The First European Energy Conference –

a joint undertaking of EPS, EuCheMS, E-MRS and ESF

held in Barcelona, 20-22 April 2010

The «First European Energy Conference» was scheduled to start just as the airspace was gradually opened again to traffic, after volcano Eyjafjallajoekull had spewed out ash that had migrated into the atmosphere over Europe with the effect that air traffic over large parts of the continent and over the British Isles had to be halted. Many pre-registered participants therefore had their flights cancelled and couldn't come to Barcelona. Nevertheless, the event was going ahead, albeit with a reduced schedule, running over two and a half, rather than four days. Yet even this abridged version clearly demonstrated the potential of a conference focusing on a vital theme with the collaboration and support of three major European Learned Societies – the European Physical Society (EPS), the European Association of Chemical and Molecular Sciences (EuCheMS) and the European Materials Research Society (E-MRS) – and the European Science Foundation (Figure 1).

With 280 pre-registered participants from 54 countries the interest in the Conference had been high, but in the end only about a third of the pre-registered participants made it to Barcelona. These were mostly younger – apparently more adventurous – scientists and engineers; in fact, only a few of the invited plenary speakers were eventually present in Barcelona. However, the Chair of the Scientific Organising Committee, Augustin McEvoy, was on site. Together with the very few Committee Members, who had arrived in Barcelona, he immediately prepared a replacement programme of 30 talks. All of these were given in plenary session and, after the day's lectures, people gathered in the reception area of the auditorium, kept on discussing in a relaxed atmosphere with drinks and snacks, and visited the fifty posters displayed.

The conference began on Tuesday afternoon. Two introductory talks set the stage by examining the relation between energy and the environment, and by weighing the 'pros' and 'cons' of the various methods of energy production. Then, as Barcelona was in easy reach for our Spanish colleagues, speakers, who came from Spain, gave the remaining talks of this first afternoon. Owing to its favourable insolation, Spain is a leader in photovoltaics. But Spain's strength, we learned, lies not only in advanced research by skilled and creative scientists and engineers, it also consists of science and management support extended beyond the borders of Spain – to Egypt and even to Abu Dabi.

The two ensuing full days of the conference started out with major keynote talks. On Wednesday, participants were introduced to the European umbrella strategy on energy innovation. This will be brought about through the Knowledge and Innovation Community (KIC) «InnoEnergy», a branch of the European Institute of Technology (EIT). The aim is to boost innovation for sustainable energy; and «InnoEnergy», indeed, is designed to cover the entire energy mix of the EU's Strategic Energy Technology (SET) plan.

«InnoEnergy» will be organised and managed as a business, in the form of a European Company (*Societas Europaea*, SE). It will formally start operating in June 2010 at a number of co-location centres (CCs) that are distributed all over Europe:

- CC ‘Benelux’ in Eindhoven and Leuven will deal with energy-efficient buildings, and address energy efficiency in highly populated areas;
- CC ‘Sweden’ in Stockholm will study and develop a smart super-grid system for distributing electric energy, and also develop methods for energy storage;
- CC ‘Poland Plus’ in Krákow will work on clean coal technologies;
- CC ‘Germany’ in Karlsruhe and Stuttgart will engage in energy from chemical fuels;
- CC ‘Alps Valleys’ in Grenoble (also including Cadarache) will deal with sustainable nuclear technology; and
- CC ‘Iberia’ in Barcelona and Madrid, and extending into Portugal, will address solar, wind and other renewable energies, such as wave and tidal energy from the ocean.

Moreover, a co-location ‘centre’ distributed over most of the continent will be operated under the guidance of industrial companies like *Total* and *Electricité de France* (*EDF*).

Each co-location centre will be involved in research, development and education; for the latter segment, «InnoEnergy» will sponsor some University chairs. Financing will be a mix of seed money from the EIT (i.e., direct EU funding), local contributions, applied-for financing through the EU Framework Programmes and, on a longer timescale, self-supporting income from patents, tuition fees etc. Funding is expected to increase from 50 M€ in 2010 to 156 M€ in 2014. The goals are ambitious: the strategy is supposed to insert 450 students per year into the labour market, and result in 15 patent applications annually.

Thursday, the second full meeting day, started with a keynote talk on ITER. This project – in Latin ‘the way’ – has a broad international participation (Figure 2). ITER is intended to show the scientific and technological feasibility of fusion energy for peaceful purposes. The principal goal is to achieve a gain factor of $Q \geq 10$ by producing ten times the input power of 50 MW, i.e., generating an output power of 500 MW. The site of ITER is now under construction at Cadarache, located in France, about 100 km north of Marseille. The budget, estimated in 2001, of ITER is 5 G€, with 90 % in-kind contributions; 2 G€, i.e., about 40 % of the overall budget has already been committed.

ITER will harness nuclear fusion, the process fuelling the stars, to produce energy on Earth on a large scale. ITER will produce energy

- by using an essentially limitless fuel that is available all over the world,
- without generating greenhouse gases,
- yet operating with intrinsic safety, and
- without producing long-lived/highly radioactive waste.

