

Commission of the European Communities



Proceedings of the International Seminar held in Brussels,
23-25 October 1979

Edited by

A. S. STRUB

and

H. EHRINGER

Commission of the European Communities



D. REIDEL PUBLISHING COMPANY

Dordrecht : Holland / Boston : U.S.A. / London : England

Library of Congress Cataloging in Publication Data

CIP

Main entry under title:

New ways to save energy.

At head of title: Commission of the European Communities.

English and French.

Includes bibliographical references and index.

I. Energy conservation Congresses. I. Strub, Albert S. II. Ehringer, H.

III. Commission of the European Communities.

TJ163.27.N48 621.402 79 29720

ISBN 90 277 1078 3

Organization of the Conference by

Commission of the European Communities

Directorate-General Research, Science and Education, Brussels

Publication arrangements by

Commission of the European Communities

Directorate-General Scientific and Technical Information

Information Management, Luxembourg

EUR 6666

Copyright © 1980 ECSC, EEC, EAEC, Brussels and Luxembourg, 1980

LEGAL NOTICE

Neither the Commission of the European Communities nor any person acting on behalf of the Commission is responsible for the use which might be made of the following information.

Published by D. Reidel Publishing Company

P.O. Box 17, 3300 AA Dordrecht, Holland

Sold and distributed in the U.S.A. and Canada

by Kluwer Boston Inc., Lincoln Building,

160 Old Derby Street, Hingham, MA 02043, U.S.A.

In all other countries, sold and distributed

by Kluwer Academic Publishers Group,

P.O. Box 332, 3300 AH Dordrecht, Holland

D. Reidel Publishing Company is a member of the Kluwer Group

All Rights Reserved

No part of the material protected by this copyright notice may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording or by any informational storage and retrieval system, without written permission from the copyright owner

Printed in The Netherlands

INTRODUCTION

The International Seminar "New Ways to Save Energy" was organized by the Commission of the European Communities to highlight the results of energy conservation projects carried out in the framework of the Community's first Energy Research and Development Programme (1975-1979) and to inform representatives of national authorities, public organizations, industries, universities and other interested persons about this.

The seminar was opened by Dr. Guido Brunner, Member of the Commission of the European Communities, responsible for Energy, Research, Science and Education.

The information presented in each of the topic areas has been summarized by session chairmen in the final plenary session.



OPENING SESSION : (from left to right) Dr. Guido Brunner (speaker),
 Dr. H. Ehringer, Dr. A. Strub, Dr. L. Williams, Dr. J. Poulit, Prof. A. Jaumotte,
 Dr. M.H. Chiogioji, Prof. H. Schaefer (not visible), Dr. W.M. Currie.

Panel chairman	:	Dr. G. SCHUSTER
Conference chairman	:	Dr. A. STRUB
Scientific chairman	:	Dr. H. EHRINGER
Session chairmen	:	Mr. L. WILLIAMS Mr. B. GEERAERT Ing. J.A. KNOBBOUT Dr. J. DURANDET Mr. P. MÜLLER Dr. P. LEPRINCE Dr. J. BUTTERWORTH Dr. D.A. REAY Dr. M. GROLL Prof. Dr. J.A. KETELAAR Prof. Dr. L. GÖTTSCHEG Dr. G. LIMIDO Prof. C. HIRSCH Prof. J. PATIGNY Dr. A. ROSSI Prof. J. LERRIN Mr. J. UYTENDROECK Dr. S.J. LEACH
Key-note speakers	:	Dr. J. POULIT Dr. W.M. CURRIE Prof. A. JAUMOTTE Prof. H. SCHAEFER Dr. M. CHIOGIONI
Secretariat	:	Mr. P. ZEGERS Mr. G. HOYAUX
Publication arrangements	:	Mr. D. NICOLAY

CONTENTS

Page

OPENING SESSION

- Opening address 1
Dr. Guido BRUNNER, Member of the Commission of the European Communities, responsible for Energy, Research, Science and Education

SESSION I : Need for Energy Conservation and R & D Potential of Energy Conservation Technologies 7

Key-note speeches by :

