



WREC IX - Final Report

World Renewable Energy Congress
Florence, Italy 19-25 August 2006

Final Congress Report

Prof Ali Sayigh - Chairman of WREC

The ninth WREC Congress was held in the beautiful city of Florence. The Congress grand opening was on Monday the 21st of August 2006 in the Florence Congress Centre. Then the Congress moved to the Architecture Department of the University of Florence for the main technical sessions on Tuesday, Wednesday and Thursday. The Palazzo Vecchio was the venue on Friday the 25th of August for the final plenary session and the closing ceremony.

The World Renewable Energy Network (WREN) Council meeting was held on Saturday the 19th of August 2006 followed by the AGM which included Prof Sayigh's review of WREN/WREC activities during the last two years. The Council then listened to four presentations about future congresses and regional meetings planned for 2007, namely: Abu Dhabi, UAE in January 2007; Perth, Australia in February 2007;



The Palazzo Borghese - Venue of the WREN / Elsevier dinner on Saturday the 19th of August

Taiwan in October/November 2007 and Maastricht, Netherlands in November 2007. Three proposals to host the World Renewable Energy Congress XI in 2010 were tabled by Thailand, the Azores, and Abu Dhabi, UAE. All three proposals were excellent presentations and each place offered the appropriate support and services for a very fruitful Congress in their country. After discussion among the members, a vote was taken and Abu Dhabi, UAE won to host WREC-XI in 2010. The other two proposals from Thailand and the Azores were accepted as regional WREC conferences in 2009 provided that they are held four months or more apart. In the evening the WREN / Elsevier dinner was held at the Palazzo Borghese in honour of all WREN members and reviewers of the Renewable Energy Journal. There were 74 participants at the dinner. Dr Claire Lahene, publishing editor Elsevier, gave the welcome speech at the dinner. During this evening the WREC-Chairman award for the 'Outstanding Renewable Energy Scientist of 2006' was presented by Prof Ali Sayigh to Dr Lawrence Kazmerski, the Director of the US Photovoltaic Centre. The guests also enjoyed an evening of medieval style entertainment.

On Sunday the 20th of August, the traditional three mile race organized by Dr Larry Kazmerski started at 8:30 am in front of the Grand Cavour Hotel. 14 participants took part and the route was planned carefully by Dr Kazmerski. Dr Stan Bull and Prof Ali Sayigh officiated. The men's winner was Architect Ian Giuliani, UK followed by Dr Hasan Nfaoui, Morocco. From the ladies side Dr Barbara Farhar was the winner. All participants received one of Dr Kazmerski's famous ties or scarves.

On the same day, the registration office was opened while Dr Barbara Farhar and Mrs Sheila Oparaocha ran their



At the start of the three mile race



WREN Trustee Ken Stratton (left) and the winner of the race Architect Ian Giuliani (right)



Three mile race participants arriving at the final destination

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workshop on poverty reduction and gender. In the evening a reception was held at the University of Florence, School of Architecture.

On Monday the 21st of August the Congress moved its activities to the Florence Congress Centre where Dr Faiq Billal gave a speech on behalf of His Excellency Dr Abdullah Alttwajri, Director General of ISESCO. This was followed by Professor K.R. Sreenivasan, Director of ICTP, Trieste who stressed the importance of physics and renewable energy. He furthermore explained the ICTP programme in this field. The next speaker Dr Wiktor Raldow, Head of the Unit New and Renewable Energy Sources at the European Commission highlighted the importance of renewable energy in combating climate change and outlined the EU programme for renewable energy. His Excellency Dr Hamid Chitchian, the Senior Vice Minister, Ministry of Energy, Iran outlined the need for more use of renewable energy even in an oil producing country such as Iran and emphasized the role of renewable energy applications in remote areas. He also explained Iran's active programmes in wind energy, solar water heating and photovoltaic applications. The next speaker was Hon. W.D.J. Seneviratne, the Minister of Power and Energy, Republic of Sri Lanka who emphasized the role of renewables for the electricity generation in Sri Lanka. The final speaker at the opening ceremony was Mr Hans-Josef Fell, Spokesperson on energy and technology for the parliamentary group of Alliance 90 / The Greens, Germany who showed the progress made in Germany in renewable energy application and how the country is dealing with climate change. He also presented the various measures being implemented in order to reach maximum usage of renewable energy in electricity generation.

After the opening speeches, 12 outstanding personalities in the world of renewable energy gave invited presentations, the details of which can be found in the Congress Proceedings.

