

# The IEA, Austria, and Heat Pumping Technologies

H. HALOZAN

# The IEA

- Founded as an autonomous body within the OECD in 1974, in the wake of the first oil shock.
- Initial objectives were to represent major energy-consuming nations and to work for stability in world energy markets.
  - *Commitments to hold oil stocks, co-ordinate emergency responses, share oil*
  - *Work to reduce reliance on oil*
  - *Dialogue with oil producers*
  - *Production of oil market statistics*



# Heat Pumping Technologies

Mid of the Seventies:

First Implementing Agreement (IA) for a

Programme of Research and Development on the Application  
of Heat Pump Systems to Energy Conservation

First Heat Pump Annex:

"Programme on Heat Pump Systems with Thermal Storage"



# Heat Pumping Technologies

1978: New Implementing Agreement for a

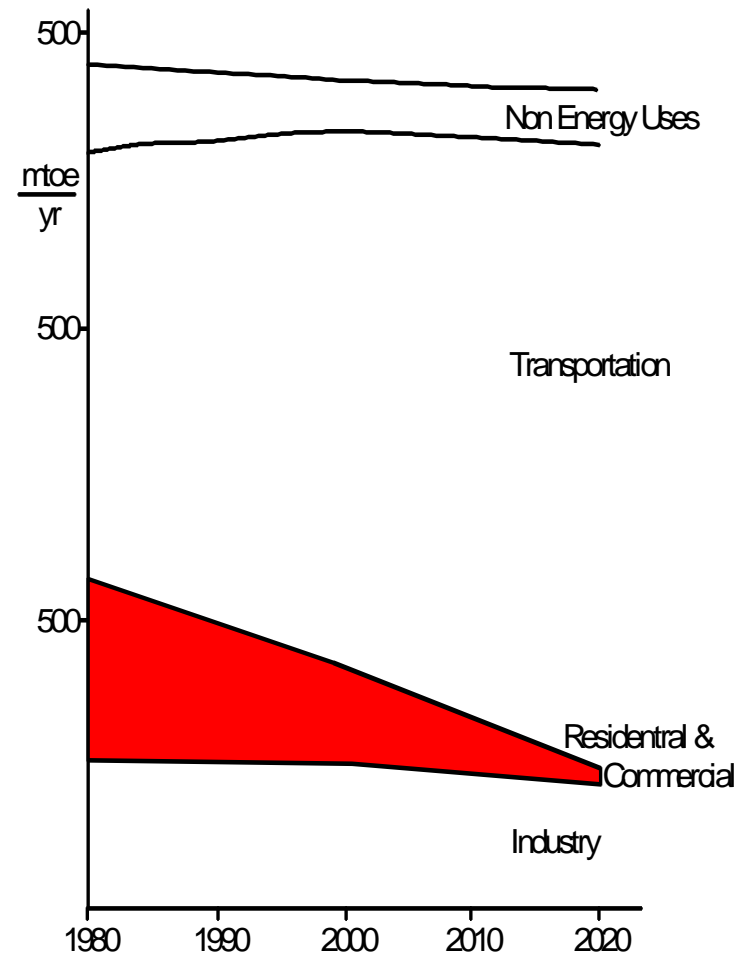
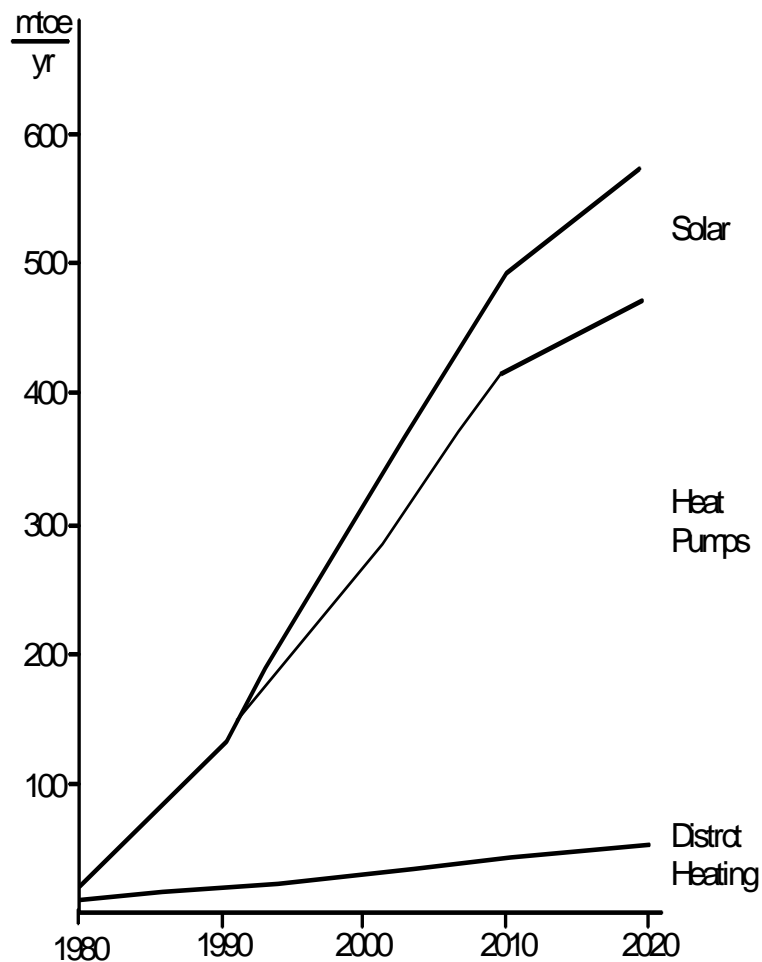
Programme of Research and Development on Advanced Heat Pump Systems

1992: Renamed to Implementing Agreement for a

Programme of Research, Development, Demonstration and Promotion of Heat Pumping Technologies  
IEA Heat Pump Programme

Now: Technical Collaboration Programme - TCP - on Heat Pumping Technologies





## IEA Strategy Study 1980



# Heat Pumping Technologies

IEA Heat Pump Center      1982 – 1990    FIZ Karlsruhe, Germany  
Annex 4      Karl Holzapfel, Prof. Hans-Jürgen Laue

Austria, Belgium, Canada, Finland, Germany, Italy, Japan, The Netherlands,  
Norway, Sweden, USA

Newsletter  
Organisation

Analysis Center Graz      1982 - 1985    Rechenzentrum Graz  
AirCond (W. Hochegger)  
Institute of Thermal Engineering  
Graz University of Technology  
(Univ.-Prof. P.V. Gilli)

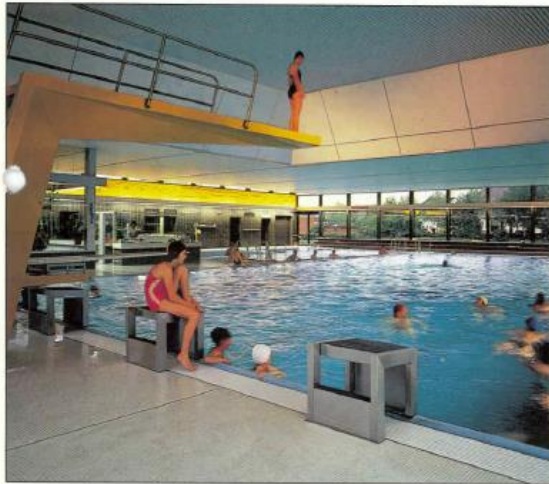
Workshops  
Analysis Studies  
1. IEA Heat Pump Conference



# NEWS LETTER

PERIODICAL OF THE  
IEA HEAT PUMP CENTER

VOL. 1, JUNE '83



Indoor Swimming Pool Heated by Electrically Driven Heat Pump at Forchheim near Karlsruhe. Photograph by Bauer/Badenwerk.

Editorial by John RYAN\*

## The IEA Heat Pump Center and its Role:

Research and development in heat pumps has intensified ever since the oil price rises of the 1970s improved prospects for their wider application in the economies of the developed world. Both governments and private firms have invested considerable sums in the development of advanced products using heat pump cycles that have, in many cases, been known theoretically since the early decades of the century. While a heat pump market has existed in North America and Japan for some time due to the need for both heating and cooling, the European market has developed more recently and is less robust due to the need to amortize the capital costs of the equipment over the heating season alone.

Ongoing R and D throughout the IEA countries is producing significant new data on heat pump technologies, as well as a wide range of heat pump prototypes, including both electric and fossil-fueled units. Now the task is to disseminate this new information so as to speed the introduction of heat pumps into buildings and industrial plants in order that their full energy savings potential may be realized. The new IEA Heat Pump Center is designed to serve this end by making better information on heat pumps available to industrial, research, and consumer groups interested in heat pumps. Through this newsletter and through published reports on important technical issues affecting the technology, the Center will contribute

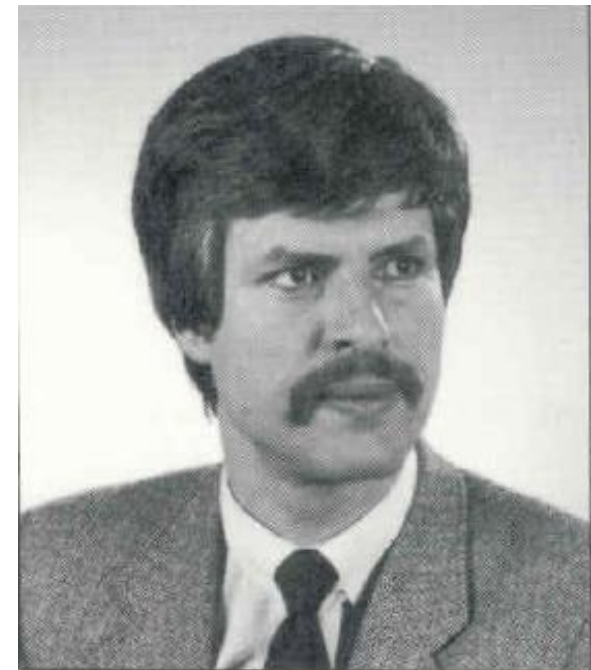
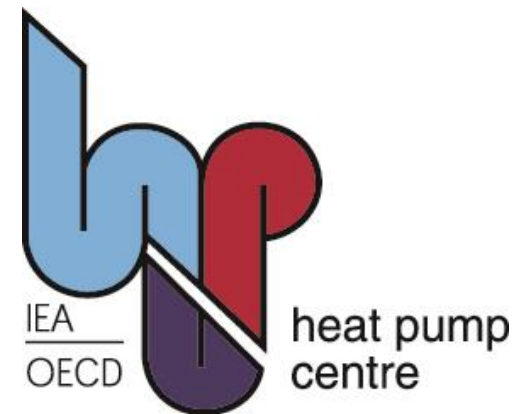
much to improving heat pump prospects in the IEA countries.

The Center complements the ongoing activities of the IEA Executive Committee on Heat Pumps, many of which will be reported in this newsletter from time to time. It also represents the implementation of key recommendations of the "1981 IEA Berlin conference on new energy conservation technologies and their commercialization" as well as the "IEA technology review of heat pump systems" published in 1982, which called for improved information collection, analysis, and dissemination on energy-efficient technologies.

I am sure that all the members of the IEA Executive Committee on Heat Pumps join me in celebrating the birth of this important institution and in wishing it all possible success during the first three years of its work.

\* John Ryan, US Department of Energy; Chairman of the Steering Committee for the IEA Heat Pump Center.

