Strengthening cooperation between EU and MENA: lessons learnt from EU R&D programmes to stimulate industry involvement

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RES policy developments in the European Union

On 10 January 2007, the European Commission issued a communication "*Renewable Energy Road Map. Renewable energies in the 21st century: building a more sustainable future*"[1]**.** In the Road Map, the Commission proposes a new legislation that should:

– be based on long term mandatory targets,
– include increased flexibility in target setting across sectors,
– be comprehensive, notably encompassing heating and cooling,
– provide for continued efforts to remove unwarranted barriers to renewable energies deployment,
– take into consideration environmental and social aspects,
– ensure cost-effectiveness of policies, and
– be compatible with the internal energy market.

The new framework proposes:

- An overall legally binding EU target of 20% of renewable energy sources in gross inland consumption by 2020,
- A minimum target for biofuels of 10% of overall consumption of petrol and diesel in transport for 2020.

The new framework will propose measures to improve the Internal Market and **remove the barriers** to developing renewable energy in the electricity sector and the heating and cooling sector by, for example, reducing the administrative burden, improving transparency and provision of information, and adjusting and increasing the number of installations and interconnection systems. Additional measures will be proposed to **support, encourage and promote** renewable energy sources, including an incentive/support system for biofuels and the use of public procurement, particularly in the transport sector. Under the new framework, an enhanced cooperation among those involved in the renewable energy sector (grid

[1] Communication from the Commission to the Council and the European Parliament, Renewable Energy Road Map, Renewable energies in the 21st century: building a more sustainable future, (COM(2006) 848 final, Brussels, January 2007.

authorities, European electricity regulators and the renewable energy industry) to enable **better integration of renewable energy sources into the power grid** is envisaged.

The new legislative framework is expected to be finalised by the end of 2007.

Bridging the gap between R&D and markets: Europe in practice

In this context of complex interaction between global actors, it is essential that EU continues to **support research and innovation but also to assess and be forthcoming in meeting the needs of the markets to ensure a speedy deployment of innovative solutions.** Creating the framework conditions and incentives for the development and take-up of new energy technologies is a matter of public policy. A whole range of instruments is available at European and national level to help accelerate technology development (technology push) and the market introduction process (demand pull). The following is a non-exhaustive inventory of such instruments[2]:

– ***Technology push instruments:*** EU Research Framework Programme and associated initiatives (e.g. European Research Area Networks scheme, Risk Sharing Finance Facility of the European Investment Bank, Infrastructures for research, Joint Technology Initiatives and other possibilities under Articles 168, 169 and 171 of the EC Treaty and Title II of the Euratom Treaty), European Coal and Steel Research Fund, national research and innovation programmes, venture capital and innovative financing mechanisms, European Investment Bank, Structural Funds for innovation, COST, EUREKA, European Technology Platforms.

– ***Demand pull instruments:*** EU directives setting targets and minimum requirements, performance regulations, pricing policies (Emissions Trading Scheme and fiscal instruments such as energy taxation), energy labeling, standards policy, voluntary agreements of industry, feed-in tariffs, quotas, obligations, green and white certificates, planning/building regulations, grants for early adopters, fiscal incentives, competition policy, public procurement policies, trade agreements.

– ***Integrated innovation instruments:*** The proposed new European Institute of Technology (EIT) will play an important role in enhancing the relations and synergies between innovation, research and education. The Seventh Framework Programme, seeks to remove non-technological barriers that prevent market take-up. In addition, the lead market approach announced in the recent innovation strategy could lend itself well to the launching of large-scale strategic actions aimed at facilitating the creation of new knowledge-intensive energy markets.

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[2] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions towards an European strategic energy technology plan, Brussels, 10.1.2007, COM(2006) 847 final

The **Seventh Framework Programme for Research and Development.** The framework programme will run for seven years, from 1 January 2007 to 31 December 2013. The budget allocated is €3.621 billion for the whole period with the following indicative breakdown: 60% of the overall budget (€2.170 billion) is allocated to the Entrepreneurship and Innovation Programme, one fifth of which (€430 million) being earmarked to promote eco-innovation. 20% of the overall budget (€730 million) has been allocated to the ICT Policy Support Programme, and the last 20% (€730 million) is for the Intelligent Energy - Europe Programme.