- Ambassador Irene Freudenschuss-Reichl, Director General for Development Cooperation, Ministry for Foreign Affairs, Austria
- Dr Chris Luebkehan, Director for Global Foresight + Innovation, Arup, London, UK



Auditorium of the Florence Congress Centre with WREC IX delegates



Dr Martin Green, Australia

- R. Vigotti, Chairman Renewable Working Party of IEA, Consultant to Enel spa on international energy strategy, Rome, Italy
- Lionel Kambeitz, HTC Purenergy, Regina, SK, Canada.
- Dominique Lallement, World Bank, New York, USA
- Gustav R Grob, Executive Secretary ISEO, Geneva, Founder-Chairman of ISO/TC197 on Hydrogen Energy Technologies, Chairman ISO Committee on Energy Systems Analysis and Statistics, Switzerland
- Arno A. Evers, Arno A. Evers FAIR-PR, Starnberg, Germany
- Stanley R. Bull, Associate Director for Science and Technology, National Renewable Energy Laboratory, Denver, Golden, USA



Dr Chris Luebkehan, UK



Alexandros N. Tombazis, Greece presenting "A Letter of advice from a grandpa architect to his grandchild"

- Michael Jefferson, Chairman, Policies Committee, World Renewable Energy Network & Congress
- David Lindley, OBE FREng, Director, Ocean Power Delivery Ltd, Edinburgh, UK
- Martin A. Green, Centre of Excellence for Advanced Silicon Photovoltaics and Photonics, University of New South Wales, Sydney, Australia
- Alexandros N. Tombazis, A.N. Tombazis and Associates Architects Ltd, Athens, Greece.



Dr Lahene, Mrs Sims and Prof Brandani



His Excellency Dr Hamid Chitchian and Prof Thorsteinn I. Sigfusson

The WREC VIP dinner in the evening for invited guests and the Monday speakers was attended by 78 people.

During the technical sessions on Tuesday, Wednesday and Thursday a total of 840 papers were presented spanning the WREC Congress themes in 12 different sessions. For details on the presented papers please see the Congress programme which is available on the WREC / WREN website.

On Tuesday afternoon there were visits organised to sights of interest and renewable energy applications. 102 Congress participants went to Bologna where MCA director Dr Mario Cucinella and the Consorzio Cooperative Costruzione hosted a presentation of Cucinella's work followed by a dinner in a wonderful location in the hills overlooking Bologna. Our thanks and



VIP-Dinner on Monday evening



Some participants of the Bologna visit



Dr Martin Green and Mrs Judy Green in Bologna



Prof Manuel Correia Guedes, Dr Runming Yao, Mrs Elizabeth Cucinella, Mrs Linda Sayigh, Prof Oscar D. Corbella, Dr Mario Cucinella, Prof Helena Coch, Prof George Baird and Prof Andrew Miller

appreciations go to Mario Cucinella, his wife Elizabeth and the architect Susanna Quadralli from MCA for giving all the visitors an excellent evening.

The Congress Dinner was held at Palazzo Pitti on Wednesday the 23rd of August. 407 Congress participants were present including Their Excellencies, the President of Iceland Olafur Ragnar Grimsson, his wife Dorrit, the New Zealand Ambassador, W.D.J. Seneviratne and the Cyprus Director of the Energy Services of the Ministry of Energy Mr Solon Kasinis. During the evening, His Excellency the President of Iceland gave an excellent speech outlining the importance of renewable energy and its role for saving our planet. Then he gave a brief outline of how The World Renewable Energy Congress / Ali Sayigh Trophy was initiated and explained how the winning country, Cyprus, had been chosen to receive the Trophy. (His speech is included at the end of this report.) The Trophy was handed over to Mr Solon Kasinis, the representative of the Ministry of Energy, Cyprus. This was followed by the award Ceremony for the WREC Pioneers 2006, honoured for their work in the field of renewable energy over the last 10 years.

On Thursday four simultaneous debates were held followed by a WREC reception which was attended by 600 Congress participants.

On Friday the 25th of August all activities took place at Palazzo Vecchio. Several plenary speakers gave excellent talks to an audience which exceeded 500 people. In the afternoon, a trip to Sienna was arranged.

Participants of the Congress were encouraged by the numbers of young scientists who attended this WREC IX Congress. As usual at WREC meetings



410 participants attended the Congress Dinner at Palazzo Pitti



Speeches at the Congress Dinner at Palazzo Pitti



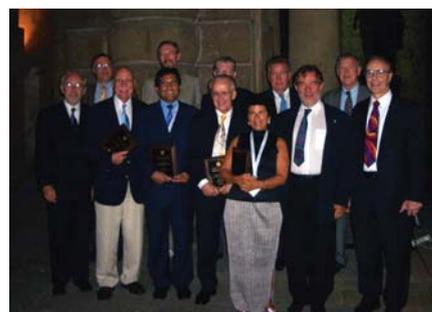
His Excellency the President of Iceland, Olafur Ragnar Grimsson and Mrs Doritt Grimsson, with the New Zealand Ambassador at Palazzo Pitti



VIP-table at Palazzo Pitti



The President of Iceland Olafur Ragnar Grimsson handing the World Renewable Energy Congress / Ali Sayigh Trophy to Mr Solon Kasinis, the representative of Cyprus.



WREC Pioneers 2006 from left to right: Mr Robert Noun - member of the pioneer committee, Dr Ulrich Schmidtchen, Dr Fred Morse, Prof Robert Critoph, Dr Faiq Billal, Prof Joe Clarke, Prof George Baird, Arch Prof Cettina Gallo, Prof Michael Hutchins, Prof Marco Sala - Host Chairman, Dr Stanley Bull - member of the pioneer committee and Dr Larry Kazmerski - member of the pioneer committee. (Missing on the picture: Dr Barbara Farhar who also received her award the same evening.)



