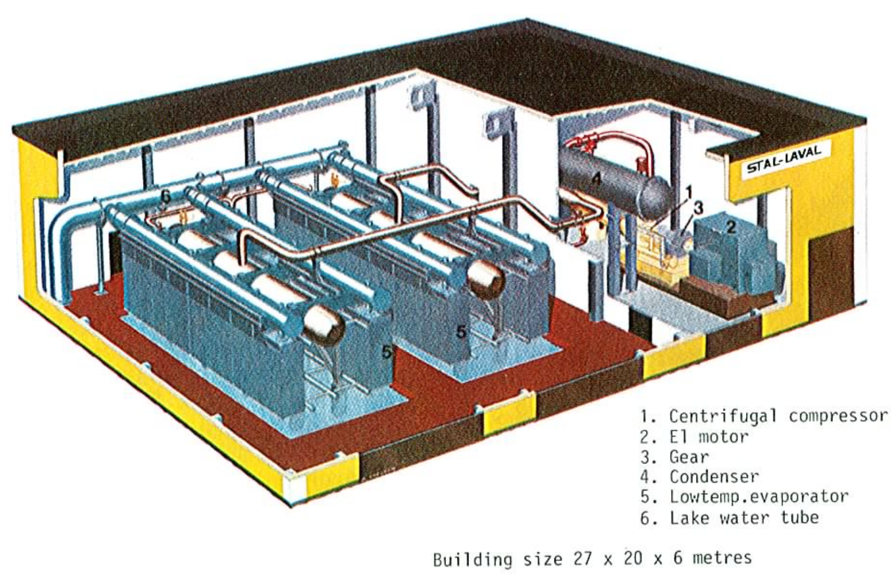
A number of large electrically driven heat pumps are running in Sweden today and even more are ordered or planned. Large heat pumps are defined as equipment with an output of about 500 kW or more. The following are the main reasons for the massive introduction of large heat pumps in the Swedish energy system.

— Sweden has extensive electricity generation over-capacity, as well as low-cost electricity (2 to 4 US cents per kWh) which results from extensive hydroelectric resources and a large nuclear capacity. With the remainder of Sweden's 12 nuclear power plants coming on-line, the contribution of nuclear power plants (now accounting for 35% of output) will increase further.

— Imported oil covers 61% of the space heating demand in the commercial and residential sectors. District heating with emphasis on multifamily residences accounts for 18%. Still most of the district heating installations are oil-fired. Solid fuel systems are beginning to make a small but growing impact.

— Almost all sewage water from the municipalities is passing centralized waste water treatment plants. The cleaned sewage water is a good heat source for large heat pumps. Cities in Sweden are often conveniently located to utilize lake or sea water as a heat source.

— The refrigeration industry is well established and screw compressors for large heat pumps have been manufactured in Sweden for many years. A steam turbine manufacturer, Stal Laval, belonging to one of the largest industrial groups in Sweden, decided some years ago to go into the heat pump market with a 10—13 MW turnkey-plant using a two-stage centrifugal compressor.



10 MW Lake Water Source, Electrically Driven Heat Pump supplying Energy for Space Heating of Industrial Buildings

— There is no need for space cooling in residential buildings in Sweden which means that there is no market for individual household or central plants which can be used for both heating and cooling.

District Heating

In Sweden electricity and district heating are complementary rather than competitive. The former is deemed suitable for low-density use, single family houses, and the latter for high-density areas. To ensure this, regulations ban the use of electricity for heating in new multi-family homes. In addition, the municipalities can mandate district heating in high-density areas. At the same time the use of electric resistance heating is restricted for new single-familiy homes. Thus, electric heating must be based on indirect systems, e.g. electric boilers coupled with an existing furnace or heat pump. Government grants are available for conversion.

A very special type of competition has arisen during the last few years. The municipalities which run most of the district heating networks prefer large heat pumps in their district heating systems. At the same time they try to prevent the house owners from installing local heat pumps. The discussions are now concentrated on the use of so-called exhaust air heat pumps connected to district heating systems.

The temperatures of the water in the flow and return pipes are dictated by housing standards. These mandate that radiator water temperatures shall average 55 to 60° C, with 80° C on the coldest day on the flow circuit and 40—45° C on the return. Domestic hot water temperatures shall be in 45—55° C range throughout the year. Standards also necessitate the use of heat exchangers, so that the water temperature in the primary network ranges between 80 and 120° C in the flow system and 50—60° C on the return. The highest flow temperatures are only required during periods of extreme cold and the lower temperatures apply during summer when only hot water is required. The mean annual temperature for the flow system is 90—100° C.

Direct piping systems which use low-temperature flows are utilized in smaller centralized heating systems as well as in some older district heating systems. The application of direct systems has been tried but a number of incidents have resulted in a reluctance to install such systems widely. It is recognized, however, that direct systems would be more economical than indirect systems due to the lower temperatures necessary and to the absence of costly heat exchangers in the system.

Some efforts have been made in order to lower the system temperatures, thus rendering conditions more favorable for heat pump application but it seems too expensive to change an existing system drastically.

The large heat pumps are used for base load supply in district heating. The water in the return pipe with a temperature of 50—60° C is heated in the condenser and thereafter in the boiler. The water can be heated in the condenser to 70—80° C with an acceptable COP even with low-temperature heat sources. It is often more attractive to accept somewhat worse running conditions than to put in costly measures in the existing plant.

At present, 114 municipalities are running district heating systems, and in 15 of those large heat pumps are used. In 43 cases electric boilers are operated. The reasons for the application of the latter are, firstly, that the electric boiler is a simple product which can easily be installed, secondly, that the investment cost per kWh heat is very low which effects short payback periods, and, thirdly, the absence of any necessity for further technical complications like e.g. piping from a heat source or similar.

The total power demand of a district heating system is approximately 16 GW and the annual energy distributed is 28 TWh/year.

Large Heat Pumps

By the end of 1983 large heat pumps with a total heating capacity of approx. 250 MW will be running. With 7,000 hours of operation per year they will produce 1.75 TWh heat/a or 6 percent of the 28 TWh delivered from all district heating systems. The electrical energy consumption for these heat pumps is approx. 0.6 TWh/a or only 1 percent of the energy delivered by all Swedish hydro power stations.

Typical data:

As mentioned, centrifugal compressors are used in the largest units and screw compressors in the lower range with heat output of approx. 0.5—5 MW.