- Dr. Jean POULIT : Les économies d'énergie - source de compétitivité 9
- Dr. W.M. CURRIE : Energy conservation R & D - Is it vital or is it incidental? 29
- Prof. A. JAUMOTTE : Nécessité d'économie, économie de nécessité 39
- Prof. Dr.-Ing. H. SCHAEFER : Forschung und Entwicklung zur rationelleren Energieverwendung, Mode oder Beitrag zur Energieökonomie 51
- Dr. M.H. CHIOGIOJI : The impact of new technologies on improved energy usage efficiency 59

SESSION II A : Heat Sources for Heat Pumps 71

- Comments by the Session Chairman : B. GEERAERT 72
- Investigations on using the earth as a heat storage medium and as a heat source for heat pumps 75
P.G.M. NIEVERGELD and A.D. KOPPENOL, Organization for Industrial Research TNO, Apeldoorn, The Netherlands
- Factors determining the COP of heat pumps, and feasibility study on its improvement 85
M. FORDSMAND and A. EGGERS-LURA, European Heatpump Consultants Ltd.
- The use of soil with and without artificial heat regeneration as a heat source for the heat pump 94
B. GEERAERT and J.C. STEFFENS, Laborelec (Section 8 + S.M.), Rhode-Saint-Genèse, Belgique
- Wärmrückgewinnung aus Abwässern durch energiesparende Wärmepumpensysteme 102
R. FLORSCHUTZ, E. HAU, U. WIEDMANN, Maschinenfabrik Augsburg-Nürnberg Aktiengesellschaft, Neue Technologie, Systemtechnik

	<u>Page</u>
<u>SESSION II B : Heat pump components</u>	117
- Comments by the Session Chairman : J.A. KNOBBOUT	118
- Development of domestic heat pumps J.T. McMULLAN, R. MORGAN and D.W. HUGHES, New University of Ulster, Coleraine, Northern Ireland	122
- Air source heat pumps under northern European climatic conditions T.C. O'CONNOR and J.A. McGOVERN, Department of Physics, University College, Galway, Ireland	135
- Frosting and defrosting behaviour of outdoor coils of air- source heat pumps J.W.J. BOUMA, Organisation for Industrial Research MT-TNO, Apeldoorn, The Netherlands	145
- Microprocessor based control system for heat pumps R.K. GREEN, D.F. NEALE, M. SEARLE and D.R. WILSON, Division of Engineering, Polytechnic of Central London, UK	154
- Heat pump models for microprocessor based control systems P. BILDSTEIN, Y. HAMAM, J. EHRHART, Ecole Supérieure d'Ingénieurs en Electrotechnique et Electronique, Paris	164
- A feasibility study on the improvement of the COP of a heat pump M. FORDSMAN and A. EGGERS-LURA, European Heatpump Con- sultors Ltd.	174
- Heat pumps for individual rooms K.J. SEYMOUR-WALKER, Building Research Establishment	181
<u>SESSION II C : Advanced heat pumps</u>	195
- Comments by the Session Chairman : J. DURANDET	196
- Development of a primary energy driven absorption heat pump for domestic heating H.A. JANSSEN and G. OELERT, Battelle-Institut e.V. Frankfurt	198
- Bau- und Versuchsbetriebe von Absorptions-Wärmepumpe-Prototypen H.J. KOHNKE, Stiebel Eltron, Holzminden	209
- Directly fired heat pump for domestic and light commercial application D.T.G. STRONG, Glynwed Central Resources Unit, Shirley, UK	221
- The design and development of an absorption domestic heat pump A.M.S. QASRAWI, R.E. BLAKELEY, D.N. NG and R.J. TREECE, Lucas Group Services Limited, Lucas Research Centre	232
- Heat pump operating with a fluid mixture A. ROJEY, C. MEYER, B. CHOFFE, J. JACQ, L. ASSELINEAU and J. VIDAL, Institut Français du Pétrole	242
- Industrial application of high temperature heat pumps driven by gas engines D.A. REAY and V.A. EUSTACE, International Research & Development Co Ltd (UK)	252