Congress delegates at Palazzo Vecchio



Prof Izumi Ushiyama, Japan



Prof Ralph Sims, New Zealand

participants literally came from every corner of the world, from 107 countries to be precise. The technical committees' reports are included in this document. It has been declared that the Congress was a great success. We are looking forward to the World Renewable Energy Congress WREC X in 2008 which will be held in Glasgow.

My thanks as Chairman go to all the Technical Committees, all the sponsors in particular ISESCO, EC, Elsevier, Wind Direct, and Dr Mario Cuchinella. Special thanks go to Prof Fernando, Arch Lucia, Arch Antonalla, Mr Felippo and all the students of the University of Florence who helped throughout the Congress.

Professor Ali Sayigh

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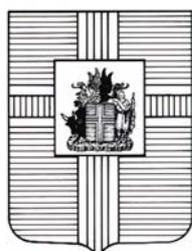
Closing ceremony at Palazzo Vecchio



Prof Sayigh with the Ecuador Minister of Environment and local organizers



Prof Max Fordham, UK



**A Speech
by the
President of Iceland
Ólafur Ragnar Grímsson
at the
Renewable Energy Trophy
Award Ceremony
Florence, Italy
23 August 2006**

Distinguished ministers,
Ambassadors,
Scientists, delegates,
Ladies and Gentlemen,

It is a great pleasure for me to present here today a new award which symbolizes a profound vision of the future, an award which is dedicated to a more sustainable world and inspired by the conviction that we can reform and change our societies in a responsible way.

I applaud the two great scientists and visionaries, Professor Ralph Sims from New Zealand and Professor Thorstein Sigfússon from Iceland, who initiated the World Renewable Energy Trophy and consequently headed the committee which determined the winner, evaluating countries on the basis of the yardstick of their use of renewable sources of energy. The trophy bears the name of Ali Sayigh, in recognition of his important contribution to the dialogue, discussions and research into renewable energy.

It is symbolic that the idea for the creation of this important award should come from New Zealand and Iceland, as these two countries, blessed with great geothermal resources, have vied with each other in the progress towards a more comprehensive use of renewable energy.

I often remind visitors to my country who marvel at the clean air and the impressive use of renewable energy resources which is now on display in Iceland, that in the middle of the 20th century we were so dependant on coal that our capital city, Reykjavík, was usually covered in smoke from the coal fires. The coal depot took up the largest part of the harbour area and coal ships from Europe were the most frequent visitors.

In less than fifty years we have completely transformed our energy usage, making Iceland the country with the highest percentage of renewables in its energy basket, now totalling more than 70%, and furthermore 100% of our electricity comes from renewables.

Geothermal energy, which to begin with was harnessed mainly in Reykjavík, but was later adopted by other municipalities all over the country, has now totally displaced coal in the heating of our houses.

In the production of electricity, 80% of our energy comes from hydropower stations and 20% from geothermal steam turbines. The percentage derived from the geothermal resource will increase significantly in the coming years, as we are now building a geothermal electricity plant primarily intended to provide power to an aluminium smelter which will be the first such smelter in the world to receive most of its electricity from geothermal resources.

There is however one area in the Icelandic energy portfolio that remains to be conquered; the imports of oil and gasoline for road transport, the fishing fleet and aviation.

We therefore some years ago embarked on an important project dedicated to mak-

ing our own fuel by electrolysing water and utilizing the hydrogen for powering our transport sector. In cooperation with Shell Hydrogen, Daimler Chrysler and Norsk Hydro, we founded the Icelandic New Energy company and now we have some hydrogen buses running as a part of the Reykjavik transport system; the first hydrogen fuelling station in the world was opened in Reykjavik three years ago. If the early promise of this international project based in Iceland on the use of hydrogen is fulfilled, it could enable our country to enjoy the possibility of becoming completely independent of hydrocarbon fuel in the future.

I mention this here today because as we all know the world is in a great need of making renewables serve as a far higher proportion of global energy usage. Fortunately, all forecasts point towards a considerable increase in renewables throughout the 21st century. However, given the easy access to hydrocarbons and fossil resources, renewables still remain very expensive for most nations. But the governments which put renewable energy high on the energy agenda soon realize that they will be saving on other costs which accompany the use of fossil energy resources because disruption of weather-patterns, damage to health, pollution and many other costs are associated with the use of hydrocarbons.

In the light of the important energy tasks facing all governments of the world and the priorities emphasized by my nation, it is for me both a privilege and an honour to present here today for the first time the Renewable Energy Trophy. It is awarded to the country which has shown the highest percentage increase in renewable energy use in the two years preceding your congress.

This winner country currently has a very

high dependence on imported oil, not just for transport fuels but also for oil-fired electricity generation. So a move towards the greater use of local renewable energy resources was seen to be strategic by its House of Representatives for both economic and security of supply reasons.

In this regard a new Law on the Promotion and Utilisation of Renewable Energy Sources and Energy Conservation was passed in 2003. It created a small levy on electricity consumers which, together with government grants, has been used to promote and support investments in renewable energy projects.