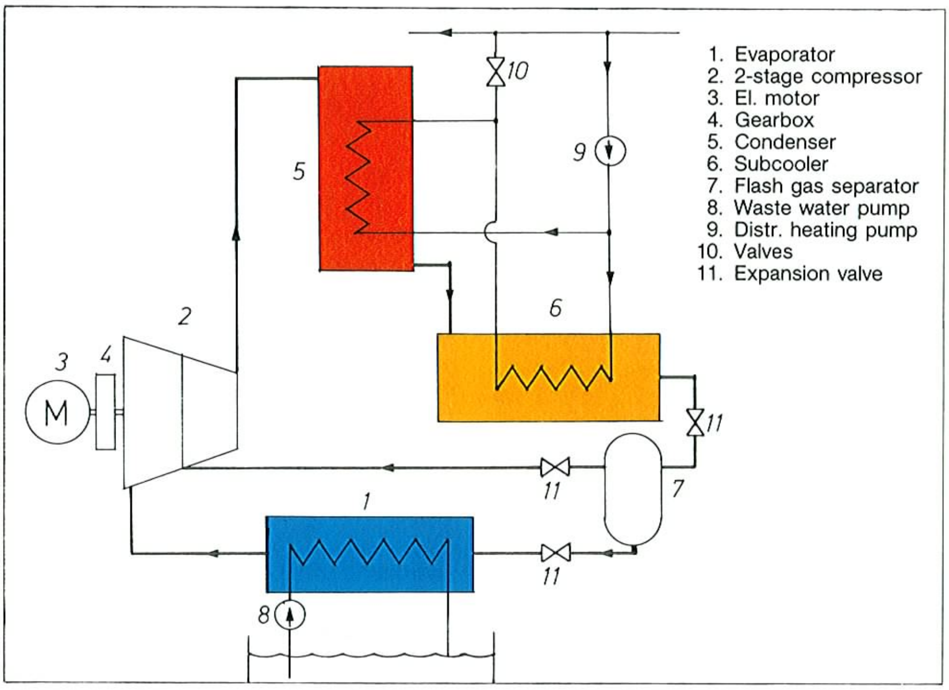
One very large unit with almost 30 MW heat output is running today. In two other cases plants with a total heat capacity of 40 MW consisting of 3 units of 12 to 14 MW each are operated. The heat source which is used for most of the large heat pumps today is cleaned sewage water. Industrial waste water, sea and lake water are other common heat sources.

A typical large heat pump system has the following data:

Compressor	2 stage centrifugal
Refrigerant	R12, 12—14,000 kg
El. motor	3 phase, 10 kV, 4 MW 1,500 r/min
Evaporator	shell and tube; 7—9 MW
Sewage water	7—15° C, 500 kg/s
Condenser	shell and tube
Heat output	10—12 MW
Dist. heating water	
flow	400 kg/s
temp. in	50—70° C
temp. out	60—80° C
COP	≈3.0

The investment for a 10—12 MW plant with sewage water as heat source is in the range of 1,200—1,500 SEK/kW heat. Compared with oil (about 1,800 SEK/m^3) and 0.2 SEK/kWh for the electricity the pay-off period is about 2 years.

The total investment for the same type of heat pump using lake or sea water as heat source is about 50 to 100 percent higher because of the necessity of larger and much more expensive evaporators



Heat Pump with 2-Stage Centrifugal Compressor and Economizer and technical modifications outside the real heat pump, e.g. piping for sea water or district heating water and electrical supply.

The range of 0.5—5 MW heat output per unit is covered by screw compressors (the traditional twin screw type). Depending on the heat sink temperatures, refrigerant R22 (<50° C), R500 (<60° C) or R12 (<80° C) is used. The compressors are normally equipped with a capacity control device for the range of 100—10 percent. A so-called economizer arrangement can be used in most of the screw compressors. This means that two-stage expansion is used and the flash gas is led into "the middle of the compressor".

It is not so easy to describe the typical plant in the screw compressor range. Some of the plants using sewage water or industrial waste water as heat source very often comprise 2 or 3 units (complete with separate refrigerant systems). Others have only one compressor with heat output in the 1—1.5 MW range. Often the heat sink is not a district heating system but a local distribution system with somewhat lower temperatures than the traditional district heating system.

The use of different heat sources results in varied operating conditions and COPs. In some cases an indirect system has been chosen for heat transfer from the real heat source — e.g. sewage water — to the evaporator. It is a little more expensive but more reliable.

A few plants with ambient air as heat source and heat output in the range of 0.5—2.5 MW are now under construction. These are more or less experimental plants supported by special loans from the Swedish Council for Building Research. The total investment for complete plants in this range depends very much on the local conditions and can vary from 2,500 to more than 5,000 SEK/kW heat.

The Future?

As mentioned before, all large heat pumps in Sweden are electrically driven and most of the heat produced is fed into existing district heating systems. Cleaned sewage water is a well-suited heat source for these systems and should preferrably be used in the future.

What will happen in the future, particularly if nuclear power is, according to the results of the referendum, phased out during the 1990s and after that?

The market for large heat pumps, particularly for 10 MW units, is limited. On the other hand, the use of large heat pumps in the process industry has not yet started.

The Swedish State Power Board has announced that the price of electric energy will rise slower during the next 5-years' period than the general price level. The large heat pumps built today have a pay-back period of less than 5 years which means that the investment is profitable even if the nuclear power is phased out later on.

The era of large heat pumps in Sweden can be short and intensive. It can be a very profitable business for the users who started early and understood that heat pumps for efficient operation do not only require well-established district heating engineering but also consideration of their specific thermodynamic needs.

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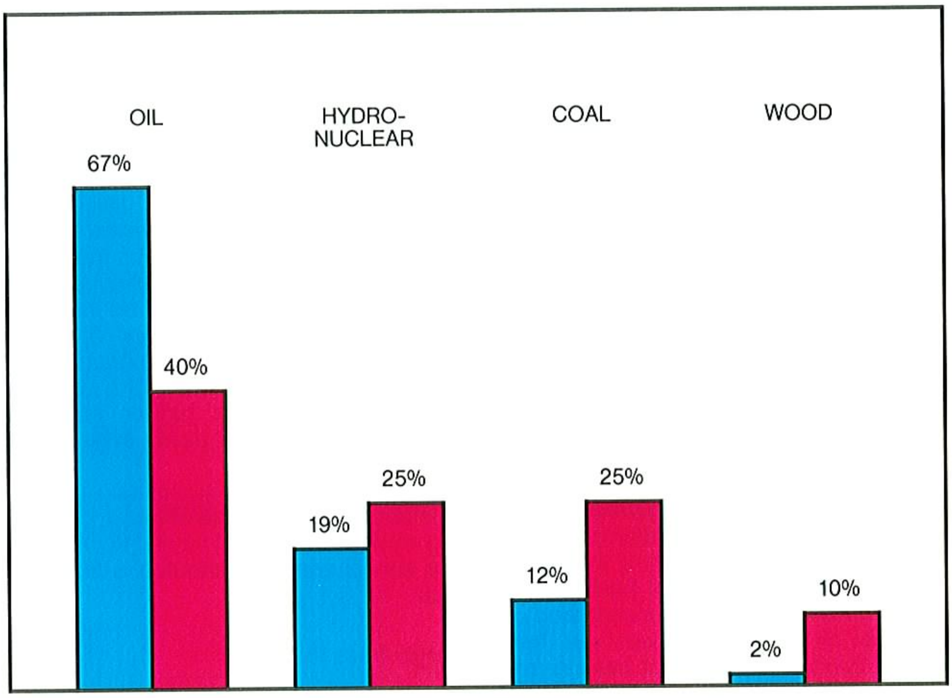


