EC/ESA Workshop "Space & Energy" – 15 January 2010 – ESA HQ, Paris

Synthesis of the work performed in splinter sessions

Space applications for energy policy enforcement

Norela Constantinescu (EC DG-TREN) - Erwin Duhamel (ESA DG-P)

The splinter session on energy policy enforcement was attended by representatives of different services of ESA, European Commission, Member States and European Energy Research Alliance.

The exchanges of views were structured along few identified policy enforcement issues: sustainability criteria for biofuels and biomass, monitoring of energy savings in buildings, monitoring of infrastructure projects like those developed in the European Energy Recovery Plan, monitoring of CO_2 storage as well as provisions to support the logistics of nuclear waste and fuel

The *general remarks* can be summarised as following:

- Recommendation first to screen the already existing services such as those provided by EUROSTAT, EC, UN. Some procedures already exist, e.g. GMES user forums, and should be used
- Deeper exchanges between the direct users of possible applications and ESA experts are needed to understand the requirements and to identify the next steps for further cooperation: launching feasibility study, pilot + demo project and passing then to operational phase

Possible *concrete actions* on cooperation between ESA and EC:

- **Sustainability criteria for biofuels and biomass**:

The main elements revealed by the discussions were

- the enforcement of sustainability criteria should be addressed worldwide and not only in Europe. The global monitoring of the land use is only possible from space (NO_2, import control, etc)
- technology is probably not an issue but understanding the requirements (e.g. resolution of the images, the needed frequencies) should be the first step which will allow further assessment of available space applications and of their costs
- legal aspects and regulatory issues have to be also considered
- Further considerations and possible links with water supply, deforestation, climate change can be envisaged

The enforcement of sustainability criteria for biofuels and biomass can greatly benefit from space application (Earth observation programme). Land use and to a certain extent biodiversity issues and indirect land use can be monitored

from satellites. ESA expertise could be used directly for this purpose. A first contact and screening can be established with GMES/DG Enterprise and Eurostat. A small working group on how to take this initiative further might be envisaged.

- **Energy efficiency:**
  - The space applications can be used as first screening to identify the heat losses/ hot spots but the present technology can not be directly used for monitoring buildings.
  - Space should complement local measurements (for updates, quick assessment). Studies are on-going in ESA Directorate of Earth Observation Programmes. Interaction with EC services is possible at this stage.

- **CO_2 storage:**
  - ESA has a feasibility study foreseen in 2010 for an EU utility to investigate the requirements for monitoring CO_2 storage. At this stage the space applications for the CO_2 monitoring are not as mature as for biofuel applications
  - The feasibility study and the pilot projects can become a good base to identify the possibilities for using space applications for CO_2 storage monitoring.

- **Infrastructure projects** (European Economic Recovery Plan)
  - Earth Observation applications can be directly used for monitoring the development of infrastructure projects:
    - Offshore wind
    - Carbon Capture & Storage
    - Interconnections
  - Space applications already work for utilities in monitoring existing infrastructures (e.g. to reduce maintenance costs of high voltage lines).

- **Nuclear:** provision of support to the logistics of nuclear waste and fuel

- **Other uses:** Several applications can also be useful for transport sector

Space Applications for energy systems management

Massimiliano Esposito (EC DG ENTR) and Pierre-Philippe Mathieu (ESA D/EOP),

The session was attended by 10 people. Most of them were representatives of the Space sector (8, as ESA, DLR, CNES); 2 representatives from the Energy sector (Technology platforms: Wind and Carbon Capture Storage).

Session's Focus:

- It was recognised that the session's theme is very wide. Space applications can support Energy sector by delivering accurate and timely information for the Exploration (e.g. Renewable Energy, Oil & Gas seismic survey), Production (renewable, O&G), Transport (e.g. nuclear, oil spill, Arctic) to Exploitation (e.g. grid) and energy efficiency.
- A certain agreement was reached on the time scale: the focus was on short-term. For some projects this meant already this year.