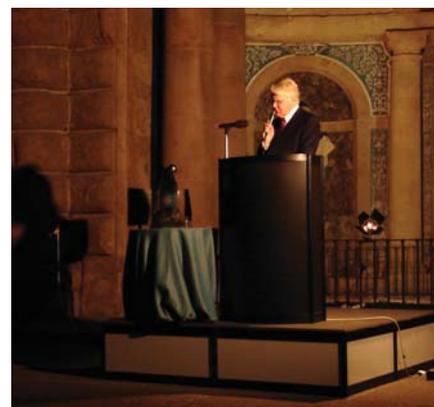
The government endeavoured to align its policies with that of the European Union and an Action Plan for the promotion of renewable energy was drawn up. It set a target to double its total share from renewable energy and also to increase its electricity generation from renewable energy sources from almost zero to 6% by 2010.

In 2004 a new guaranteed price scheme for electricity generation was introduced and capital grants and subsidies were offered up to 70 million Euros.

A new law to encourage the uptake of biofuels for transport and to support the use of flexible fuel vehicles using bioethanol was passed just over a year ago. Solar water heating has been in place for some years and was the main contributor to the nation's 1.8% of total primary energy from renewable energy as registered in 2002.

Nowadays approximately 92% of the buildings, including 53% of the hotels, have solar water heaters installed. In addition several new wind, geothermal and bioenergy projects have been developed.

Overall this strategy has increased the total



Olafur Ragnar Grimsson, President of Iceland giving his speech

share of renewable energy to 7.4% - an impressive increase of 5.6% in just 2 years.

Other nations also with impressive increases of their renewable energy include Albania, Brazil, Kyrgyzstan, Panama and Paraguay.

However, tonight it is most fitting that we honour the endeavours of a small island nation in being the recipient of the 2006 World Renewable Energy Trophy.

Ladies and gentlemen, the winner is: CYPRUS.

Cyprus has shown the world how it is possible to increase in a dramatic way the role of renewables and thus move away from the tremendous costs of hydrocarbons, costs incurred not only by our respective countries but by all of humankind.

Two years from now we will learn who will be the next winner. It could indeed be Cyprus again if it continues on its remarkable path, but it could also be another country that makes outstanding progress.

We congratulate and applaud Cyprus and express our profound gratitude for the leadership it has provided.



Speaker Prof Thomas Johansson



Speaker Miss S. Bakshi



Speaker Dr Nebojsa Nakicenovic

Policy Issues Summary Report

Mr Michael Jefferson, Chairman of the Policies Committee

The policy issues part of the Congress programme had been organised around a number of themes:

- policy and performance at the international level;
- prospects for sustainable development;
- renewable energy for social and industrial development;
- technological innovation and diffusion;
- financing renewable energy;
- renewable energy for reducing local and regional pollution; and
- alleviating global climatic change.

Speakers took varied positions on policy initiatives at the international level, from the optimistic to the downright critical, with even the optimists taking the view that there were already too many general recommendations in circulation and the need was for real action. A recurring theme was that policymakers seemed more concerned with announcing targets (realistic or otherwise) rather than ensuring a systemic approach to adopting rapidly those forms of renewable energy most suited to local circumstances (a portfolio approach), which is consistent with sustainable development and the efficient deployment of taxpayers' and shareholders' funds.

There was concern that progress was insufficient given the prospective shortfall in the availability of conventional oil resources in relation to expected global demand within fifteen years. Fossil fuel (especially coal) use has been increasing its share of World primary energy use so far this century, and given the pace of expansion in the Asia/Pacific region (particularly in China) it is difficult to see how this can be reversed in the short to medium term.

Although more people are able to access modern energy services, the number of people who cannot is expected to remain in excess of 1.4 billion for some decades. New forms of renewable energy, if hydro is excluded, now account for under 2.5% of World primary energy usage, and if modern biomass is excluded this figure falls to 0.5%. Despite impressive annual rates of growth of grid-connected

solar PV, wind and modern biomass, the overall figures are not consistent with sustainable development.

The huge potential that the expanded use of renewable energy has for social and industrial development is, by the same token, not being realised fast enough. Distributed generation systems, so beneficial to community and household initiatives, are still not receiving adequate backing. Technological innovation and diffusion is not progressing at an adequate pace, with a lack of real awareness that our present course is not sustainable in even the relatively short term. The fact that government RD&D expenditure has generally fallen over the past 20 years compounds the problem, and subsidies to conventional fuels which still far outrun support for renewable energy further intensify it. However, a number of speakers had critical comments to make about the wind energy industry, which was failing to answer a number of challenges and attracting undue financial and policy support while other forms of renewable energy were sidelined (critical comments were focussed on the UK, Denmark and Germany at the Congress). These criticisms suggested that feed-in-tariff systems, though relatively attractive, are not without weaknesses.

Given the slow expansion of renewable energy use, speakers not surprisingly pointed to continuing localised pollution (especially affecting the young,

the elderly, and women in and around the home), and to the near 29% rise in global carbon dioxide emissions from fossil fuel use since 1990 (with China, USA and India accounting for over 70% of the increase). Although hundreds of scenarios exist which give a flavour of the possible alternative paths the World could follow over the next century, the current trajectory is not one to give confidence in the wellbeing of future generations.