Energy Supply of Sweden 1979 vs 1990 by Energy Sources

Subsidies and Incentive Programs for Heat Pumps in Member Countries: A Review

Subsidies for Heat Pump Applications in Italy

Subsidies and financial incentives for heat pump applications are available in Italy in the frame of law No. 308 dated May 29, 1982 "Norme sul contenimento dei consumi energetici, lo sviluppo delle fonti rinnovabili di energia e l'esercizio delle centrali elettriche alimentate con combustibili diversi dagli idrocarburi" (Rules for energy conservation, use of renewable sources and operation of electric power plants fed by non-oil fuels).

According to the EEC energy policy, the law assigns 1608 billion (10^{12}) lire, for a period of three years 1981—83, to reduce energy consumption while favoring the use of renewable resources in the civil, industrial and agricultural sectors.

For heat pump systems, the subsidies are allocated according to the articles 6 and 8 of the law for the civil and industrial-agricultural sectors, both regionally managed in the allocation of funds.

For heat pump applications in the civil-residential sector, the conditions for obtaining subsidies are:

— annual heat delivery by heat pump more than 30 percent of the total heat demand of the installation;

— heat pump COP higher or equal to 2.65.
The subsidies available for these interventions, which also include solar active installations, are 50 billion lire (30 for the years 81—82 and 20 for 1983). The subsidy fixed for each installation is up to 30 percent of investment cost and a maximum of 15 million lire.

A special item does not exist for heat pump applications in the industrial and agricultural sectors (art. 8). Each region can allocate its own funds with different priorities. The minimum energetic condition for obtaining the subsidy is a 15 percent reduction of oil or electric consumption in the plant. For this evaluation, the ratio between thermal and electric energy is assumed to be 2,500 kcal/kWh. The subsidies for these interventions are 450 billion lire (90 for 81—82, 270 for 1983). The contribution for each installation can be up to 25 percent of the cost up to a max. of 500 million lire. Distribution of funds and priority decisions are made at regional level.

To assign these contributions, the Regions have developed operative rules and computer programs to assess the financial priorities of the installations. By the end of September the Treasury Minister should sign the final decree that will start the subsidy distribution for the mentioned years 1981—1983.

For demonstration projects (art. 11 of the law), and this includes heat pump applications, another 51 billion lire (10 billion for 81, 20 billion for 82 and 21 billion for 83) are available. These funds are managed by the Ministry for Industry, Trade and Handicraft (MICA) and can be granted up to 50% of the investment.

Law No. 308 also states that each heating apparatus will be provided with a label for its certification of quality and therefore all heat pumps will be tested according to national standards.

For more detailed information please contact
E. Piantoni
CISE
P.O. Box 12081
20100 Milano (Italy)

Review of the Subsidy-Granting Regulations Relating to Energy Conservation in the Netherlands (May 1983)

1. Subsidy-granting regulation for obtaining advice on energy conservation measures in the industry

A government subsidy is granted for providing preliminary advice by an independent consultant on energy conservation in existing industrial enterprises. This regulation applies to any sector of industry, local government organization, a foundation or an association; in principle to any body with the exception of private persons and government-administered establishments.

The subsidy amounts to 50 percent of the cost of the consultation to a maximum of Dfl 5,000.

2. Subsidy-granting regulation for obtaining advice on energy conservation measures in smaller industry

In order to make it possible for a smaller firm or institution to make use of the foregoing subsidy granting regulation, "Advice on energy saving in industrial companies", the Foundation for Information on Energy Conservation in the Netherlands (SVEN) has proposed to apply this regulation in a special manner and in agreement with a number of independent consultants. This implies that these consultants will provide advice concerning energy conservation at a fixed rate of Dfl 800 per day of expended time per establishment.

The subsidy amounts to 50 percent of the fixed costs of Dfl 800 (excl. VAT) entailed in providing the advice.

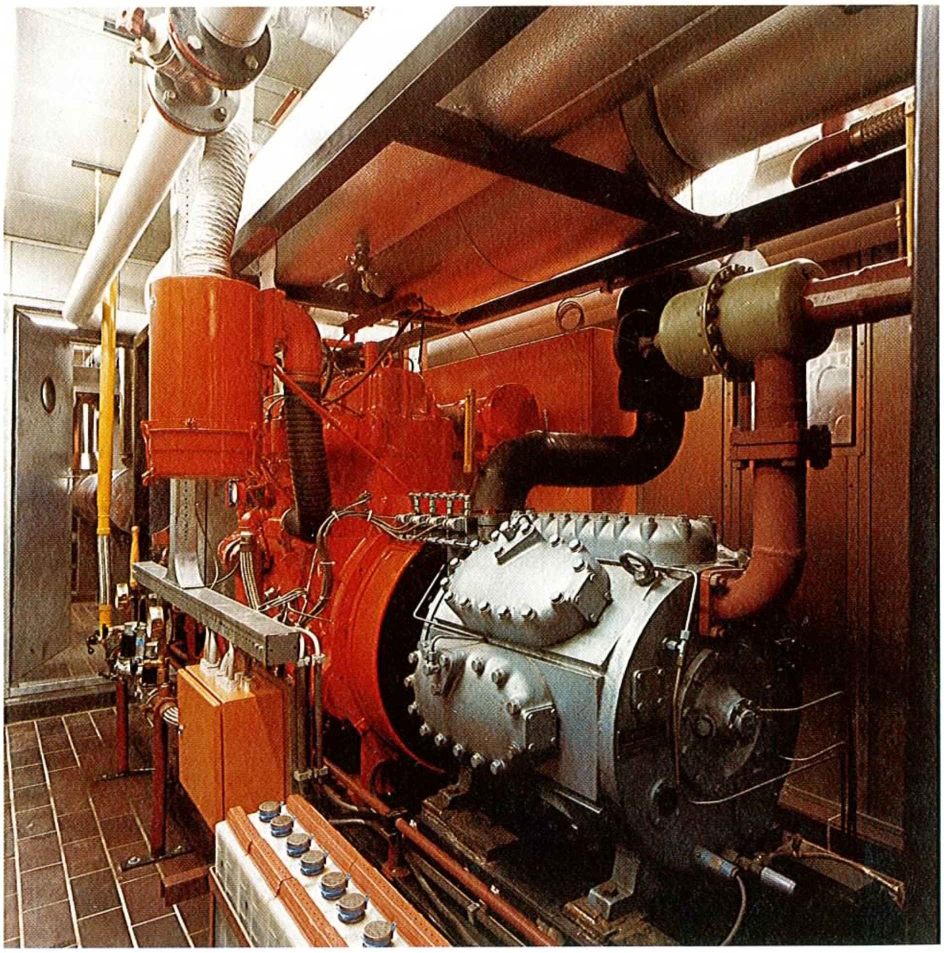
3. Subsidy for installing insulation in existing rented residential properties