- The ***European Research Council (ERC)***[3] is the first pan-European funding body set up to support investigator-driven frontier research. The main aim of the newly-established body is to stimulate scientific excellence by supporting and encouraging the very best, truly creative scientists, engineers and scholars to be adventurous and take risks in their research. The ERC complements other funding activities in Europe such as those of the national research funding agencies, and is a flagship component of the 'Ideas Programme' of the European Union's Seventh Framework Programme (FP7). The ERC has pre-allocated most of the 2007 funds to three broad domains, based on the pattern of allocations in research-intensive countries throughout the world: 15% for Social Sciences and Humanities (SH), 40% for Life Sciences including Medicine (LS) and 45% for Physical, Mathematical and Engineering Sciences (PE). Multidisciplinary evaluation panels (5 in SH, 7 in LS and 8 in PE) were constituted to cover all fields. Five panels (3 in PE and 2 in LS) were very heavily subscribed, with 672-768 applications each.

- The ***Intelligent Energy Europe Programme***[4] helps speed up efforts to achieve the objectives in the field of sustainable energy. It supports improvements in energy efficiency, the adoption of new and renewable energy sources, greater market penetration for these energy sources, energy and fuel diversification, an increase in the share of renewable energy and a reduction in final energy consumption. The second Intelligent Energy – Europe programme started in early 2007 as part of a broader EU programme called “Competitiveness and Innovation”.

- The ***High Growth and Innovative SME Facility (GIF)*** promotes the supply of seed and early-stage capital for SMEs for their start-up, and a new feature introduced by the Competitiveness and Innovation Programme is the provision of "follow-on" capital during their growth phase. The SME Guarantee Facility, for its part, facilitates access for SMEs to financing (loans or leasing), microcredit and equity or quasi-equity. This facility also includes

[3] For more details see http://erc.europa.eu/index.cfm?fuseaction=page.display&topicID=26.
[4]For more details see http://ec.europa.eu/energy/intelligent/index_en.html

a new securitisation instrument for bank loan portfolios to help mobilise additional loan financing for SMEs.

The objective of the **European Technology Platforms (ETPs)**[5] is multifold:

- To provide a framework for stakeholders, led by industry, to define research and development priorities, timeframes and action plans on a number of strategically important issues where achieving Europe's future growth, competitiveness and sustainability objectives is dependent upon major research and technological advances in the medium to long term;
- To play a key role in ensuring an adequate focus of research funding on areas with a high degree of industrial relevance, by covering the whole economic value chain and by mobilising public authorities at national and regional levels. In fostering effective public-private partnerships, technology platforms have the potential to contribute significantly to the renewed Lisbon strategy and to the development of a European Research Area of knowledge for growth. As such, they are proving to be powerful actors in the development of European research policy, in particular in orienting the Seventh Research Framework Programme to better meet the needs of industry.
- Address technological challenges that can potentially contribute to a number of key policy objectives which are essential for Europe's future competitiveness, including the timely development and deployment of new technologies, technology development with a view to sustainable development, new technology-based public goods and services, technological breakthroughs necessary to remain at the leading edge in high technology sectors and the restructuring of traditional industrial sectors.

The essence of the **European Strategic Energy Technology Plan (SET-Plan)**[6] will be to match the most appropriate set of policy instruments to the needs of different technologies at different stages of the development and deployment cycle. The consultation process has now been closed and the Commission intends to put forward a First European Strategic Energy Technology Plan by the end of 2007.

