RESEARCH CONFERENCES

ESF-FMSH Entre-Sciences Conference in partnership with UPCAM

Global Change Research II: Environmental Crisis, Energy Issues and Global Regulation Policies

IGESA, Porquerolles Island, France, 11-16 June 2010

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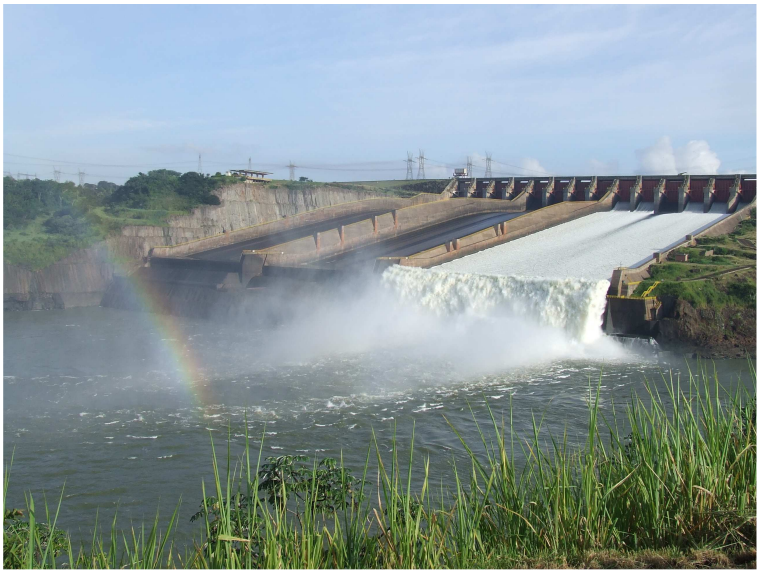

Conference Highlights

Please provide a brief summary of the conference and its highlights in non-specialist terms (especially for highly technical subjects) for communication and publicity purposes. (ca. 400-500 words)

In continuity with the 2008 conference “Global Change Research I”, focussed on climate modelling and risks/impacts estimation, this second conference of the series tried to examine the deep interaction between the environmental crisis (climate change, urbanization/land use, exhaustion of resources, and degradation of ecosystems), the energy production, conversion and use, and global regulation policies.

If the relationship between the use of carbon-based energy and global warming seems now well recognized, more general aspects of environmental degradation related to energy production, in particular impacts on the biosphere and health have also been addressed in the first part of this conference. For instance, because in the next twenty-five years almost two billion more people will move into cities, sustainability and vulnerability analysis of urban areas is an issue of increasing concern due to global change. Urban infra structure is a vital component of a city including utility and transport networks, water and flood management structures, underground networks for which the energy needs become now a challenge. A second example dealt with the impact of Compressed Natural Gas conversion of motor vehicles in Dhaka and the air quality, climate benefits and the number of premature death avoided.

A second part of the conference has analysed the links between “energy and human needs” on one hand, and “energy and environment“, on the other. It provided a panorama of research efforts and technological implementations in the field of energy efficiency and environmental performance, for today’s energies (nuclear, transport and buildings…), emerging technologies (biofuels, wind turbines…) and longer term opportunities (hydrogen and fuel cells, recycling of CO_2 and its conversion back to fuels or even to trees!…).

The last part of the Conference focussed on the interface between Technologies, Science and Society. The implementation of good practices and the diffusion of new energy technologies worldwide strongly depend on global regulation policies, international agreements and global/local governance. Emphasis has been laid on the environmental aspects of international trading and the laws related to the production and transportation of energy (environmental damage liability, environmental catastrophes…). The choice of adapted robust technologies in the less developed countries has been illustrated by the presentation of improved cooking stoves for poor villagers in Nepal leading both to an improvement of the deforestation and to the reduction of lung diseases. Finally, the political, economical and social impacts of energy policies both at national or of international level have been illustrated (effectiveness of the Kyoto protocol, after Copenhagen, the role of carbon finance…).

