

RISØ NATIONAL LABORATORY FOR SUSTAINABLE ENERGY

Risø is the National Laboratory for Sustainable Energy at the Technical University of Denmark - DTU, and carries out R&D in a broad range of sustainable energy technologies covering individual technologies as well as systems.

Education, innovation and consultancy are integral parts of Risø's research activities.

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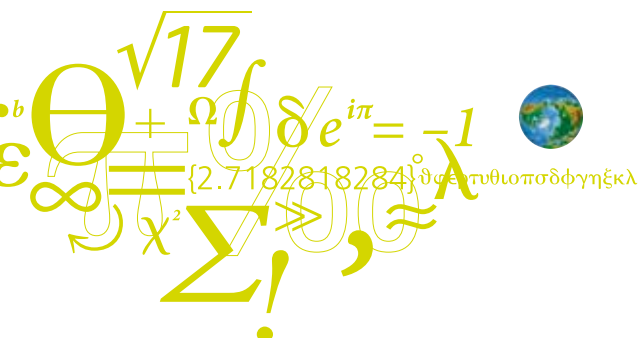
ENERGY SOLUTIONS FOR CO₂ EMISSION PEAK AND SUBSEQUENT DECLINE



Risø International Energy Conference 2009

At Risø National Laboratory for Sustainable Energy,
Technical University of Denmark, 14-16 September 2009

Final Programme



INFORMATION

SCIENTIFIC PROGRAMME COMMITTEE

Hans Larsen (chairman), Risø National Laboratory for Sustainable Energy, Technical University of Denmark
Lars Aagaard, Danish Energy Association, Denmark
Dan Arvizu, NREL, USA
Niels Bergh-Hansen, DONG Energy, Denmark
Ogunlade Davidson, Energy Minister of Sierra Leone
Christian Kjaer, EWEA - European Wind Energy Association, Belgium
Jose Roberto Moreira, National Reference Center on Biomass, Brazil
Mark Radka, UNEP, Paris
Priyadarshi R. Shukla, Indian Institute of Management, India
Jim Skea, UK Energy Research Centre, UK
Anders Stouge, Danish Energy Industries Federation, Denmark
Dieter Wegener, Siemens, Germany
John Wood, Imperial College London, UK
Nicolai Zarganis, Danish Energy Agency, Denmark

LOCAL ORGANIZING COMMITTEE

Hans Larsen (chairman), Risø DTU
Henrik Bindslev, Risø DTU
Henrik Carlsen, DTU Mechanical Engineering
Kim Dam-Johansen, DTU Chemical Engineering
Jørgen Kjems, DTU Electrical Engineering
Søren Linderoth, Risø DTU
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Niels Michael Petersen, Risø DTU
Leif Sønderberg Petersen, Risø DTU
Kim Pilegaard, Risø DTU

INTRODUCTION



ENERGY SOLUTIONS FOR CO₂ EMISSION PEAK AND SUBSEQUENT DECLINE

The world is facing major challenges with regard to climate change and security of supply. At the same time it is necessary to provide energy services to accommodate economic growth and in particular to meet the growing needs of the developing countries.

We have been aware of these challenges for a number of years, however, the need for rapid action was made clear with the release of IPCC's 4th assessment report in November 2007.

IPCC states that in order to stabilize the concentration of GHGs in the atmosphere, emissions must peak soon and decline dramatically thereafter. Delay in reducing emissions significantly constrains opportunities to achieve lower stabilization levels and increases the risk of more severe climate change impacts.

The conference aims at identifying energy solutions on local, regional and global level which can lead to a peak in CO₂ emissions in 2015 - 2020 and a 50% reduction before 2050.

The conference focuses on the scientific development of new technologies, their market perspectives and realistic contributions to achieve these ambitious goals. Furthermore, the conference will address systems aspects, end use technologies and efficiency improvements.

The conference will aim at identifying mixes of existing and new energy technologies and future energy systems that can meet the CO₂ reduction requirements on a global, regional and local scale.