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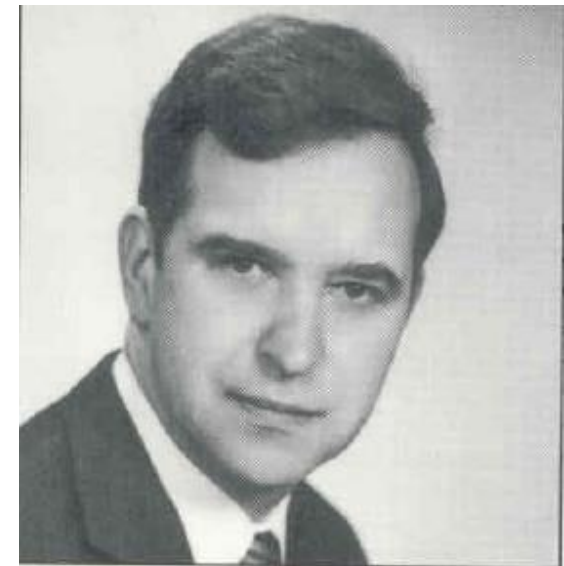
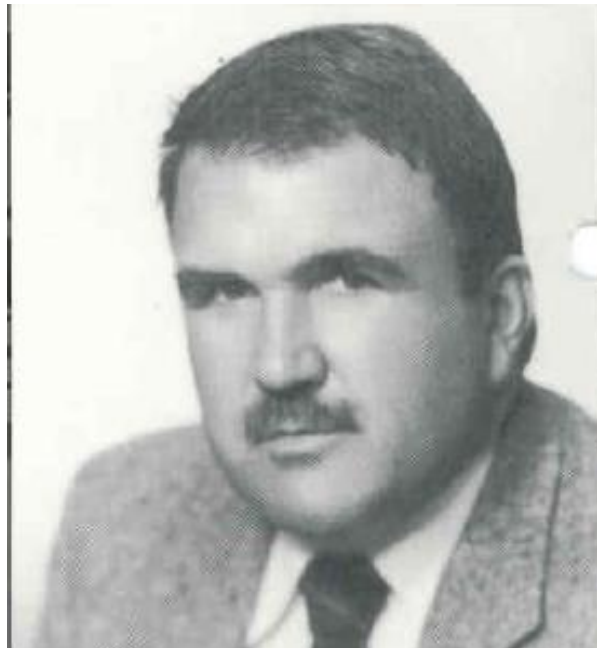
TUG

Hal 7

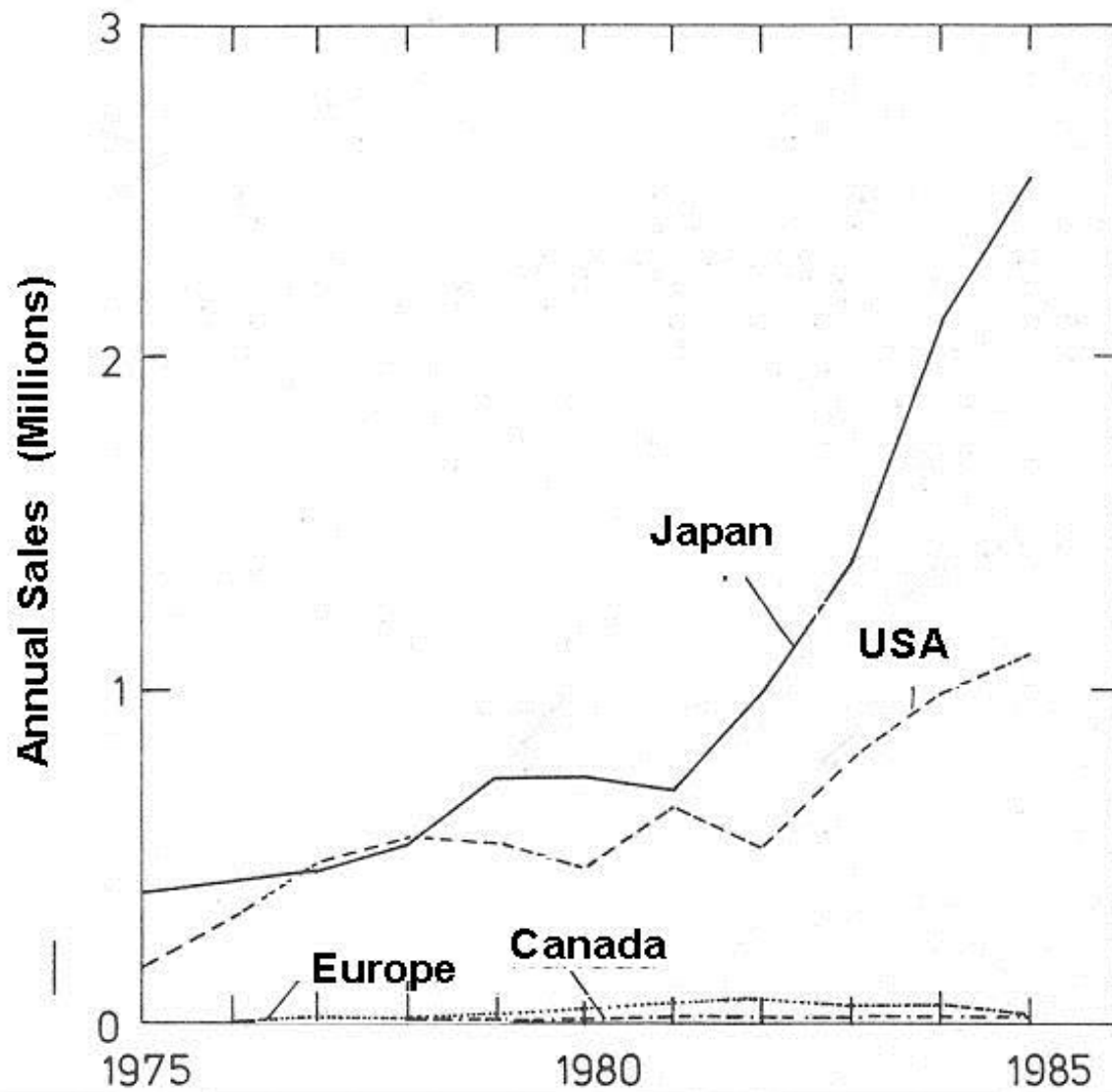
# Heat Pumping Technologies

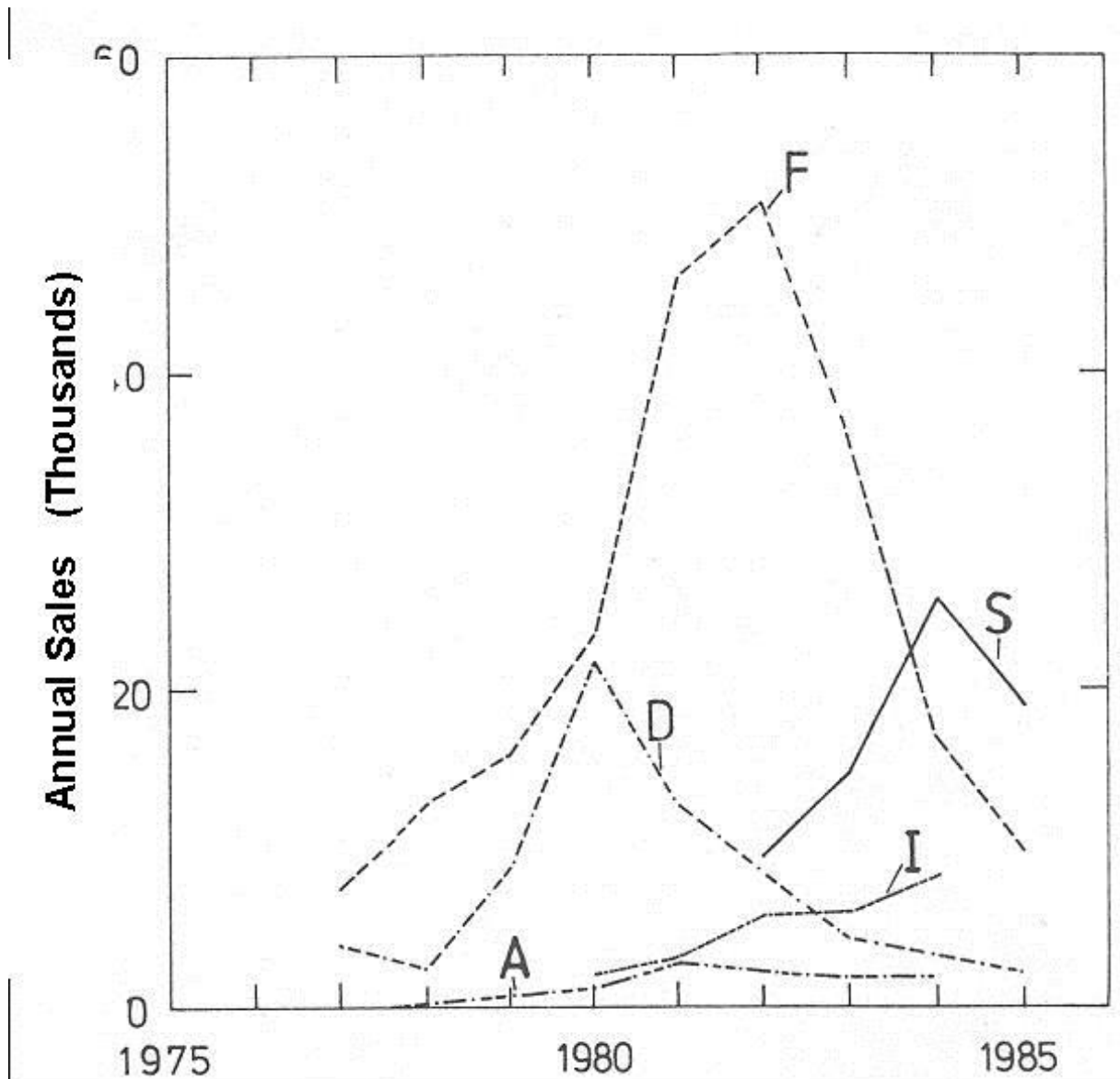
## Tasks of the Analysis Centre

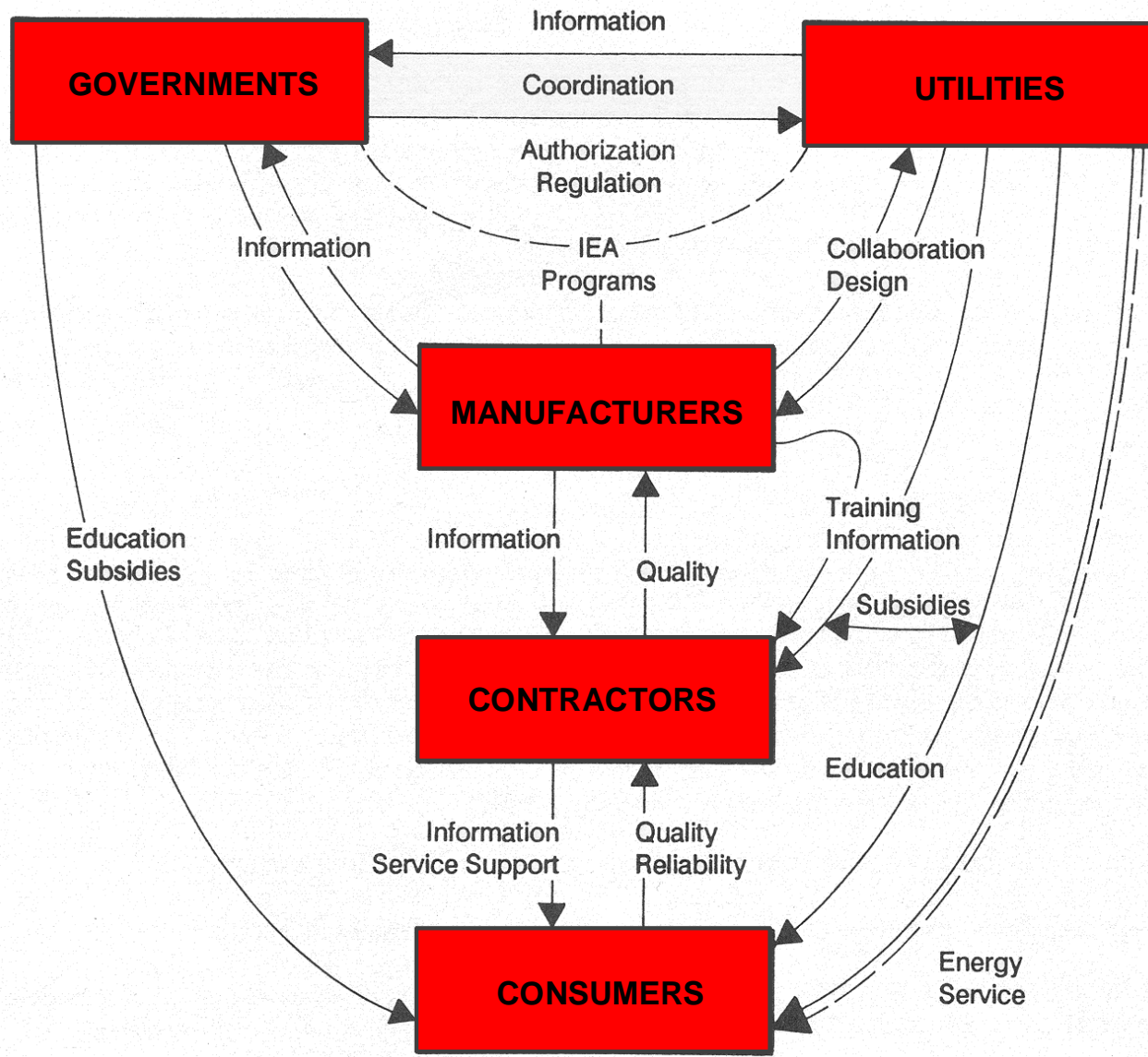
- Workshops
- Studies
- Newsletter Articles
- Promotion Tours with the Heat Pump Center
- Organisation of the first IEA Heat Pump Conference in Graz







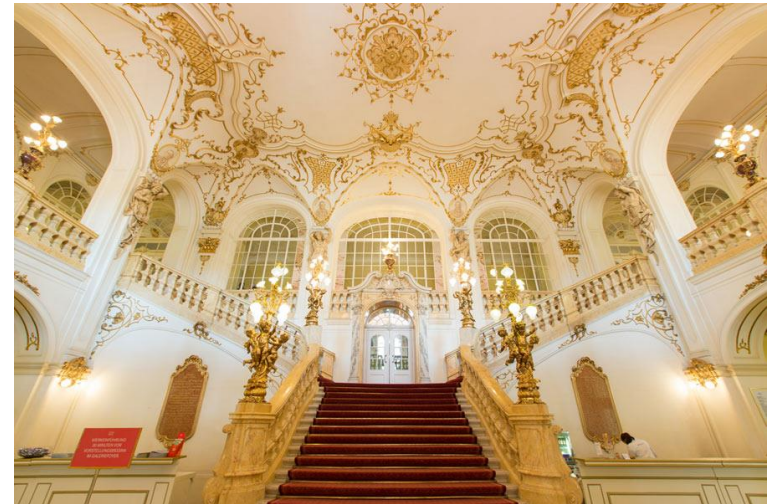




# Heat Pumping Technologies



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, Petergasse 45, A-8010 Graz





# Heat Pumping Technologies

## International IEA Heat Pump Conferences

1984 in Graz, Austria,  
1987 in Orlando, Florida, USA  
1990 in Tokyo, Japan,  
1993 in Maastricht, the Netherlands,  
1996 in Toronto, Canada,  
1999 in Berlin, Germany,  
2003 in Beijing, China,  
2005 in Las Vegas, USA,  
2008 in Zürich, Switzerland,  
2011 in Japan (Web Conference),  
2014 in Montreal, Canada,  
2017 in Rotterdam, Netherlands.



