

# NEWS LETTER

PERIODICAL OF THE  
IEA HEAT PUMP CENTER

IEA  heat pump  
center

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Stouffer Orlando Resort (formerly the Wyndham Hotel)

**F. Creswick\***

## Comments from the Organizing Committee Chairman

As you can see from a casual inspection of this issue of the Newsletter, it is devoted to a preview of the 1987 IEA Heat Pump Conference. We welcome this opportunity to make some advance comments on the Conference and encourage you to join us.

First, I hope you will agree with me that we have an excellent program and that our speakers and session chairmen are among the foremost authorities worldwide in their respective subject areas. I say "among" because many of the top people in each area are not included in the program. This is regrettable, but there simply was not enough time in the program to include all of the prominent people.

We also regret that some important topics had to be omitted from the program because of the limitations of a three-day conference.

The 1987 Conference is in large measure an update of the 1984 IEA Heat Pump Conference in Graz, Austria. While technologi-

cal advances are an important part of the subject matter, they are presented in the context of their potential impact on future economic and energy-use benefits of heat pumps. Marketing, promotion, and policy matters are also addressed.

Participating in the organization of an international conference has been a fascinating and rewarding experience. Initially, the North American sponsors met to establish a conference concept and draft a proposal to the IEA Executive Committee. After the proposal was accepted, organizing meetings were held both in Europe and the United States in which I was the only common link. I was somewhat apprehensive about whether this arrangement would work, but there have been no major problems. There was excellent cooperation on both sides of the ocean.

Once the program organization and topics were agreed on and candidate speakers were nominated by the committee, individual organizers in Europe, Japan, and

Contents	Page
F. Creswick Comments from the Organizing Committee Chairman	1
Session I	2
Session II	4
Session III	8
Session IV	11
Session V	14
Session VI	17
Session VII	19
Session VIII	22
Session IX	24
Preconference Site Visits	25
Postconference Field Trips	26
IEA Activities	27
News Briefs	28
Selected Book and Report Reviews	29
Schedule of Conferences and Trade Fairs	29
Next Issue	32

North America proceeded to recruit the speakers and session chairmen. Personally, I am well pleased with the results. I congratulate the organizers for their excellent work.

I want to take this opportunity to give special thanks to the sponsors of this event. Their generous contributions have enabled us to set a reasonable registration fee; hopefully, this will result in an increase in the number of people who are able to attend the Conference.

Finally, a word about Orlando. While this city has an international reputation as an attractive resort area, it also happens to have excellent conference facilities. So I hope you will find your attendance at the conference pleasant and comfortable and I am certain that you will discover interesting ways to spend your spare time.

I look forward to seeing you in Orlando!

*\*F.A. Creswick, Chairman,  
Organizing Committee, Oak Ridge National Laboratory*

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## Session I

### Opening Plenary Session

Welcome, opening remarks, and a keynote address. Overview presentations will be given on the IEA Advanced Heat Pump research program, the IEA Heat Pump Center Activities, and the CEC Heat Pump activities.

#### Chairman

##### **John P. Millhone**

U.S. Department of Energy  
Washington, D.C., USA

Mr. Millhone is director of the Office of Buildings and Community Systems of the U.S. Department of Energy (DOE), a position he has held since 1979. This office is responsible for DOE's research and regulatory programs affecting residential and commercial buildings. The research programs include building systems, building equipment, district heating and cooling, and indoor air quality. Regulatory programs include Building Energy Performance Guidelines and Standards and Appliance Standards. Mr. Millhone is co-chair of the Committee on Indoor Air Quality that is responsible for coordinating indoor air quality planning and research among 15 U.S. Federal agencies. He is former chairman of the Working Party on End-Use Technologies of the International Energy Agency, which coordinated end-use planning and research activities among the IEA countries. Before joining DOE, he was the director of the Minnesota Energy Agency (1975-1979) and director of the Iowa Energy Policy Council (1974-1975). During this period, he was staff director of the Energy Conservation Subcommittee of the National Governors Association, and also served as a member and chairman of DOE's Fuel Oil Marketing Advisory Committee. Mr. Millhone is a frequent speaker on energy conservation subjects and has presented numerous papers on energy conservation, research management, and indoor air quality. His early experience was as a journalist, specializing in energy and environmental subjects. He worked for the Associated Press, Detroit Free Press, and Des Moines Register and Tribune. He received a bachelor of journalism degree from the University of Missouri and has done graduate work in law and political science.

### Opening Addresses



##### **Leslie Boxer**

International Energy Agency  
Paris, France

Mr. Boxer is currently the deputy director of the Office of Energy Research, Development and Technology Application in the International Energy Agency. In this capacity, he has special responsibility for the IEA program of collaborative projects, in which heat pumps figure prominently. Prior to this assignment, he was a division head with the Nuclear Energy Agency of OECD, being concerned with international cooperation in nuclear science and technology. Before coming to France in 1960, he worked with the U.K. electric and nuclear engineering industries. Mr. Boxer is a Fellow of the Institution of Electrical Engineers and graduate of the Harvard Business School. He is also part-time lecturer at the leading French business school Hautes Etudes Commerciales.

**Arvo Lannus**

Electric Power Research Institute  
Palo Alto, California, USA

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**John J. Cuttica**  
Gas Research Institute  
Chicago, Illinois, USA

Mr. Cuttica is vice president of Research and Development at the Gas Research Institute (GRI), Chicago, Illinois. His responsibilities include the strategic planning, program implementation, and completion of research programs aimed at developing cost-competitive gas utilization technologies that will improve energy service to both the residential and commercial building sectors. This includes programs in appliance, space heating, space cooling, and cogeneration technologies. In addition, Mr. Cuttica has responsibility for the Environment and Safety Research program which is aimed at developing technologies to characterize and control environmental and safety problems associated with current and future natural gas industry operations. Prior to joining GRI in 1982, he was responsible for the Consumer Products R&D Program at the U.S. Department of Energy. Work included the development of not only gas-fueled, but also oil-fired and electric-driven energy conversion consumer products. Mr. Cuttica spent the first ten years of his career in the U.S. Department of Defense as a design engineer and later program manager on several missile system projects. He received his bachelor of electrical engineering from the Catholic University of America and his masters in engineering administration from the George Washington University, both located in Washington, D.C.

**Keynote Address**

**Arnold W. Braswell**  
Air-Conditioning  
and Refrigeration Institute  
Arlington, Virginia, USA

Mr. Braswell, president of the Air-Conditioning and Refrigeration Institute (ARI) since February 1984, retired from active military service as an Air Force Lieutenant General in September 1983. His last position was Commander-in-Chief of Pacific Air Forces, one of the major operating commands of the U.S. Air Force, with headquarters in Hawaii. A graduate of West Point, his military career encompassed duties as a jet fighter pilot, combat mission leader, high-level planning director and senior commander. Mr. Braswell served for nine years in executive positions in the Air Force and the Organization of the Joint Chiefs of Staff. He received several awards and decorations for combat actions and for distinguished service, including the Distinguished Service Medal (awarded three times), the Legion of Merit (twice), and the Distinguished Flying Cross. Braswell was an engineering student for two years at LSU, then entered West Point, graduating in 1948. He subsequently studied at George Washington University, receiving an M.B.A. degree, and attended the National War College in Washington. Braswell is a native of Minden, Louisiana.

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**IEA Advanced Heat Pump Research Program**

**Jan E. Berghmans**  
Catholic University  
Leuven, Belgium

IEA Heat Pump Center Activities



**Karl O. Holzapfel**  
IEA Heat Pump Center  
Eggenstein-Leopoldshafen  
Fed. Republic of Germany

Mr. Holzapfel is head of the IEA Heat Pump Center, near Karlsruhe, Fed. Republic of Germany. He received his Dipl.-Ing. degree in mechanical engineering from the Technical University, Stuttgart, in 1976. After three years of work in industry and research and development activities in the field of heat pump heating systems, emphasizing ground-source systems, he joined the staff of the Fachinformationszentrum Energie, Physik, Mathematik GmbH (FIZ). He specialized in energy-efficient end-use technologies and authored several publications addressing heat pump technologies and their application. Since 1983, he has been involved mainly in development and operation of the IEA Heat Pump Center, initially as a senior engineer, and as head of the Center since 1986.

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**Heat Pump Research Carried Out by the European Communities**

**Peter Zegers**  
Commission of the European Communities  
Brussels, Belgium

Session II

**Operating Experience with Heat Pumps for Residential and Commercial Space-Conditioning Applications**

Thermal performance, seasonal efficiency, reliability, durability, maintenance requirements, and user satisfaction in both residential and commercial applications will be discussed.



**Chairman**  
**Arvo Lannus**  
Electric Power Research Institute  
Palo Alto, California, USA

Dr. Lannus is manager of the Residential and Commercial Program, Energy Management and Utilization Division, at the Electric Power Research Institute (EPRI), Palo Alto, California. Before joining EPRI in 1980, he spent six years with Gordian Associates, an international consulting subsidiary of Pullman, Inc. As director of advanced technology, he was responsible for research on heat pumps and efficient use of energy in buildings and industrial centers. For the year previous, Dr. Lannus was director of research for Herculite Corporation. From 1969 to 1973, he was an assistant professor of chemical engineering at the Cooper Union School of Engineering, while also working as a consultant on energy and environmental problems. Dr. Lannus received a B.S. degree in chemistry from Drexel Institute of Technology in 1960 and was awarded a Ph.D. in chemical engineering from Drexel in 1970. A registered professional engineer in the states of New Jersey, New York, and Florida, Dr. Lannus is a member of the American Institute of Chemical Engineers and the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE), and has authored numerous papers on the subjects of heat pumps, energy conservation, and environment.

## Operating Experience with Heat Pumps in North America

**Assistant Chairman**

**David J. Young**  
Ontario Hydro  
Research Division  
Toronto, Ontario, Canada

Mr. Young is head of the Thermal Systems Unit in the Utilization Section of Ontario Hydro's Research Division. He is an active member of ASHRAE and its Technical Committees on heat pumps, a voting member of the Canadian Electrical Association's (CEA) Utilization Research Committee, and CEA's representative on the Canadian Standards Association Heat Pump Committee. Mr. Young earned a bachelor's degree in engineering science from the University of Toronto in 1972 and joined Ontario Hydro's Research Division in 1974. He has worked on a wide variety of subjects in the electric energy utilization area. In 1977, having worked on the design and commissioning of Ontario Hydro's Environmental Test Facility for Heat Pumps, Mr. Young became project leader for a joint Canadian Electrical Association/Ontario Hydro project to design and construct a prototype northern climate heat pump. Since the completion of this work, he has served as technical advisor on further CEA projects to commercialize this and other heat pump technologies. He is currently responsible for planning research work on residential and commercial heat pumps.



**Carl C. Hiller**  
Electric Power Research Institute  
Palo Alto, California, USA

Dr. Hiller is project manager of Heat Pump Applications at the Electric Power Research Institute (EPRI). He received a Ph.D. in mechanical engineering from the Massachusetts Institute of Technology in 1976. His Ph.D. dissertation on capacity control of heat pumps produced the first publicly available detailed computer simulations of heat pump systems, which formed the starting point for the well-known Oak Ridge National Laboratory heat pump models. Prior to joining EPRI, Dr. Hiller spent several years with General Motors Corporation working on advanced automotive power plant design, and five years with Sandia National Laboratories working on thermal analysis of weapon systems, chemical heat pump/energy storage programs, and solar electric generating plant design studies. He also spent two years with Acurex Corporation working on advanced solar energy concepts, electric generating plant design, cogeneration power plant design, and industrial process heat system design. He has also served in a consulting capacity to the U.S. Department of Energy on advanced heat pump concepts, and as an independent consultant on cogeneration power plant design, and various other energy conservation and utilization projects. Since joining EPRI, Dr. Hiller has been responsible for research into the life and maintenance of residential heat pumps, heat pump field test activities, studies of advanced electric water heating alternatives, advanced heating and cooling concepts development activities, and stratified chilled water storage system design and testing. A member of the American Society of Mechanical Engineers, the Society of Automotive Engineers, and ASHRAE, Dr. Hiller has authored numerous publications on the subjects of heat pumps, computer modeling, energy storage, solar energy and thermal analysis, and is active in ASHRAE Technical Committees. A licensed professional engineer in California, he is also a member of the Society of Professional Engineers.