☐ I hereby authorize ESF – and the conference partners to use the information contained in the above section on ‘Conference Highlights’ in their communication on the scheme.

Scientific Report

Executive Summary

(2 pages max)

The conference took place in Isle de Porquerolles (South of France, near Toulon) from June 11th to 16th 2010. It had been prepared by a scientific committee which started to work in April 2009. A set of potential keynotes lecturers was identified and finally 11 high level scientists accepted to deliver a lecture.

Thanks to a call for proposal which was disseminated by ESF and by the French CNRS Energy Research program, 90 people applied for a presentation, and 47 were selected, either for a short talk (28) or for a poster (19). They were offered the opportunity to participate to the conference (49 % female participants and 74 % less than 36 years). Because of various problems (visas, financial support…) 12 posters were finally shown and 18 short talks were presented. Let us observe that the proposals came from 32 different countries, all over the world, with peak values for France, India and Russia.

During the opening session, welcome addresses were presented by Bruno Hamelin, vice president of the Paul Cezanne University, Paola Campus, representative of ESF and Jean Bernard Saulnier representative of CNRS.

The presentation of the conference was organised into 7 sessions dealing with :

- Climate change, perception, impacts and adaptation (1 session),
- Energy and human needs versus energy and environment (1 session),
- Basic science and the development of sustainable energy technology (2 sessions)
- The interface between Technology, Science and Society (3 sessions),

and respected a balance between keynote lectures, short talks and discussions. Many good questions came from the audience, bringing answer of great quality and even if the chairmen tried to master the time schedule, sessions often happened to stop late.

The posters were hung all the conference long, but we had a specific session for discussion among them on Saturday night.

A specific session was also devoted on Sunday Night to the discussion about “can we rely only on technical solutions ?” Nuclear energy, renewable energies, and use of end use efficiency were screened and none of them was of course considered as the only gate way to master the crisis of energy. The global agreement converged towards the idea of a mix, the components of which can evaluate with time and with the progresses of science and technology. The discussion also covered the convergence to be optimised between transport, energy and megacities of the future, or the coupled mechanism between the oil/ gas resources evolution, the increase of their cost, the decrease of their consumption and finally the decrease of CO_2 emissions. A point was also mentioned about not only the progresses in the CO_2 capture and sequestration techniques but also about the important problem of their acceptability.

Finally, because of a particularly bad weather on Tuesday, we could use, with the agreement of all the participants, the afternoon pause for complementary discussions. An interesting point

appeared: because of the particularly multidisciplinary nature of the conference, it would be useful , for the next conference, to include specific lectures intended to supply the essential preliminary knowledge to approach the main domain of energy (bio fuels, hydrogen, photovoltaics, nuclear…).

Scientific Content of the Conference

(1 page min.)

- *Summary of the conference sessions focusing on the scientific highlights*
- *Assessment of the results and their potential impact on future research or applications*

Let us recall that the conference was organised in 7 sessions according to the following titles:

- Climate change, perception, impacts and adaptation (1 session),
- Energy and human needs versus energy and environment (1 session),
- Basic science and the development of sustainable energy technology (2 sessions)
- The interface between Technology, Science and Society (3 sessions),

The first session provided a general frame for the introduction of the conference and started with the presentation of the recent work performed by the International Energy Agency. The main figures of the scenario 450 (the objective of which is to try to maintain roughly at the present value, 450 ppm , the CO2 concentration in the atmosphere) helped to identify the general trends that can be proposed for the 20 next years, concerning the production of electricity, the possible role of renewable, and the content of the mix, at world level and regional as well… The world abatement of energy-related CO2 emissions and the main road maps associated were also presented and discussed (PV, CSP…). An important point is to be kept in mind: these exercises use modelling and the level of confidence of the results is of course decreasing with the time of the predictions: none is able to day to put values on the uncertainty of these predictions which are all but prognosis.