# Heat Pumping Technologies

IEA Heat Pump Center  
Annex 16

1990 - 2003 NOVEM, the Netherlands

Jos Bouma

Rebecca van Leuwen-Jones

Austria, Japan, Norway, Spain, Switzerland, The Netherlands, UK, USA

Workshops

Analysis-Studies

Newsletter TCP-Studien (Tailored Collaborative Studies)

Cooperation with

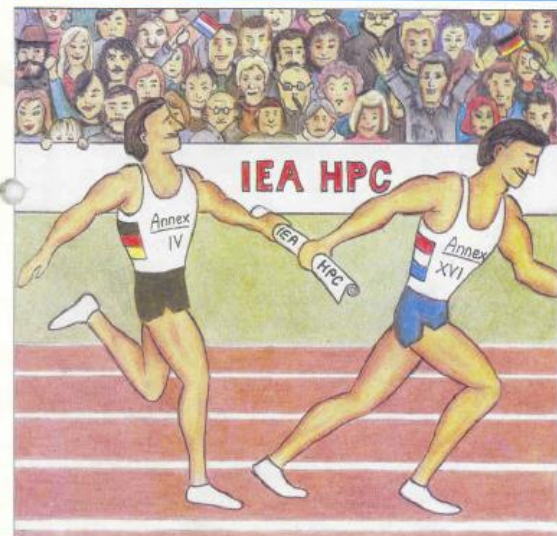
Future Buildings Forum,  
International Institute of Refrigeration,  
D-A-CH (Heat Pump Quality Label),  
European Heat Pump Association



# NEWS LETTER

PERIODICAL OF THE  
IEA HEAT PUMP CENTER

Vol 7, No 4, Dec '89



A Heat Pump Center Transition--Annex IV Concludes, Annex XVI Commences

**This issue: Planning for the future --  
national R,D&D programs, incentives,  
codes, and standards**

Dear Reader:

This December 1989 Newsletter is the last issue published by the Fachinformationszentrum Karlsruhe, the current operating agent of the IEA Heat Pump Center. This is due to a decision made by the Executive Committee of the IEA Heat Pump Center, with the support of the majority of the member countries, to terminate the Fachinformationszentrum's operation of the Center at the end of 1989.

This, however, will not be the last issue of the Newsletter published by the IEA Heat Pump Center. The new operating agent of the IEA Heat Pump Center, NOVEM, Sittard, the Netherlands, plans to continue with a similar quarterly publication beginning March 1990. We will do our best to ensure the continued receipt of the Newsletter for those subscribers in countries which are continuing their membership in the new IEA Heat Pump Center.

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# ANNEXES of the IEA HEAT PUMP PROGRAMME

## Common Studies

**One type of Annexes dealt with common studies on the state of the art of heat pumps and the market situation like**

- **Common Study of Advanced Heat Pumps, finished in 1980, joined by Germany - Austria, Belgium, Canada, Denmark, Italy, Japan, The Netherlands, Spain, Sweden, Switzerland, UK, USA**

**and**

- **Technical and Market Analysis of Advanced Heat Pumps, finished in 1991, joined by the USA - Sweden.**





# ANNEXES of the IEA HEAT PUMP PROGRAMME

## Large and Small Heat Pumps

Another criterion has been the size of the heat pumps, and Annexes dealing with this topic have been:

- **Integration of Large Heat Pumps into District Heating and Large Housing Blocks** finished in 1986, joined by Sweden - Denmark, Germany, Italy.

It was the time when Sweden introduced large heat pumps for their district heating networks.

- **Heat Pump Systems for Single- Room Applications**, finished in 1999, joined by Canada - France, Switzerland,

shows a complete different situation, this Annex has been carried out to find possible ways to replace direct electric heating systems.



# Nahwärme Aschach/Hartkirchen



Nutzung der Generatoren- und Transformatorenabwärme  
mit einer Wärmepumpe [ 1 MW]

Verbrennung des Schwemmhholzes in Biomassekesseln [1,5 + 2,5 MW]

Spitzenabdeckung mit einem Gaskessel





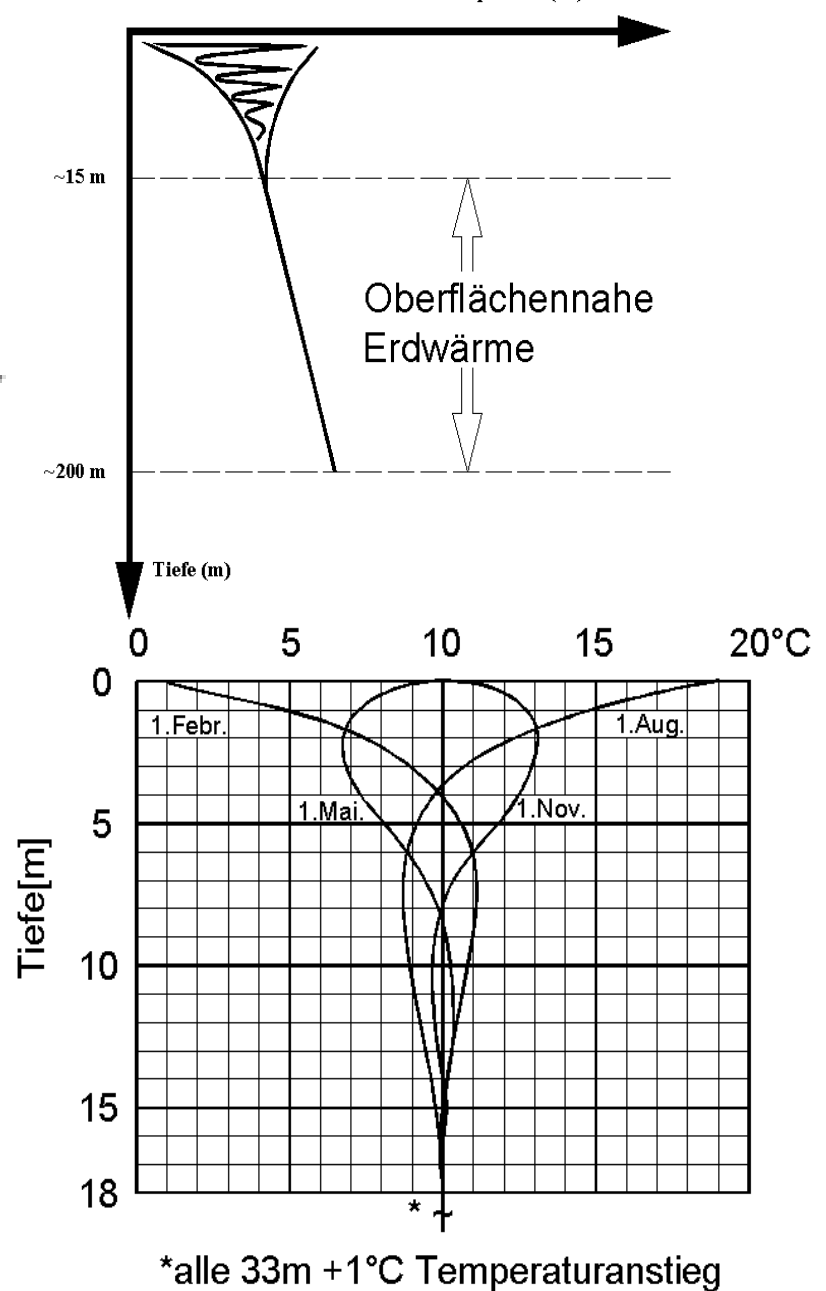
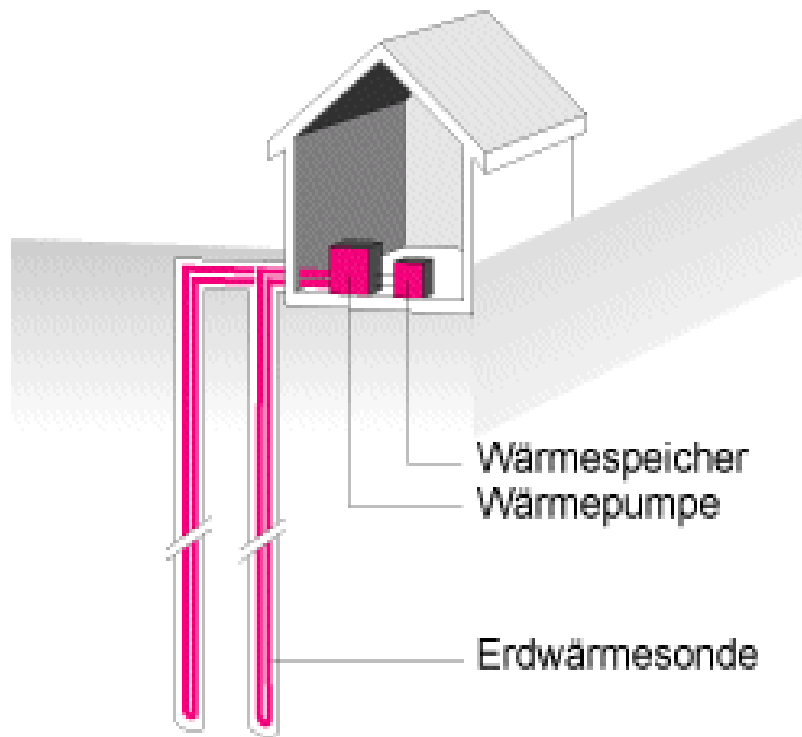
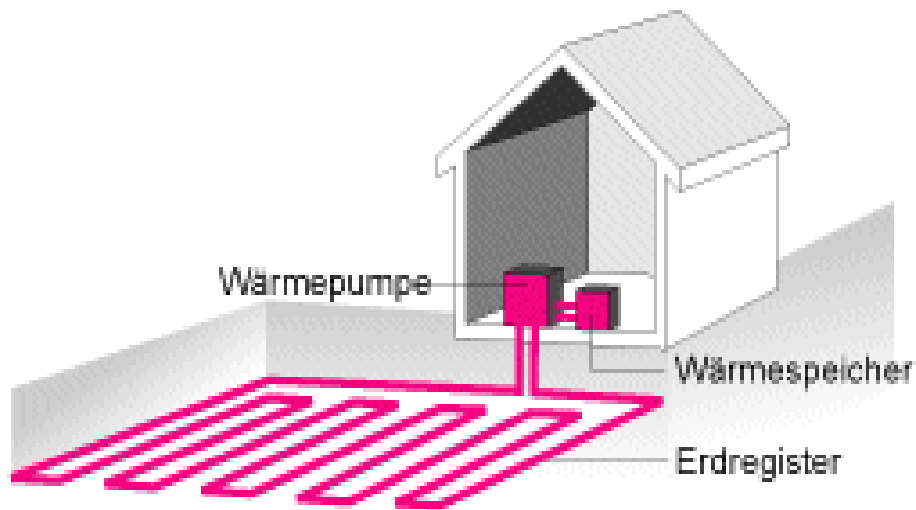
# ANNEXES of the IEA HEAT PUMP PROGRAMME