### Operating Experience with Heat-Pump-Type Room Air Conditioners for Cold Districts



**Tsunehiko Minagawa**  
Tohoku Electric Power Co.  
Nakayama, Japan

Mr. Minagawa is chief research manager of the General Research & Development Center, Tohoku Electric Power Company, Japan. His specialty is the engineering of electric power distribution systems. He has held various positions as business manager, and at present is directing the activities of two research and development groups. One group is studying demand equipment and systems for utilizing electric power effectively. The other group is studying the preventive engineering of snow disasters of roofs or roads, including using heat pump systems for snow melting. Mr. Minagawa is an editing member of the academy magazine of Japanese Society for Snow Engineering.

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**Zenkichi Yamaguchi**  
Tohoku Electric Power Co.  
Nakayama, Japan

Mr. Yamaguchi is assistant research manager of the General Research & Development Center, Tohoku Electric Power Company, Japan. He is a member of the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan, the Illuminating Engineering Institute, the Japanese Solar Energy Society, and the Japanese Society of Scientific Fisheries. He is involved in research and development for energy-saving air-conditioning systems for cold districts using natural energies, heating systems with latent heat storage, microwave heating devices for making fish meat products, and heat pump type room air conditioners for cold districts. He attends study-related symposiums as a speaker and often presents his reports to each academy.

### Operating Experience with Multizone Air-Source Heat Pumps in Residential and Commercial Applications



**Katsushige Kawahara**  
Daikin Industries Ltd.  
Sakai-city, Osaka, Japan

Mr. Kawahara is the section manager of the Design Department of Daikin Industries Ltd., in Osaka, Japan. Previously, he has worked on designing heat exchangers of chilling units and packaged air conditioners. He has also been in charge of development work for packaged air conditioners for commercial use and succeeded in developing packaged air conditioners for computer rooms, VAV packaged air conditioners and multizone heat pump systems for commercial use.

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**Kazuo Tanaka**  
Daikin Industries Ltd.  
Sakai-city, Osaka, Japan

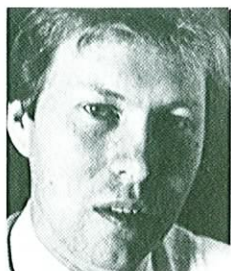
Mr. Tanaka is president of Daikin U.S. Corporation in Atlanta, Georgia, USA. He had worked at the Design Department of Daikin Industries Ltd. on development of many kinds of refrigeration and air-conditioning products such as condensing units, water chilling units, and packaged air conditioners. He then became factory general manager of Daikin Europe N.V. in Belgium, and was appointed president of the company. He moved to Daikin U.S. Corporation as president in 1983.

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### Operating Experience with Air-Source Heat Pumps in Europe

**Christian A. Vidal**  
Electricity of France  
SEPAC  
Paris, France

## Exhaust Air as a Heat Source for Heat Pumps



**Henrik Enstroem**  
Skandinavisk Termoekonomi A.B.  
Stockholm, Sweden

Mr. Enstroem received his master of science degree in 1976 at the Royal Institute of Technology, Stockholm. He continued to work at the Institute as a teacher and researcher in the fields of applied thermodynamics and refrigeration. His efforts have mostly been concentrated on the applications of heat pump systems. In order to achieve knowledge of heat pumps in practice, he has studied a large number of such installations. Since 1980 he is a part-owner of Skandinavisk Termoekonomi, a firm which is installing large heat pumps for block heating to industries, multi-family houses, offices, etc., on a turn-key basis. Mr. Enstroem has contributed to the development of some large exhaust air and outdoor air heat pumps. He has written about 20 technical publications. As Secretary of the heat pump group of the Swedish Council for Building Research, he is involved in the national R&D work concerning heat pumps.

## Operating Experience with Water-Loop Heat pumps



**H. Michael Hughes**  
Climate Master, Inc.  
Utica, New York, USA

Mr. Hughes is director of engineering for Climate Master, Inc., the world's largest manufacturer of water-source heat pumps. He represents Climate Master with the Air-Conditioning and Refrigeration Institute (ARI). He currently serves as a member of 11 different Product Sections and Technical Committees within ARI. He is a member of ASHRAE where he serves on two Special Project Committees and two Technical Committees including the chair of the TC on Applied Heat Pump/Heat Recovery Systems. Mr. Hughes has participated in research involving ground-coupled heat pumps with Brookhaven and Oak Ridge National Laboratories and is currently the principal investigator in a water-loop heat pump research project sponsored by the Electric Power Research Institute. He has previously held engineering management and design positions with the John Zink Co., Modine Manufacturing Co., and Carrier Air Conditioning Co. He received a bachelor's degree in engineering from Cornell University in 1961.



**Lars-Olof Glas**  
Skandinavisk Termoekonomi A.B.  
Stockholm, Sweden

Mr. Glas received the degree of "teknologie licentiat" (comparable to ph.D.) in thermodynamics and refrigeration at the Royal Institute of Technology, Stockholm, in 1966. He has been working in the field of building services research, development, design, manufacturing, installation, and marketing. Main tasks have been cold stores, air conditioning, industrial heat recovery, heat pumps and control systems. During 1978-1979, he worked as consulting engineer and adviser in building services at Ministry of Public Works and Housing, Riyadh, Saudi Arabia. Since 1980, Mr. Glas is part-owner of a company which installs heat pump systems up to 3.5 MW capacity in dwellings. Since 1984, he is a professor in heat pump technology at the Division of Thermodynamics and Refrigeration, Royal Institute of Technology, Stockholm. Publications in above mentioned fields include six books and about thirty articles in journals of air-conditioning, refrigeration, etc. He has also taught numerous courses in the same subjects since 1965.

## Development of a System for Hot Water Supply by a Heat Pump That Recovers Heat from Daily Wastewater



**Masaaki Ukaji**  
Kumagai Gumi Co., Ltd.  
Tokyo, Japan

Mr. Ukaji is a researcher in heating, air conditioning and sanitary engineering. He is now working for the Institute of Construction Technology of Kumagai Gumi Co., Ltd., a general contractor in Japan, and is currently engaged in studying and developing energy-saving technology concerning building equipment. Mr. Ukaji holds both a bachelor of engineering and a master of engineering from Kanto Gakuin University, and is a registered first class architect in Japan. Mr. Ukaji is a member of the Architectural Institute of Japan, and the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan. In the Architectural Institute of Japan, he serves on the Committee of Environmental Engineering (Branch of Kanto).

**Karl O. Holzapfel**  
IEA Heat Pump Center  
Eggenstein-Leopoldshafen  
Fed. Republic of Germany

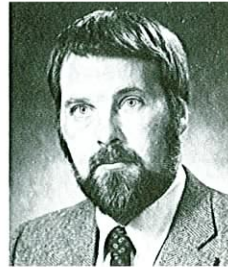
## Advances in Electric Heat Pumps

Presentations will feature promising prospects for technological improvements in heat pumps that can contribute to better performance, economics, and user satisfaction.

### Chairman

**Takamoto Saito**  
The University of Tokyo  
Department of Mechanical Engineering  
Tokyo, Japan

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### Assistant Chairman

**Phillip D. Fairchild**  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee, USA

Mr. Fairchild is program manager for the Building Equipment Research (BER) program in the Energy Division at Oak Ridge National Laboratory (ORNL). He recently completed a one-year assignment with the Electric Power Research Institute (EPRI) as a project manager, and previously served in two different group leader positions for heat pump research within the BER program. He began his employment with ORNL in 1978 as a project manager. Mr. Fairchild previously worked for EBASCO Services, Inc., an architectural-engineering firm, where he served as principal engineer and senior engineer responsible for design engineering. He received B.S. and M.S. degrees in mechanical engineering from Louisiana Tech University in 1965 and 1966, respectively. He is a registered professional engineer and is actively involved in ASHRAE.

## Current and Future Advances in Small Heating-Only Heat Pump Systems



**Hermann Halozan**  
University of Technology  
Graz, Austria

Mr. Halozan graduated from the University of Technology, Graz, Austria, in 1965. After one year of work in industry, he returned to the University as an assistant professor at the Institute of Thermal Engineering, under Prof. P.V. Gilli. In 1974 he received the degree of Doctor of Technical Science with a thesis on the static and dynamic stability of two-phase flow in steam generators. Subsequently, he specialized in the field of energy conservation with particular emphasis on heat pumps and heat pump systems. Since 1976 he has lectured on energy efficiency in buildings at the University of Technology, and on heat pump technology since 1984. He has authored several papers as well as a book on ambient air heat pumps which won the Research Award of the state of Styria. In 1980 he received the *venia legendi* (Univ. Doz.) and since 1982 he is head of the HVAC department at the Institute of Thermal Engineering. He is an Associate Member of the International Institute of Refrigeration (IIR). In addition to his university activities, he worked as a consultant for industry and governmental organizations. He is co-inventor of a patent on intermittent ice storage for peak load operation of heat pumps. Within the IEA Heat Pump Center, he is responsible for part of the analysis work.

## Prospects for Improved Components



**Richard G. Maier**  
Kulmbacher Klimageräte-Werk GmbH  
Kulmbach, Fed. Republic of Germany

Dr. Maier is technical managing director of Kulmbacher Klimageräte-Werk GmbH (KKW), Kulmbach. He has a doctorate from the Technical University of Munich, and began his employment at the R&D center of Siemens at Erlangen, Germany. Several assignments in Germany and Iran followed. Dr. Maier is a member of the National German Refrigeration Association (DKV), and has published 22 articles. In addition, he is engaged in consulting work for many different institutions. For the last few years, he has been responsible for developing and manufacturing heat pumps and refrigeration units.

## Technology, Economics, and Future Potential of Variable-Capacity Heat Pump Room Air Conditioners



**Sei Suma**  
Toshiba Corporation  
Shizuoka, Japan

Mr. Suma is a mechanical engineer in the Air Conditioner and Compressor Division of Toshiba Corporation. He has been engaged in research, development, and design of room air conditioning systems at Fuji Works of Toshiba Corporation since he graduated. His major fields are thermodynamics and fluid dynamics, and he is currently engaged in development of refrigeration cycles, refrigeration parts, fans and control systems. Mr. Suma holds bachelor and master of science degrees from Waseda University in Japan and researched two-phase flow at Massachusetts Institute of Technology as a Fellow of the Center for Advanced Engineering Study. He is a member of the Japanese Society of Mechanical Engineers and Japanese Association of Refrigeration.

## The Latest Compressor Technologies for Heat Pumps in Japan



**Katsumi Matsubara**  
Mechanical Engineering  
Research Laboratory  
Hitachi, Ltd.  
Ibaraki, Japan

Mr. Matsubara is a mechanical engineer and received his M.S. in mechanical engineering from Nagoya University in Japan in 1968. He has been with the Mechanical Engineering Research Laboratory, Hitachi, Ltd., since 1968. He has been engaged in research and development of refrigerating compressors and air compressors for many years. From 1971 to 1985, he developed refrigerating screw compressors that were applied to water chilling units and heat pumps, and received the Technical Award for the development of screw heat pumps from the Japanese Association of Refrigeration in 1983. He has managed the research and development programs of rotary displacement compressors such as screw and scroll type, and the application of these machines to new industrial fields such as vacuum pumps. He is a member of the Japanese Society of Mechanical Engineers, the Japanese Association of Refrigeration and the Vacuum Society of Japan.