	<u>Page</u>
<u>SESSION II D : Heat pump applications</u>	263
- Comments by the Session Chairman : P. MÜLLER	264
- Energieeinsparung bei der Beheizung und Brauchwasserversorgung in Mehrfamilienhäusern durch den Einsatz einer gasmotorangetriebenen Wärmepumpe mit der Wärmequelle Luft, die monovalent bis minus 12 °C Aussentemperatur arbeiten soll O. HEIBURG, W. LOHSTRÄTER, Dortmunder Stadtwerke AG	266
- Energieeinsparung bei der Raumheizung und Brauchwasserbereitung im Mehrfamilienhausbereich unter Einsatz von elektrischen Wärmepumpen H. KLAUS, Vereinigte Elektrizitätswerke Westfalen A.G.	275
- Large Diesel driven heat pumps for district heating B. PETERSEN, Corporate Research & Development, Copenhagen	278
<u>SESSION III : Energy analysis of industries</u>	291
- Comments by the Session Chairman : P. LEPRINCE	292
- Optimized plant design to ensure energy conservation C. RAIMBAULT, A. ROJEY and J. SALVAT, Institut Français du Pétrole	293
- Application of the second law of thermodynamics to basic industrial processes J.J. DEROUETTE, Battelle Institut e.V.	303
- Energy analysis of an aluminum plant D. KIPPING and W. SCHMITZ, Vereinigte Aluminium-Werke AG, Bonn/Berlin, Lippewerk, Münen	312
- Formulation of a stochastic model for the evaluation of the specific consumption of electric energy of a mechanical plant A. DE FILIPPI and R. IPPOLITO, Istituto di Tecnologia Meccanica, Politecnico di Torino, Italy	322
- Energy saving opportunities in the food industry W.E. WHITMAN, C.R. ELSON and A.G. CRAWFORD, Leatherhead Food Research Association	335
- Les paramètres économiques et financiers des investissements économiseurs d'énergie dans l'industrie chimique française M. CASTAGNE, J. CHEF, J.J. PICARD, Département Economie et Gestion des Entreprises de l'Institut National Polytechnique de Lorraine	345
<u>SESSION IV : HEAT RECOVERY</u>	355
- Comments of the Session Chairman : J. BUTTERWORTH	356
- Heat recovery in the iron melting industry M. DEL BORGHI, E. FOPPIANO, D. DE FAVERI, G. FERRAILOLO Chemical Engineering Department, University of Genoa, Italy	359
- Etude des possibilités de récupération des chaleurs perdues dans les installations thermiques - Application aux cokeries classiques R.H. BUSSET et P. TRIBODET, Centre d'Etudes et Recherches des Charbonnages de France	373

	<u>Page</u>
- Four convectif de préchauffage de la composition verrière sous forme de granulés à l'aide de fumées perdues A. POTIRON, A. BOBLETER, Bertin & Cie	383
- Recovery of residual heat in the extraction of oilseeds and in the hydrogenation of edible oils and fats T.L. ONG, Organisatie voor toegepast Natuurwetenschappelijk Onderzoek (TNO)/Centraal Instituut voor Voedingsonderzoek	396
- The saving of energy when cooling milk and heating water on farms J. UBBELS, A.P. MEULMAN and C.P. VERHEIJ, Netherlands Institute for Dairy Research, Ede ; J. BROUWER, Milk Hygiene Research Centre TNO, Wageningen	408
- Wärmerückgewinnung durch Kühlen von heissem Koks G. VOLLRATH, K.H. FLASCHE and J. LANG, Stahlwerke Röchling-Burbach GmbH	422

SESSION V : Heat exchangers 433

- Comments by the Session Chairman : D.A. REAY	434
- The development of a falling cloud heat exchanger - Air and particle flow and heat transfer M.S. SAGOO, Stone Platt Fluidfire Limited	436
- Aluminium melting furnace heat regeneration project M.M. GORDON and N.B. ORR, James Howden & Company Limited	445
- Comparative study of rotating regenerators and heat pipe heat exchangers D.A. REAY, N.K. SEARLE, International Research & Development Co Ltd; E.L. FORSTER, Imperial Chemical Industries Ltd	455
- Heat pipe heat exchangers for waste heat recovery G.H. CHAFFEY, M.J. DAVIES and J.T. KLASCHKA, Engineering Sciences Division, UKAEA, Harwell	462
- Recovery of heat from exhaust air of spray driers in the dairy industry L.A. JANSEN and A.E. STEENBERGEN, Netherlands Institute for Dairy Research (NIZO), Ede	472
- Reflux heat pipes as components in heat exchangers for efficient heat recovery M. GROLL, H. NGUYEN-CHI, H. KRÄHLING, Institut für Kerntechnik und Energiewandlung e.V. (IKE e.V.)	481