In the majority of cases, a subsidy is granted for insulating walls, roofs, windows, and floors of an existing rented residential property. This subsidy is granted to the owner of that property.

For double-glazed windows and similar arrangements the subsidy amounts to 25% of the cost up to a maximum of Dfl 1,250. For other forms of insulation like walls, roofs, and floors, the subsidy amounts to 30% of the cost, to a maximum of Dfl 1,500. The maximum subsidy allowed per residence amounts to Dfl 1,500.

4. Subsidy for high-efficiency central heating appliances and associated economizers

For the purchase of a high-efficiency central heating appliance or a special heat exchanger (economizer) for an existing central heating installation, a subsidy is granted. The subsidy covers the additional cost over a conventional installation (including the cost of maintenance over a period of 5 years) decreased by the saving in energy to be achieved with a high-efficiency installation or economizer during a period of five years.



7 MW Gas Engine Driven Heat Pump in Apeldoorn, Netherlands. This Waste Water Source Heat Pump supplies Heat to a Large Office Building and Workshops

The subsidy amounts to Dfl 250 per high-efficiency installation or economizer.

5. Subsidy-granting regulation for the reduction of energy consumption in non-profit-making establishments

This particular regulation replaces the regulation relating to "Monetary support for reducing the energy consumption in buildings", and can be considered as an extension of and or an amendment to this regulation. In principle, the following can be considered as subsidy deserving projects: effective insulating, heating, cooling, and illumination of buildings; the effective use of production equipment; co-generation of heat and electric power; use of heat released during the combustion of solid, liquid, or gaseous waste materials; useful application of solar energy; useful application of wind energy; efficient transport of goods; reduction of heat loss from open air swimming pools; use of hydropower by means of hydroelectric power plants. This regulation also applies to the owners of buildings not intended for use as private residences and to installations not forming part of private households. As an exception to the non-residential premises regulation, the owners of nursing homes for the elderly or student accomodations indeed come into consideration. The regulation also applies to open-air swimming pools. It does not apply to: companies and institutions that come into consideration for subsidies granted within the framework of the Government legislation relating to particular investments (WIR) and the energy cost supplementation regulation. Neither does it apply to those who are able to take advantage of the provisions made in the Government's energy saving program and for projects in the field of residential heating in towns located at long distance from the energy providing installations.

The subsidy amounts to 25 percent of the investment cost up to a maximum of Dfl 2,000,000. The subsidy is granted in the form of a single payment.

6. Experimental projects on energy conservation in building construction (PREGO)

A subsidy will be granted for the introduction of new energy-saving systems, technologies or construction methods to the Dutch building trade for the construction of private residences or utility buildings. The subsidy is granted to those on whose account an experimental project is to be built.

A subsidy will be granted for private residences, homes for the elderly and projects developed for particular manners and conditions of living, equal to the amount of the additional investment cost involved in the PREGO design, up to a maximum of Dfl 200,000. For utility buildings a subsidy will be granted equal to the amount of the non-profit part of the additional investment cost involved in the PREGO design, to a maximum of Dfl 200,000. The non-profit part of the additional investment cost is considered to be that part the payback time of which is longer than 5 years.

7. Regulation applicable to the support of demonstration projects relating to energy conservation

Applications for support must relate to new energy conservation equipment, systems or technologies saving sufficient energy to be profitable as such. In principle, anyone can apply for financial support, for the regulation is intended both for trade and industry and for foundations, associations, local government bodies and private persons.

The financial support to be granted comprises a subsidy of 25 percent of the invested amount including engineering cost. A credit of another 25 percent of this amount will also be granted at an annual interest rate of 5 percent.

8. Supplementary allowance to undertakings within the framework of the legislation for regulations relating to particular investments (ET-WIR)

This supplementary allowance applies to investments made to procure an effective use of energy through the efficient uses of: insulation or heating of buildings; energy production equipment; co-generation of heat and power; heat released during the combustion of solid, liquid or gaseous waste materials; solar energy using solar boilers or solar heating apparatuses; electric power generated by wind turbines; coal as fuel. The supplementary allowance is intended for concerns that come into consideration for the basic premium of the WIR.

This supplementary allowance amount to 15 percent of the investment for the utilization of solar and wind energy and 10 percent for all other energy invest-ments.

General:

These regulations are subject to regular amendments and modifications.