**Kazutaka Suefuji**  
Mechanical Engineering Research Laboratory  
Hitachi, Ltd.  
Ibaraki, Japan

**Hiroaki Kuno**  
Shimizu Works  
Hitachi, Ltd.  
Shizuoka, Japan

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#### Dynamic Loss Reduction with Electric Heat Pumps



**Charles E. Bullock**  
Carrier Corporation  
Syracuse, New York, USA

Dr. Bullock is a senior project leader with the Advanced Technology's Engineering Group, Carrier Corporation, a division of United Technologies Corporation. He is responsible for analysis and evaluation of new space heating/cooling system concepts via computer simulation as well as field and lab testing. He is a member of ASHRAE and the International Institute of Refrigeration (IIR); he has served on several ASHRAE Technical Committees and as past U.S. editor for the International Journal of Refrigeration. Dr. Bullock holds bachelor, master of science and doctor of philosophy degrees in mechanical engineering from the University of Minnesota and has authored more than 30 technical publications.

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#### Dynamic Electrical Control for a Variable-Capacity Heat-Pump Air Conditioner



**Fumio Matsuoka**  
Mitsubishi Electric Corp.  
Kamakura, Japan

Dr. Matsuoka is a research engineer at Mitsubishi Electric Corporation, Consumer Products Research Laboratory, Air Conditioning Group. His expertise is refrigeration cycle analysis and control. He holds a doctorate from Tokyo University and is a member of the International Institute of Refrigeration (IIR) and Japanese Association of Refrigeration.

#### Current Status and Future Potential of Nonazeotropic Mixed Refrigerants



**Horst H. Kruse**  
University of Hannover  
Hannover, Fed. Republic of Germany

Professor Dr.-Ing. Kruse has been a professor for Refrigeration and Heat Pumps at the University of Hannover since 1969, where a special research institute was created for this field. His special interests are refrigerating compressors and nonazeotropic mixtures in refrigerating and heat pump systems. He has consulted and worked together for many years with several German industrial companies. To promote technology transfer between university and industry, especially small-sized companies, he founded a special research center for refrigeration and heat pumps in the Technology Center Hannover. Here, additional cooperative projects between industry and university are conducted. In the university itself, main research projects are handled and these projects have led to 12 doctoral theses in the fields of refrigeration systems, compressors, refrigerant mixtures and tribology. Professor Kruse holds the Diplom-Ingenieur degree and the doctor degree (both summa cum laude) from Hannover University and is a member of the National German Refrigeration Association (DKV), ASHRAE, and IIR. He is vice president of DKV until 1988 and the deputy president of Commission B2 (refrigerating machinery) of IIR. At the University of Hannover, he served for three years as dean of the faculty for mechanical engineering, for two years as member of the senate of the university and is president for the senate committee for international relations of the University of Hannover and delegate of the senate for international relations for the external international links of the university.

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#### What Needs to Be Known About Working Fluids to Calculate Coefficients of Performance

**Georg Alefeld**  
Technical University of Munich  
Munich, Fed. Republic of Germany

Professor Alefeld received Diplom-Ingenieur degree in 1959 and Ph.D. in physics in 1961, both from the Technical University of Munich. From 1962-1965, he worked in research in material science at General Atomics, La Jolla, California. From 1966-1968, he worked at the Institute for Reactor Materials; from 1968-1970, he was a director at the Institute for Solid State Research, Jülich. Since 1971, he has been a physics professor in the Physics Department of the Technical University of Munich. Professor Alefeld's fields of interest include applied thermodynamics, zeolites, materials for heat storage and heat transformation, advanced cycles for power generation, advanced absorption and compression cycles for heat pumps, methods for evaluating cycles and fluids, optimization procedures for cycles, and relations between entropy and economy.

## Session IV

## Heat Pumps for Industrial Applications

A broad range of topics relating to heat pump systems for industrial applications will be covered, including operation experience and economics, potential applications, market prospects and financing, and technological developments.

### Chairman

#### Jan E. Berghmans

Catholic University  
Leuven, Belgium

Mr. Berghmans is a professor of mechanical engineering at the Catholic University of Leuven, Belgium. He holds a bachelor of science degree from the University of Leuven, M.S. and Ph.D. degrees from the University of Wisconsin, USA. He taught at Drexel University in Philadelphia, Pennsylvania, and consulted at Argonne National Laboratory. His scientific interests are in the areas of heat transfer, heat pumps, energy conservation, and explosion safety. Mr. Berghmans authored some 40 technical papers and is the editor of a book on heat pumps. He is a consultant to several companies in the field of energy conservation and safety, and is a member of the American Society of Mechanical Engineers and of several Belgian engineering societies. He is a member of the Board of the Belgian Society of Mechanical Engineers and Belgian Refrigeration Society. Mr. Berghmans is the delegate of Belgium to the Executive Committee on Advanced Heat Pumps of the International Energy Agency (IEA) and presently serves as its chairman.

### Assistant Chairman

#### Robert N. Chappell

U.S. Department of Energy  
Idaho National Engineering Laboratory  
Idaho Falls, Idaho, USA

Mr. Chappell is project manager for the U.S. Department of Energy (DOE), Industrial Heat Pump Program, Idaho Operations Office, Idaho National Engineering Laboratory, a position he has held since 1982. During his stewardship, DOE has completed performance testing on a reverse rankine cycle high temperature heat pump featuring methanol as the working fluid, a waste heat driven vapor recompression heat pump, a mechanical temperature amplifier, and a reverse brayton cycle heat pump used for solvent recovery. The last is being installed in a 3M Corp. audio-visual tape manufacturing facility. Ongoing work initiated under his direction includes research on heat pumps based on heats of reaction for recovery of industrial process heat, magnetic heat pumps for industrial cryogenic applications, and most importantly, identification of heat pump placement opportunities in industrial processes. He has authored several papers and reports ranging from cost requirements for industrial heat pumps to technological requirements for advanced heat pumps to application possibilities for heat recovery in industrial processes.

## Vapor Recompression Systems: Different Compressor Technologies and Various Examples of Industrial Applications

#### Philippe P. Letout

Alsthom-Rateau  
La Courneuve, France

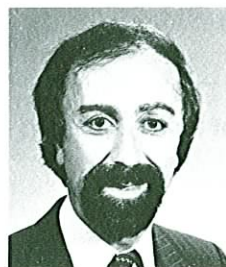
## Vapor Recompression Systems: State of the Art in Europe - Economic Analysis and Optimization

#### Jean-Francois Reynaud

AMPERE 82 Tour Atlantique  
Paris La Defense, France

Mr. Reynaud is a consultant in energy analysis of industrial processes, design of electric equipment and corresponding economic assessment and optimization. He is working for the French National Electricity Board and is currently engaged as an adviser to engineering companies and consulting engineers. He is a specialist in mechanical vapor recompression and compression heat pumps, and a teacher in various technical training centers and engineering graduate schools. In prior employment, he was a technical and commercial engineer for centrifugal blowers and compressors in a private company and was responsible for steam compressor projects. Mr. Reynaud holds a degree in electrotechnology and has authored a dozen technical publications on energy analysis, mechanical vapor recompression, variable speed electric motors and motor starters.

## Heat Pumps for Waste Heat Recovery in the Pulp and Paper Industry



#### M. Kamran Azarniouch

Pulp and Paper Research Institute  
of Canada  
Pointe Claire, Quebec, Canada

Dr. Azarniouch is head of the Energy Research Section of the Pulp and Paper Research Institute of Canada. He received his Diplom-Ingenieur degree (mechanical engineering) from the Technical University of Aachen, Fed. Republic of Germany, in 1967; and his Ph.D. in chemical engineering in 1974 and a graduate diploma (management) in 1980, both from McGill University, Montreal, Canada. From 1967-1968, he worked as a project engineer for VEBA-Chemie, a petrochemicals manufacturer in the Fed. Republic of Germany. In 1973, he joined the Pulp and Paper Research Institute of Canada and has conducted research and development work in air pollution control and energy recovery. He is a member of the Order of Engineers of Quebec, the American Institute of Chemical Engineers, the Canadian Pulp and Paper Association (Technical Section) and the National Heat Pump Coordinating Committee of Canada.

**John M. Romagnino**

Pulp and Paper Research Institute of Canada  
Pointe Claire, Quebec, Canada

Mr. Romagnino is a research engineer at the Pulp and Paper Research Institute of Canada. He is currently working on a partly government-funded project regarding the use of heat pumps for waste heat recovery in the pulp and paper industry. The study involves simulation, integration, and feasibility studies of pulp and paper mills with steam-generating R114 and R113 heat pumps. In prior employment in Canada, he worked as a modeller on nuclear power plant simulators for CAE Electronics Ltd. Mr. Romagnino holds a bachelor of chemical engineering degree from McGill University. He is a member of the Quebec Order of Engineers, the Canadian Pulp and Paper Association, the American Institute of Chemical Engineers, and the National Heat Pump Coordinating Committee (Canada).

**Fishing Industry Applications**



**Per-Erling Frivik**  
Norwegian Institute of Technology  
SINTEF  
Trondheim, Norway

Mr. Frivik is the director of the Division of Refrigeration Engineering at the Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology (SINTEF). He is also a professor of heat pumps at the Norwegian Institute of Technology. He has conducted research on thermal insulation systems, as well as frost protection of/frost action in soils, before he became responsible for the Division's heat pump research program in 1978. In the management of this program, he has been involved in the planning, construction and testing of several medium-sized and large heat pump installations in Norway. Mr. Frivik graduated from the Norwegian Institute of Technology in Trondheim, and has authored more than 50 technical publications. He has been chairman of the Norwegian Society of Refrigeration, and is presently vice president of Commission E2 of IIR.

**Operating Experience with Industrial Heat Pump Systems:  
Economic Advantages, Obtained by  
Several Actual Installations**



**Masahiro Wakabayashi**  
Mayekawa Mfg. Co., Ltd.  
Tokyo, Japan

Mr. Wakabayashi is currently the chief engineer of Mayekawa Mfg. Co., Ltd. He has been deeply involved in the development of the screw steam compressor and heat pumps as well as their control systems. A graduate of Sophia University in Tokyo, Mr. Wakabayashi did graduate work in solar energy utilization technology for electric power generation using the Rankine cycle and molten salt brine heat storage.



**Shigeru Sakashita**  
Mayekawa Mfg. Co., Ltd.  
Tokyo, Japan

Mr. Sakashita is currently involved in refrigeration facilities analysis to determine the feasibility of industrial heat pump system applications and the study of heat pump applications to new process construction, the design and marketing of heat pump systems. This work involves evaluation of heat pump systems in a wide range of manufacturing facilities such as foodstuffs processing, brewery distillation processes, sugar manufacturing, paper and pulp mills, and chemical engineering facilities. Prior to undertaking this work at Mayekawa Mfg. Co., Ltd., Mr. Sakashita spent considerable time as a design and supervising engineer for freezing, cold storage and air conditioning equipment. Subsequently, he became part of the R&D team for Mycom's SSH (Screw Steam Compression Heat Pump) project focusing on screw compressor utilization in an open cycle heat pump system. In addition to his other duties, he is on the staff of the Mayekawa Heat Energy Technical Research Center. He participated in the first Heat Pump Conference held in Graz, Austria, in 1984 and the subsequent meeting held in Bern, Switzerland, in 1986.

**Chemical Heat Pumps**

**Scott Richlen**  
U.S. Department of Energy  
Washington, D.C., USA

Mr. Richlen is the program manager for the U.S. Department of Energy's Industrial Heat Pump Program. His previous position was at the Idaho National Engineering Laboratory where he provided managerial and technical support to advanced heat exchanger and industrial heat pump development. Mr. Richlen holds a bachelor of science degree in mechanical engineering from Montana State University. His master's degree in mechanical engineering is from the University of Idaho.

**Overview of Heat Transformers in Japan**



**Katsuyuki Mashimo**  
SANYO Electric Co., Ltd.  
Oizumi, Gunma, Japan

Mr. Mashimo is an engineer of absorption systems at SANYO Electric Co., Ltd., Tokyo Plant. He is currently working as a research engineer on the "Sunshine Project" funded by the New Energy Development Organization (NEDO). In this project, he has developed the absorption refrigerating machine with a new working pair providing refrigerated warehouse temperatures of 0°C to -5°C by solar heat. In prior work in the NEDO project, he developed the absorption heat pump and heat transformer applied to industrial and commercial fields. He has also consulted in system design using the absorption machines. Mr. Mashimo majored in thermodynamics at Gunma University and has authored several technical papers concerning the absorption process. He is a member of the Japanese Association of Refrigeration.