## Ground-Coupled Heat Pumps

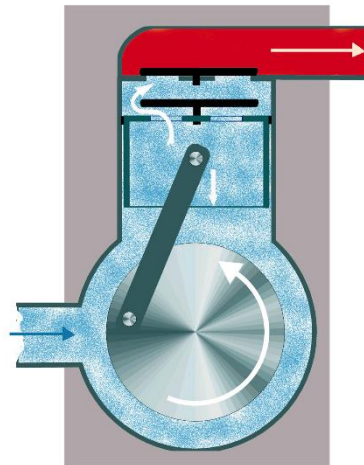
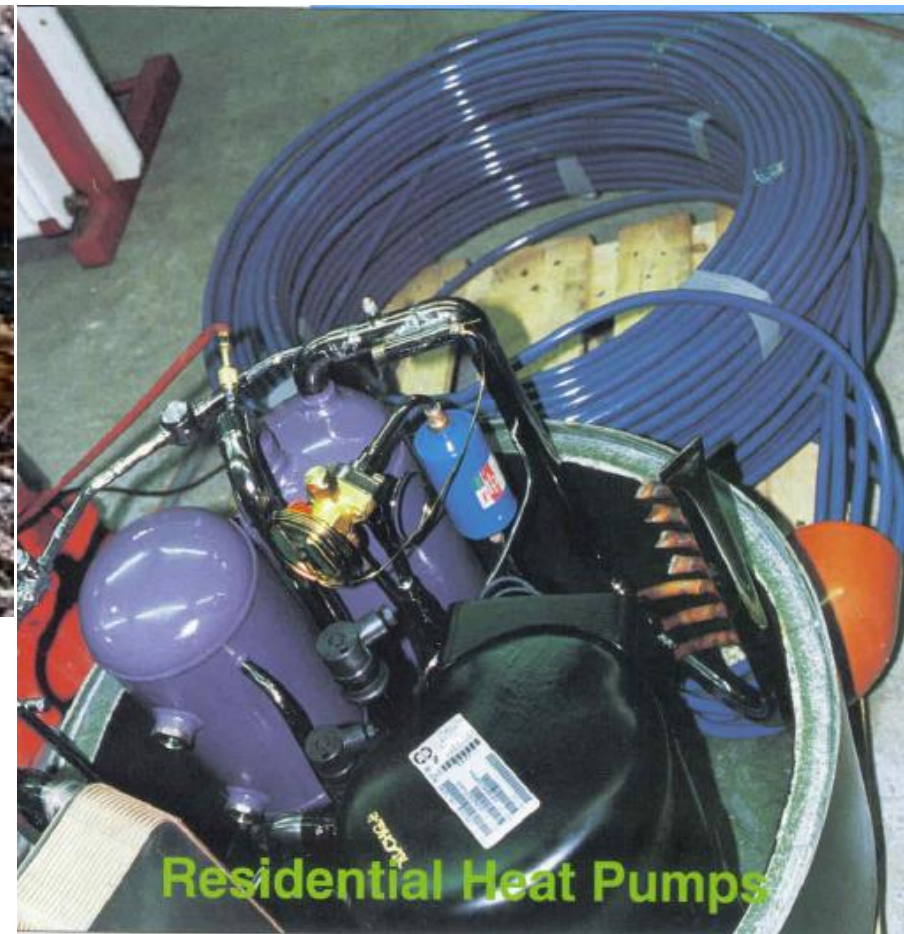
For cold districts Ground Coupled Heat Pump Systems have been and still are very interesting due to the fact, that the ground as heat source offers better operation conditions for heat pumps, i.e. the SPF can be increased significantly.

- **Vertical Earth Heat Pump Systems**, finished in 1983, joined by Sweden - Austria, Canada, Denmark, USA, was the first investigation on this technology.
- **Advanced in-ground Heat Exchange Technology for Heat Pump Systems**, finished in 1992, joined by Canada - Germany, Switzerland, USA, was a look into efficient and thereby cost efficient ground heat exchange technology.
- **Heat Pump Systems with Direct Expansion Ground Coils**, finished in 1993, joined by Canada - Austria, (Germany), Japan, USA, dealt with direct-evaporation systems with respect to improve SPFs further by omitting the secondary ground loop and thereby heat transfer temperature losses and the power requirement of the circulation pump. This technology was domination the Austrian market.









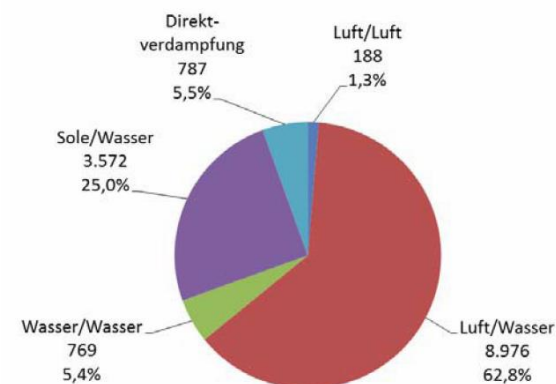
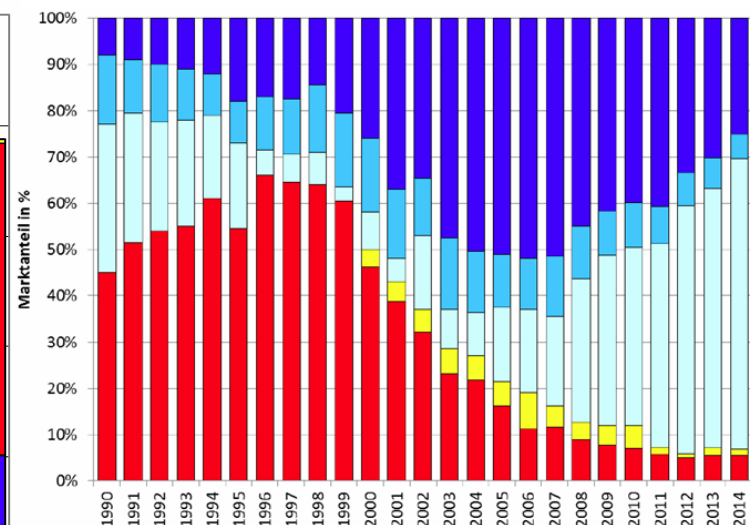
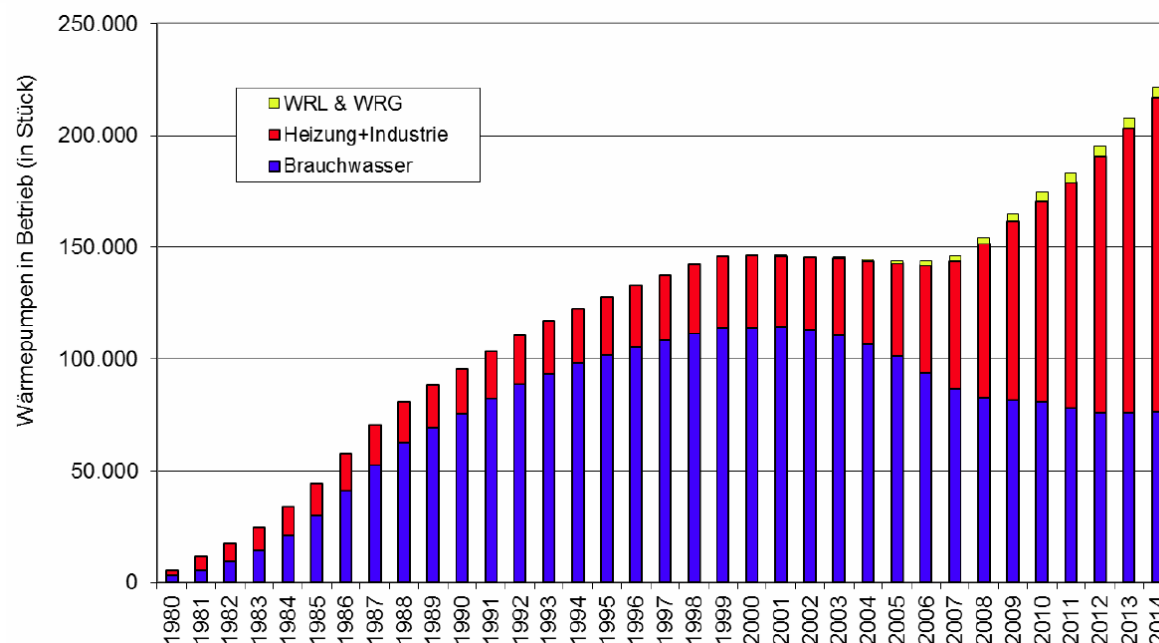
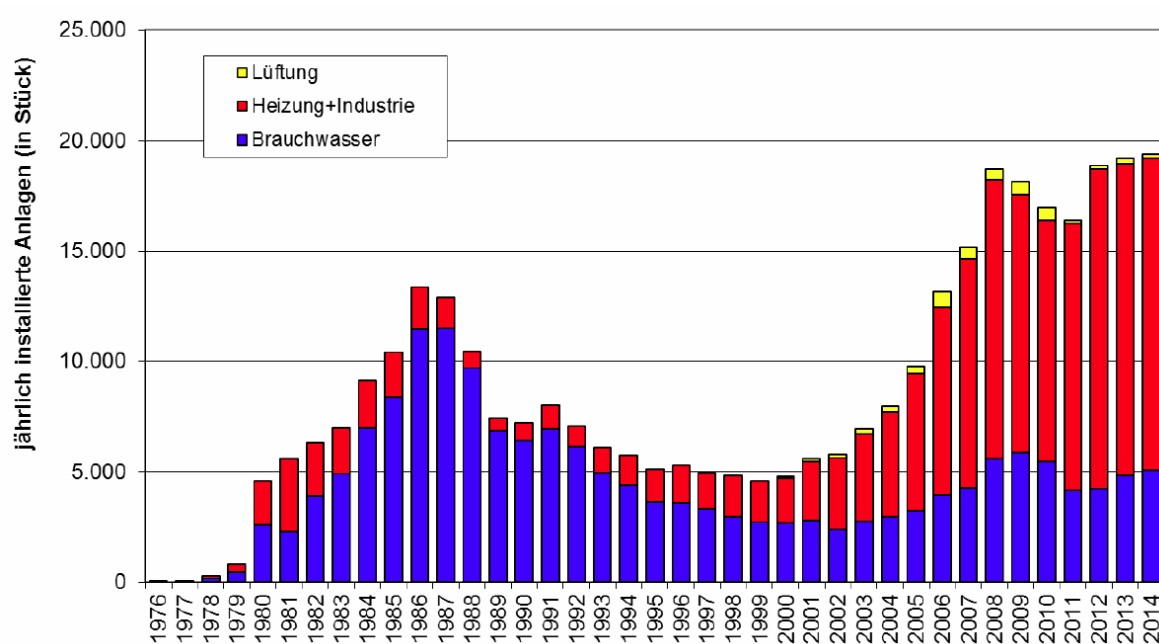
## Propane Direct Exchange Heat Pump System



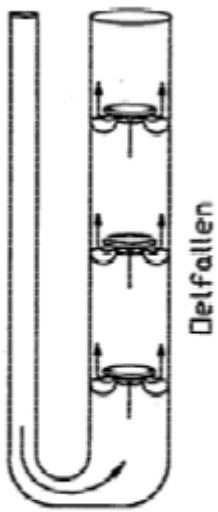


# Direct Exchange Ground Source Heat Pump Test Rig

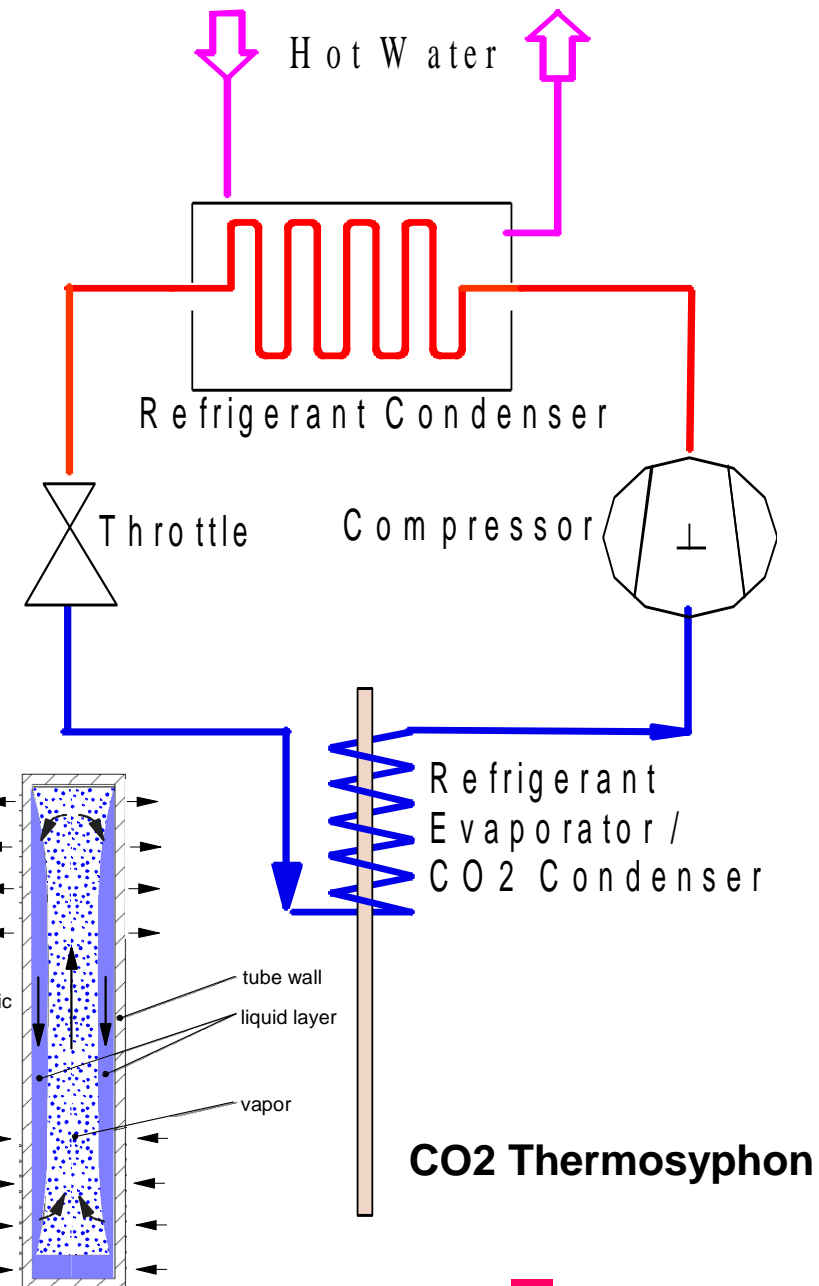
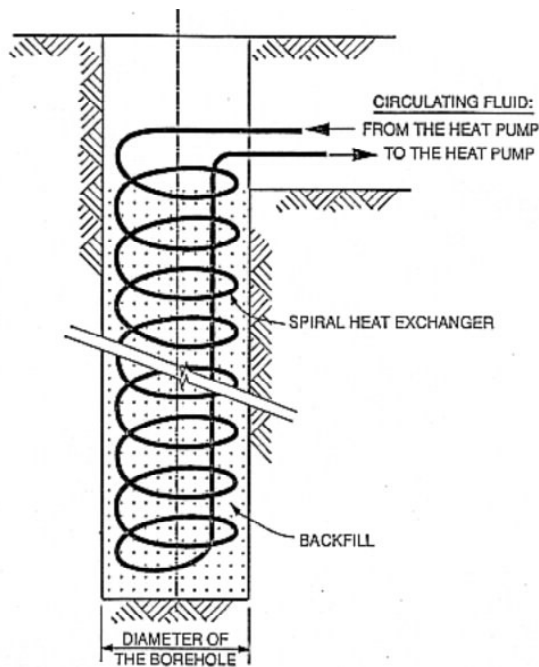