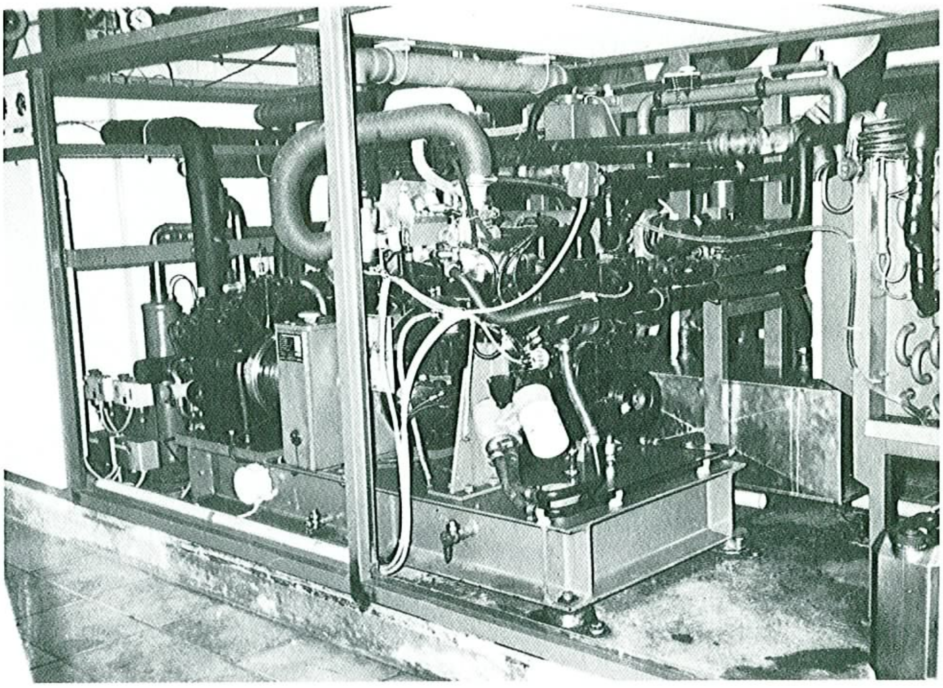
For more detailed information, please contact:

SVEN
P.O. Box 503
7300 AM Apeldoorn
The Netherlands

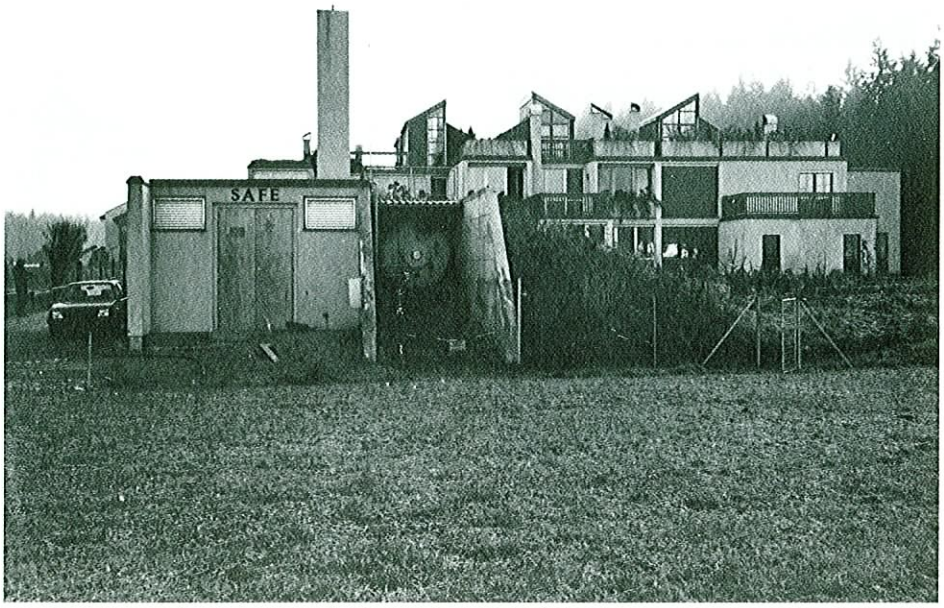
Financial Incentives for Energy-saving Investments in Austria

Tax reductions are granted for energy saving investments made after January 1, 1980, both by private households and by firms.

An investment for an energy saving device (solar plant, heat pump, heat recovery system) can be considered within the scope of this law when it can be called "appropriate in view of power economy". For this consideration, one of the following requirements must be met:



Gas-engine Driven Ground-water Source Heat Pump with Capacity Control (Nominal Heating Capacity 115 kW) at Buermoos, Austria



16 Residential Units Heated by a Gas-engine driven Ground-water Source Heat Pump in Combination with a Gas Boiler for Peak Load Supply at Buermoos, Austria

1. The supplier of the plant guarantees a service life of at least five years for the plant.

2. A service contract together with a declaration of taking over any cost occurring in the exchange of defect parts of the plant not being expressly excluded must have been made between supplier and investor.

3. The type of unit must be tested and the correct installation must be certified by the contractor.

Within the scope of this law, investments for energy saving plants either paid cash or by means of a loan taken for this particular purpose are considered. In case of a loan, repayments as well as interest payments can be deducted from income tax.

The minimum investment amount is fixed at AS 5,000/a. The deductable maximum is of AS 10,000 for singles. Married couples can deduct another AS 10,000 when only one partner has an own income and another AS 5,000 for each child living in the household. Besides these tax credits, there are other possibilities for investors offered by the federal states, like loans at subsidized interest rates.

Business enterprises have the following advantages for energy saving investments:

1. Special rates from electric energy suppliers.

2. Writing-off of the investment cost in a short period (60 percent in the first year and 10 percent in each following year).

3. Subsidized loans for small and medium-sized enterprises.

Incentive Programs for Heat Pumps in the Federal Republic of Germany

Energy conservation is considered to be of high priority. Therefore the Federal Government has allowed a four years' federal income tax credit for energy saving investments in buildings beginning in 1979 (§ 82a Einkommensteuerdurchführungsverordnung v. 12. 7. 1978 BGBl. I S 993). A prolongation of this program until 1987 was decided in 1983 for investments which are not yet profitable for the houseowner or building sponsor. Investments for installation of heat pump systems, solar heating systems, heat recovery systems, some wind power plants, and under certain conditions retrofitting of older buildings for connection to district heating systems are subsidized.

Possibilities of granting incentives:

1. For ten years, 10 percent of the investment cost can be deducted from the taxable income.

2. For enterprises, the Federal Government grants 7.5 percent of certain energy saving investments according to the federal law (Investitionszulagegesetz 4a v. 2. 1. 1979 BGBl. I 1979 S. 24, with alteration of 25. 6. 1980 BGBl. I 1980 S. 737). Under this regulation, heat pump systems, solar systems, heat recovery systems, cogenertion systems and others are subsidized. The application must be accompanied by a certificate confirming that the investment is designed especially to achieve energy conservation. This certificate is issued by the Bundesamt für gewerbliche Wirtschaft (Federal Trade Office) 6936 Eschborn
Federal Republic of Germany

Sweden: Subsidies for Heat Pump Application

Subsidies generally take the form of direct loans at subsidized interest rates. The amount of the loan depends directly on the projected energy savings during the service life of the system.

Heat Pumps for multifamily houses

The loans are given to a calculated value based upon the projected savings over 15 years of operation. Interest rate increases, rising energy prices and maintenance costs are considered when calculating the amount of the loan.