## Industrial Heat Recovery with Heat Transformers - Practical Applications and Development of Advanced Systems



**Horst Bokelman**  
GEA GmbH  
Bochum, Fed. Republic of Germany

Dr.-Ing. Bokelman is a member of the staff of the research and development department of GEA GmbH, Bochum, FRG. The GEA-Group (36 companies in 12 countries) is a manufacturer of heat exchangers of many kinds. The product range of the GEA-Group includes components for power stations (e.g., cooling towers), components for chemical and petroleum industry, iron and steel mills, energy saving technology, engine cooling, components and process plants for dairies, beverages and breweries, heating, ventilation and air conditioning. In the central research and development department of the GEA-Group, Dr. Bokelman is responsible for advanced energy saving technologies. He is the project leader of two research projects dealing with absorption heat pumps and heat transformers (Eureca-project "PACA" and EEC R&D-project "Advanced Heat Transformer"). Before he switched to GEA in 1985, he worked as an assistant to Prof. Steimle at the Institute of Applied Thermodynamics and Air Conditioning of the University of Essen. His doctoral thesis deals with the thermodynamic properties of working fluids for absorption heat pumps. He has authored more than 20 technical publications.

## Future Prospects for Industrial Heat Pumps in Europe

**Thore Berntsson**  
Chalmers University of Technology  
Gothenburg, Sweden

Mr. Berntsson received a master of science degree from Chalmers University of Technology, School of Chemical Engineering, in 1971. That same year, he was employed as an assistant at the Department of Heat and Power Technology. There, in 1976, he defended his doctoral thesis titled "Heat Transfer Studies in a New Type of Heat Exchanger for Divided Solids." During the years 1976-1979, he was employed at the department as a lecturer, and between 1979 and 1982 as an appointed professor. Since 1982, he is a full professor at the department. His research activities have mainly been concentrated in four areas: heat pump technology, energy storage, industrial energy systems studies, and two-phase heat transfer. He has participated in several international cooperation projects, including some as chairman, e.g., within the work of IEA. At present, he is taking part in a group for evaluation and initiation of heat pump technology at the Swedish Council for Building Research and in the Scientific Council of the Energy Research Board for general energy system studies. He has recently also taken part in an expert group, appointed by the Swedish government, for the direction of future Swedish energy research activities.

## Future Prospects for Industrial Heat Pumps in Japan



**Takeshi Yoshii**  
Mitsubishi Heavy Industries, Ltd.  
Tokyo, Japan

Mr. Yoshii has been a mechanical engineer at Mitsubishi Heavy Industries for his entire career. He started as a research engineer for the development of heat pumps and air-conditioning equipment. He is currently engaged in the management of research and development programs. He is also working as a plant engineer for district heating and cooling systems engineering. Mr. Yoshii is a graduate of the mechanical engineering department of Gunma University, is a registered professional engineer in Japan, and has authored many technical papers. He is a member of the Japanese Association of Refrigeration (JAR, affiliate of ASHRAE) and has served on JAR's and JRAIA's (The Japanese Refrigeration and Air-Conditioning Industry Association) research and technology programs on heat pumps and their applications.

## Future Prospects for Industrial Heat Pumps in North America



**Richard C. Niess**  
Dames & Moore  
Washington, D.C., USA

Mr. Niess is working as a specialist in industrial energy conservation with industrial companies and utilities to develop programs in management, planning, and energy conservation. Prior to his current position as manager of Energy Management and Planning Services at Dames & Moore, he managed the Templifier Heat Pump Department at McQuay, Inc. and spent 20 years with Westinghouse Electric Corporation. Previous to that, he worked in the Engineered Machinery Division of Borg-Warner. Mr. Niess has a B.S. in civil engineering from the Virginia Military Institute and has authored numerous professional articles. He is a member of ASHRAE, where he serves on the Applied Heat Pump and Heat Recovery Technical Committees and on the Geothermal Energy Utilization Technical Committee. He is also a member of the Association of Energy Engineers, the Geothermal Resources Council, and the American Solar Energy Society.



**Joel S. Gilbert**  
Dames & Moore  
Washington, D.C., USA

As the director of Energy Management and Planning Services at Dames & Moore, Mr. Gilbert's services are offered primarily to industrial companies and utilities, and stress development of energy conservation, planning and implementation programs. He is a three-time graduate of Rensselaer Polytechnic Institute, New York, with a B.S. and M.S. in chemical engineering and a M.S. in management. Prior to joining Dames & Moore, he was Machinery Development Manager at Mechanical Technology Inc. (MTI), Albany, New York, where he designed and developed advanced heat pump and cogeneration systems. He also directed energy conservation consulting activities at MTI, assisting large and small industrial firms in their heat recovery and energy conservation efforts. While employed by Knolls Atomic Power Laboratories, he worked as a nuclear reactor plant analysis engineer, designing submarine power plants. Mr. Gilbert has published numerous professional articles and now serves on the Advisory Board of the Association of Energy Engineers and the Industrial Energy Technology Conference.

## Session V

### Advances in Thermally Activated Heat Pumps

In recent years, there has been significant world-wide activity in the development of thermally activated heat pumps (TAHP). Work has progressed in both absorption and engine-driven heat pumps as well as working fluids and components. This session will focus on the status of current research and development, examine the prospects for the future, and encourage the interchange of knowledge. Progress reports on the development of TAHP systems, principally absorption, internal-combustion engine-driven, and Stirling engine-driven, will be presented.

#### Chairman

**William E. Krauss**  
Gas Research Institute  
Chicago, Illinois, USA

Dr. Krauss is director of Heat Pump and Appliance Research at the Gas Research Institute (GRI) in Chicago, Illinois. As director, he is responsible for the internal planning and R&D implementation in five program areas: residential space conditioning, residential and commercial appliances, residential and commercial gas heat pumps, and building systems research. Prior to joining GRI, he was vice president of Engineering and Research at Cleaver Brooks Division of Aqua Chem Corporation. He received his bachelor of mechanical engineering and master of science in mechanical engineering degrees from Ohio State University and his Ph.D. in engineering from the University of Florida. Dr. Krauss is a registered professional engineer and a member of ASME, NSPE, Sigma Xi and other professional and scientific organizations.



#### Assistant Chairman

**Robert A. Macriss**  
Institute of Gas Technology  
Chicago, Illinois, USA

Mr. Macriss is the research director for Energy Utilization at the Institute of Gas Technology (IGT). His current duties include the direction of R&D activities on appliance development, indoor air quality, fuel combustion, fluid properties, pollution control, energy conservation systems development, heat pumps, and heating and cooling systems. During his 26 years at IGT, he has engaged in research on the thermodynamics and transport properties of fluid mixtures, including refrigerant, absorption, cryogenic and hydrocarbon fluids. He has led the development of IGT's Solar-MEC<sup>®</sup> heating, air conditioning and ventilating system, of new absorption heat pump concepts (HCOP<sup>®</sup>), of building energy simulation models (SPACE-FI), and of IGT's air infiltration and indoor air quality model (INFIL). He holds an Ing.-Dipl. in chemical engineering from the National Technical University of Athens, Greece, a M.S. in chemical engineering from the University of Alberta, Edmonton, Canada, has authored over 60 technical publications and holds 15 U.S. and foreign patents. He is a member of ASHRAE, has served on several ASHRAE Technical Committees, and is listed in *American Men of Science*.

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#### Developments in Gas-Fired Absorption Heat Pumps in North America

**Robert C. Devault**  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee, USA

Mr. Devault is a research engineer in the Energy Division of Oak Ridge National Laboratory (ORNL). Since 1980, he has been the technical program monitor for the U.S. Department of Energy absorption heat pump program. He has bachelor and master of science degrees in engineering science from the University of Tennessee and is a member of ASHRAE.

#### Developments in Utilization Technology for Absorption Heat Pumps in Japan



**Shigekichi Kurosawa**  
Tokyo Gas Co., Ltd.  
Tokyo, Japan

Mr. Kurosawa was employed by Tokyo Gas Co., Ltd. upon graduation from the Keio University where he had studied mechanical engineering. He has been engaged in development of gas air-conditioning and heating systems and district cooling and heating systems. His specific responsibility is the technologies related to a gas-fired absorption water chiller-heater and gas-fired absorption heat pump. His team has successfully introduced the highest efficiency type, the intelligent type, and the air-cooled type into the market which substantially contributed to expanding gas air-conditioning in the market. All these gas-fired absorption units were successful by using a combination of water as refrigerant and lithium bromide as absorbent. He presented his study results at the following occasions: "Development of Energy-Saving Gas-Fired Absorption Water Heater-Chiller" at the International Gas Research Conference, Los Angeles, September 1981; "The Highest Efficiency Gas-Fired Absorption Water Heater-Chiller" at ASHRAE Meeting, Houston, January 1982; and "Application of Gas-Fired Absorption Heat Pump for Commercial Purposes" at Absorption Experts' Meeting, Paris, March 1985. In Japan, Mr. Kurosawa makes presentations at technical meetings, as well as serving as chairman at these meetings. Also, he is chairman of the Committee of Absorption Water Chiller-Heater Technology of the Japanese Refrigeration and Air-Conditioning Industry Association.

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#### What Needs to Be Known About Fluid Pairs to Determine Heat Ratios of Absorber Heat Pumps and Heat Transformers

**Georg Alefeld**  
Technical University of Munich  
Munich, Fed. Republic of Germany

## Future Prospects for Thermally Activated Heat Pumps



**Arthur R. Maret**  
Gas Research Institute  
Chicago, Illinois, USA

Dr. Maret is the assistant director of the Heat Pump and Application Department at the Gas Research Institute (GRI), Chicago, Illinois. In this capacity, he has overall responsibility for a \$40 million program in Space Conditioning and Heat Pumps. He received his undergraduate education in the United Kingdom and a Ph.D. in chemical physics from Case Western University, Cleveland, Ohio. He has held engineering management positions at Xerox, Sperry Corporation, and AM International. Prior to joining GRI five years ago, he was president of Teran Corporation, an international management consulting company. His 27 years of industrial and research work have yielded over 60 publications. He has made contributions in a wide range of fields including laser technology, ultrasonics reprography, and fuel cells. For the past ten years, he has managed various efforts in the energy sciences. Dr. Maret is an ardent amateur classical composer with several works performed by local musicians.

## Development of Gas-Engine Heat Pumps in Japan



**Tadashi Fukuda**  
Osaka Gas Company, Ltd.  
Osaka, Japan

Mr. Fukuda belongs to the Total Energy Systemizing team of Commercial & Industrial Sales & Engineering Department of Osaka Gas Company, Ltd. This team is devoted to research and development work for systems utilizing gas engines and gas turbines. His assignment in this team is to research and develop the gas engine heat pump system and cogeneration system for commercial applications. He is also engaged in consultation of planning and design for installation of these systems at clients' premises. "GASMULTI," a gas engine heat pump package to be presented at this meeting, has been developed and commercialized by his leadership. He majored in mechanical engineering at Kyoto Institute of Technology. He is a member of the Japanese Society of Mechanical Engineering (JSME) and Japanese Gas Association (JGA), and is a certified energy consultant. Currently, he is actively working on development of a gas engine heat pump with hot water supply function.