In view of the rather pessimistic tone adopted by most speakers on policy issues it was a great pleasure to have a joint Policy/Gender Issues panel discussion, with Bundit Fungtammasan (Thailand), John Constable (UK), Ruth Potopsingh (Jamaica), and Nicola Steen (UK) answering questions – there were 18 in all – from the policy perspective. The first three related to wind energy, and were crisply dealt with by John Constable – including the incorrect suggestion made in one plenary speech that UK wind energy developers receive no public subsidy! Thereafter questions related to tackling local deprivation in order to progress social advancement, and accelerating technological and economic drivers to improve material conditions while making serious efforts to ensure environmental protection. These questions were very competently dealt with by the joint team under the chairmanship of Barbara Farhar and Michael Jefferson.



Members of the WREC Technical Committees

Fuel Cells and Hydrogen Summary Report

*Dr Imad Mahawili, Chairman of the
Fuel Cells and Hydrogen Committee*

The following presented papers in these sessions that I chaired:

Session 1: Hydrogen Technology

- Hydrogen Production from Biofuels: Prof. S. Freni
- Developing a Renewable Hydrogen Economy: David Joffe
- Distributed Generation Facility with Integrated Molten Carbonate Fuel Cell, Amorphous Silicon Photovoltaic Cells (PV), Combined Heat Power Micro Turbine, and Nickel Metal Hydride Battery: Imad Mahawili
- PEM Fuel Cell Fundamentals: Bent Sorenson

This session covered a wide range of technical topics ranging from quantum mechanics analysis of Proton Exchange Membrane (PEM) fuel cells by Bent Sorenson to integrated renewable energy systems in a single distributed generation facility. Prof. Freni's work addresses a renewable approach to hydrogen production from biofuels and David Joffe expanded on this approach as he expounded on its implementation using the City of London waste management as an example.

Session 6: Hydrogen Technology

- The Bridge to our Energy Future: Steve Heinz. Orion Energy Systems
- The Hydrogen Energy and Fuel Cell Roadmap of Malaysia: Prof. Sopian
- The Role of Hydrogen and Fuel Cells in a Sustainable Energy Economy: Ulrich Schmidtchen

Steve Heinz of Orion Systems clearly explained the Company's focused strategy on energy efficiency that can be applied economically today as the hydrogen economy develops over the next few decades as Prof. Sopian explained this perspective for Malaysia. Ulrich Schmidtchen's paper focused on defining hydrogen as an energy carrier, its global generation, storage, and transportation.

Both sessions were very well received by the attendees. The audience participated very well after each paper as they dialogued and asked about key issues salient to each paper.

In general, these sessions were timely and very relevant and I feel they, and other sessions, need to be augmented by a much expanded technology exhibits.

Biomass Conversion Summary Report

*Prof Stefano Brandani, Chairman of
the Biomass Conversion Committee*

The Biomass Conversion committee was extremely pleased to receive more than 120 abstract submissions from all over the world. This resulted in a selection of approximately 80 papers that were contributed to the final programme of the congress.

We were able to structure the contributions into several themes that give an insight into the breadth of the research potential in the field of biomass conversion.

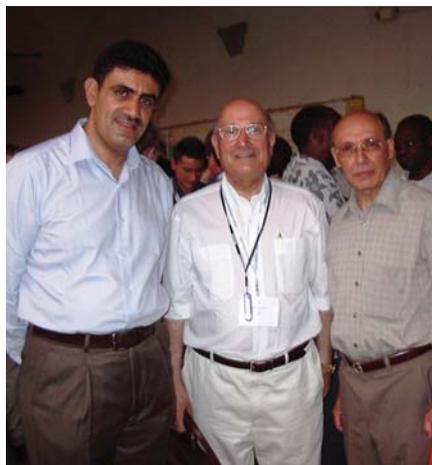
The papers presented at the congress in the "Biomass in Different Regions" sessions highlighted the need for integration of resource generation and the choice of the appropriate technology that has to consider the local conditions and benefits to the communities. "Liquid Biofuels – Biodiesel and Bioethanol" sessions included presentations on the most recent developments in the conversion of different crops into fuels needed to make a significant impact on the emissions of greenhouse gases from transportation. "Biogas Technology" sessions had contributions that ranged from direct production of biogas from digestion of different biodegradable

sources to recent developments in gasification technology for the production of hydrogen. General "Biomass Conversion" special sessions included numerous contributions that presented techno-economic analyses of several applications including: charcoal production; co-combustion; pyrolysis; gasification; re-use of vegetable oil; biodiesel production.

A particular mention should be made of the plenary lecture on "Converting a kraft pulp mill into an integrated forest biorefinery" as this talk highlighted the opportunities that lie ahead in terms

of carrying out exciting and novel research into converting biomass into many different chemical components thus contributing to reduce the need to use fossil fuels derived products.

As the Congress drew to an end it was fitting that, in the wonderful surroundings of the Salone dei Cinquecento, we had the opportunity to include the plenary lecture on "The economic drivers of bioenergy" with an expert's overview of the field of biomass conversion and how all the work presented in Florence falls within the wider horizon of the world's energy needs.