The Objectives of the session were:

- Define what to do and how to exploit the potential of space applications in the energy sector
- Identify some Pilot actions to implement taking into account the maturity of the applications and the high impact for EC strategy
- Identify mechanisms for collaboration

The first question to be addressed is: Who are the Users?

- Governmental - Policy-driven user (e.g. EC, National Government...)
- Industry (or umbrella organisation)
- Citizen (end-user)

And then what are their needs?

- Basically "no space-related" questions (e.g. how to manage resources, how to improve transport, improve energy efficiency…)

What are the solutions from Space or what Space can contribute to the solution?:

- Information services (e.g. from data to service),
- New technology

What are the concerns? :

- Cost (effective?, value-added of space vs traditional methods)
- Continuity (operational vs research)

What could be pilot actions? Some have been identified:

- Mapping of Renewable Energy resources at EU level (e.g. biomass) with Earth Observation satellites
- CCS (e.g. interferometry, GNSS)
- Smart Grids

Are they:

- Technically possible? Some are mature, on a small scale
- Economically possible? Need of seed funding
- Legally possible? Analysis is needed
- By when can it work? NOW … but need to scale-up

Any need for international cooperation? YES. For example with some international organisations like IEA, GEO, IAEA,..

Who should validate pilot proposals? :

- EC (DG-TREN) could for policy enforcement, other applications to be checked together with industry and stakeholders (including the users)

Some ideas for cooperation mechanisms have been identified: ESA-EC cooperation, including ESA participation (on an ad-hoc basis) with the Technology platforms (cluster of end-users, roadmap), and also the industrial Initiative.

Offer from Technology Platforms: ESA should send proposed projects for review and comments.

ESA role: technical oversight

It has been recognised that important role is played by increasing the AWARENESS / COMMUNICATION about existing techniques.

Transfer of technology

Carrie Pottinger (IEA) - Aude de Clercq (ESA, TTPO)

The technology transfer (TT) group welcomed the opportunity to explore with ESA and the European Commission the opportunities for collaboration between the space and energy sectors. TT group members recognised the challenges to governments to extract the greatest results from RD&D funding, and, as a result, regarded this workshop as a key first step to achieving substantial knowledge transfer between the two sectors.

The group examined the existing and potential applications for TT. Three priorities areas were chosen and the rationale for those choices was detailed for workshop participants. Finally the TT group proposed a mechanism for the priority applications to be implemented.

Status and Potentials

There are existing technologies developed for space with immediate applications or adaptation for the energy sector and vice versa (for example thin film for solar). In discussions, experts in the technology transfer (TT) group made an inventory of this and other current examples and explored potentials for technology transfer between space research and energy applications, notably:

- Robotics: Oil and gas exploration, geothermal exploration, remote renewables locations such as offshore wind, and large-scale solar plants.
- Advanced materials: Reducing weight (carbon fibre, alloys) and structural (thin films, nano-indentation).
- Energy storage: Electrical, thermal, chemical, hydrogen, circuits, piping
- Monitoring/ maintenance: Mapping renewable resources (solar irradiation, wind speeds, etc.), mapping installations (pipes, electric grids, etc), monitoring and maintenance (smart grids, industrial energy efficiency).
- Energy and water: Increasing water treatment efficiency and breakthrough technologies (e.g. membranes) and identifying water sources through EO.

Priorities and Rationale

Among the status and potentials identified, TT group members felt the following priority areas for combined space and energy research efforts as they have the greatest potential energy gains, cover a wide range of industries and energy systems, and are obtainable in the near to medium term:

1. Thermal control: For example using multi-layer insulation film (MLI) for increased insulation in buildings, district heating networks, industrial processes, high-temperature superconducting cables for offshore wind, or internal combustion engines. Though MLI is widely used for thermal control in space it has not yet been widely developed for energy-saving applications on earth. MLI

is therefore an existing application that requires no further R&D yet holds substantial potential for energy savings in a broad range of sectors and specific applications as outlined above in the near term.