## Gas-Engine-Driven Heat Pumps: Design, Components, Experience, Layout, and Economic Feasibility

**Wilhelm Struck**  
MAN Technologie GmbH  
Munich, Fed. Republic of Germany



**Franz Hirschbichler**  
MAN Technologie GmbH  
Munich, Fed. Republic of Germany

Dr. Hirschbichler is employed in the energy and environmental technology sector of MAN Technologie GmbH, Munich. He is responsible for the computation and drafting of development projects for the better exploitation of energy. This primarily includes the development of heat pumps, heat transformers, cogeneration plants, and the improvement of internal combustion engines. Through the development of computer programs for the design of heat pumps and cogeneration plants and for simulation of their operational characteristics, as well as by the calculation of their economic feasibility, his activities also cover the sales sector. He is the author or co-author of several publications and lectures. Dr. Hirschbichler studied general mechanical engineering at the Technical University, Graz, Austria, where he received his doctorate in engineering.

## Development of a Kinematic Stirling-Engine-Driven Heat Pump System

**Russell Monahan**  
Stirling Power Systems  
Ann Arbor, Michigan, USA

Mr. Monahan is a program manager with Stirling Power Systems (SPS), Ann Arbor, Michigan, where he supervises the systems development engineering department and has served as the laboratory manager and senior engineer. He has two bachelors of science degrees (mechanical engineering and environmental sciences engineering) and a master of science degree from the University of Michigan where he concentrated on automotive power train design. Prior to joining SPS, he was a senior mechanical engineer at the Bendix Research Laboratories in Southfield, Michigan, where he did development engineering on several automotive projects including fuel-saving devices and supercharging. He has worked for the U.S. Environmental Protection Agency (EPA) at its headquarters in Washington, D.C., and at the Motor Vehicle Emission Laboratory in Ann Arbor. In addition to several technical publications, he also has a U.S. patent for a long-life light bulb.

## Session VI

## Heat Pumps for District Heating Applications

Topics to be presented include operating experience, economics, technological developments, and practical viewpoints.



### Chairman

**Joachim Paul**  
SABROE Kältetechnik GmbH  
Flensburg, Fed. Republic of Germany

Mr. Paul is president of SABROE Kältetechnik Ltd., a company involved in refrigeration and energy technology. His background is a mechanical engineer with specialization in refrigeration and applied thermodynamics. His professional education took place at the University of Stuttgart and at the University of Essen where, after seven years of research on heat pumps, refrigeration and air-velocity measurements, he finished as Dr.-Ing. under the auspices of Prof. Dr. Steimle. Since 1981, he has worked for SABROE, a company headquartered in Denmark, specializing in the production of compressors (recips and screws), heat exchangers, valves, ice-machines and coolers, and involved in the design, assembly and erection of refrigeration plants, compressed air-dryers, large heat pumps, ORC-systems, and special high-tech applications in the energy field. Mr. Paul is active in national and international organizations, is a member of ASHRAE (US), vice president of Commission E2 of IIR/IIF (France), chairman of the Industrial Section of CECOMAF (European Committee of Manufacturers of Refrigeration Equipment), member of the Finnish and German Refrigeration Associations and participating as member and/or chairman in national and international standardization (DIN, CEN, ISO).

### Assistant Chairman

**Hans O. Nyman**  
District Energy St. Paul, Inc.  
St. Paul, Minnesota, USA

Mr. Nyman, a native of Sweden, has nearly 30 years of district heating experience. For 16 years he was employed by the Uppsala District Heating Company where he supervised the design, construction, and operation of its hot water district heating system. On leave of absence from his Swedish company, he came to the United States in 1978 as a hot water district heating consultant to the Minnesota Energy Agency. In July 1979, his experience earned him his present position as president of District Energy St. Paul, Inc. District Energy owns and operates the centralized, energy-efficient hot water district heating system in St. Paul, Minnesota. It currently provides heat to more than 400 St. Paul customers. Mr. Nyman has authored several technical publications and has presented papers at numerous district heating seminars and conferences. He is a member of ASHRAE and also a board member of the International District Heating and Cooling Association (IDHCA).

## Heat Pumps in Block Centrals



**Rolf B. Westerlund**  
K-Konsult  
Stockholm, Sweden

Mr. Westerlund is a consultant for analyzing technical and economical performances of heating systems. He is engaged in the process of integration of various new production plants in existing systems. His clients are building owners, research organizations and district heating plants. He is employed by K-Konsult, one of Sweden's leading technical engineering and architectural consulting firms. Prior to his present position, he was employed by the Ministry of Housing, managing the national energy saving program. He also worked at the Royal Institute of Technology in Stockholm with research on energy efficiency of transport systems. Mr. Westerlund holds a master of science degree from the Royal Institute of Technology in Stockholm and has studied economy and law at the University of Stockholm.

## Heat Pumps for District Applications - Operating Experience in Japan



**Takanori Chiba**  
Takenaka Komuten Co., Ltd.  
Tokyo, Japan

Mr. Chiba has worked on M/E designs for buildings in the Design Department of Takenaka Komuten Co., Ltd., one of the largest general contractors in Japan, since 1965. Currently, he serves as a deputy manager in charge of M/E Engineering Branch of Takenaka's Building Design Department. During his work at Takenaka, he developed a heat recovery system for heating/air conditioning/hot water supply system in large-type heat pumps for buildings; he also developed a heat pump system as heat resource for the heating and air conditioning of more than one building. He holds a bachelor's degree in architecture from Waseda University, and is licensed by the Japanese Ministry of Construction as first class architectural engineer and a consultant engineer (air conditioning).

### Operating Experience: Selected Technological Issues



**Horst A. Rostek**  
Gaswärmepumpen Gesellschaft mbh  
Dorsten, Fed. Republic of Germany

Mr. Rostek is technical and marketing director of Gaswärmepumpen Gesellschaft mbh (GWP), a Ruhrgas subsidiary engaged in the introduction of modern gas technology into the market. One sector of activity is the application of gas-fuelled engines and gas turbines in processes for the combined generation of power and heat. GWP acts as a consultant to plant operators, the manufacturing industry and planners of plants of this type. The company carries out measurements at installed plants and makes the data available. Prior to the foundation of GWP, Mr. Rostek cooperated in a joint venture of Ruhrgas and the car manufacturers Audi/NSU and Volkswagen for the development of gas-fuelled heat pumps under an R&D project sponsored by the Federal Ministry of Research and Technology.

### Operating Experience in Sweden



**Lars E. Astrand**  
Uppsala Energi AB  
Uppsala, Sweden

Mr. Astrand has been president of Uppsala Energi AB, the municipal utility of Uppsala, Sweden, since 1974. Uppsala Energi produces and distributes electricity and district heating. The utility has pioneered the use of heat pumps for district heating applications and is currently operating a 40 MW mechanical heat pump and a 50 MW absorption heat pump. Mr. Astrand holds a master of science degree in chemical engineering from the Royal Institute of Technology in Stockholm, Sweden. He is a member of the Royal Academy of Engineering Sciences and the Swedish Government's Energy Research Commission; he serves as chairman of the Swedish Thermal Engineering Research Association and the Swedish Solar Energy Association. Within the IEA CRD, he has served from 1981 to 1985 as chairman of the Working Party on Renewable Energy.

## Session VII

**Economics, Marketing, and Promotion**

The relatively low oil price has diminished the interest for heat pumps, especially in Europe. As heat pumps are energy efficient and also superior from an environmental viewpoint, it is important to try to get more heat pumps installed. The main problem seems to be the relatively high cost. The question is, therefore, can marketing and promotion help us to overcome that problem? The goal must be to try to get people convinced that in the long run it is best economically for them to use heat pumps. Can international cooperation help us? Could utilities adjust their tariffs to give heat pumps better possibilities to compete? What can be done in each country? Would more education help? Is it possible to get lower cost through more standardization? How could environmental benefits achieve higher priority in national energy policy?

**Chairman**

**Bengt Nordstroem**  
SwedPower AB  
Stockholm, Sweden

Mr. Nordstroem is currently a consultant to SwedPower AB, Stockholm. Prior to this, he has held various positions with Vattenfall, the Swedish State Power Board. From 1982-1985, he worked on the "Solar Project" research on heat pumps and solar energy. He received his master of science in electrical engineering from the Royal Institute of Technology, Stockholm, Sweden, in 1946. In 1962, he received a certificate from the Royal Institute of Technology declaring competence as a professor in electrical construction techniques. He is involved in numerous organizations and committees, is chairman of the international heat pump group within the electric utility companies and member of the IEA heat pump promotion group. He has authored many technical publications dealing with power production, power transmission, and heat pumps.

**Assistant Chairman**

**James M. Calm**  
IEA Heat Pump Center  
Eggenstein-Leopoldshafen  
Fed. Republic of Germany

Mr. Calm is a consultant in analysis, design, and both technical and economic assessment of heating and air-conditioning systems. His clients have included manufacturers, engineering and architectural firms, building owners, research organizations, trade associations and governmental agencies in the United States, Europe, and the Mideast. He is currently engaged in a consulting capacity as Technical Manager in the International Energy Agency (IEA) Heat Pump Center in Germany. In prior employment in the U.S., he managed heat pump development projects for the Electric Power Research Institute and led research programs in community heat pump systems for Argonne National Laboratory. He also worked, on a sabbatical, at the Institut CERAC in Switzerland and served as a mechanical engineer, in systems design and operation, in both Italy and the United States for the U.S. Air Force. Mr. Calm holds bachelor (cum laude) and master of science degrees from Tufts University, is a registered professional engineer in three states, and has authored more than 60 technical publications. He is a member of the American Society of Mechanical Engineers, Sigma Xi, Tau Beta Pi, and ASHRAE; he has served on ASHRAE's Program, Research and Technology, and several Technical Committees, including as past chairman on the Technical Committee on Applied Heat Pump and Heat Recovery Systems.

**Estimating International Heat Pump Use**

**James M. Calm**  
IEA Heat Pump Center  
Eggenstein-Leopoldshafen  
Fed. Republic of Germany

### The International Heat Pump Council: A Vital Step Toward Successful Heat Pump Marketing



**Werner Hochegger**  
Energiesparhaus Graz  
Graz, Austria

Mr. Hochegger graduated from the Technical University in Graz, Austria in 1940. Following positions as sales manager for various companies, he established a sales and distribution organization for air-conditioning and heat pump products in Austria in 1971. This organization achieved a position of prominence in its field in the following years. In 1980, he founded the "Energiesparhaus-Forschungs-gesellschaft" to promote the heat pump in Austria and the world market. The Energiesparhaus is involved in R&D to improve installation methods for heat pumps in residential and commercial applications, and in training courses for manufacturers and installers. It works in close cooperation with the Technical University in Graz. Mr. Hochegger has also served as Senior Engineer and Deputy Head of the IEA Heat Pump Center Analysis Center in Graz. He organized the first IEA Heat Pump Conference in Graz in May 1984, and is a member of the organizing committee for the 1987 Heat Pump Conference in Orlando, Florida. He has been involved in the International Heat Pump Council since its inception in November 1986.

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### Factors Affecting the Marketing of Heat Pumps in North America

**Ted C. Gilles**  
Lennox Industries, Inc.  
Dallas, Texas, USA

Mr. Gilles is a registered professional engineer and director of Advanced Energy Systems for Lennox Industries, Inc., at their corporate headquarters in Dallas, Texas. In the 29 years he has been with Lennox, he has authored six patents related to high-efficiency HVAC systems. These include the original add-on heat pump as a substitute for conventional air conditioning with fossil fuel furnaces and an optimized energy reclaim boot strap multi-zone heat pump. He holds a bachelor of science in engineering degree from the University of Iowa and did post-graduate work at Stanford University in engineering economics. In 1974, he originated and authored the first widely used computer-assisted HVAC energy and economic analysis procedures known as the Lennox LOGIC series. These programs include LESIA (Lennox Energy Savings Investment Analysis) which became the first discounted cashflow analysis suitable for hand-held computers as a selling aid for heat pumps and high efficiency air conditioning in the residential market. Mr. Gilles has been a member of ASHRAE since 1959, and has authored numerous technical papers and articles relating to the efficient use of energy for HVAC.