**Congress participants from Yemen
with Prof Ali Sayigh**



**Prof Ali Sayigh with Dr Teresa Pontes
from Portugal and Mr Komninos
Diamantaras (EU)**

Energy, Poverty Reduction, and Gender Summary Report

Dr Barbara Farhar, Chairman of the Energy, Poverty Reduction and Gender Committee

The gender and energy part of the Congress focused on opportunities and challenges in energy, poverty reduction, and gender. It included a workshop roundtable discussion, a Congress plenary speaker, two technical sessions, and a joint panel with policy. Men and women from at least 24 countries participated in gender and energy sessions, including several graduate students. Invited speakers were Dominique Lallement, The World Bank; Sheila Oparaocha, ENERGIA; Dr. Jyoti Parikh, IRADE; Dr. Manorama Bawa, AIWC; and Laura Kuri, Bioregional Resource Center, Mexico. Other esteemed speakers from around the world presented 12 technical papers. A facilitated discussion of 50 participants (the majority men) resulted in recommendations that will be carried forward to international meetings, such as the Commission on Sustainable Development (CSD-15). WRECs first included gender and energy tracks in 1998.

The Sunday workshop's primarily focused on developing countries, where 70% of the world's poor are women. Speakers reported that, since 1992's Agenda 21, gender issues have gradually been integrated into international agendas, including those of the Commission on Sustainable Development (CSD), which monitors progress with women as key stakeholders; and the Beijing Conference, which called for the integration of gender analysis in program design. The Millennium Development Goals (MDGs) include universal childhood education, gender equality, and women's empowerment. Although access to energy is not an MDG, the international community has now explicitly recognized the prominent role that energy services play in achieving the other MDGs. At CSD-9, energy and development were included in the international agenda and linked with women's empowerment and poverty reduction. In September 2005, the MDG+5 summit defined energy as a crosscutting issue. In 2006, the World Bank held Energy Week and CSD-14 was convened. Women and energy are defined as key issues,

with best practice, lessons learned, and gender issues defined (e.g., decision-making, time, health issues, production, and the design of houses in developing countries).

An international debate continues on investments to reduce energy poverty and local deprivation. In 2030, 1.4 bn people will probably still lack electricity and 2.6 bn will rely on basic biomass; 1.4 mn women and children will die of diseases from poor indoor air quality. India and Africa have the largest concentrations of the energy poor. Critical energy applications are income generation, nutrition, health, safe water, lighting, communications, and mechanical energy for work. Women lack education, access to credit, authority over the use of lands, basic legal rights, and access to energy. Girls cannot attend schools because they are gathering fuels; therefore women are left behind. The World Bank's plan is designed to accelerate women's access to land, financial markets, labor markets, and products and services markets to reach the MDGs. Professional women working in energy is increasing with positive impact for women's programs (such as the Energy Ministry in Africa).

As a direct follow-up to WREC-IX and other consultations with gender and energy practitioners around the world, ENERGIA will take proposed policy options and actions to CSD-15 to address four challenges: (1) integrate gender perspectives into planning, decision-making, management and implementation, (2) enhance the roles and status of women as participants and agents of change, (3) provide access for all to reliable, affordable energy services, with particular attention to the rural and urban poor (especially women and children) to meet the MDGs, and (4) reduce air pollution, with particular attention to indoor air pollution from traditional biomass fuels and its health impacts on women, children, and the elderly of both sexes.

The Policy-Gender panel was organized around two broad themes: (1) drivers (local deprivation and economic and technological) and (2) needs (social advancement and environmental protection). Mmes. Lallement, Parikh, and Oparaocha competently answered challenging policy questions from a gender

perspective. Key points included:

- Women should be seen as agents of change, not victims. A gender-equitable society results in benefits to households and economies as a whole. Gender inequitable societies cannot be completely functional or sustainable. Strong political commitment is required.
- To expedite such commitment, new female/male coalitions are needed which band together the reasonable against those who are unreasonable or indifferent. These coalitions would work to reduce barriers and achieve needed changes, recognizing reluctance to change (fear of the unknown and cultural conservatism), lack of awareness, shifting gender roles, fear of reaching out in case of rejection, and misunderstandings between the genders.
- Appropriate energy technologies and energy-using devices (not just renewable energy technologies) are required; these must be affordable, accessible, and suited to local needs.
- Women need more access to financing, full rights to property, ownership and control over lands, and authority to make decisions to help bring about real change.
- To have qualified women to fill these roles, a serious effort in capacity building, education, and training is required.
- Effective policy relies on a profound understanding of what is happening "on the ground", and a preparedness to challenge longstanding local cultures and customs. Surveys, fieldwork, and national accounting must accurately reflect local deprivation and the real contributions of women.
- In the developed world, action at the state and local levels where women have more influence than they do at national levels, can be effective in reducing greenhouse gas emissions.

The track was finalized by WREN's recognition of the contribution made by organizations and professionals working on gender and energy issues, including the United Nations Development Programme (accepted by Susan McDade), the Energy Sector Management Assistance Program (ESMAP) (accepted by Dominique Lallement), and The All-India Women's Conference (AIWC) (accepted by Dr. Manorama Bawa). The researcher award was presented to Dr. Barbara Farhar (National Renewable Energy Laboratory).