THE CONFERENCE IS SPONSORED BY:



SESSIONS OVERVIEW

| MONDAY 14 SEPTEMBER 2009 | |
|--------------------------|--|
| 08:00-09:00 | COFFEE AND REGISTRATION |
| Room | Big lecture hall |
| 09:00-10:30 | OPENING SESSION FUTURE GLOBAL ENERGY DEVELOPMENT OPTIONS |
| 10:30-11:00 | BREAK |
| 11:00-12:30 | SESSION 1 SCENARIO AND POLICY ISSUES |
| 12:30-13:30 | LUNCH |
| 13:30-15:00 | SESSION 2 LONG TERM ENERGY SOLUTIONS |
| 15:00-15:30 | BREAK |
| 15:30-17:00 | SESSION 14 MECHANISMS |
| 17:00-18:00 | RECEPTION |

| TUESDAY 15 SEPTEMBER 2009 | | |
|---------------------------|--|--|
| Room | Big lecture hall | Small lecture hall |
| 09:00-10:30 | SESSION 3 SYSTEMS ASPECTS I | SESSION 6 EFFICIENCY IMPROVEMENTS IN END-USE |
| 10:30-11:00 | BREAK | |
| 11:00-12:30 | SESSION 8 RENEWABLE ENERGY TECHNOLOGIES: SOLAR | SESSION 9 RENEWABLE ENERGY TECHNOLOGIES: BIOENERGY I |
| 12:30-13:30 | LUNCH | |
| 13:30-15:00 | SESSION 7 RENEWABLE ENERGY TECHNOLOGIES: WIND | SESSION 11 ENERGY FROM WASTE |
| 15:00-15:30 | BREAK | |
| 15:30-17:00 | SESSION 12 RENEWABLE ENERGY FOR TRANSPORT | SESSION 15 SYSTEMS ASPECTS II |
| 17:00-18:00 | BREAK | |
| 19:00 | CONFERENCE DINNER | |

| WEDNESDAY 16 SEPTEMBER 2009 | | |
|-----------------------------|--|---|
| Room | Big lecture hall | Small lecture hall |
| 09:00-10:30 | SESSION 10 FUEL CELLS AND HYDROGEN I | SESSION 4 RENEWABLE ENERGY TECHNOLOGIES: BIOENERGY II |
| 10:30-11:00 | BREAK | |
| 11:00-12:30 | SESSION 13 CARBON CAPTURE AND STORAGE | SESSION 16 FUEL CELLS AND HYDROGEN II |
| 12:30-13:30 | LUNCH | |
| 13:30-14:45 | PANEL DISCUSSION: WHAT ACTIONS ARE NEEDED NOW TO OBTAIN A PEAK IN CO ₂ EMISSIONS BEFORE 2020? | |
| 14:45-15:00 | CLOSING REMARKS | |

PROGRAMME



MONDAY 14 SEPTEMBER 2009

08:00 – 09:00 COFFEE AND REGISTRATION

09:00 – 10:30 OPENING SESSION-
FUTURE GLOBAL ENERGY DEVELOPMENT OPTIONS

Big lecture hall

Chairman: Hans Larsen, Risø DTU, Denmark

KEYNOTE SPEECHES

- Global Energy Assessment (GEA), Nebojsa Nakicenovic, the International Institute for Applied Systems Analysis (IIASA), Austria
- **When will renewables be able to deliver 80 percent as fossils do now?**
Jose Roberto Moreira, National Reference Center on Biomass, Brazil
- Brian Castelli, Executive Vice President of the Alliance to Save Energy, USA
- Ogunlade Davidson, Energy Minister of Sierra Leone

10:30 – 11:00 BREAK

11:00 – 12:30 SESSION 1 – SCENARIO AND POLICY ISSUES

Big lecture hall

Chairman: Dieter Wegener, Siemens AG, Germany

- **Presentation of Risø Energy Report 8: The intelligent energy system infrastructure for the future,**
Hans Larsen, Risø DTU, Denmark
- **Renewable energies and efficiency are the solution for global CO₂ reduction - results of the energy (r)evolution 2008 scenario,** Thomas Pregger, DLR - German Aerospace Center, Germany
- **Heat Plan Denmark - The Danish heating sector can be CO₂ neutral before 2030.** Anders Dyrelund, Ramboll Denmark and Henrik Lund, Aalborg University, Denmark