### How to Raise the Competitive Position of Heat Pumps in Air-Conditioning Systems of Large Office Buildings



**Kihachiro Kubota**  
Shimizu Construction Co., Ltd.  
Tokyo, Japan

Mr. Kubota is a chief research engineer at Shimizu Construction Co., Ltd. Though he specializes in architectural acoustics, he is currently engaged as a technical manager in Shimizu Institute of Technology in promotion of research and development of new technology in air-conditioning systems of large scale buildings and apartment houses, district heating systems and heat storage. He is also working as a member of MITI's projects on development of super heat pump energy accumulation systems, and heat recovery system for new apartment houses in the 21st century. He is a member of the Architectural Institute of Japan, the Acoustical Society of Japan, and the INCE Japan.



**Kimio Morino**  
Shimizu Construction Co., Ltd.  
Tokyo, Japan

Mr. Morino is a research engineer at the Institute of Technology, Shimizu Construction Co., Ltd., engaged in environmental engineering. He has conducted analysis, design, and both technical and economic evaluation of heating and air-conditioning systems. He has also conducted analysis of energy consumption for commercial buildings and residences, solar energy utilization, and snow melting for air-supported dome. Currently, he is studying a long-term heat storage and ground-coupled heat pump system. He is working on MITI's project which aims at development of heat recovery systems for apartment houses in the 21st century. He is a member of the Architectural Institute of Japan and the Society of Heating, Air-conditioning and Sanitary Engineers of Japan. He has served on several committees of government agencies and commercial associations in Japan.

**European Market for Small Electric Heat Pumps: Economic Attractiveness of Heat Pumps and Short-Term Market Prospects**

**Jean-Francis Harris**  
Groupe MAC  
Paris, France

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**Experiences with an Electric Utility Incentive Program - TEPCO's Activities for the Use of Heat Pumps**

**Katsuhiko Narita**  
Tokyo Electric Power Co., Inc.  
Tokyo, Japan

**Experience with Electric Utility Incentive Programs and Market Prospects in Europe**

**Michael F. Schneeberger**  
Oberösterreichische  
Kraftwerke AG (OKA)  
Linz, Austria

Mr. Schneeberger is the head of the energy consulting department of the Oberösterreichische Kraftwerke AG (OKA), Austria. As a consequence of the oil price shocks, this company has developed an energy conservation program for customers, following closely the IEA recommendations. The investigation of heat pump applications in industry, commerce and private areas characterizes a main professional target of Mr. Schneeberger. The utility heat pump program of OKA, based on international experience and cooperation has been steadily expanding since 1980. Recently, Mr. Schneeberger was elected chairman of the electricity application committee of Austria's utility companies. In prior employment, he worked in energy research and industry in the Federal Republic of Germany and in nuclear physics and reactor development in France. His professional activities included consulting projects in different countries. He has authored numerous publications in physics, energy analysis and energy research. As a member of the Oil Substitution Task Force of the World Energy Conference, he contributed to energy strategic analysis and environmental studies.

**Session VIII**

## **Government's Role in Energy Conservation**

Energy conservation is essential to all governments to save limited energy resources and preserve our comfortable environment. Additionally, countries that depend on imported oil can improve their balance of trade and produce new employment through developing energy conserving technology. Most governments have incentives based on their energy policy after the oil price crisis. What kinds of incentives have been offered and which have been effective in promoting energy conservation? We are now at the stage of evaluating the results of government incentives and selecting the most effective measures for energy conservation. The incentives offered by governments are subsidies, loans, grants, and some tax reductions. In some countries, governments themselves originated research, development and demonstration projects, and set up recommendations and guidance for efficient use of energy. What are their results? Some are successful, some are not successful and are abandoned. What are the reasons for success? What is the role of heat pump technology in these projects and recommendations? Generally speaking, new technology is introduced to the market through the following stages: research, development, demonstration, and commercialization. Some technologies take a long time to be accepted and some take a short time, even if both are equally expected to become popular. The principle of economy is an essential factor for new technology in market introduction. Government incentives can be useful only when the barriers to market introduction have reached the point where they can be broken through by these incentives. Subsidies often create artificial and temporary markets, which rarely continue for a long time. The fundamental role of government in energy conservation is to establish definite, continual energy policy for efficient use of energy and environmental conservation.

In this session the role of government in promoting heat pump technology will be discussed, including the following issues:

- Meaning of energy conservation and important role of heat pump technology in energy conservation
- Assignment and cooperation in RD&D with related institutions and industries
- Various effective and expected incentives in relation to each stage of introduction
- Experiences with government incentives that resulted in success and failure
- Experiences with government projects that resulted in success and failure

In short, how can each government carry out its important role for energy conservation by promoting heat pump technology.

### **Chairman**

#### **Katsuhiko Narita**

Tokyo Electric Power Co., Inc.  
Tokyo, Japan

Dr. Narita is a consulting engineer in research, development, and design of energy systems in buildings and urban planning. He has worked at Tokyo Electric Power Company since 1960. In the 1960's, his work involved designing office buildings, multi-family apartment houses, hospitals, colleges and others. After the oil price crisis, he worked in research and development activities in efficient use of energy in buildings and urban development. Currently, he is involved in planning and constructing energy systems in urban areas with market research. He holds a doctor of engineering degree from Tokyo University and has authored technical papers on analysis and design of energy systems. He is a member of the Japanese Association of Building Science, Japanese Society of Heating, Refrigerating, and Air-conditioning Engineers, Japanese Society of Electric Engineers, and some committees of national projects such as super heat pump, design standards for efficient use of energy, and others. He has served on heat pump activities in IEA and WEC.

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### **Assistant Chairman**

#### **John D. Ryan**

U.S. Department of Energy  
Washington, D.C., USA

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### **Government Energy Policy in Japan**

#### **Teruo Hatano**

New Energy Development Organization (NEDO)  
Energy Conversion and Storage Department  
Tokyo, Japan

## State Support to the Heat Pump Industry: An Assessment of Governmental Policy in the Residential Sector of Sweden, France, and Germany

### Torbjorn Bostroem

Swedish Council for Building Research  
Stockholm, Sweden

Mr. Bostroem has been the director for the Department of New Energy Systems at the Swedish Council for Building Research since 1981. This department has been given the task to carry out the national energy RD&D program in the field of end-use technologies in buildings. The program includes small-scale district heating as well as solar heating and cooling. The major thrust is in the field of heat pumps and system technologies related to building. He is the Swedish delegate to the IEA working party on end-use technologies and alternate delegate to the working party on renewable energy. In prior employment, he was engaged by the Ministry of Housing and Physical Planning with the responsibility for building services and district heating in the development of the ten-year national energy conservation program in 1977 and 1978. Since the mid 1960's, he has worked with a major consulting engineering company in Stockholm in the field of HVAC in hospitals and the pharmaceutical industry. He was involved in several R&D projects related to ventilation, and thermal comfort. He was also engaged in international projects in the U.K., Kuwait, and Iran.

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### Jean-Francis Harris

Groupe MAC  
Paris, France

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### N. Haskins

Groupe MAC  
Paris, France

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## The Government Role in the United States

### John Berg

U.S. Department of Energy  
Washington, D.C., USA

## Impact of Heat Pumps on Energy Resources and the Environment Worldwide



### Otto Zellhofer

Federal Ministry for Science  
and Research  
Vienna, Austria

Mr. Zellhofer joined the Federal Ministry for Science and Research in 1971, where he managed the division of industry related research. Since 1974, he is head of the division of energy and space research. In prior employment he was engaged in the building up and operation of a modern isotope laboratory and a tritium and C-14 laboratory especially for hydrology research in the years 1961 to 1969. From 1969 to 1971 he led the coordination of the working plans and investments as well as the budgeting of the Federal Testing and Research Institute Arsenal, Vienna. Mr. Zellhofer received a degree in technical physics from the Technical University of Vienna. He authored several publications, including "The Austrian Energy Research Concept (1974 and 1980)." For many years he has been a member of the Councils of the Industrial Research Promotion Building Research and Road Research Funds, the Board of Directors of the Austrian Solar and Space Agency and of the Austrian Research Center Seibersdorf. He was the representative of the Federal Ministry for Science and Research in the ministerial committee for the coordination of energy-saving measures at government level and vice chairman of the committee formulating the energy reports and energy concept of the government. At an international level, he has been a delegate of the CRD of the IEA and delegate to the IAEA for several years, and is Austrian delegate of the Council of ESA.

**Session IX**

## **Closing Plenary Session**

The closing plenary session is intended to discuss pertinent results and issues from the sessions of this conference. Accordingly, each session chairman will briefly summarize presentation topics of his session. His summary should relate to only subject matter covered in his respective session and factually represent the contents of his session. After each summary, the chairman should present his perceptions on the future prospects for heat pumps and the need (or lack thereof) for international cooperation. It is important that each session chairman present his views on technical and political issues, barriers, or global situations which may have an impact on the future of heat pumps.

### **Chairman**

#### **Louis E. Chaump**

Trane Co.  
Dealer Products Group  
Tyler, Texas, USA

Mr. Chaump holds a B.S. degree in mechanical engineering and an M.S. in engineering science from Penn State. Prior to entering the heating, ventilating, and air-conditioning industry in 1978, he was engaged in jet engine development with Pratt & Whitney and General Electric (GE) until 1961 when he joined GE's Aerospace Group, working on NASA and U.S. Air Force development programs. In 1978, he was appointed manager of engineering for the Central Air Conditioning Department of GE, which was acquired by Trane in 1982. In April 1983, he was named vice president of engineering for the Dealer Products Group of Trane Co., responsible for the design, development, and evaluation of HVAC products and systems. Mr. Chaump has been active in ASHRAE, GRI, and the Air Conditioning & Refrigeration Institute since 1978. He has served on the large unitary, small unitary, air filters, and humidifiers sections. He is a past chairman of the small unitary section and has served on the board of directors.

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### **Assistant Chairman**

#### **Sumihisa Kotani**

Hitachi Europe GmbH  
Düsseldorf, Fed. Republic of Germany

Mr. Kotani is currently assigned at Düsseldorf, Fed. Republic of Germany, as a technical representative from the Mechanical Engineering Research Laboratory of Hitachi Ltd., Japan. He is engaged in reliability analysis of various kinds of machine components and structure elements ranging from power generator to electronic devices mainly from the viewpoint of fatigue strength and fracture mechanics. He has also joined in-house R&D project of scroll compressor for air-conditioning. Mr. Kotani holds bachelor and master of science degrees from Osaka University. He is a member of the Japanese Society of Mechanical Engineers, the Japanese Society of Material Science, the Japanese Association of Refrigeration and the American Society of Automotive Engineers.

## Preconference Site Visits

The United States sponsors of the 1987 IEA Heat Pump Conference invite conference participants to tour a variety of heat pump related sites during the week before the conference, April 20-24, 1987. The tour will present a cross-section of heat pump activity in the United States, including research, development, product design, testing, manufacturing, and installation.

### Cost

The full cost of \$1,300.00 includes inter-city air flights, ground transportation, hotel accommodations, lunches, and social functions. A reduced cost of \$670.00 includes all of the above except for the inter-city air flights for which the participants will be required to make their own arrangements. In both cases, participants must make individual travel arrangements for arrival in New York City on Monday, April 20, 1987, and to Orlando, Florida, from Washington, D.C., for the beginning of the conference.

### Registration

Conference participants who wish to attend the preconference site visits should contact:

Pamela J. Lewis  
Oak Ridge National Laboratory  
Building 9102-2  
P.O. Box Y  
Oak Ridge, Tennessee 37831, USA  
Telephone: 1-615/574-2012  
Telex: 854481 ud

### Sites to be Visited

#### Tuesday, April 21

Stamford, Connecticut, area: Water-loop heat pump installations

Stamford, a suburban community that is conveniently located near New York City, is the site of the world headquarters for many major corporations. Many of the modern structures that house these corporate giants are comfort-conditioned with water-loop heat pump systems. Some of these systems have been in operation for over 15 years with a remarkable record of performance and reliability. The installations cover a range from low-rise complexes to 21-story buildings. A number of premium water-loop heat pump system sites will be visited. These installations will demonstrate practices utilized for conditioning the building perimeter and core areas. Tours of mechanical rooms will be included to give observers a close-up view of the methods used to control the flow and temperature of the circulating loop.