U-Rohr-Verdampfer  
mit Ölfallen



# ANNEXES of the IEA HEAT PUMP PROGRAMME

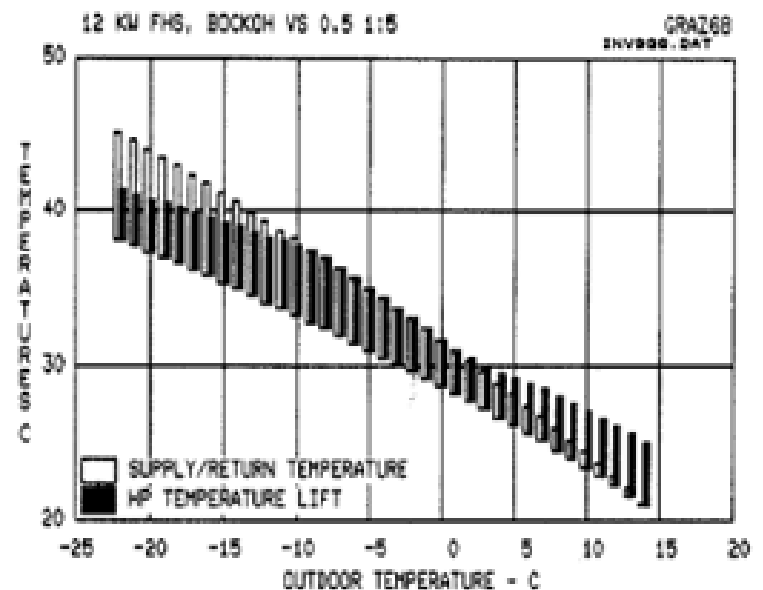
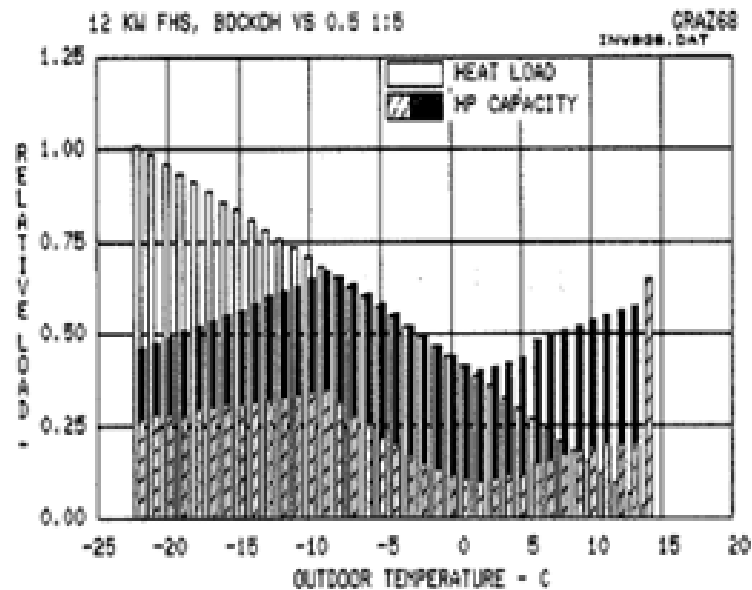
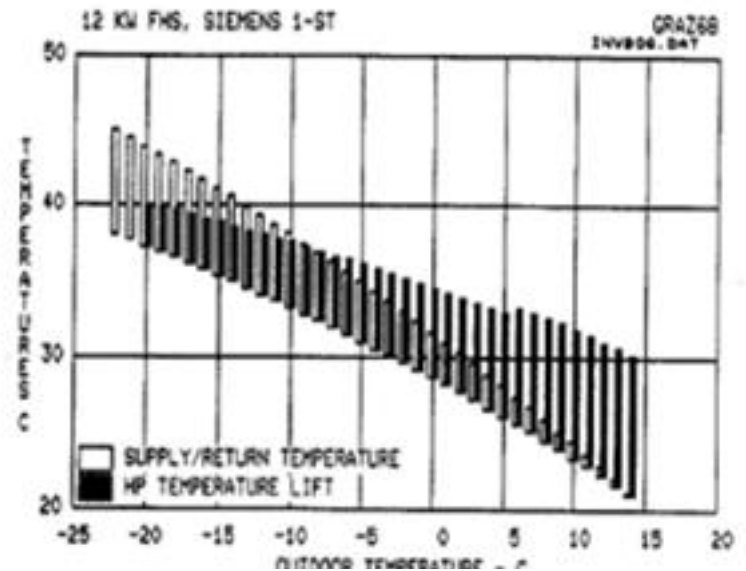
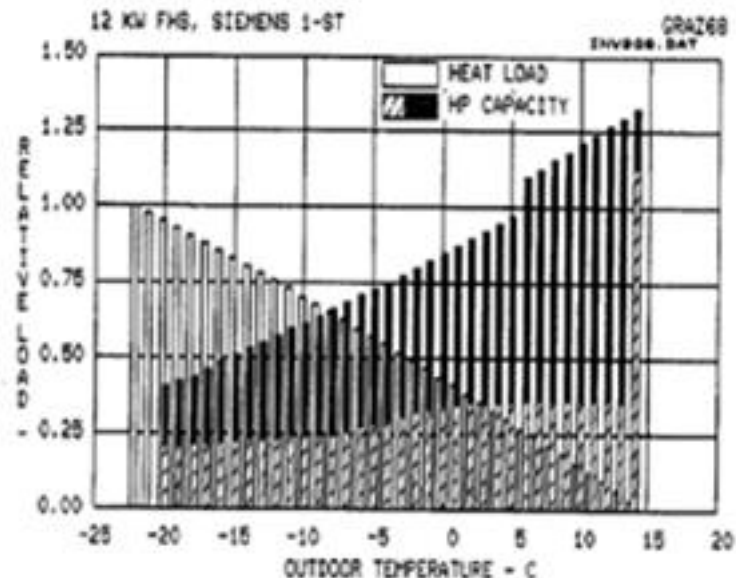
**A special Annex was**

- **Modelling Techniques for Simulation and Design of Compression Heat Pumps, finished in 1992, joined by the USA - Austria, Belgium, Germany, Italy, Japan, Switzerland. The goal was to develop, improve and compare heat pump design and SPF models.**

**Another special topic was working fluid safety, which became interesting when natural working fluids became important.**

- **Working Fluid Safety, finished 1993, joined by Belgium - Japan, The Netherlands, Norway, Switzerland, investigated the risk of the different possible working fluids.**





# ANNEXES of the IEA HEAT PUMP PROGRAMME

## Industrial Heat Pumps - Heat Pumps in Industry

- **Heat Pump Systems Applied in Industry, finished in 1984, joined by Belgium, - Austria, Canada, Denmark, Finland, Germany, Italy, Japan, The Netherlands, Sweden, was the first Annex in this field.**
- **Study of Working Fluid Mixtures and High Temperature Working Fluids for Compressor Driven Systems, finished in 1986, joined by Sweden - Austria, Denmark, Finland, Germany, Japan, USA, dealt with the temperature requirements in industry.**
- **High Temperature Industrial Heat Pumps, finished in 1990, joined by Belgium - Germany, Finland, Japan, The Netherlands, Sweden, Switzerland, USA, was an advanced investigation in the same direction.**
- **Global Environmental Benefits of Industrial Heat Pumps, finished in 1996, joined by the USA - Canada, France, Japan, The Netherlands, Norway, Sweden, UK, was already influenced by the climate change issue and the Kyoto targets, the results are energy savings, market potentials and integration methods for industrial heat pumps.**



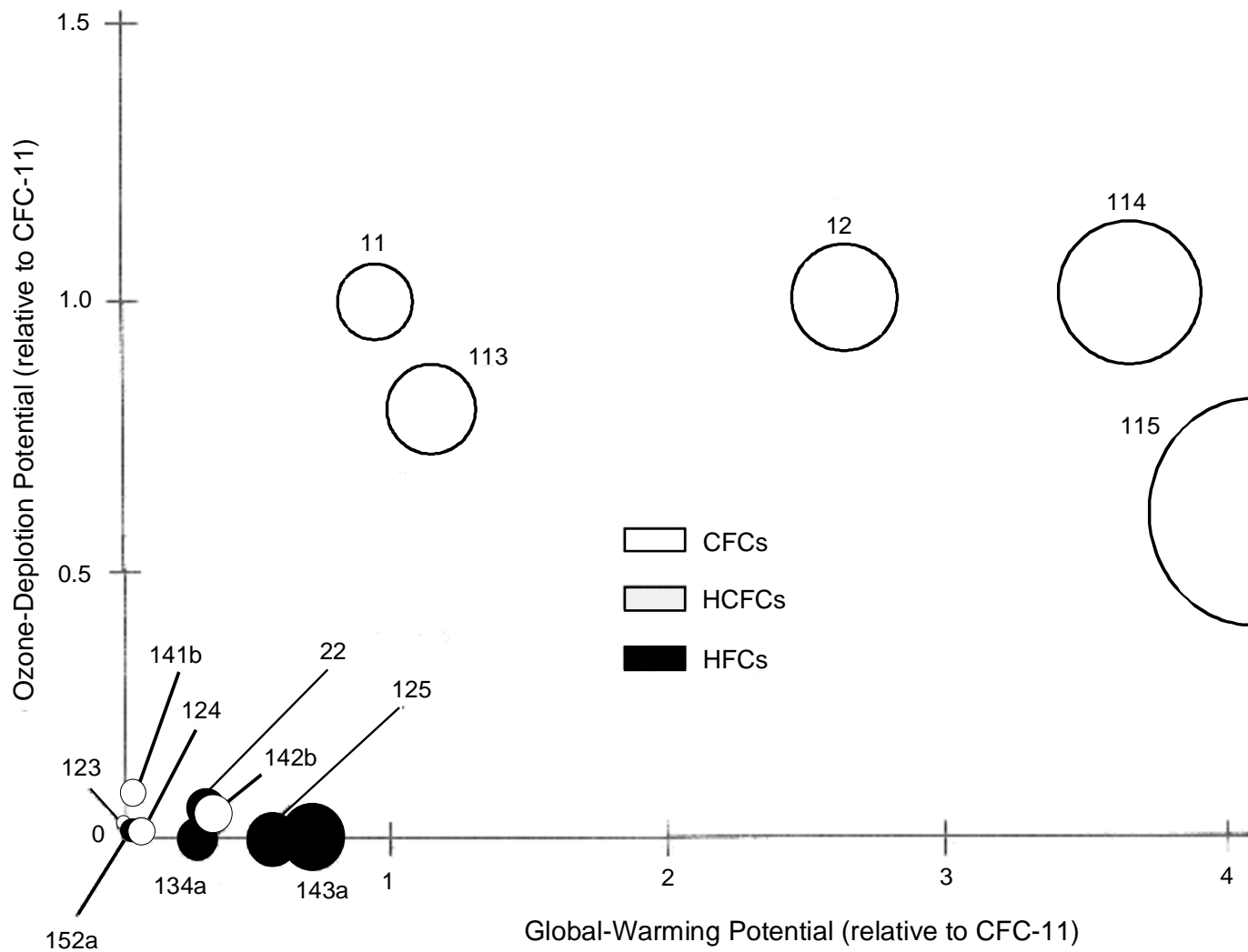
# ANNEXES of the IEA HEAT PUMP PROGRAMME