Low Energy Architecture Summary Report

Dr Hazim Awbi, Chairman of the Low Energy Architecture Committee

Sessions

- One Plenary Session (3 presentations)
- Seven Technical Sessions (total of 44 presentations)
- Three Special Technical Sessions (total of 34 presentations)
- One All Day Session on Teaching in Architecture (total of 17 presentations)
- One Panel Discussion

Plenary Session

Three presentations covered the impact of climate change on building design (Prof. Stephen Belcher, UK), the obstacles hindering the specification and use of renewable energy systems in buildings (John Easton, UK), and an overview of availability of current and future

fossil energy resources to the world population and the impact of the predicted shortage in conventional energy supply on building users around the world (Prof. Fredrico Butera, Italy).

Technical Sessions

Presentations of 15 minutes were made under the following session titles:

- Thermal Environment – Ventilation
- Visual Environment – Daylighting
- Building Design Case Study – Forms, Elements and Material
- The Urban Environment, Building and Sustainability I & II
- Building Refurbishment, Integration of Renewables, Social and Psychological Issues
- Building Simulation and Policy Issues

Special Technical Sessions

Brief presentations of between 6 to 10 minutes were made in three Special Technical Sessions. These covered wide-

ranging topics under the LEA themes.

Teaching in Architecture Session

A full-day session of papers related to the Teaching in Architecture covering social and technical aspects of architectural design and the methods that should be used in teaching and applying new low energy and renewable energy concepts.

Panel Discussion

A panel discussion under the title “Is architecture sustainable? Will renewable energy make a difference?” started by a presentation from an architect from MC Architect, Italy, on low energy buildings that the practice have designed or have been associated with. A panel of five including the chairman of LEA also presented their views. This was followed by questions and comments from the audience not only on the MC Architect presentation but on wider issues of sustainable buildings and user influence.

Solar Thermal Summary Report

Prof Robert Critoph, Chairman of the Solar Thermal Committee

A total number of forty plenary and full presentations were made to a full audience. The standard of presentation was, in general, good. Of the forty, eleven were on cooling, eight on power cycles and thermodynamics, seven on collector technology, five on agricultural applications, four that may be regarded as country specific reports and two on solar cookers. Sadly, a further thirteen papers were not delivered, the authors not being present. The special sessions worked well throughout the proportion of papers presented was less than for main sessions. The authors' home countries were geographically diverse, from Europe, Asia, Africa and Latin America.

Of particular note were the presentation of Prof Wang of Shanghai Jiao Tong University, who is involved with the commercialisation of solar cooling and drying products, Dr Chwieduk of Polish Academy of Sciences, working on trigeneration systems and design/orientation of glazing systems for optimum annual performance and Prof Eames of Warwick for his presentation on modelling of solar systems and research into evacuated glazing.

Wind Energy Applications Summary Report

Dr D.T. Swift-Hook, Chairman of the Wind Energy Applications Committee

A number of the papers in the plenary sessions and on policy issues confirmed the leading position of wind energy amongst renewable technologies with more than 50GW installed to date around the world. The rate of expansion seems to be easing back but it still exceeds 20% annually. The UK and Japan continue to lag behind leading countries like Germany, Spain, USA, India and Denmark but there are signs of increased interest in these two countries, particularly in the off-shore sector, which is also receiving renewed attention in the USA because their highest winds on land are in areas remote from their centres of population and load, which are mainly coastal.

Several papers dealt with the power system integration of wind farms as penetrations increase to 25% and 30% in some regions but no problems were reported and no new features emerged.

There were no presentations describing the designs of the large wind turbines that are the basis of this huge expansion, although different energy vectors were

considered for widespread applications, notably hydrogen and compressed air. On the other hand, many papers dealt with small wind turbines, micro-wind and hybrid systems. Several case studies described experiences with specific installations and applications including fish-farms (in Taiwan) and holiday resorts (in Italy).

Perhaps the most notable feature of the Wind Energy Sessions was the wide range of novel technologies proposed and tested, including vertical axes, complex 3-dimensional blade designs and various ducting arrangement. Unfortunately, none of these had reached the stage where reliable costs could be established.



Nigerian participants at the Congress with Prof Ali Sayigh

Solar Materials Summary Report

Prof Michael G. Hutchins, Chairman of the Solar Materials Committee

The scope of the Solar Materials component within the WREC is in providing underpinning to the solar thermal, daylighting, low energy architecture and photovoltaic elements of the conference.

The materials of interest are employed principally in solar collectors, windows, facades and buildings applications. Optical properties measurement, optical modelling, performance assessment, durability and environmental impacts are also considered.

10 papers were presented within the Solar Materials sessions of WREC IX. A comprehensive and extensive

review of materials use in solar thermal and energy saving applications was presented by Prof P Yianoulis, University of Patras, Greece, in an Invited Paper. He also presented a second paper addressing the environmental rating of electrochromic glazing. Dr Zorica Crnjak Orel, National Institute of Chemistry, Slovenia, delivered an invited presentation which detailed many interesting and informative results concerning the use of mixed vanadium cerium oxides as a novel counter electrode for optically passive ion storage. Prof Michael Hutchins, Sonnergy Ltd., UK, demonstrated a novel means for in situ determination of the U-value of glazings using a near infrared reflectance measurement technique.