12:30 – 13:30 LUNCH

13:30 – 15:00 SESSION 2 – LONG TERM ENERGY SOLUTIONS

Big lecture hall

Chairman: Henrik Carlsen, DTU Mechanical Engineering

- **Comprehensive approach to energy and environment in the Eco Care Program for Design, Engineering and Operation of Siemens Industry Solution,** Dieter Wegener, Siemens AG, Germany
- **The role of high efficiency steam power plants - development status,** Rudolph Blum, DONG Energy, Denmark
- **Indian energy system and global climate stabilization regimes,** P. R. Shukla, Indian Institute of Management, India, Kirsten Halsnæs and Subash Dhar, Risø DTU

15:00 – 15:30 BREAK

15:30 – 17:00 SESSION 14 – MECHANISMS

Big lecture hall

Chairman: Mark Radka, UNEP, Paris

- **Support schemes and risk premiums for renewable energy technologies,** Poul Erik Morthorst, Risø DTU, Denmark
- **The interactions of renewable energy promotion schemes and energy efficiency support,** Pablo Del Rio, National Research Council of Spain, Spain
- **Influence of market rules for wind integration in the European power markets,** Peter Meibom, Risø DTU, Denmark

17:00 – 18:00 RECEPTION AT THE LOBBY TO THE AUDITORIUMS

TUESDAY 15 SEPTEMBER 2009

09:00 – 10:30 SESSION 3 – SYSTEMS ASPECTS I

Big lecture hall

Chairman: Flemming G. Nielsen, Danish Energy Agency

- **Why go for less? - Denmark 100% CO₂ neutral before 2050,** Jens Christian Riise, NIRAS A/S, Denmark
- **Large scale integration of wind,** Tommy Mølbak, DONG Energy, Denmark
- **Rural electrification in SSA in a context of fluctuating oil-prices: Is the time ready to move from SHS to hybrid PV-diesel systems?** Ivan Nygaard, Risø DTU, Denmark

SESSION 6 – EFFICIENCY IMPROVEMENTS IN END-USE

Small lecture hall

Chairman: Anders Stouge, Danish Energy Industries Federation, Denmark

- **High-power blu/red LED lighting system for future energy efficient artificial lighting in greenhouse production of potted plants**, Birgitte Thestrup, DTU Fotonik, Denmark
- **Automatic energy labeling of buildings using Smart Meters**, Henrik Madsen, DTU Informatics, Denmark
- **Magnetic refrigeration - an energy efficient technology for the future**, Christian R.H. Bahl, Risø DTU, Denmark

10:30 – 11:00 BREAK

11:00 – 12:30 SESSION 8 – RENEWABLE ENERGY TECHNOLOGIES: SOLAR

Big lecture hall

Chairman: Peter Hauge Madsen, Risø DTU, Denmark

- **CSP research and perspectives**, Craig Turchi, NREL, USA
- **Option values of concentrating solar power and photovoltaics for reaching a 2°C climate target**, Susanne Manger, Potsdam Insitute for Climate Impacts Research, Germany
- **Solar energy - new photovoltaic technologies**, Peter Sommer-Larsen, Risø DTU, Denmark

SESSION 9 – RENEWABLE ENERGY TECHNOLOGIES: BIOENERGY I

Small lecture hall

Chairman: Kim Pilegaard, Risø DTU, Denmark

- **Principles of sizing 2G biofuel plants and biorefineries**, Chresten Meulengracht, EthanoLease I/S, Denmark
- **Pre-treatment of biomass**, Martin Møller, DONG Energy, Denmark

12:30 – 13:30 LUNCH

13:30 – 15:00 SESSION 7 – RENEWABLE ENERGY TECHNOLOGIES: WIND

Big lecture hall

Chairman: Steve Sawyer, Global Wind Energy Council

- **Off-shore wind**, Rudolph Blum, DONG Energy, Denmark
- **Nature's limit to the energy that can be extracted for human use**, Sten Frandsen, Risø DTU, Denmark
- **Offshore wind technology, possibilities and trends**, Peter Hauge Madsen, Flemming Rasmussen and Peter Hjuler Jensen, Risø DTU, Denmark

SESSION 11 – ENERGY FROM WASTE

Small lecture hall

Chairman: Peter Sommer Larsen, Risø DTU, Denmark

- **The organic farm as energy utility - environmental assessment of farm-scale combined heat and power production**, Marie Kimming, Swedish University of Agriculture, Sweden
- **Integrative approach for utilization of olive mill wastewater and Lebna's whey for ethanol production**, Mohammed Ibrahim, Royal Scientific Society, Jordan
- **Optimizing biogas production in the Arctic**, Marianne Willemoes Jørgensen, DTU, Denmark