Loan Condition:

15 years annuity loan with amortization calculated from a 8 percent interest rate.

The net interest on the capital borrowed will be 3 percent during the first year, subsequently rising at the rate of 0.25 percent per year.

Single-Family Houses

$$\text{Loan} = (f - 1.2) \times 25{,}000 + 15{,}000 \text{ SEK}$$

The loan is however at the most 47,500 SEK. For ground coupled heat pumps or ground-water heat pumps it is increased by another 8,000 SEK.

f is an energy saving factor:

$$f = \frac{A + B + C}{A + C} \left(1.1 - 0.1 \sqrt{\frac{C}{A + B + C}}\right)$$

A = Annual electric power consumption of the heat pump
B = Energy delivered by the heat pump minus A
C = Energy delivered by conventional system.

Loan conditions:

15—20 years annuity loan

30 percent of the loan is a government loan with no interest during the first ten years.

70 percent is a mortgage loan, given by mortgage institution with an interest rate lower than the ordinary bank interest rate.

Capital cost on the capital borrowed will be approximately 8 percent/a.

For more detailed information please contact:

Ingvar Grane, Energiprojekt AB
Skanegatan 37, S-41251 Goeteborg, Sweden

Incentive Programs for Heat Pumps in the United States

Through 1983, the U.S. Federal Government has allowed a federal income tax credit for the installation of residential space conditioning systems using solar or geothermal energy. The credit amounts to 40 percent of equipment cost up to a maximum credit of $ 4,000. However, the regulations exclude credits for ground-coupled (geothermal) installations in which the soil or ground water is at normal temperature levels. Because almost all U.S. residential heat pumps sold are electric air-source systems, there are, in effect, no federal tax credits of any consequence for heat pumps in the U.S. This is fitting because heat pumps are already highly competitive in the U.S., with about 25 percent penetration in the new housing market over the past few years.

Summer-peaking utilities have an interest in improving the sale of high-efficiency heat pumps (and air conditioners) so that the addition of new generating capacity can be delayed. Accordingly, many utilities have instituted incentive programs for the sale of high-efficiency equipment. The incentives may be in the form of rebates, special rates, or low-interest loans to the consumer or assistance allowances to the installer. The program may be based on a fixed rebate and a minimum efficiency rating or a variable schedule wherein the rebate is a function of the efficiency level. Such programs are proving to be effective, to the extent that the manufacturers express concern over whether their equipment will be acceptable under the various programs. To date, there is little uniformity in these programs, and this writer is not aware of any single, current source of information on them. The Air-Conditioning and Refrigeration Institute (the U.S. national manufacturers' trade association) has expressed disapproval of fixed-minimum-efficiency programs, claiming that they do not necessarily give the consumer maximum value and that they discourage sales of the highest-efficiency models. The ARI favors the variable-schedule programs.

Some states are now allowing credits on property taxes for the purchase of heat pumps which meet prescribed efficiency levels. These incentives can be justified on the basis that they will promote locally adequate energy supplies and low energy costs and thereby benefit local industry and taxpayers. As with the utility programs, we are not aware of a central source of information on state programs in the U.S.

F. A. Creswick
Technical Coordinator
Building Equipment Research Program
Oak Ridge National Laboratory
USA

Schedule of Conferences and Trade Fairs

Jan 20—Feb 2, 1984 Atlanta, GA (USA), Semi-annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Contact: R. S. Burkowsky, American Society of Heating, Refrigerating and Air-Conditioning Engineers; 1791 Tullie Circle NE, Atlanta, GA 30329 (USA)

Feb 13—18, 1984 Karlsruhe (German Federal Republic), Wärmepumpen-Fortbildungskursus, Contact: Fachhochschule Karlsruhe; P.O. Box 6240; D-7500 Karlsruhe 1, (German Federal Republic)

Feb 22—28, 1984, Milan (Italy), EXPOCLIMA, Trade fair for Ventilation, Heating, and Air-Conditioning, Contact: Mrs. Mirella Poggi, Segretaria Mostra Convegno, via Fratelli Bressa 2, I-20126 Milan (Italy)

Feb 22—26, 1984, Essen (German Federal Republic), Energieforum '84, Contact: Messe Essen, Norbertstr.; P.O. Box 100165, D-4300 Essen (FRG)

Feb 23—24, 1984, Milan (Italy), International Congress of the Italian Association for Air-Conditioning and Refrigeration: Components, design, selection, application and testing of air-conditioning and refrigeration plants, Contact: Segretaria Convegno Internazionale AICARR 84; Via Sardegna, 32; I-20146 Milan (Italy)

Apr 2—6, 1984, Birmingham (UK), HEVAC '84, 13th International Trade Fair for Heating, Ventilation and Air-Conditioning, Contact: Industrial & Trade Fairs Ltd., Radcliff House, Blenheim Court, Solihull, W. Midlands B912BG (UK)

Apr 11—14, 1984, Vienna (Austria), Aquatherm '84, International Trade Fair for Heating, Ventilation, Air Conditioning and Sanitary Engineering. Contact: Wiener Messe Ag, A-1071, Messeplatz 1, P.O. Box 124 Vienna (Austria)

May 9—12, 1984, Florence (Italy), Seminar on Utilization of Geothermal Energy for Electric Power Production and Space Heating, Contact: Energy Division, UN Economic Commission for Europe, Palais des Nations, CH-1211 Geneva 10 (Switzerland)

May 14—16, 1984, Budapest (Hungary), 10th Conference on Heating, Ventilation and Air-Conditioning, Contact: Scientific Society for Building; 6—8 Kossuth Lajs ter, H-1055 Budapest (Hungary)

May 22—25, 1984, Graz (Austria), IEA Heat Pump Conference: Current Situation and Future Prospects, Contact: W. Hochegger, IEA Heat Pump Center, Analysis Center Graz, Petersgasse 45, A-8010 Graz (Austria)

Jun 4—7, 1984, Amsterdam (Netherlands), Gas Turbine Exhibition, Contact: American Society of Mechanical Engineers, Gas Turbine Division, International Gas Turbine Center, 6065 Barfield Rd, Atlanta GA 30328 (USA)

Jun 13—17, 1984, Genova (Italy), 6th International Exhibition and Congress on Solar, Renewable and Alternative Energy Sources, Contact: Mrs. Mirando Cinzia; Fiera Internazionale di Genova; P.le J. F. Kennedy, 1, I-16129 Genova (Italy)