Other papers presented included the properties of photolytic cadmium stannate transparent conductors by Prof

Kuku, Obafemi Awolowo University, Nigeria; the use of selectively reflecting organic mirrors for use in luminescent solar concentrators by Michael Debije and co-workers, Eindhoven University of Technology, the Netherlands; TiO₂/Cr/TiO₂ thin films for photocatalytic dye decolorisation by M Leunga, University of Guilan Rasht, Iran, compared transparent conducting thin films of doped indium oxide and zinc oxide. The results of an EU project addressing the use of encapsulated phase change materials were presented by Dr Maria Hadjieva of the Bulgarian Academy of Sciences.

The papers presented were of high quality although the overall number of papers submitted was small. The Solar Materials contributions continue to provide support to the success of the WREC programme.

Photovoltaic Applications Summary Report

Prof Ali Sayigh, Chairman of WREC

The section had 64 papers presented covering: Solar cell technology, BOS components, PV manufacture, testing and certification, stand alone systems, PV for rural development, PV in the built environment, utility and grid connection issues, markets and commercialisation, financing schemes and national programme. Papers were from: USA, Spain, France, Jordan, Algeria, Australia, Japan, Iran, Austria, Italy, Bulgaria, Latvia, Germany, Tunisia, Nigeria, Malaysia, Brazil, China, Cyprus, Belgium, South Africa, India, Greece, Lithuania, Egypt, Iraq, Denmark and Saudi Arabia. There is a clear indication that photovoltaic technology is being used in the above 28 countries in vital applications. The papers explained some applications ranging from remote areas to the built environment. Several papers tackled the issues of overheating, desalination, refrigeration and total electricity supply also covering PV parks or communities as well as grid connection. In terms of research and development several papers dealt with PV types: CdS, mc-Si, bifacial SC, Cu₂S-CdS, ITO, CdS/CuS and CuS/CdS, CuIn_{1-x}GaxSe₂ and aSi cells.

Related Topics Summary Report

Prof Ali Sayigh, Chairman of WREC

72 papers were presented in this section covering a large number of topics. 22 papers were on education and promotion mechanisms in Pakistan, Romania, Argentina, Croatia, Greece, Peru, Malta, Turkey, Tunisia, Bangladesh, Morocco and Brazil. Four papers from India, Thailand, China and Kuwait covered environmental issues.

21 papers were covering solar radiation and associated topics in: Libya, Brunei, India, China, Cameroon, Australia, Morocco, Tunisia, Argentina, Burundi, Brazil, Italy, Denmark, USA and Greece.

24 papers dealt with devices and applications, lighting, cooking, refrigeration, hydro-power generation, dryers, electrical motors, hot water and heat exchangers, small PV applications, Geothermal plants, UV sterilization devices and biomass plants. The presenters were from Uzbekistan, China, India, Greece, Romania, Thailand, Nepal, Jordan, Bulgaria, Tunisia, Algeria, Argentina, Iran, Kuwait, Tunisia, Morocco, Greece, Spain and Switzerland.



Young scientists at WREC IX in Florence



Some Turkish delegates at the WREC reception on Thursday in the courtyard of the University of Florence

Marine Energy Summary Report

Prof AbuBakr S. Bahaj, Chairman of the Marine Energy Committee

The marine energy programme at WREC IX encompassed 43 invited and contributed papers and 2 plenary papers. The programme was delivered in parallel with other sessions of the congress in self contained sessions over three days with contributions from developers, academics, policy and funding agencies and more importantly from research students.

The programme was structured to allow marine energy participants to attend other important segments of the congress. The plenary talks were as follows:

Plenary 1

11:00 Wednesday 23rd of August

The history of and progress in wave energy conversion devices - António F. de O. Falcão, Mechanical Engineering Department, Institution Superior Técnico, Portugal

Plenary 2

11:00 Thursday 24th August

DTI Technology Programme for Marine Energy - Gary Shanahan, Department of Trade and Industry UK

Many of the EU's Consorted Action on Ocean Energy CA-OE community attended and contributed to the programme of the Congress. In addition, Dr Komninos Diamantaras of RTD-J3, New and Renewable Energy Sources, EU gave a talk on the "EU FP6 and FP7 Funding for Marine Energy Programmes"

The marine energy programme culmi-

nated in debate entitled **Economics, Deployment and Funding**. (The debate's structure is shown in the table below.)

At the end of the short presentations by the eminent panellists, the debate took the form of statements from the floor (including, those from developers, academics, students and funders) combined with questions and answers to the panellists related to the issues presented and to ocean energy in general. The debate was lively, and the discussion had to be curtailed by the Chair at around 20:00, an hour later than the allotted time.

Topic	Time	Title	Speaker
Developer issues	5 min	How long and how much? A developer view of development, the real market and the pressure for funding	David Lindley Ocean Power Delivery - UK
Cost of energy	5 min	A view of the cost of marine energy	David Ward – Culham Science Centre, Abingdon, UK UK
Funder issues	10 min	Two funders view of the criteria required to achieve successful funding	(i) Gary Shanahan (UK DTI) (ii) Komninos Diamantaras (EU)

Marine Energy Programme - The Debate (*Economics, Deployment and Funding*)
18:00 – 19:00 Thursday 24th August