## Working Fluids for Heat Pumps

**1987 was an important year for heat pumping technologies: The Montreal protocol on Substances that Deplete the Ozone Layer went into force.**

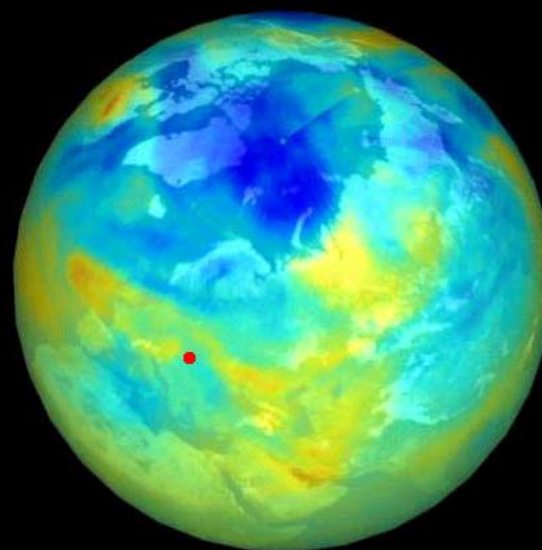
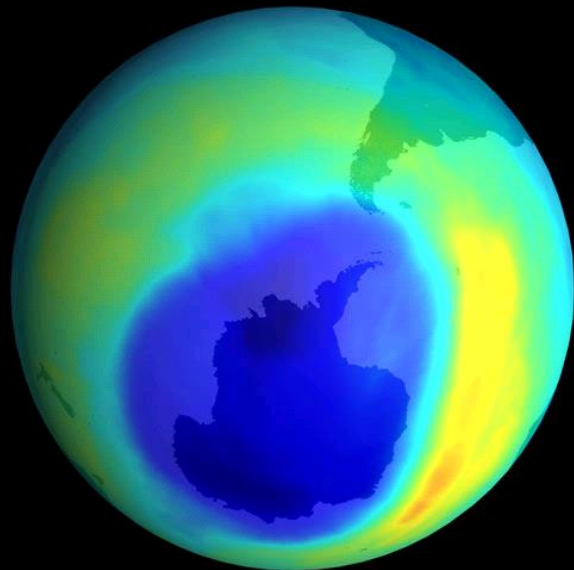
- **Experiences with New Refrigerants in Evaporators, finished in 1993, joined by Sweden - Canada, The Netherlands, Norway, Switzerland, dealt with heat transfer of new working fluids.**
- **Thermo-physical Properties of Environmentally Acceptable Refrigerants, finished in 1999, joined by the USA - Austria, Canada, Germany, Japan, Sweden, UK, became a very scientific Annex, where equations of state have been developed based on measurements carried out by the international research community. This Annex was driven by the regulations coming in force and accelerating the phase-out schedules for substances which are harmful for the ozone layer.**
- **Compression Systems with Natural Working Fluids, finished in 1999, joined by Norway - Canada, Denmark, Japan, The Netherlands, Switzerland, UK, USA, concentrated its efforts on natural substances, which already had been in use before the (H)CFCs had entered the market.**





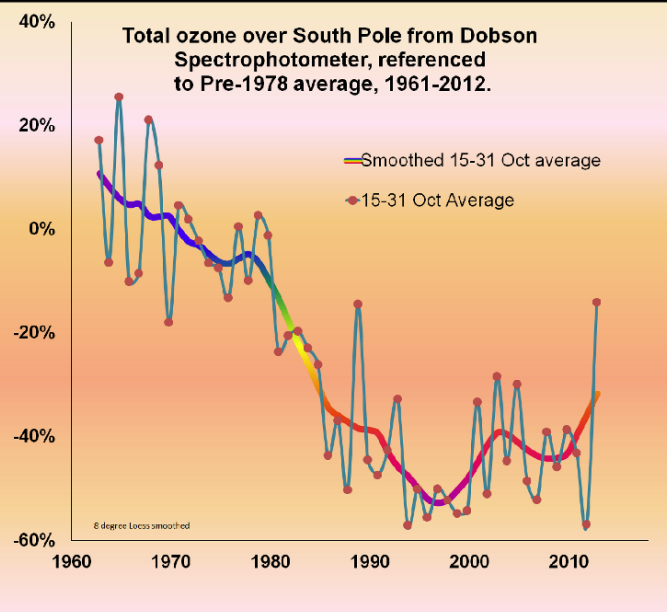
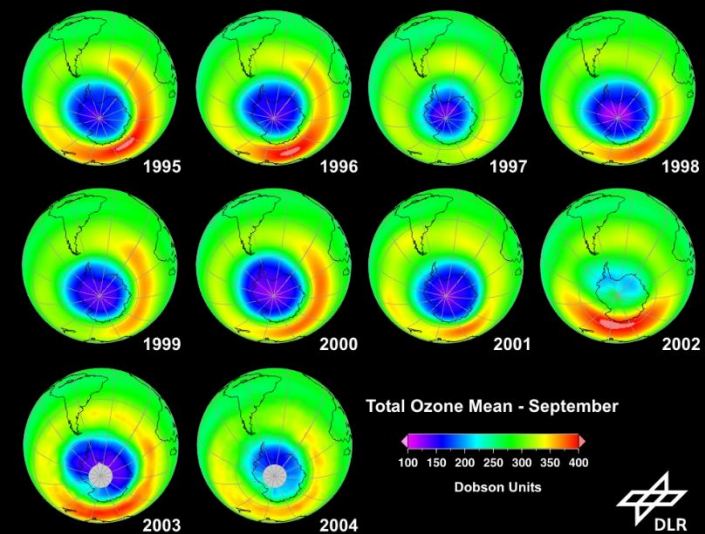
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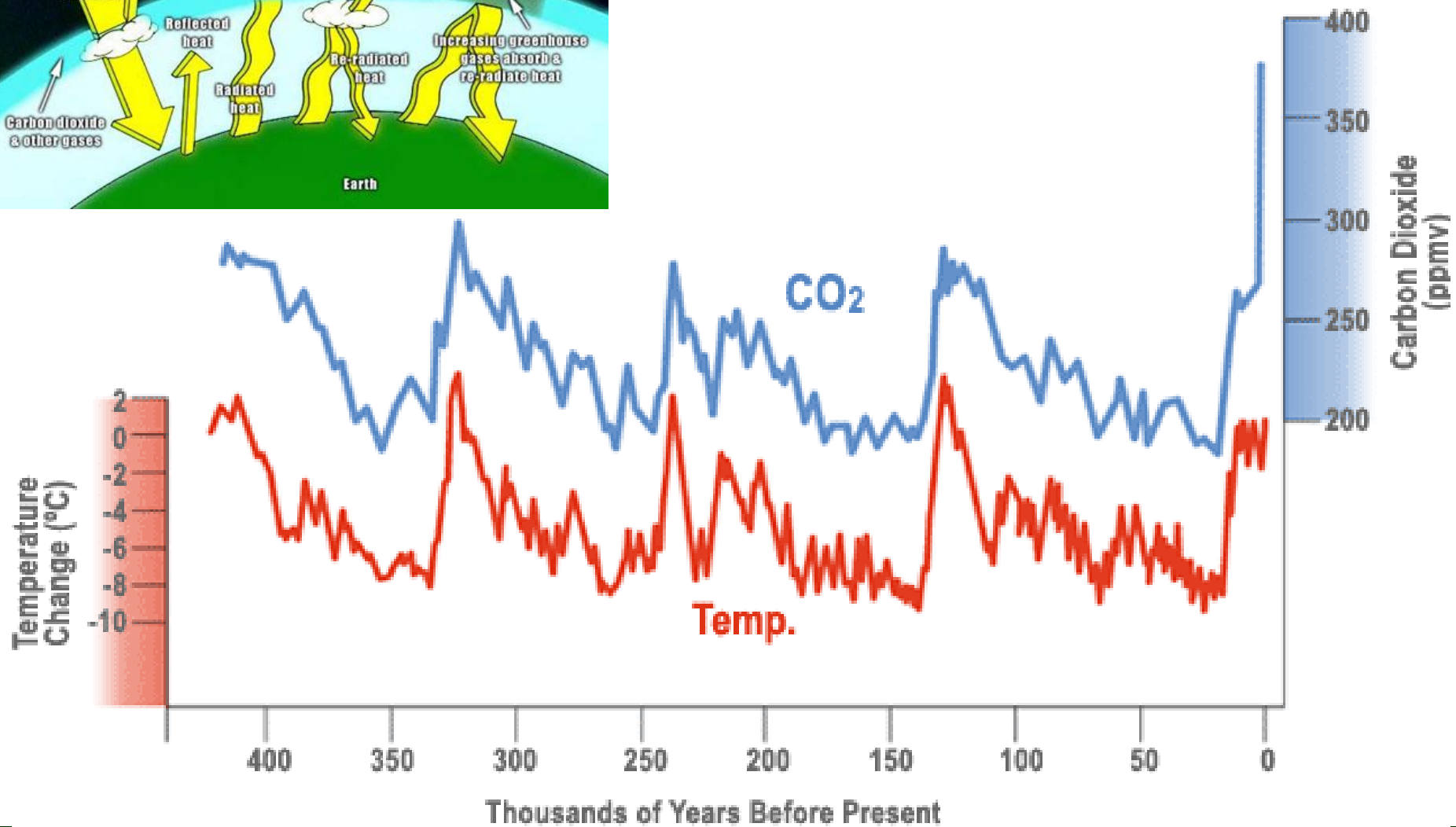
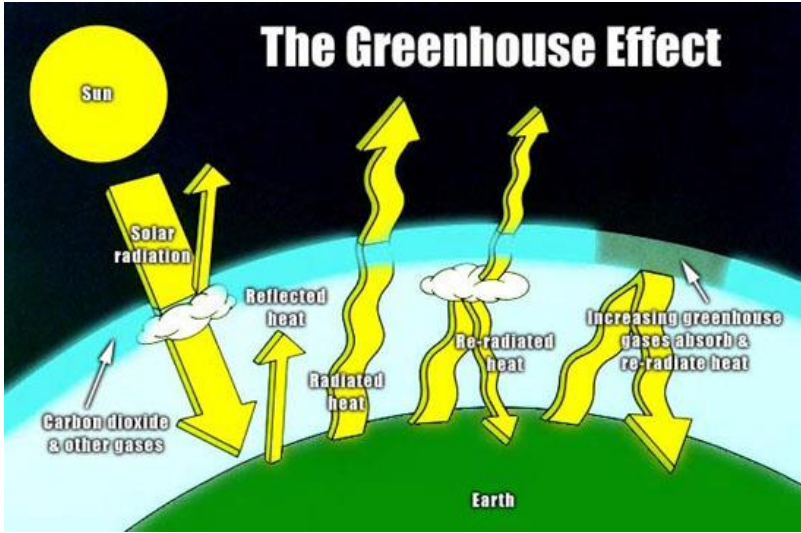
RHADER FELD • GERMANY • EUROPE • WORLD • SPACE

