

J. BOSMA, EDITOR



**HEAT PUMPS**  
**FOR ENERGY EFFICIENCY**  
**AND ENVIRONMENTAL**  
**PROGRESS**

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# HEAT PUMPS FOR ENERGY EFFICIENCY AND ENVIRONMENTAL PROGRESS

Proceedings of the Fourth International  
Energy Agency Heat Pump Conference  
Maastricht, The Netherlands, 26-29 April, 1993

Edited by

J. BOSMA

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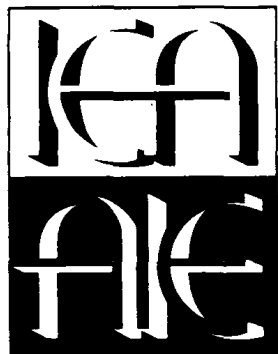
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## ORGANIZATION

IEA	-	International Energy Agency
EZ	-	Ministry of Economic Affairs
Novem	-	Netherlands Agency for Energy and the Environment

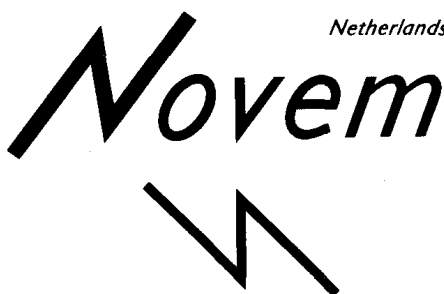
INTERNATIONAL ENERGY AGENCY



AGENCE INTERNATIONALE DE L'ÉNERGIE



Ministerie van Economische Zaken



*Netherlands agency for energy and the environment*

## FOREWORD

"Heat Pumps for Energy Efficiency and Environmental Progress" is the theme for the Fourth IEA Heat Pump Conference. The four day event provides a challenge for participants who must divide their time effectively in order to attend the many sessions of interest. In order to allow both participants and readers access to all information presented at the Conference, we offer these Proceedings which contain not only the scheduled session papers, but also the many poster papers presented during the course of the Conference. A second, shorter collection of papers not available for publication in this volume will be sent to all participants at a later date.

The theme stresses that the heat pump is a highly effective energy conserving option, particularly when designed and used as an integral part of a system instead of in isolation. Of course, environmental benefits are obtained when energy is conserved, and heat pumps can make a major contribution in this area. Some heat pumps use working fluids which are unfriendly to the environment, and must be replaced in the coming years, and the progress that has been made in the field of alternative refrigerants is reported on in these pages. In addition, results from heat pump field trials, pilot plants and development programmes are reported and state-of-the-art of the technology is provided.

In order to maximize the effectiveness of the heat pump, its implementation in a system or process must be carefully considered at an early stage of design or development. The integration of heat pumps in buildings and industrial processes also affects other aspects of energy conservation planning. Process integration a valuable tool for industry, is highlighted in selected presentations.

The heat pump often has to compete with other options that are long established. Competing technologies benefit from the existing infrastructure, such as a natural gas grid. Particularly in heating-only regions, economic benefits of heat pumps are therefore more apparent in large systems such as district heating. The interest of utilities in implementing heat pumps is essential for improved utilization of heat pumps in particular regarding market introduction, as shown at this Conference.

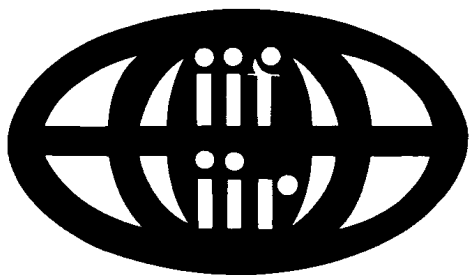
The Conference underlines the point that the heat pump must be regarded as part of a comprehensive system, and although a wide acceptance of this option may take some time, the heat pump is a mature device providing energy and green-house gas emission reductions.

The organization of this conference has been made possible by the financial support of the following countries:

Canada, Germany, Japan, The Netherlands, Norway, Sweden, U.S.A., Switzerland.

and by the financial and in situ support of the following companies and institutes:

- Institut International du Froid / International Institute of Refrigeration (IIR), Paris, France
- Samenwerkende elektriciteits produktiebedrijven (Sep), Arnhem, The Netherlands
- Nederlandse Gasunie, Groningen, The Netherlands
- Commission of the European Communities (DG-12)



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- the National Organizing Committee;
- all those who presented and submitted papers, particularly those who made their papers available for this publication;
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- Gasunie;
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- Van Namen and Westerlaken Congress Services.

On behalf of the International Organizing Committee

John D. Ryan



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**Session 1**  
**OPENING PLENARY SESSION**