Two complementary lectures offered on one hand an analysis of the history of the development of cities and transportation systems in USA during the 20th century, and on the other hand concepts for the city of the future.

The main and original comments of the two first sessions came with the conclusions of Prof. Ziegahn:

- Acceptance of energy technologies by the public has to be prepared free of ideology and facts based communication
- Media and politics, researcher and developer have to provide information without stereotypes
- Permanent threat scenarios and ‚last-days-of-the-earth' prophecies will not provide a break-through-thinking
- To awake unrealistic expectations will lead to disappointment and less power for a change
- Creativity and invention capacity are Europe's only unlimited resources. It should not be stopped by required mainstream thinking or ban of unconventional ideas.

Concerning role of basic science to the development of sustainable energy development, four main contributions can be mentioned.

A view on new energy sources using solar energy with rather classical aspects (solar thermolysis, thermo chemical cycles, solar cracking, solar reforming, solar gasification, algae and cyano bacteria…), associated to a new means of CO2 recycling thanks to electro photo

catalysis which clearly might lead to an interesting breakthrough: taking advantage in fuel cell developments, using both photo catalyst and electro catalyst on two separate electrodes, including a protonic membrane, this new process is able to transform CO2 (entering at the cathode) and water (entering at the anode, with light) into higher hydrocarbons and alcohols. This contribution was one of the most promising concerning issues for the next 10 years.

Another lecture of interest provided a very comprehensive overview on hydrogen and fuel cells, particularly adapted to the audience. To discuss the problem coming from the intermittency of some renewable sources of energy (photovoltaic, wind turbines…) and the necessity of storage of energy, a practical hydrogen chain operating in Denmark was shown, including: production of electricity by a wind turbine, conversion into hydrogen by electrolysis and return to electricity with a fuel cell.

A clear analysis of the contribution of nuclear (essentially fission) started from the observation that Europe is clearly a world leader, but competition is building (Russia, Japan, USA, India, and China). With 152 reactor (450 at world level) nuclear is, for Europe producing 31 % of electricity, providing the larger source of low carbon energy, with an excellent safety record. Because fossil and nuclear power plant generation are ageing, there is a need to invest in plant lifetime management and large investments are necessary to build new plants to satisfy the demand. This will be accomplished thanks to scenarios adapted to the transition between the present generations II and III, to the Generation IV: its characteristics concern essentially an increase of safety and a huge decease of nuclear wastes. From a scientific point of view, the main issues were identified in the field of material sciences and fuel research, simulation, modeling and experiments for validation. Another important point was mentioned, concerning the need of well trained and educated specialists in the various fields related to nuclear fission. A long discussion with the audience offered in particular the opportunity to clearly explain the difference between the physics basic mechanisms used in classical plants and in the Gen IV.

As an example of detailed possible contribution of renewable energies, the case of wind turbines was analyzed and led to the following conclusions:

- Onshore wind is the less expensive after hydro, but limited, like hydro
- Solar energy id the most abundant and well distributed in the world, but is still expensive
- Biomass can be stored, but resource is not really free
- Marine energy including offshore wind can provide a massive production of green electricity, but still with high industrial risk.

So, there is no “technological miracle”: to reach sustainability, the idea of a mix was still recognized, and all renewable energies should be associated to strong energy saving: in this view, wind appears as a necessary step, even if it is not the most efficient way to decrease CO2 content. Besides, wind fluctuations (intermittency) have to be manages at the system level and is more an economical issue than a technical one (for instance best remuneration of hydro power ?). The main progresses still to be accomplished on the wind systems concern:

- Better prediction at different time scales,
- Tighter and real time information exchange with grid operators (“smart grid” approach)
- Storage technologies in extreme cases, like islanded systems.