SESSION VI A : Thermal and mechanical energy storage 491

- Comments by the Session Chairman : M. GROLL	492
- R and D systems for thermal energy storage in the temperature range from -25 °C to 150 °C J. SCHRÖDER, Philips GmbH Forschungslaboratorium Aachen	495
- Etude du stockage de l'énergie thermique par fusion des matériaux organiques P. DUBOIS et B. HOCHON, Laboratoires de Marcoussis, Centre de Recherches de la Compagnie Générale d'Electricité	505

	<u>Page</u>
- The performance of thermal energy storage systems R.J. WOOD, M.A. BELL, P.W. O'CALLAGHAN, I.E. SMITH, S.D. PROBERT, Applied Energy Group, School of Mechanical Engineering, Cranfield Institute of Technology, UK	516
- Entwicklung eines Aquiferspeichers B. WEISSENBACH, Messerschmitt-Bölkow-Blohm GmbH	527
- Physical and chemical properties of latent heat storage materials D. HEINE, F. HEESS, M. GROLL, Institut für Kernenergetik und Energiesysteme (IKE), Universität Stuttgart	536
- Stationäre Schwungrad-Energiespeicher A. GILHAUS, Maschinenfabrik Augsburg-Nürnberg Aktiengesell- schaft, Neue Technologie, Systemtechnik	546
 <u>SESSION VI B : Electrical energy storage</u>	 555
- Comments by the Session Chairman : J.A.A. KETELAAR	556
- Optimisation du procédé d'élaboration d'un électrolyte solide en alumine bêta pour accumulateur Na-S destiné au stockage de l'énergie électrique G. DESPLANCHES, A. WICKER, J.P. DUMAS, Laboratoires de Marcoussis, Centre de Recherches de la Compagnie Générale d'Electricité	558
- Galvanische Hochenergiezellen mit Schmelzelektrolyten W. BORGER, D. KUNZE, H. PANESAR, Varta Batterie AG	569
- Materials research and development for advanced batteries B.C. TOFIELD, Materials Development Division, AERE Harwell	579
- Battery application and assessment studies J. JENSEN, Odense University	600
- Synthesis and characterization of new solid electrolytes of lithium A. LEVASSEUR, J.C. BRETHOUS, J.M. REAU, M. COUZI and P. HAGENMULLER, Laboratoire de Chimie du Solide du C.N.R.S., Université de Bordeaux	610
- Synthesis and characterization of new intercalated lithium cathodes R. BREC and J. ROUXEL, Laboratoire de Chimie du Solide - UER de Chimie, Nantes	620
- Contribution to the study of a fluorine-metal battery J. LUCAS, Université de Rennes, Laboratoire de Chimie Minérale	631

	<u>Page</u>
<u>SESSION VII A : Optimization of industrial processes : paper industry</u>	641
- Comments by the Session Chairman : L. GÖTTSCHING	642
- Reduction of power consumption in refining paper stock P.G. BURKITT, E.R. GATES and M.W. MOORE, PIRA, Leatherhead	644
- Energy savings in paper making by means of increased water removal in the press section H.A. WESTRA, Fibre Research Institute TNO, Delft	654
- Energy saving in connection with paper drying A.L. RAMAZ, System and Technology Department, Centre Technique du Papier, Grenoble	664
- Energy analysis in the paper industry N.J.D. LUCAS, Energy Policy Unit, Imperial College, London	672
 <u>SESSION VII B : Optimization of industrial processes : textile</u>	 683
- Comments by the Session Chairman : G. LIMIDO	684
- Economy and energy saving in textile industry J. LANERES and J. PERRIN, Institut Textile de France, NORD	686
- A continuous wet-on-wet treatment of fabric webs : impregnating a fully wet fabric with a solution R.B.M. HOLWEG, Fibre Research Institute TNO	702
- Energy consumption and energy saving in the heat-setting and dye-fixation of textile fabrics on stenters G.J. PARISH and C.M. REED, Cotton Silk and Man-made Fibres Research Association, Shirley Institute	712
 <u>SESSION VII C : Optimization of industrial processes : other industries</u>	 723
- Comments by the Session Chairman : G. LIMIDO	724
- Economie d'énergie au haut fourneau par l'emploi de nouveaux moyens de contrôle R. CAPELANI, IRSID - Station d'Essais, Maizières-lès-Metz	726
- Research on energy saving in a brewery T.S. KAMPFTMEYER, Forschungsstelle für Energiewirtschaft	733
- Energy savings at wastewater treatment plants L.G. ANDERSSON, Vandkvalitetsinstitutet, ATV (Water Quality Institute)	741
 <u>SESSION VII D : Power production</u>	 751
- Comments by the Session Chairman : Ch. HIRSCH	752
- Recovery of energy from LNG vaporization D. WEBER, Gutehoffnungshütte Sterkrade AG, Oberhausen	755
- Combined generation of electricity and power in the dairy industry L.A. JANSEN and H. PIERSMA, Netherlands Institute for Dairy Research, Ede	766