Jun 24—28, 1984, Kansas City MO (USA), Semi-annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Contact: R. S. Burkowsky, American Society of Heating, Refrigerating and Air-Condi-tioning Engineers, Inc., 1791 Tullie Circle NE, Atlanta GA 30329 (USA)

Aug 20—24, 1984, Stockholm (Sweden), 3rd International Conference on Indoor Air Quality and Climate (Indoor Air 3), Contact: Indoor Air '84 c/o RESO Congress Service, S-10524 Stockholm (Sweden)

Sep 10—12, 1984, Zürich, (Switzerland), International Seminar 'ORC-Technology', New Working Fluid for Energy Engineering, Contact: ETH Zürich, (Switzerland)

Sep 10—13, 1984, Washington D.C. (USA), International Gas Research Conference: Natural gas production, substitution, utilization, Contact: 1984 Gas Research Conference c/o Gas Research Institute, Att. Dr. L. Hirsch, 8600 W. Bryn Mawr Ave, Chicago IL 60631 (USA)

Sep 25—27, 1984, York (UK), 2nd BHRA International Symposium: Large Scale Applications of Heat Pumps, Contact: Conference Organizer 2nd Heat Pump Symposium, BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK430AJ (UK)

R. Brandner*

A first survey of current research activities in Austria

Emphasis in Austria is concentrated on systems development for residential and industrial heat pumps and for improved small size units. Highlights include:

Solar/Wind Energy Collectors:
Promising system configurations with different modes of operation, system sizes, heat pump types, heat and energy sources, storage systems, recharging components and control were tested in SOLAR HOUSES, which ought to be designated more appropriately as HEAT PUMP HOUSES. More recently, systems without solar collectors, using heat exchangers, which can exploit heat from ambient air and rain, preferrably in connection with direct evaporation are being developed.

Subsoil Storage:
Gravel storage using air as heat transfer medium and earth storage with horizontal or vertical tubes are being developed for seasonal heat storage to achieve higher SPF values.

Gas Engine:
One of the more advanced projects using ground water as heat source is situated near Salzburg; it is remarkable for its continuous variable capacity control by means of both speed regulation and selective operation of its two compressors.

Absorption:
Absorption heat pump systems with low generator temperatures suitable for solar or waste heat input are being developed.

Open cycle:
An open cycle vapour recompression heat pump is applied in an evaporation-crystallization unit of a large saline. Main technical issues considered are the avoidance of fouling in the heat transfer areas, minimization of the service interruptions for cleaning, prevention of compressor pumping, and reduction of electrical power peaks.

Domestic Hot Water:
Improvement of units with particular emphasis on small units for single family houses or dwelling units (0.5 to 1.5 kW electric input) is being made by the industry.

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NEWS

IEA Heat Pump Conference Current Situation and Future Prospects 22—25 May 1984, Graz, Austria

P. Küppers, Chairman of the Organizing Committee

Heat pump development intensified during the 1970s when the two oil price shocks improved heat pump prospects of penetrating major heating and cooling markets in the developed world. As heat pumps allow substitution of oil by other fuels and as they are often more efficient than conventional technologies, their development has been strongly supported both by national governments and international bodies such as the International Energy Agency (IEA) and the Commission of the European Communities.

At present, falling oil prices imperil the ability of advanced heat pumps to compete in major air conditioning markets and to justify the necessary investment. The threat is greatest in the field of heating-only where heat pump cost must be amortized over the heating season alone. Recognizing the importance of the issue, the International Energy Agency has decided to hold a Conference to address the following questions:

- Can heat pumps compete with conventional technologies in major markets?
- How can heat pumps be made more competitive?
- Which types of heat pump products are selling best in Europe, North America and the Pacific?
- How are heat pump prospects influenced by electric and gas utility pricing policies and by government actions?
- How do heat pumps actually perform in residential, commercial and industrial installations?

In contrast to many other heat pump conferences, the IEA conference will not discuss R & D results per se or describe government programs in heat pumps. Rather it will seek to reach conclusions about heat pump prospects, to extract implications and meaning from trends in the market and from government and private experience. The conclusions will help the IEA and member governments to develop their energy policies over the rest of the 1980s.

The conference will be sponsored by:
- Ministry for Science and Research, Austria
- National Research Council of Canada
- Canadian Electrical Association
- Ministry of Energy, Denmark
- Federal Ministry for Research and Technology, Fed. Republic of Germany
- Rheinisch-Westfälisches Elektrizitätswerk AG (RWE)
- Ministry of International Trade and Industry (MITI), Japan
- Committee of the IEA Heat Pump Conference, Japan
- Swedish Council for Building Research
- Swedish State Power Board
- US Department of Energy
- Gas Research Institute, USA

The Conference will be subdivided in three main sessions:
- Residential/Commercial Applications
- Industrial/District Heating Applications
- Policy Considerations

At a final plenary session, chairmen will report their conclusions regarding heat pump prospects in the applications addressed in their sessions. There will be about 50 presentations by invited speakers most of whom come from industry or from the electric and gas utilities.

Detailed information on the Conference is available from the Conference Organizer

W. Hochegger
Energiesparhaus Forschungsgesellschaft mbH
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The Heat Pump Center R, D&D Data Base

Information about demonstration projects, ongoing and already terminated research in heat pump and related fields is being compiled to produce the first extensive data base of the IEA Heat Pump Center. This database contains a short description of every project, along with all relevant information regarding researcher and research organisation, sponsors, time schedule, project status and publications relating to the project.
Available publications of state and federal government-sponsored projects in participating countries, the European Community and direct information from different research organisations are being considered for inclusion.
The IEA HPC Data Base is continuously updated to include latest information. At present, it contains some 30 Austrian, 35 Dutch, 75 German, 12 Italian, 100 Swedish and 230 US projects. As the information in the computerized data base is completely inverted, any particular topic can be retrieved with little effort in short time. The IEA HPC Data Base is also being prepared in printed form and will be available upon request to interested parties from participating countries in December 1983. The HPC is also able to produce extracts from the DB covering a topic or project of particular interest. Please address your special requests to the IEA Heat Pump Center.

DEAR READER!

Our NEWSLETTER is designed to become an international information forum for whoever is concerned with heat pumps - in research, development, installation, production and marketing. Our Readers' Column will be an important section for exchange of opinions, collection of new ideas, or criticism of present procedures.

We need your cooperation!

Please send in your drafts (contributions in the languages of participating countries will also be accepted) - together with a photograph if you like - up to half page DIN A 4 to:

IEA Heat Pump Center
c/o Fachinformationszentrum GmbH
D-7514 Eggenstein-Leopoldshafen 2

Our next topic will be: "What are the obstacles for a broad utilization of heat pumps in the residential sector?"