New York City area: Packaged-terminal heat pump installations

This portion of the tour will include an installation of packaged-terminal heat pumps. About 50% of the packaged-terminal air conditioners being installed in the United States are of the heat pump variety. These zonal products can be installed with advanced control systems that feature energy management. The combination provides the benefits of full zonal comfort conditioning while maintaining some degree of central control.

#### Wednesday, April 22

Cortland, New York: ETL Testing Laboratories, Inc.

The world's most versatile independent product testing laboratory, ETL, provides many of the audit tests for performance certification programs for HVAC products in the United States. ETL performs tests in accordance with the U.S. Department of Energy requirements and industry-developed standards. This includes programs sponsored by the Air-Conditioning and Refrigeration Institute (ARI) and the Gas Appliance Manufacturers Association (GAMA). The Air Conditioning Division specializes in testing heating and cooling equipment. The Heating Division tests fur-

naces, boilers, and water heaters, including the heat pump type. The Safety Division offers a safety testing service (including testing, labeling, listing, and follow-up service for electrical products) which is recognized by most inspection jurisdictions in the United States.

Syracuse, New York: W.S. Fleming & Associates, Inc.

There are several office buildings in Syracuse that feature the installation of earth-coupled heat pump systems. One design utilizes vertical earth loops, and the other is coupled to the earth with horizontal loops. These buildings have been designed and instrumented to develop system data for use in the planning and design of future installations. The systems are constantly monitored on a second-by-second basis for 24 hours per day to determine technical performance, economic benefits, and occupant satisfaction throughout the year. One of the buildings contains the offices of W.S. Fleming & Associates, Inc., designer of the systems. From this building, the firm monitors the performance of numerous other commercial and residential earth-coupled heat pump systems installed in the area.

Utica, New York: Climate Master, Inc.

Climate Master is the world's largest manufacturer of water-source heat pumps. This plant manufactures water-source heat pumps in cooling capacities from 1/2 ton to 40 tons, including horizontal and vertical indoor units, rooftop units, and console units. The products have been installed in a wide variety of residential and commercial units including the 76-story Columbia Center tower in Seattle, Washington, which is the tallest building ever to use water-source heat pumps. The facility includes a complete engineering design and development laboratory dedicated to the advancement of the technology of water-source heat pumps. Climate Master is also in the forefront in the development of useful computer software programs to assist in the application of water-source heat pumps in the most effective manner.

#### Thursday, April 23

West Lafayette, Indiana: The Ray W. Herrick Laboratories

The Ray W. Herrick Laboratories is a graduate research facility of the School of Mechanical Engineering of Purdue University. More than 300 M.S. and Ph.D. theses

have been written by its graduate students, along with numerous technical articles and a substantial number of reports for sponsors. The research efforts are strongly concentrated in the HVAC field and include engineering acoustics; noise and vibration control; energy utilization in heating, ventilating, air-conditioning, and refrigeration equipment and systems; modeling of thermal systems; positive displacement compressors; and microprocessor control of mechanical, acoustical, and electrical systems. The laboratory also sponsors conferences on compressor and HVAC equipment development that serve to update the engineering community on the current state of the art.

Indianapolis, Indiana: Carrier Corporation

Carrier Corporation is one of the major U.S. producers of air-source heat pumps. Unitary air-source heat pumps for residential and light commercial applications are designed and manufactured. The equipment includes both split-system and single-package units for all Carrier Corporation brands (Carrier, Bryant, Day and Night, and Payne). The engineering team has at their disposal one of the finest air-source heat pump engineering laboratories in the world. This includes facilities to subject equipment to the full range of environmental conditions that air-source heat pumps will encounter, and to test the equipment for performance and compliance with codes and standards. Other residential and light commercial HVAC products, including gas-fired equipment, are also designed and manufactured at this location.

### Friday, April 24

Gaithersburg, Maryland: The National Bureau of Standards

The Center for Building Technology of the National Bureau of Standards is the national building research laboratory. The center conducts research to increase the usefulness, safety, and economy of buildings through the advancement of building technology and its application to the improvement of building practices. The Building Environment Division is active in the research of solar equipment, combustion equipment, mechanical systems, controls and thermal machinery. Activities include advancing the state of the art of heat pump systems and supporting the development of performance standards and codes for these products. One of the unique features of this laboratory is one of its seven environmental chambers, a 30 x 40 x 50 ft test room that is used for evaluating the thermal performance of full-scale buildings over a wide range of weather conditions.

Washington, D.C. area: Air-source heat pump installations

Over one-third of the new homes and apartments in the United States are being comfort-conditioned with air-source heat pumps. The Washington, D.C., area (including surrounding suburbs) is one of the principal users of these systems. The tour will include visits to both single-family and multi-family residential building sites where equipment is in the process of being installed. The split-system air-source heat pump systems at various stages of completion can be observed, including the installation of the indoor air system with its ducting, supply registers, and return air grilles; the positioning and mounting of the indoor and outdoor units; and the installation of the interconnecting re-

frigerant lines. Completed installations will also be included on the tour.

### Saturday and Sunday, April 25-26

The weekend is free for sightseeing in and around the Washington, D.C., area, or for departure to Orlando, Florida, and its multitude of attractions.

Registration for the conference begins in Orlando on Monday, April 27; the conference program begins on Tuesday, April 28.

## Postconference Field Trips

At the conclusion of the 1987 IEA Heat Pump Conference, two optional field trips are available. Please note that these are not included in the conference registration fee.

Attendance for these trips is limited. If you are interested, please contact Pamela J. Lewis, Oak Ridge National Laboratory, as soon as possible.

### Friday, May 1

#### Florida Solar Energy Center and Kennedy Space Center

The Florida Solar Center, located at Cape Canaveral, is a nationally recognized, renewable energy research and development organization. The Center's work focuses on cooling buildings in hot, humid climates; innovative mechanical systems; photovoltaic system applications; and solar thermal systems. Laboratory facilities include a completely refigurable building for cooling research; a heating, ventilating, and air-conditioning laboratory; and several photovoltaic prototypes.

At the Kennedy Space Center, the tour will include the Space Shuttle, Moon Launch facilities, and the 160 meter (525 foot) high Vehicle Assembly Building. Depending on activity at the Center, other stops may be made at the Flight Crew Training Building, Mission Control Center for early manned flights, Atlas Center Pad, Mercury Pad, Gemini Pad, and the Air Force Space Museum.

Cost:  
U.S.\$ 14.00 for adults and children

### Saturday, May 2

#### Walt Disney World -- "Innovations in Action"

This 3-1/2 hour tour demonstrates the technological and creative innovations behind the scenes at Walt Disney World. Topics covered in the tour include integrated water management strategy, Disney's approach to mass transportation, governmental duties and responsibilities, and the EPCOT building codes. Stops and walking tours will be made in the corridors beneath the Magic Kingdom that house the utility systems; at a topiary garden, tree farm, and nursery; and at the Central Energy Plant, a unique computer-controlled system that monitors and controls power distribution across the Disney property. The energy plant control room is housed in a prototypic solar-energy-powered office building.

Cost:  
U.S.\$ 42.00 for adults (not recommended for children under 16)

# IEA Activities

The International Energy Agency (IEA), founded in 1974, is the energy forum for 21 industrialized countries. IEA Member governments agreed that in the event of a severe oil supply disruption they will share remaining supplies. They also undertook to coordinate their energy policies. These provisions were embodied in the International Energy Program, the agreement by which the Agency was established, and also in the IEA's Long-Term Cooperation Program of 1976.

Countries cooperating in the IEA are: Australia, Austria, Belgium, Canada, Denmark, Germany, Greece, Ireland, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States. The Commission of the European Communities also participates in the IEA's work. The IEA, based in Paris, is an autonomous agency within the framework of the Organization for Economic Cooperation and Development (OECD). The IEA's main decision-making body is the Governing Board, composed of senior energy officials from each participating country. The Governing Board is assisted by the following standing groups and special committees, which bring together energy specialists from Member countries:

- Long-Term Cooperation (SLT) - promotes conservation and efficient use of energy, increased production and use of energy alternatives to oil, and other measures to reduce long-term dependence on oil
- Committee on Energy Research and Development (CRD) - encourages cooperative research by Member countries into new technologies to achieve these objectives
- Emergency Questions (SEQ) - refines, tests, and maintains on a stand-by basis, the IEA emergency oil-sharing system for use if needed in major oil supply disruptions
- Oil Markets (SOM) - collects and analyzes information on the international oil market

- Relations with Producer and Other Consumer Countries - an ad hoc group considers energy developments in their global context, including possibilities for cooperative relations with non-member countries and international organizations.

## Committee on Energy Research and Development (CRD)

The CRD supports IEA efforts to reduce Member countries' long-term dependence on imported oil through energy research, development and technology demonstration (RD&D). It achieves its objectives through three distinct but related activities. First, by carrying out annual reviews of national energy RD&D programs, and confirming that each program remains relevant to the overall energy security goals of the IEA. Second, by sponsoring state-of-the-art reviews of promising energy technologies. Third, by promoting collaborative RD&D projects between two or more Member countries. These projects cover a wide range of energy technologies. Several of the collaborative projects concern energy conservation. They contribute to national RD&D programs covering buildings and community energy systems, heat pumps, automotive engine improvement, district heating and industrial energy efficiency.

In the area of Energy Research, Development and Demonstration, IEA activities are further broken down into various technologies: energy end-use technology, fossil fuel technology, renewable energy, controlled thermonuclear fusion, and energy technology systems analysis.

The Energy End-Use Technology activities are categorized as Buildings and Community Systems, District Heating, Heat Pumps, Energy Storage, Combustion Processes, Energy Cascading, Heat Transfer, Energy Conservation in Industry, and Automotive Engines.

## Heat Pumps

In IEA countries, a large portion of energy consumption is used as low temperature heat for domestic purposes such as space and water heating. With the advent of a steep rise in energy prices in the mid-1970's, more vigorous efforts were applied to the development of energy saving techniques. One device which received particular attention was the heat pump. Apart from improvements of the thermal design of buildings, the application of heat pump systems based on the compression cycle is one of the most promising possibilities of reducing energy consumption for space heating. When electrically driven heat pumps are compared with electric resistance heating, or diesel/gas-driven heat pumps are compared with direct oil or gas firing, energy savings of the order of 50 to 75% are possible. Furthermore, the substitution of light fuel oil and of gas by electricity generated by nuclear power, coal, or renewable energy sources is possible with the heat pump at a high overall efficiency, the coefficient of performance (COP) being measured by the ratio of usable heat output to power supplied to the heat pump and its auxiliaries.

The annexes covering Heat Pumps include the following projects:

- Heat Pumps with Thermal Storage
- Advanced Heat Pump Systems
- Vertical Earth Heat Pump Systems
- Heat Pump Systems Applied in Industry
- Large Heat Pumps for District Heating
- High Temperature Working Fluids in Compressor Driven Heat Pumps
- Heat Pump Center

In the next issue of the Newsletter, details of each of these projects will be presented from the recently published "Ten-Year Review of Collaboration in Energy RD&D" prepared by IEA.

# NEWS BRIEFS

## Engine-Driven Heat Pump Task Group

Formation of a Task Group (TG) on Unitary Combustion-Engine-Driven Heat Pumps was announced at the 1987 Winter Meeting of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). The TG is one of four new ones announced at the meeting held in January in New York. The Engine-Driven Heat Pump TG has already been meeting since 1985, as one of its activities, had organized a seminar on the *Characteristics of Prime Movers as Energy Converters* for the January meeting. Chaired by Dr. William E. Murphy of the University of Kentucky, the well-attended session included four presentations on engine drives for heat pumps. The seminar addressed the characteristics, both mechanical and thermal, of such drives with attention both to mechanical reliability and thermal efficiency. Further information on the TG can be obtained from its chairman, Mr. Donald D. Colosimo, Mechanical Technology Incorporated, 968 Albany-Shaker Road, Latham, New York 12110, USA, telephone 1-518/785-2211.