Coming now to the sessions dealing with the interface between Technology, Science and Society, contributions covered the following aspects:

The global environmental policies at world level were examined first through the effectiveness of the Kyoto protocol on Green Houses Gases Production. A second lecture dealt with the analysis of the Copenhagen process and the different ways to consider it as a failure or a success, particularly by revisiting both scientific and political frames of the climate change regime.

The lack of instruments to help the CDM process (Clean Development Means) was clearly identified. In fact, because two-thirds (7900 Mtoe in 2006) of world energy are consumed in cities contributing roughly 80% to global GHG emissions, and because most of increased urban population and demand for energy in cities will come from developing countries over the next decades, it is important to examine the role of carbon finance in the governing of urban infrastructures in developing countries. Existing instruments need improvement: so far, there is no systematic and comprehensive approach with appropriate financial and technology support , and the existing financial tools including carbon finance (CDM) do not allow cities in Developing Countries to change substantially the course of development to avoid the long-term energy and carbon lock-in.

An interesting association combined two lectures, dealing on one hand with the implementation of the Grenelle II law in France (help and constraints for building renovation) and, on the other, the Modeling the efficiency of economical measures enforced to reduce CO2 emission in residential sector. The model includes 216 typical renovation work scenarios, and their energy performance has been assessed using the official energy performance diagnosis method.The results provide the impact of energy efficiency measures in the residential sector:

- Energy efficiency tax credit reform
- Thermal performance modification
- Zero interest loan introduction
- Influence of Carbon tax ?

Such an example appeared convincing to shows how to the modelling can help to prepare the law and how to process its follow on.

Finally a last type of contributions dealt with the international environmental law, the question of damage liability in the context of environmental catastrophes linked to energy production (case of BP in Mexico gulf).

Forward Look

(1 page min.)

- *Assessment of the results*
- *Contribution to the future direction of the field – identification of issues in the 5-10 years & timeframe*
- *Identification of emerging topics*

Good quality of the presentations and, as a consequence, effective discussions could take place with high scientific quality exchange.

Future directions of issues:

Urban infra structure (utility and transport networks, water and flood management structures, underground networks…) for which the energy needs become now a challenge.

Considering the example of the impact of Compressed Natural Gas conversion of motor

vehicles in Dhaka on the air quality, climate benefits and the number of premature death avoided, extension of such improvements using new internal combustion technologies , and also air quality measurements and population health control will be generalized.

Same remark with the domestic combustion for cooking (1.3 millions death per year, same order as for malaria or tuberculosis).

Still a necessity for a mix of energy sources with specific development involving technologies adapted to intermittency (wind, PV…) .

New technologies in the nuclear field for gen IV and for fusion (material science, simulation, and necessity of education efforts).

Emerging topics:

According to the World Energy Council, the rate of fossils will move from 82 % in 2003 to 71 % in 2050. There is then a crucial need to consider the CO2 abatement problem. The technologies of underground sequestration have not yet been demonstrated neither cheap, nor secure and they could be complemented by new ones, less dangerous. In these conditions the new CO2 recycling process with electro photo catalyst process that was presented during the conference (Mrs Perathoner) appears as a new gateway to the problem of CO2 abatement.

The new international environmental law conception appears as absolutely necessary, particularly in the case of environmental catastrophes linked to energy production or transportation.

Modelling and law generation seems also as a promising topic (example of building renovation, but could also concern the solar, biofuels, hydrogen…)

- Is there a need for a foresight-type initiative?

Clearly yes (to be developed)

Atmosphere and Infrastructure

- *The reaction of the participants to the location and the organization, including networking, and any other relevant comments*

There was globally a favourable apreciation of the site and of the organisation. Very intensive discussions, during the sessions and after : for instance after dinner. New contacts have effectively been established.

An interesting point appeared: because of the particularly multidisciplinary nature of the conference, it would be useful , for the next conference, to include specific lectures intended to supply the essential preliminary knowledge to approach the main domain of energy (bio fuels, hydrogen, photovoltaics, nuclear…).

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