Deadline for your contributions: Jan 31, 1984

Readers' Column

Which field of heat pump research should be emphasized in the near future?

P. A. Oostendorp
Netherlands Organization for Applied Scientific Research
TNO-MT

The present situation of the market for heat pumps is characterized by the availability of both electrical heat pumps in a wide range of capacities and applications and gas engine driven heat pumps mainly in the large capacity ranges.

In countries with mainly individual heating systems based on natural gas, there is a strong need for small gas-fired heat pumps. Especially in the Netherlands, units which can replace the conventional boiler will become very attractive in the future, taking into consideration that many boilers installed in the starting period of natural gas utilization will be worn out in the next few years. For this replacement market the absorption heat pump is promising and should therefore be a main item for heat pump research. Particular efforts are necessary to improve the economic viability of the absorption system. In this respect the campaigns in recent years providing for improved thermal insulation of houses and more efficient boilers have negative influence on the possibilities for heat pumps. In spite of these factors, small gas-fired heat pumps appear to have a good chance in the Netherlands when mass production can bring the sales prices to an acceptable level.

E. Piantoni
CISE (Italy)

Although the research activities in the fields affecting the heat pump technology are widespread, there are only a few development guidelines which could be addressed as evident.

In electric heat pumps, which have already reached a commercial status, R&D activities will center on technical improvements. For the absorption heat pump, however, fundamental research both on the processes and on the suitable working fluids is necessary. Therefore, the efforts should be aimed at development in the absorption field whose potential seems very promising due to the availability of natural gas.

For engine driven heat pumps, the possibilities are also promising, and a commercial status can be reached if present activities are continued.

I. Grane (Sweden)

According to a proposal from the working committee appointed by the Swedish Council for Building Research, the following fields should be emphasized in Sweden during the next 3 years' period (1984—87):

Energy systems including heat pump applications;

development of heat pump components, particularly evaporator heat exchangers;

medium sized heat pumps for centralized heating systems (supplying multifamily homes, commercial and industrial buildings).

Utility-financed Heat Pumps in Austria

An investigation of OKA, the electric utility company of Upper Austria, has shown that the installation of bivalent heat pumps in existing community-owned, oil-heated school buildings is prevented by the investment barrier. In order to overcome this constraint, OKA is now financing, installing and operating such heat pump systems. Two units have already started operation, substituting oil since the beginning of the heating season 1983/84. These are air-to-water heat pumps in the range of 50 to 100 kW electric input and 150 to 300 kW heat output. Investment cost is paid back from energy cost savings, accrueing from the greatly reduced fuel oil bill.

Selected Book and Report Reviews

Ganssen, M.; Hunke, D.; Schewen Ingenieure GmbH, Düsseldorf (FRG). BMFT-FB-T 82-235 Investigation into possibilities of utilization of heat recovered from waste water illustrated by the example of the City of Lemgo.
1982 (in German) *
95 p.
The study covered investigations into the amount of heat contained in municipal waste water and into the possibilities of recovering it as well as into the effects of heat recovery on efficiency of water treatment. The conception resulting from this investigations is based upon direct heat extraction at suitable stations, i.e. without any purification of the water effected before. Heat pumps will produce temperatures suitable for heating. Various possibilities for recovering heat from waste water have been investigated. The conservation of primary energy can be called considerable compared with conventional heating; cost-benefit analysis, however, shows that no savings could be achieved in comparison with conventional heating.

VDI Berichte 491, VDI Verlag Düsseldorf (FRG), ISBN 3-18-090491-7. Municipal and Regional Energy Supply Concepts.
1983 (in German)
142 p.
The report contains 18 contributions presented at Freiburg on Sep 29—30, 1983 and at Hannover on Oct 27—28, 1983. Emphasis is put on development of conceptions and to matching technologies to existing supply and demand configurations. 4 contributions deal with heat pumps for waste heat recovery at low temperature levels from power stations and industrial plants and with the economics of such measures.

Mucic, V.; Czink, F.; Doering, Hans; Energie- und Wasserwerke Rhein-Neckar AG, Mannheim (FRG), BMFT-FB-T 83-144 Preliminary project for district heat supply to Heidelberg City by heat transportation from GROSSKRAFTWERK MANNHEIM with reduced return temperatures in the consumer installations and by means of heat pumps.
1983 (in German) * 74 p.
Main objective of the investigations carried through in the preliminary project was realizing the technical and economical analyses of the possibilities for the heat transportation from GROSSKRAFTWERK MANNHEIM to HEIDELBERG City over a distance of 15 km. These analyses have shown that, especially in the case of long distance between heating power station and supply area, transport cost will be much lowered by reducing the return temperatures in the consumer installations and by the use of heat pumps, because in that way the flow pipelines will have smaller dimensions and the return lines can be piped without insulation. Conclusion: With the aid of the new heat transportation conception developed in this preliminary project the possible distance in terms of economics between heating power station and supply area will be much longer than with conventional engineering.

Zegers, P.; Pilavachi, P. A. (ed.) Commission of the European Communities, Directorate-General Science, Research and Development, Brussels, (Belgium) EUR 8661 EN, The Second Energy R & D Programme: Energy Conservation (1979—1983), Survey of Results.
1983 (in English)
309 p.
In the field of Energy Conservation R & D the Commission of the European Communities concluded between 1979 and 1983 more than 150 research contracts with organizations or undertakings in the Member States of the European Community. The total cost of this research is around 50 Mio ECU of which 25 Mio ECU is paid by the Commission. Research is carried out in the domestic, industrial and transport sector and first results are now becoming available. This booklet is a follow-up of the survey of the first Energy Conservation R & D Programme (EUR 7389) and gives one-page descriptions of the projects in the second program.

It is meant to give the widest possible dissemination of the results. 26 projects focus on heat pumps and heat pump systems. They are divided into the categories: Domestic compressor heat pump systems; Domestic absorption and other advanced heat pumps; Ground as a heat pump heat source; Industrial heat pumps.

* BMFT Reports are available at Fachinformationszentrum Energie, Physik, Mathematik GmbH

IEA heat pump center

In our next issue you will find contributions to the following topics:

1. Editorial: Market penetration of heat pumps
2. Technical Article: International marketing activities
3. Shake out in the German heat pump industry
4. Heat pump sales in member countries
5. Product information on heat pumps
6. Readers' Column: "What are the obstacles for a broad utilization of heat pumps in the residential sector?"
7. Schedule of conferences and trade shows
8. Selected reviews of new books and reports

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