# 10 Years of Ozone Hole Monitoring by GOME and SCIAMACHY





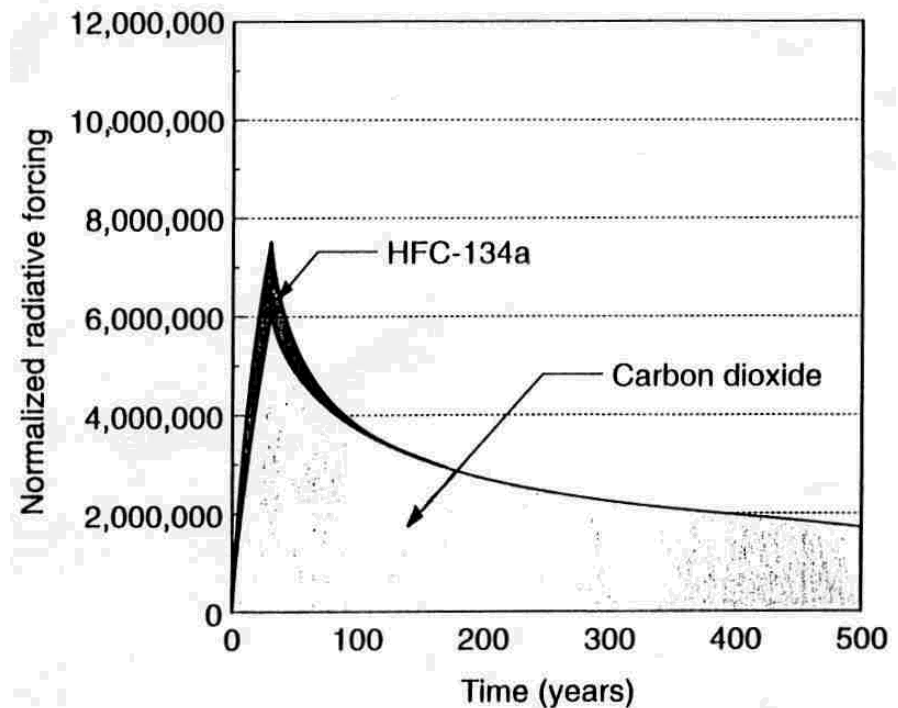
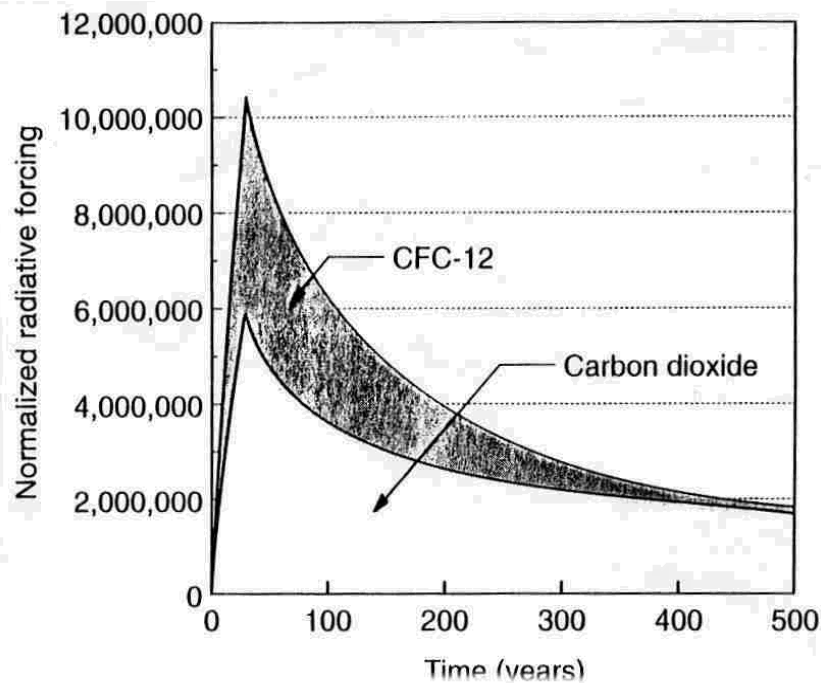
# The Greenhouse Effect





# TEWI - Total Equivalent Warming Impact

direkte Verluste      durch Kältemittelverluste der Anlage  
indirekte Verluste      aus der Bereitstellung der Antriebsenergie



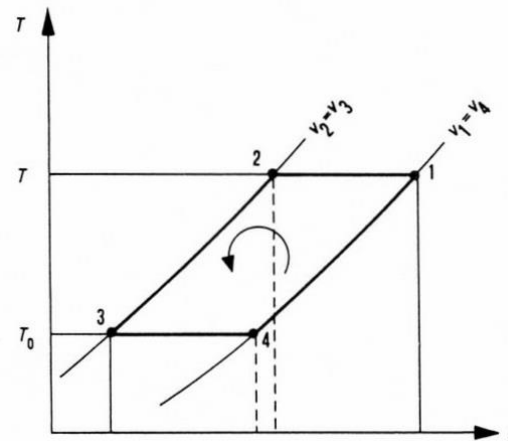
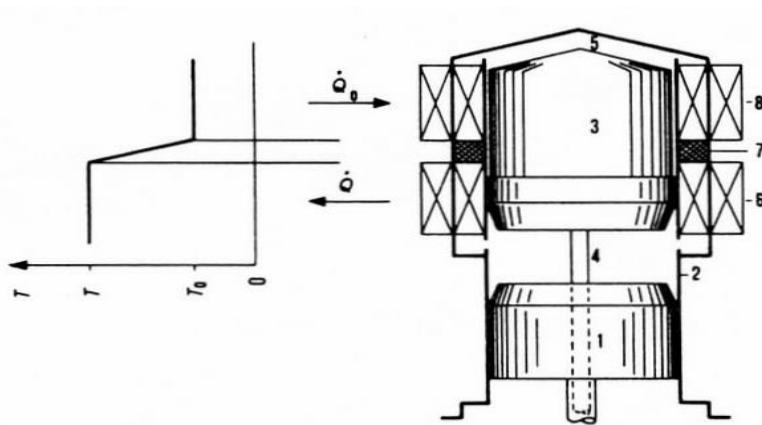
# ANNEXES of the IEA HEAT PUMP PROGRAMME

## Alternative Cycles

In this time "old" alternative cycles also became interesting, because they do not use (H)CFCs.

- **Stirling Engine Technology for Application in Buildings**, finished in 1989, joined by USA - Japan, Sweden, was such an approach, and the stirling cycle has good chances for low-temperature cooling.
- **Ab-Sorption Machines for Heating and Cooling in Future Energy Systems**, finished in 2000, joined by Sweden - Canada, Italy, the Netherlands, Norway, Japan, Sweden, UK, USA, was based on successful developments in the field of sorption systems in the last years, which are mainly the result of new heat exchanger technologies.

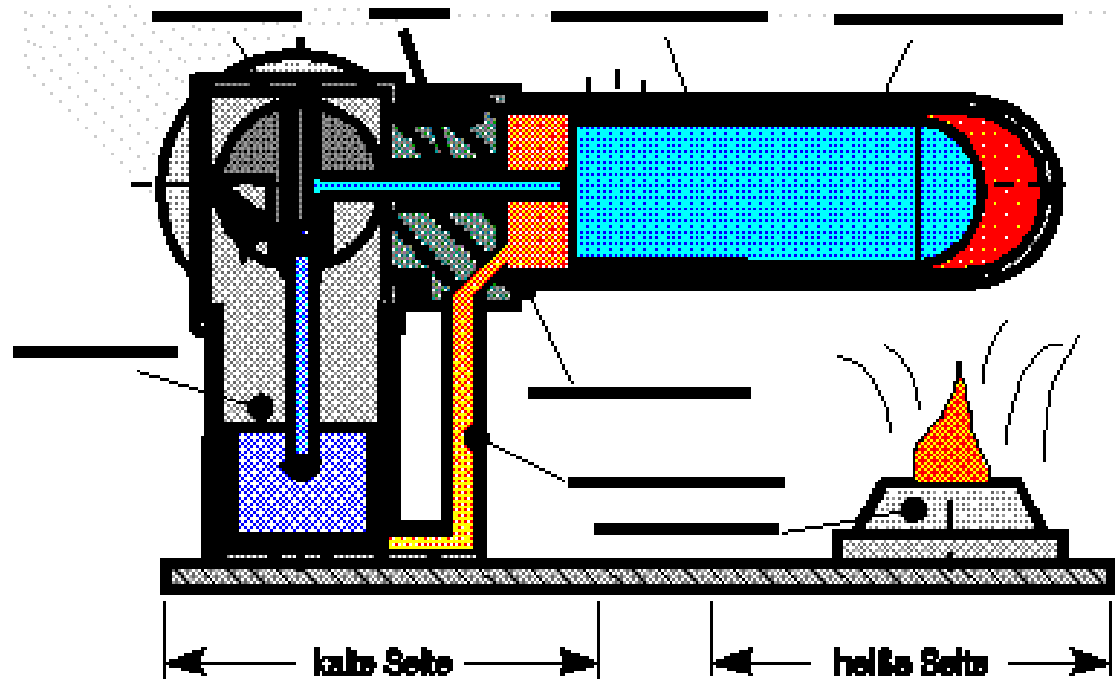




## Stirling-Kälteprozess

- 1 Hauptkolben
- 2 Zylinder
- 3 Verdrängerkolben
- 4 Verdichtungsraum
- 5 Entspannungsraum
- 6 Wärmetauscher warme Seite
- 7 Regenerator
- 8 Wärmetauscher kalte Seite

- 1-2 isotherme Verdichtung
- 2-3 isochore Verschiebung
- 3-4 isotherme Entspannung
- 4-1 isochore Verschiebung

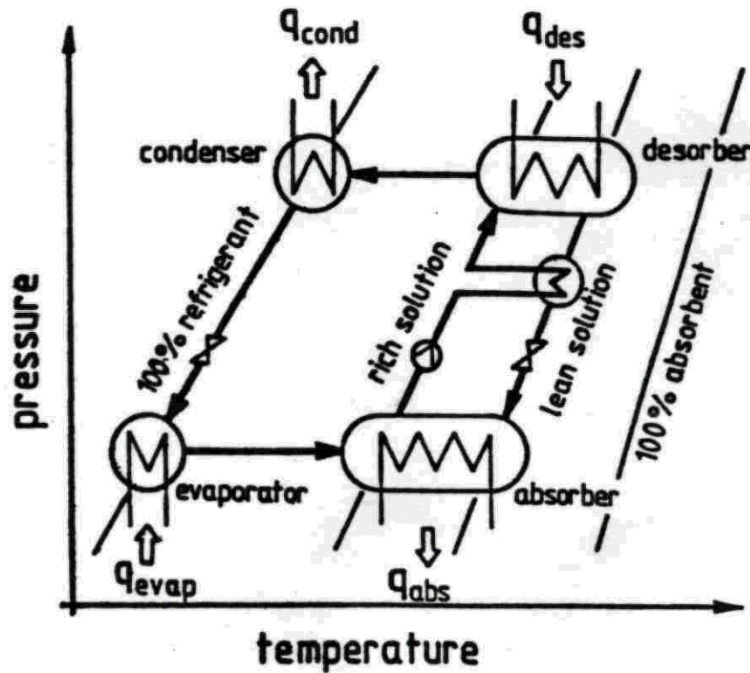


# Absorptions-Wärmepumpe

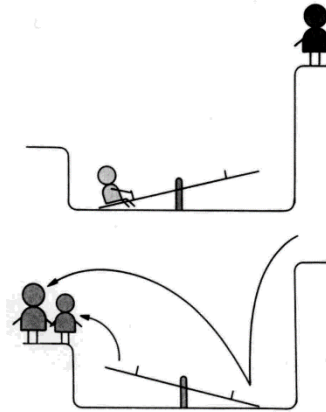
Konzept

Prozessverlauf

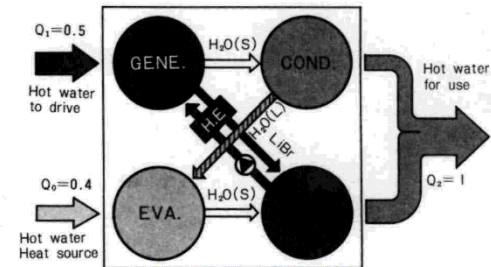
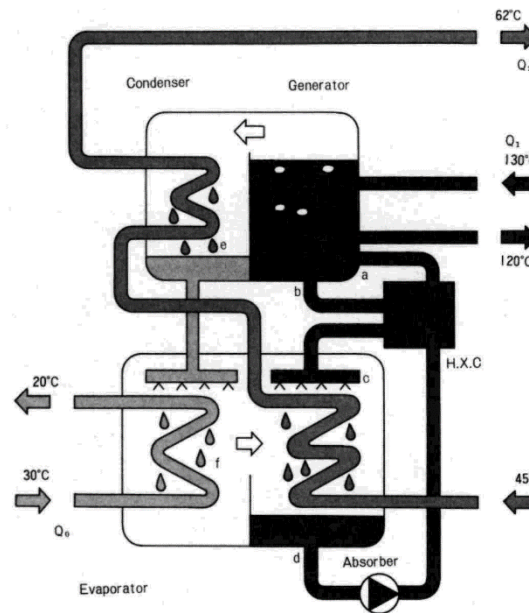
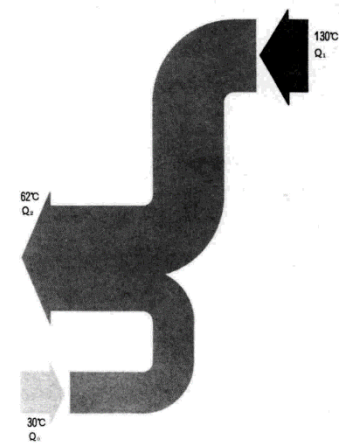
Technische Realisierung



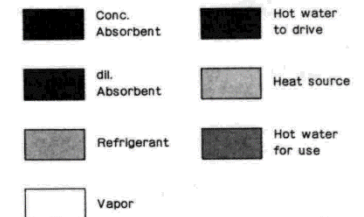
Conceptional Diagram



Heat Flow Diagram



$$C.O.P. = \frac{Q_3 + Q_4}{Q_1} = \frac{Q_3}{Q_1} = \frac{0.4 + 0.6}{0.6} = 1.67$$



# Heat Pumping Technologies

IEA Heat Pump Center  
Mandatory for the IA

2003 -

SP, Sweden  
Monica Axell



The central information activity of HPP

Publications (e.g. project reports)

Electronic newsletters (4/year)