15:00 – 15:30 BREAK

15:30 – 17:00 SESSION 12 – RENEWABLE ENERGY FOR TRANSPORT

Big lecture hall

Chairman: Lars Aagaard, Danish Energy Association, Denmark

- **Life cycle analysis of battery and fuel cell vehicles**, Ulrich Wagner, Technische Universität München, Germany
- **Towards a low carbon transport sector: electricity or hydrogen?** Coen Hanschke, ECN Policy Studies, Netherland
- **Transport and power system scenarios for Northern Europe in 2030**, Peter Meibom and Nina Juul, Risø DTU, Denmark

SESSION 15 – SYSTEMS ASPECTS II

Small lecture hall

Chairman: Hans Larsen, Risø DTU, Denmark

- **Accelerated development of low carbon energy supply technologies - and its impact on energy system decarbonisation**, Mark Winkler, University of Edinburgh, UK
- **A sustainability strategy for Ireland's electricity network**, Andrew Keane, University College Dublin, Ireland
- **Ways towards low cost renewable electricity and a European supergrid**, Gregor Giebel, Risø DTU, Denmark, and Gregor Czisch, Transnational Renewables & University of Kassel, Germany

17:00 – 18:00 BREAK

19:00

CONFERENCE DINNER AT THE BLACK DIAMOND, THE ROYAL LIBRARY, SØREN KIERKEGAARDS PLADS 1, 1221 COPENHAGEN

WEDNESDAY 16 SEPTEMBER 2009

09:00 – 10:30 SESSION 10 – FUEL CELLS AND HYDROGEN I

Big lecture hall

Chairman: Søren Linderoth, Risø DTU, Denmark

- **Hydrogen storage**, Lin Simpson, NREL, USA
- **SOFC and gas separation membranes**, Anke Hagen, Risø DTU, Denmark
- **Production of synthesis gas by co-electrolysis of steam and carbon dioxide**, Sune Dalgaard Ebbesen, Risø DTU, Denmark

SESSION 4 – RENEWABLE ENERGY TECHNOLOGIES: BIOENERGY II

Small lecture hall

Chairman: Kirsten Halsnæs, Risø DTU, Denmark

- **Fuels and chemicals from biomass: The C-factor**, Simon Ivar Andersen, Haldor Topsøe A/S, Denmark
- **Combined biogas and bioethanol production in organic farming**, Jens Ejbye Schmidt, Risø DTU, Denmark
- **Biochar (black carbon) as soil additive to fight global warming**, Esben Bruun, Risø DTU, Denmark

10:30 – 11:00 BREAK

11:00 – 12:30 SESSION 13 – CARBON CAPTURE AND STORAGE

Big lecture hall

Chairman: John Christensen, UNEP Risø Centre

- **Aqueous ammonia process for CO₂ capture**, Victor Darde, DTU/Dong Energy, Denmark
- **CO₂ capture from flue gas using amino acid salt solutions**, Benedicte Mai Lerche, DTU, Denmark
- **Energy demand for CO₂ solvent regeneration**, Philip Loldrup Fosbøl, DTU, Denmark

SESSION 16 – FUEL CELLS AND HYDROGEN II

Small lecture hall

Chairman: Erik Lundtang Petersen, Risø DTU, Denmark

- **Solid ammonia as energy carrier: Possibilities and technology development for transport and mobile applications**, Debasish Chakraborty, Amminex A/S, Denmark
- **Thermodynamic modeling of a biomass gasification, solid oxide fuel cell and gas turbine hybrid system**, Christian Bang-Møller, DTU, Denmark
- **Integrating a SOFC plant with a steam turbine plant**, Masoud Rokni, DTU, Denmark

12:30 – 13:30 LUNCH

13:30 – 14:45 PANEL DISCUSSION: WHAT ACTIONS ARE NEEDED NOW TO OBTAIN A PEAK IN CO₂ EMISSIONS BEFORE 2020?

Introductory remarks and moderator: Henrik Bindsvlev, Director, Risø DTU, Denmark

In the panel:

Jose Roberto Moreira
Niels Bergh-Hansen
Dieter Wegener
Anders Stouge
Hans Larsen

14:45 – 15:00 CLOSING REMARKS

Hans Larsen, Risø DTU, Denmark