	<u>Page</u>
- Le fonctionnement de turbines à prélèvements variables de vapeur à des fins de chauffage J.M. SNOECK et P.J. WAUTERS, Université Catholique de Louvain, Département Thermodynamique et Turbomachines	777
- Energy saving in wet dry cooling tower systems in large electrical power plants F. GIELEN, Ch. HIRSCH, Dienst Stroomingsmechanica, Vrije Universiteit Brussel	787
- Heat recovery in a ceramic kiln with an organic Rankine cycle engine M. GAIA and E. MACCHI, CNFM/Istituto di Macchine, Politecnico di Milano	799
- Experimental Rankine cycle engine designed for utilization of low temperature, low pressure heat G. CIPOLLA, Centro Ricerche FIAT	809
 <u>SESSION VII E : Combustion and boilers</u>	 823
- Comments by the Session Chairman : J. PATIGNY	824
- Combustion control system for industrial package boilers using the flame radiation peak seeking technique J.M. HARFOOT, Institute for Industrial Research and Standards and Land Pyrometers Limited	827
- Methods of measuring the overall efficiencies of industrial boilers P. EENHOLT, Dansk Kedelforening	833
- Fluidised bed combustion of low grade material E.A. ROGERS and A.J. MINCHENER, National Coal Board, Coal Research Establishment	845
- Etude expérimentale de la combustion de matières à faible pouvoir calorifique R.H. BUSO et J.Ch. DUBART, Centre d'Etudes et Recherches des Charbonnages de France	855
- Procédé et équipement destinés à valoriser des produits combustibles pauvres (schistes houillers) G. CHRYSOSTOME et E. BRUN-LABARRE, S.A. Heurtey	864
- Polarization pyrometry K.H. BERRY, National Physical Laboratory	880
 <u>SESSION VIII : Utilization of waste material and lean gases</u>	 891
- Comments by the Session Chairman : J.A. KNOBBOUT	892
- Verwertung freizusetzender Energien aus Abfällen und Abgängen zur Fertigung hochwertiger Leichtzuschläge aus Tonig-Silikatischen Rohstoffen P. NEUMANN-VEENEVERE, WIP - Wirtschaft und Infrastruktur Planung AG	894
- The production and firing of fuel extracted from domestic refuse E. DOUGLAS, Warren Spring Laboratory, U.K. Dept. of Industry	902

	<u>Page</u>
- Saving of energy and raw materials by recycling plastic waste extracted from urban garbage J. MICHAUX, Centre de Recherches scientifiques et techniques de l'Industrie des Fabrications métalliques (C.R.I.F.-Plastics - Liège)	919
- Examen des possibilités de réutilisation des déchets thermodurcissables d'origine industrielle E. MOREL et G. RICHERT, Institut National de Recherche Chimique Appliquée, Centre de Recherche	929
- Optimal working conditions determination of lean gas internal combustion engine by characterization of the induction time of the used fuel X. LYS, Institut Français du Pétrole	938
 <u>SESSION IX : Transport</u>	 951
- Comments of the Session Chairman : A. ROSSI	952
- Analysis of the partial-load running of spark-ignition engines defining practical ways of improvements in energy efficiency A. DOUAUD and P. EYZAT, Institut Français du Pétrole	954
- Etude préliminaire d'adaptabilité de la chambre de combustion à géométrie variable au moteur Diesel d'automobile A. ECOMARD, P. EYZAT, Institut Français du Pétrole	965
- No coolant Diesel engine S.G. TIMONEY, University College Dublin	967
- Potentials for energy conservation by a shift to other types of engines in passenger cars W. SMIT, Centre for Energy Studies, TNO	978
- Reduction of fuel consumption by thermodynamical optimization of the Otto-engine D. GRUDEN, R. HAHN and H. LÖRCHER; Research and Development of Propulsion Systems, R & D Center in Weissach	987
 <u>SESSION X A : Characteristics and testing of houses and buildings</u>	 997
- Comments by the Session Chairman : J. LEBRUN	998
- Basic characteristics for low cost houses in order to reduce the energy consumption - Link research program : coordination and consequences for architectural design A. DUPAGNE and J. LEBRUN, Laboratoire de Physique du Bâtiment, Université de Liège	1001
- Building characteristics and gratuitous energy H. HEIKHAUS, Centre Scientifique et Technique de la Construction CSTC; J. BADOT and L. LARET, Laboratoire de Physique du Bâtiment, Université de Liège	1015
- Etude prénormative de recherche de défauts-types d'isolation thermique par thermographie infrarouge G. VENUTI, Laboratoire National d'Essais	1025