In contrast to fusion in a stellar interior, where a large volume is

available and high pressure prevails, fusion on Earth takes place in a ‘magnetic bottle’, which confines the plasma within a volume – in the case of ITER – of 830 m^3. At least in the beginning, the fusion will occur between deuterium and tritium nuclei (rather than between protons as in the stars) and at temperatures of about $2x10^8$ K to $3x10^8$ K. The plasma will be heated by a current of 15 MA running through the vessel, and contained by a magnetic field of 5.3 T that is maintained by 48 superconducting coils. The fuel efficiency of the process is remarkable: 1 g of fusion fuel corresponds to 8 t of oil; on the other hand, the ITER machine will be rather large. With a height and width of ca. 30 m each, it will be nearly twice as tall, and about as wide but several times as deep as the Brandenburg Gate in Berlin.

Looking at the way fusion power has taken in the past and is expected to take in the future, one may say that the European JET, the American TFTR and the Japanese JT-60 machines have proven the science by maintaining output power, in the case of JET, up to 16 MW for a few seconds. ITER’s aim now is to prove both science and technology. It is expected that a power of 500 MW – over at least 400 s, but eventually up to steady state – can be generated by 2027. Given sufficient political support, this could then lead to an overall proof of science, technology as well as economy, with an output of 3 GW, towards the middle of the 21st century.

The alternative method to achieve fusion, namely heating by laser radiation where the plasma is contained by inertia – a method advanced predominantly in the USA –, was presented as well. This is to be pursued now in Europe by the proposed **Hi**gh **P**ower laser **E**nergy **R**esearch (HiPER) project.

While commercial power-generation by fusion lies still in the future, nuclear power stations generating their energy by fission, are numerous and have been in operation for a long time – most of these reactors are over 20 years old, some of them even 40 years. Worldwide, 440 such reactors generate 15 % of the electricity. 146 of these reactors are in Europe. Their fuel comes from politically stable countries, such as Australia and Canada. An initial mixture of 97 % of ^{238}U and 3 % of ^{235}U ‘burns’ to 94 % of ^{238}U, 1 % of ^{235}U, 1 % of Pu and 4 % of fission products. The problem arising from the latter – highly radioactive waste products generated by nuclear fission reactors – was, of course, also addressed during the Conference. A solution is needed, because the current energy production by fission generates an amount of waste that requires a Yucca-Mountain sized repository (the currently envisaged large US underground storage facility) every 20 years. However, a potential solution, actinide burning in a generation-IV reactor – a so-called breeder reactor – requires a much better knowledge of the neutron cross-sections. The «n_TOF» (neutron time of flight) project at CERN, produces the needed accurate cross sections. While these measurements initially had to be made almost exclusively by staff members, there is now an even participation of students and staff – giving hope that a new generation of physicists knowledgeable in nuclear sciences is being educated to deal in future with the problems of fission reactors.

The problem of efficiently storing electric energy was addressed in

a talk on ‘putting traction batteries on the road’. This gave an interesting insight in the challenges being faced in the development of batteries (cf., Figure 3).

Given the reduced size of the meeting, all participants also got to hear talks that originally had been scheduled for specialised parallel sessions. This resulted in a kaleidoscopic view of work in energy-related issues that is carried out in Europe.

The spectrum of talks reached from experiments with bio-fuels, over efficient storage of hydrogen – in liquid form on carbon nanofibres or at moderate temperature in calcium hydride/magnesium boride composites – to low-energy architecture achieved through evaporative cooling of buildings by porous wall materials. Issues, such as forecasts of electricity demand (reaching from long-term to hourly predictions) and the use of superconductors in energy grids further expanded the range of topics.

In addition to the scientific-technical talks, a philosophy student (with an engineering background) led the audience through a discussion of social and ethical considerations: he showed that intergenerational justice is intertwined with sustainability and thus reminded everybody that we must include the posterity’s interest in all our endeavours.

In a final talk entitled ‘Proper funded – well prepared for energy research’, the participants were shown the widely ranging programmes of the EU, where funds for energy research can be applied for. This topic is scheduled for a ‘feature’ in a forthcoming issue of EPN. It was also announced that the journal ‘Energy and Environmental Sciences’ would publish a special issue with refereed versions of talks given in Barcelona.

The impressive dedication of the conference organisers was gratefully acknowledged! The participants thanked the staff of the ESF Conference bureau, who had made their way by car from Brussels, as well as the members of the Scientific Organising Committee, who were present in Barcelona. Together, they had succeeded in turning a meeting that may have seemed doomed, when many speakers and participants cancelled their attendance, into an enlightening and highly enjoyable experience!

In conclusion, it is to be hoped that a second European Energy Conference of the same multi-disciplinary style – i.e., involving EPS, EuCheM, E-MRS and ESF – will be organised again in two years’ time. Indeed, if this reduced version of a European Energy Conference was so fascinating, how will it look like in full deployment?

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Some of the mostly young participants of the First European Energy Conference. (Photo: Piotr Swiatek, Forschungszentrum Jülich)