Program Support to ExCo, NTs and Project leaders

Generation of new activities

Contact within the IEA with IAs, the Secretariat, BCG, FBF

Contact with EC, UNEP, IIR, EHPA, ASHRAE, ARHI, EPEE

Website: [www.heatpumpingtechnologies.org](http://www.heatpumpingtechnologies.org)

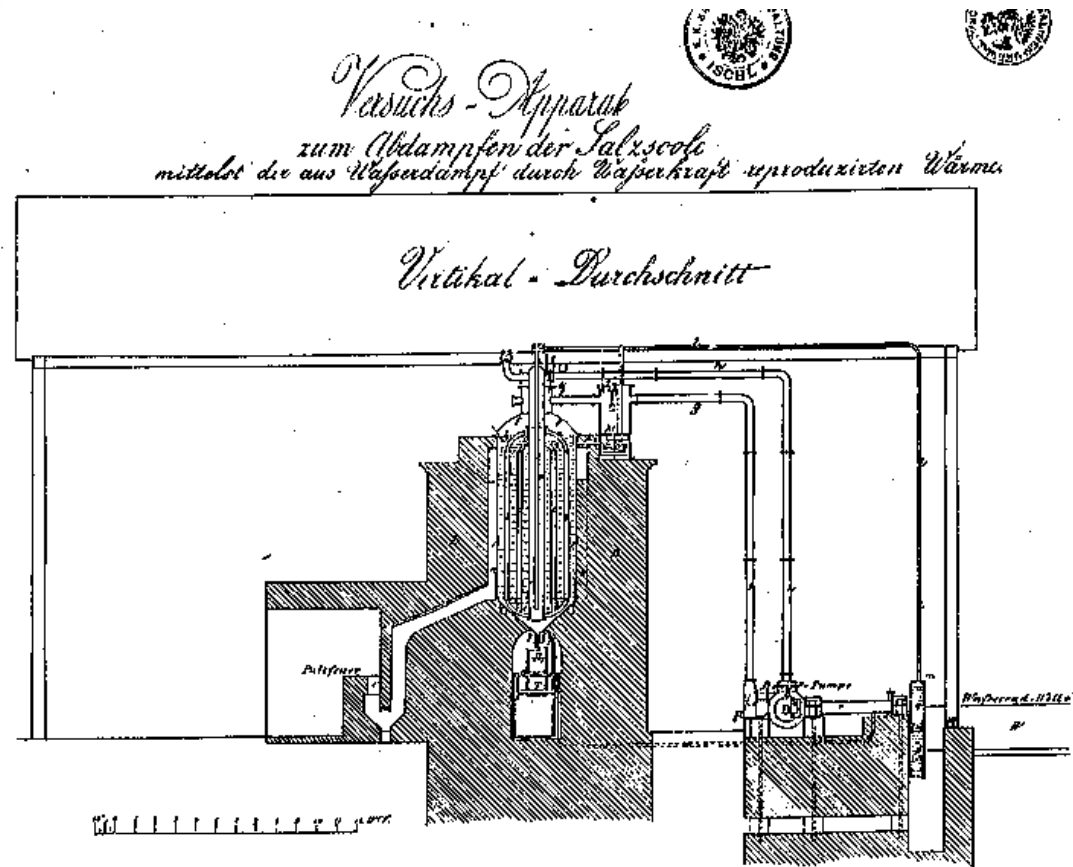






Heat Pumps - A Benefit for the Environment  
6th IEA Heat Pump Centre Conference  
30 May - 2 June 1999 / Berlin, Germany

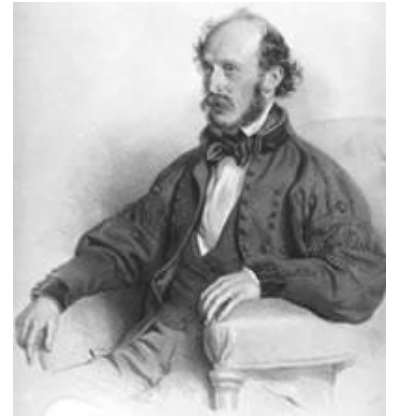




Peter Ritter von Rittinger  
Saline Ebensee: Brüdenverdichter 1853

# Ritter von Rittinger Award

The award highlights outstanding contributions to the advancement of international collaboration in research, policy development and applications for energy-efficient heat pumping technologies.















Leistungsgemeinschaft Wärmepumpe - Peter Lamm

D-A-CH Wärmepumpen Gütesiegel

Wärmepumpe Austria

EHPA

EHPA Heat Pump Quality Label

Quality Label Committee

Quality Label Commission

Heat Pump Keymark



WÄRMEPUMPE  
AUSTRIA



TUG

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Heat Pump Programme

Future Buildings Forum

Wolfsberg, Sophia Antipolis, Frankfurt, Oslo, Copenhagen, Espoo, St. Moritz

Buildings Co-ordination Group

EUWP and CERT Presentations

Reviews of Energy Technology Perspectives

IIR Commission E2 Heat Pumps and Energy Recovery

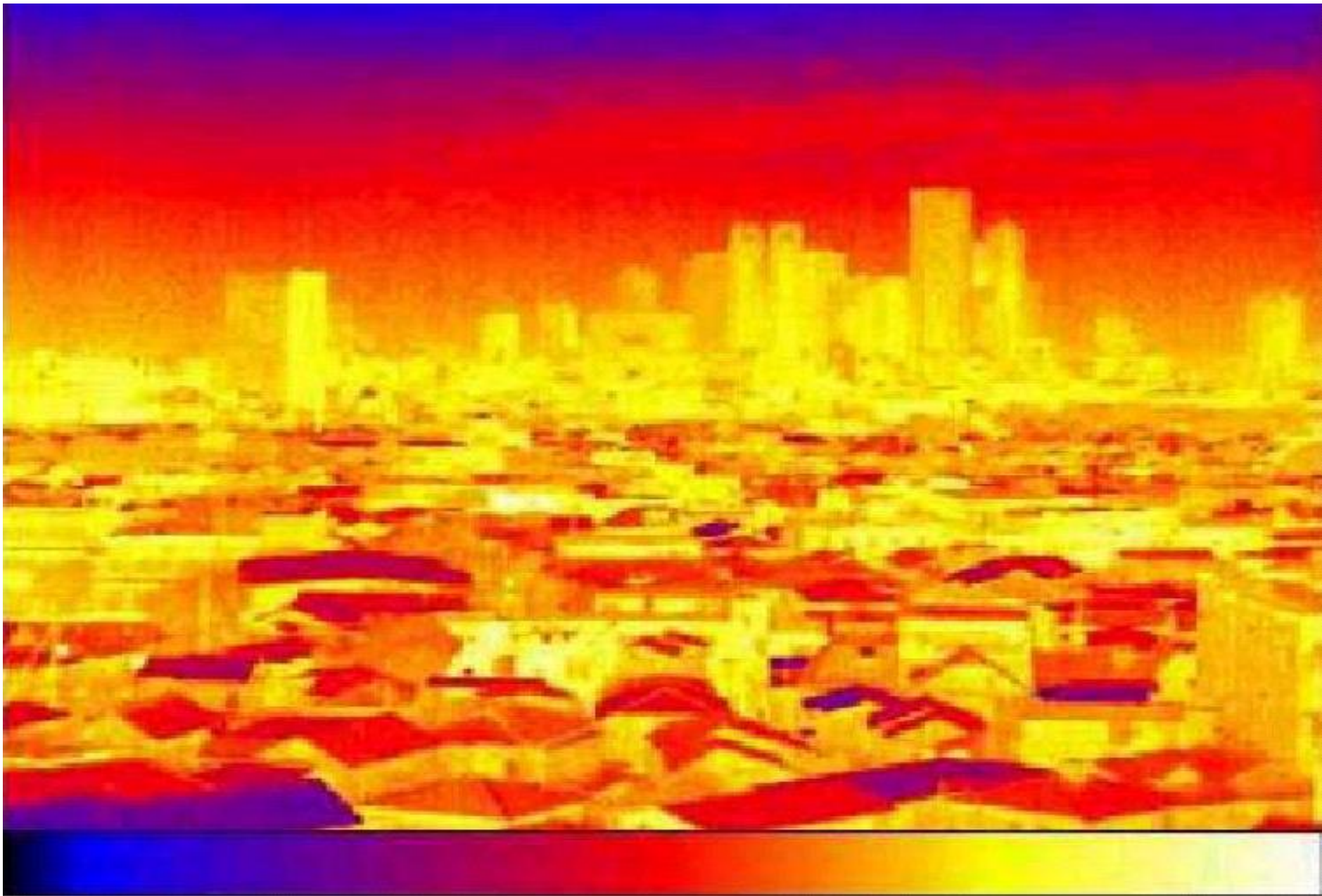
IIR Management Committee and Scientific Council

Conferences and Workshops

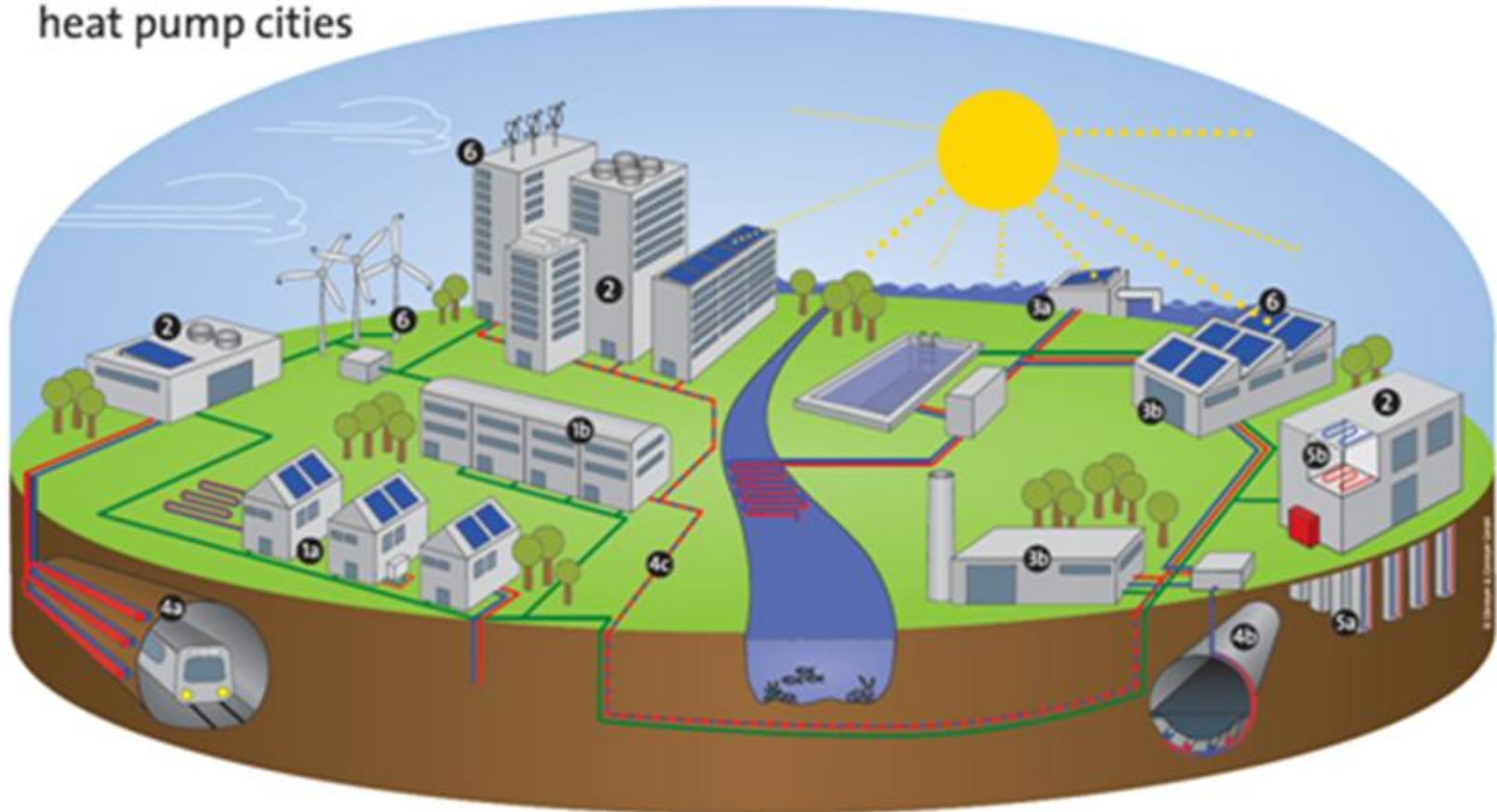
Session Keynotes and Presentations at Conferences

Promotion of Austria and the Austrian Heat Pump Industry





# Future cities = heat pump cities



## 1 Residential Heat Pumps

1a Single-Family Houses

1b Multi-Family Houses

## 2 Commercial Heat Pumps

## 3 Industrial Heat Pumps

3a District Heat

3b Process Heat

## 4 Infrastructure

4a Tunnels

4b Waste Water

4c Cold DH

## 5 Building as Source

5a Foundation Piles

5b Structure Activation

## 6 Electricity/Thermal Energy

Source: ehpa



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