## ASHRAE Standards -- Coming and Going

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), has announced a 60-day public review (March 16 - May 15, 1987) of three ASHRAE/ANSI draft standards.

ASHRAE/ANSI Draft Standard 127P, "Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners," establishes a uniform set of requirements of testing for rating a class of equipment used to air-condition computer room and data processing equipment. It does not apply to the rating and testing of individual assemblies such as condensing units or direct expansion fan coil units.

ASHRAE/ANSI Draft Standard 128P, "Method of Testing for Rating Unitary Spot

Air-Conditioners," applies to unitary air-conditioners that cool a zone within a space and discharge the rejected heat back into that space. The standard covers units in which the air leaving the evaporator and condenser is discharged into the same space and where there is no physical boundary separating the discharges.

ASHRAE/ANSI Draft Standard 24-78R, "Methods of Testing for Rating Liquid Coolers," classifies liquid coolers as to type, lists and defines the terms suggested for rating liquid coolers, and establishes methods of testing to provide a basis for obtaining ratings of liquid coolers.

ASHRAE standards with the ANSI designation signify that the standard also has been approved by the American National Standards Institute.

In addition, comments are invited by May 15, 1987, on the intent of ASHRAE to withdraw three standards.

Two standards, ASHRAE Standard 12-1975, "Refrigeration Terms and Definitions," and Standard 85-1978, "Automatic Control Terminology for Heating, Ventilating, Air Conditioning, Refrigeration Equipment," are believed to be no longer necessary because their contents have been incorporated into a new ASHRAE publication, "Terminology of Heating, Ventilation, Air Conditioning, and Refrigeration." The purpose of Standard 12-1975 was to bring a more logical and consistent use of terminology employed in all phases of activities connected with refrigeration and air conditioning, to serve as an authority on word meaning in specification and allied writing, and to be a vocabulary source for technical and standard writing, while Standard 85-1978 was intended to provide authoritative definitions of control terminology currently used in all phases of heating, air conditioning, and refrigeration activities.

The third, ASHRAE Standard 20-1970, "Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers," is intended for withdrawal because of an insufficient number of volunteers to serve on the project committee responsible for updating the standard. Specifying procedures, apparatus, and instrumentation by which condenser capacity determinations can be obtained with accuracy satisfactory for commercial rating is the scope of Standard 20-1970.

A copy of draft Standard 24-78R can be obtained for U.S.\$5.00; a copy of draft Standard 127P or 128P are available at a cost of U.S.\$8.00 each. Orders for copies of these new draft standards or comments regarding the intended withdrawals should be addressed to ASHRAE, Manager of Standards, 1791 Tullie Circle, NE, Atlanta, Georgia 30329, USA.

## National Appliance Energy Conservation Act Signed

President Reagan signed the National Appliance Energy Conservation Act on March 17, 1987. The law is designed to provide uniform efficiency standards for heat pumps as well as appliances such as central air-conditioners, furnaces, room units, and water heaters; and to preempt the assortment of minimums which have been established by individual states. However, the new law contains provisions for states to apply for non-preemption. Similar legislation was introduced in the U.S. Congress in the fall of 1986 where, after passing both houses with strong support, it was vetoed by President Reagan on November 1. The bill was reintroduced in early 1987 and, with some modifications regarding the bill's future rulemaking provisions, was passed by the Senate by an 89-6 vote. After passing House vote, it was signed by President Reagan. In the June 1987 issue of the Newsletter, there will be a summary of the provisions of the new law and its impact on the heat pump industry.



## Selected Book and Report Reviews

Reviews of the most recent publications on heat pumps

**Solar Heat Storage: Latent Heat Materials, Volume II: Technology.** Edited by George A. Lane. Boca Raton, Florida: CRC Press, Inc., 1986. (ISBN 0-8493-6586-4) (in English)

Volume I of this series dealt with the historical development of latent heat storage, and with the basic scientific and engineering knowledge applicable to the field of phase change material (PCM) research and development. Volume II is aimed at the practical aspects of PCM technology. Many PCM candidates were discussed in Chapters 1 and 2 of Volume I; several of

these have been selected for discussion at length in Chapter 1 of the new Volume II. They are in commercial use, are likely to come into use commercially, or are of historical significance. Included are organized materials and salt hydrates, both the incongruent and semicongruent PCMs that segregate, and the PCMs that do not segregate. An enormous amount of effort has been expended on stabilizing the segregating PCMs by various means, including thickening or gelling. In Chapter 2, the science and technology of thickened and gelled PCMs is selected for particular discussion. All solid-liquid PCMs, and

most solid-solid PCMs must be encapsulated in sealed containers before use. In Chapter 3, the basic requirements for PCM encapsulants are discussed. Encapsulation technology has developed many individual and specialized techniques, e.g., bulk storage, macroencapsulation, and microencapsulation, which will be outlined in this chapter. The subject of uniform testing methods for PCM storage units is discussed in Chapter 4. Chapter 5 is concerned with the utilization of PCM storage in heating systems depending on the design of storage subsystems as well as solar heating systems.

## Schedule of Conferences and Trade Fairs

### April 26-29, 1987

Berlin (F.R. Germany); **22nd International Congress for Technical Building Equipment** (Kongress für Technische Gebäudeausrüstung). Sponsored by Verein Deutscher Ingenieure (VDI), Gesellschaft Technischer Gebäudeausrüstung (TGA) (Düsseldorf), Vereinigung von Verbänden der Deutschen Zentralheizungswirtschaft e.V. (VdZ) (Hagen), Bundesverband für Heizungs-Klima- und Sanitärtechnik e.V. (BHKS) (Düsseldorf). Contact: Prof. Dr. H. Esdorn, Technische Universität Berlin, Straße des 17. Juni 135, D-1000 Berlin 12 (F.R. Germany).

### April 28-30, 1987

Orlando, Florida (USA); **IEA Heat Pump Conference.** Sponsored by the International Energy Agency, Paris. Contact: F. A. Creswick, Oak Ridge National Laboratory, P. O. Box Y, Oak Ridge, TN 37831 (USA).

### June 21-25, 1987

Baltimore, Maryland (USA); **78th Annual Conference of the International District Heating and Cooling Association.** Sponsored by the International District Heating and Cooling Association (IDHCA). Contact: IDHCA, Suite 700, 1101 Connecticut Avenue, N.W., Washington, D.C. 20036 (USA).

### June 28-July 1, 1987

Nashville, Tennessee (USA); **1987 ASHRAE Annual Meeting.** Sponsored by the American Society for Heating, Refrigerating, and Air-Conditioning Engineers. Contact: Judy Marshall, ASHRAE, 1791 Tullie Circle NE, Atlanta, GA 30329 (USA), Telephone 404/636-8400.

### August 24-29, 1987

Vienna (Austria); **International Congress for Refrigeration** (Internationaler Kongress für Kältetechnik). Sponsored by the Internationales Institut für Kältetechnik. Contact: XVII, Internationaler Kongress für Kältetechnik, Mondial Congress, Bösendorferstraße 4, A-1010 Wien (Austria), Telephone 0222-659629, telex 132597 mreis a, telegram wienkaelte.

### September 8-12, 1987\*

Beijing (People's Republic of China); **China Refrigeration '87** (International Refrigeration, Heating, Ventilation and Air-Conditioning Exhibition and Conference). Sponsored by the International Institute of Refrigeration (I.I.R.), the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), and the Japanese Association of Refrigeration (JAR). Contact: Gabriele Abbott, Director, Public Relations, Asia Team Communications Ltd., Suite 2902, Windsor House, Causeway Bay (Hong Kong), Telephone 5-768730, telex 60262 atcl, facsimile 5-768917.

(\*In the Oct '86 Newsletter, dates for this conference were listed as September 1-5, 1987.)

### September 13-18, 1987

Hamburg (F.R. Germany); **ISES Solar World Congress and Exhibition 1987.** Sponsored by the International Solar Energy Society. Contact: ISES Solar Weltkongress 1987 e.V., c/o Hanseatic Congress Management GmbH, Am Weiher 23, D-2000 Hamburg (F.R. Germany).

### September 23-25, 1987

New Orleans, Louisiana (USA); **Meeting Customer Needs with Heat Pumps.** Sponsored by the American Public Power Association, Edison Electric Institute, Electric Power Research Institute, and the National Rural Electric Cooperative Association. Contact: David P. Ross, Policy Research Associates, Inc., 12121 Basset Lane, Reston, Virginia 22091 (USA), Telephone 703/620-1008.

### September 28-October 2, 1987

Lausanne (Switzerland); **3rd International Congress on Building Energy Management** (ICBEM-3 '87). Sponsored by Ecole Polytechnique Federale (Lausanne). Contact: ICBEM '87 Secretariat, Prof. Andre P. Faist, EPFL-LESO Building, CH-1015 Lausanne (Switzerland).



# Products, Services

Available to all HPC member countries

## Inquiries



### Have a specific question about heat pumps?

Call, write, or telex the Heat Pump Center directly with your questions about heat pump technology, marketing, economics, etc. HPC staff members will do their best to answer directly or point you to the right expert.

Call: (Ctry code for FRG) 07247-82-4541

Write: IEA Heat Pump Center, c/o FIZ 4,  
D-7514 Eggenstein-Leopoldshafen 2, FR Germany

Telex: 17724710

Teletex: 724710=FIZKA

## Database Services



The Heat Pump Center maintains and continuously updates computerized databases of heat pump information. You can make inquiries to these databases according to your own needs and interests, and the HPC will send you a print-out containing the most up-to-date information available. Call or write the HPC and ask for:

### RD&D Projects:

by project, country, heat pump type, research organization, principal investigator, etc.

### Products and Manufacturers:

by type, heat source/sink, size, COP, manufacturer, country, and detailed information about individual manufacturers

### Sample Installations:

performance results and design details for actual heat pump installations, by application type/size, heat pump type/size, country, etc.

## Newsletter



The HPC publishes a quarterly **Newsletter**, each issue focusing on a particular aspect of heat pump technology or development, including:

- Reports on innovative heat pump installations, technological developments, heat pump sales and prices
- Trends in fuel prices and electricity tariffs
- Developments in energy policy affecting heat pumps
- Heat Pump Center projects and reports
- Book and report reviews, schedule of conferences and trade shows

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## Reports



The following printed reports are available direct from the Heat Pump Center (use the attached card):

- **Heat Pump Research, Development and Demonstration Projects: Summary Report, Update 1985**, Report No. HPC-R2-1, May 1986, DM 75. This report contains half-page project status summaries for over 700 heat pump RD&D projects completed and on-going world-wide.
- **Nonazeotropic Refrigerant Mixtures as Working Fluids in Compression Heat Pumps, A Bibliography**, Report No. HPC-B1, second edition, December 1985, DM 220. This report is a comprehensive bibliography of over 200 reports with complete citations and abstracts.
- **Literature Reviews:** literature surveys with complete citations and abstracts in the following areas:
  - **Environmental Aspects of Heat Pump Applications**, Report HPC-LR1, May 1986, DM 25.
  - **Industrial Heat Pump Applications**, Report HPC-LR2, July 1986, DM 40.
  - **Sorption Heat Pump Systems**, Report HPC-LR3, October 1986, DM 40.

A new literature review is compiled in conjunction with the focus topic of each issue of the HPC Newsletter.

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## Our next issue:

### Block Centrals – District Heating

The June issue of the Heat Pump Center Newsletter will focus on block centrals-district heating.

In addition, the following contributions are planned:

- Heat pump project details from IEA's "Ten-Year Review of Collaboration in Energy RD&D"
- Report on the IEA Heat Pump Conference in Orlando (Part 1)
- Report on the National Appliance Energy Conservation Act

Also included will be our regular features:

Book Reviews, Schedule of Conferences and Trade Fairs and, News updates. If you have contributions relevant to block centrals-district heating, please send them to the Heat Pump Center.

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