	<u>Page</u>
- Energy savings by infrared reflective finishing J. DE JONG and C. SMOORENBURG, Technisch Physische Dienst, TNO	1033
<u>SESSION X B : Insulation</u>	1045
- Comments by the Session Chairman : J. UYTENBROECK	1046
- Optimierung einer multifunktionalen Isolierverglasung bezüglich Schall- und Wärmedämmung P. DERNER, R. GROTH, D. MERTIN und W. ZERNIAL, Flachglas Aktiengesellschaft, Gelsenkirchen	1048
- Vitrages sélectifs obtenus par dépôt d'un oxyde transparent conducteur G. BLANDINET et Y. LAGARDE, Laboratoire d'Etudes des Matériaux Minces, Centre d'Etudes Nucléaires de Grenoble	1056
- Selective optical coatings on plastic sheet R.P. HOWSON, Department of Physics, Loughborough Univer- sity of Technology	1066
- Etude et réalisation de panneaux sandwichs isolants à base de mousses formophénoliques et de schistes expansés R. LÖDEL, Centre d'Etudes et Recherches des Charbonnages de France, Laboratoires de Verneuil-en-Halatte	1076
- Development and optimization of polyurea foam H.S. CREYF, R & D Center, P R B - Recticel	1087
<u>SESSION X C : Heating and ventilation systems</u>	1007
- Comments by the Session Chairman : S.J. LEACH	1093
- Natural ventilation and energy consumption W.F. DE GIDS, J.C. PHAFF, B. KNOLL, Instituut voor Milieu- hygiëne en Gezondheidstechniek	1100
- The performance of heating control systems in experimental houses R. RAYMENT and K. MORGAN, Building Research Establishment	1107
- Comparative efficiency of space and water heating appliances G. HAMILTON, Building Services Research and Information Association	1113
- Abhängigkeit des Energieverbrauchs bei der elektrischen Warmwasserbereitung von der Gerätetechnik und dem Bedarfs- gang K.F. EBERSBACH, Forschungsstelle für Energiewirtschaft	1127
- Abwärmenutzung von Hochbauten (Heat recovery from buildings) Entwicklung von Kennziffern für europäische Länder B. WEIDLICH, Battelle-Institut E.V.	1141

	<u>Page</u>
<u>FINAL PLENARY SESSION</u>	1153
- Introduction by the Session Chairman : G. SCHUSTER	1155
- Energy saving in housing and buildings S.J. LEACH, Head of Building Services and Energy Division Building Research Establishment, UK	1157
- Trends in the development of heat pump systems B. GEERAERT, Head of Electroheat Dept., Laborelec, Belgium	1160
- Energy analysis and optimization of industrial processes G. LIMIDO, Ecole Nationale Supérieure du Pétrole et des Moteurs, France	1164
- Energy saving by means of heat recovery and utilization of waste materials J.A. KNOBBOUT, Centre for Energy Studies, TNO, Netherlands	1168
- Energy saving in the transport sector and new energy storage systems A. ROSSI, Centro Ricerche FIAT, Italy	1172
- Closing address	1174
<u>LIST OF PARTICIPANTS</u>	1177
<u>AUTHOR INDEX</u>	1251

OPENING SESSION

Opening address

Dr. Guido BRUNNER, Member of the Commission of the European Communities, responsible for Energy, Research, Science and Education