2. Energy storage: Such as renewables/distributed generation, electric vehicles, and hydrogen storage. No significant research programmes are currently dedicated to this area, which leads to a gap in both space and energy research. Fuel cells for auxiliary power units are useful but require large volumes and do not have high energy densities. Lithium-ion batteries are relatively compact with high energy densities, though concerns about lithium supplies have not been fully analysed. Joint collaborative R&D between space and energy could lead to innovative breakthroughs in the medium-term, leading to a change in the landscape of current energy systems and supply security.

3. Advanced materials: Including vehicle efficiency, wind turbines, solar PV and concentrated solar power. There has been a significant amount of research into materials in order to more efficiently launch payloads into space and to conserve energy during operations. Efficiencies of solar PV cells and concentrated solar power have improved through technology transfer from the space industry. Potentials are great for lightweight materials such as carbon fibre in the transport (road and air) sector, though competition issues bar the technology from widespread deployment which would lower costs. Non-proprietary governmental research could help bring down costs in this area in the near term.

Pathways to Implementation

Due to the deep, largely parallel tracks of research in both sectors, TT group participants highlighted the importance of bringing together experts from both space and energy (both public and private) to work together to spur innovative pathways to wider deployment and breakthrough applications. Innovation is a non-linear process and is the key to solving any problem.

TT experts pointed to the difficulty in finding the right actors in stakeholder communities (industry, governments). Maximizing the convening power of our collective organizations to organize industry focussed events was one solution. It was generally agreed that be effective (time, money) collaboration should begin at the outset of a project with a focus on the needs.

To achieve this, the TT group recommends creating a SETPlan or a separate line in the Framework programme or other international collaborative mechanism on cross-cutting issues/technology transfer between space and energy research. The group volunteered to prepare a scoping paper to distribute to the larger group, the European Commission and other interested experts.

Long-term Research

Francesco Pignatelli (EC JRC) and Olivier Minster (ESA D/HSF)

Participants: ESA and EC (JRC and DG RTD) staff, representatives of Member States and European associations such as EERA.

After the plenary presentation that clearly identified the Earth Observation and Navigation (i.e. Galileo) applications for long-term research in the field of energy as a potential collaboration between EC and ESA, the main discussions during the session were oriented around the research done by ESA in and for space.

A large share of the session was taken up by presentations by the ESA Human Spaceflight Directorate about ongoing projects at ESA that could be relevant for EU policy, e.g. the IMPRESS project on gas turbine blades and catalytic powders, a project on thermo-diffusion in hydrocarbon wells, research on nucleate boiling and related materials issues, high-efficiency photovoltaic Si crystallization from metallurgical Silicon feedstock, combustion under microgravity, and the PYROMET project on metallic powder fuels. The space elements of these projects were submitted in response to regular ESA announcements of opportunity and reviewed by independent external peers.

During the discussion that followed, it became clear that there are large areas of potential collaboration between the energy and space sectors. The two sectors are still in a process of learning what each aims at, and what each can realize as a basis for how to collaborate, and there is significant integration work to be done. The concise summary presentation of the splinter session – which was presented to the plenary – listed a non-exhaustive list of topics on which collaboration may be envisaged:

- research in space:
    - measurements in support of CO_2 sequestration
    - research in heat transfer
    - research on crystallisation of photovoltaic materials
    - combustion research on liquid fuels
    - combustion research on solid fuels
    - light-weight alloys
- research for space with energy applications or vice versa:
    - high efficiency photovoltaic, development testing and benchmarking
    - power management and distribution
    - Li ion batteries
    - heat pipes
    - thermal coatings
    - bioreactors for life support systems
    - thermoelectric conversion
    - fuel cells testing and benchmarking
    - nuclear for space

- information for transport
- space based solar power;
- SETIS
- space based monitoring of energy critical infrastructures

The group stated that:
[1] The link [of ESA research] with EERA and other energy-oriented efforts in Europe appears natural;
[2] Further detailed expert discussions should be promoted to arrive at the definition of an R&D programme that could be justifiably sponsored by EC and that would accept the inclusion of space as an enabling technology (either tool or application).