Boosting renewable energy and energy efficiency technology calls for investment, in particular in developing countries and emerging economies. Although the prospects are promising, several factors block the participation of private-sector investors and projects and businesses have major difficulties in raising risk capital, which provides vital collateral for

[5] For more details see: http://cordis.europa.eu/technology-platforms/home_en.html

[6] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions towards an European strategic energy technology plan, Brussels, 10.1.2007,COM(2006) 847 final

lenders. One of the key reasons causing this block to investments is the significantly higher cost of initial investment in renewable energy generation than for conventional energy. While these costs are compensated by much lower running costs, private-sector investors still regard the longer repayment periods as too risky. The various risks in developing countries are another hurdle, which means that investors look for additional reassurances. Moreover, renewable energy technologies are often suited to small and medium sized projects with less than €5-10 million in total capital, whilst international finance institutions and the private sector traditionally do not invest in such small-scale projects. The regulation to establish the ***Global Energy Efficiency and Renewable Energy Fund*** was adopted on 6 October 2006[7]. The GEEREF will establish a public-private partnership by offering ways of risk sharing and co-financing for projects investing in renewable energy and energy efficiency. The fund will mainly target the raising of "patient" risk capital, in other words, capital invested with a long-term prospect of return on the investment. GEEREF participation will range from between 25 and 50% for medium to high-risk operations to 15% for low-risk operations. Provision will also be made for dedicated technical assistance funds. Rather than providing finance directly to projects, GEEREF will help create and fund regional sub-funds or scale up similar existing initiatives. Sub-funds will accommodate the specific conditions and needs of each region. The GEEREF will support projects and businesses engaged in improving energy efficiency and renewable energy. Priority will be given to deploying environmentally sound technologies with a proven technical track record. Special focus will be given to investments of less than €10 million since they are often ignored by commercial investors and international financial institutions. Regional sub-funds will be set up for the African, Caribbean and Pacific (ACP) region, North Africa, non-EU Eastern Europe, Latin America and Asia. The minimum funding target for the GEEREF was set at €100 million for it to have a meaningful impact at global level and to be sufficient to establish a public-private partnership that will be self-sustaining over time. An initial budget of €100 million should be enough to harness additional risk capital, through the sub-fund structure, of €300 million and, in the long term, up to €1 billion. The European Commission intends to contribute €80 million to the GEEREF for the period 2007-10 with an initial contribution of €15 million proposed for 2007. International financial institutions, such as the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD), private-sector investors and other financial intermediaries have already expressed their intention to contribute to this initiative. Member States, members of the European Economic Area (EEA) and other financial institutions are also invited to participate.

[7] Communication from the Commission to the Council and the European Parliament on: "Mobilising public and private finance towards global access to climate-friendly, affordable and secure energy services: The Global Energy Efficiency and Renewable Energy Fund" (COM(2006) 583 final - Not published in the Official Journal)

Europe's achievements in RES development; Examples from solar PV, CSP and wind power industries

a. Solar PV[8]

The total installed capacity of photovoltaic (PV) systems in the EU in 2005 was 2 GWp, which represents approximately 0.3% of the total EU electrical capacity (706 GW in 2004). To put these figures in a global perspective, the cumulative PV capacity installed worldwide in 2005 was 5 GWp. The annual global production of PV modules was approximately 2.5 GW in 2006 showing an annual growth rate of 40%, on average since 2000. From these figures it is apparent that Europe, and more specifically Germany, has a pivotal position in the sector, sharing with Japan and the USA, mainly California, 80% of the global market. The global business value of the sector is estimated to be €12.5 billion. Today the average turn-key system price is €5/Wp and the efficiency of commercial flat-plate modules and of commercial concentrator modules is up to 15% and 25%, respectively. The typical system energy payback time depends on the location of the installation. In Southern Europe this is approximately 2 years and increases at higher latitudes. Finally, the average generation cost of electricity today is about 30€c/kWh, ranging between 20 and 45 €c/kWh depending on the location. Deployment will take advantage of cost reductions resulting from, among other factors such as learning effects from the increased installed capacity in southern Europe. In addition to learning effects and the scale up of production, innovation will contribute to reducing costs and making this technology more cost competitive. Overall, the cost of a typical turn-key system is expected to be halved to €2.5/Wp in 2015, to €1/ Wp in 2030 and to €0.5/ Wp in the longer term. Simultaneously, module efficiencies are expected to increase. Flat-panel module efficiencies can reach efficiencies of 20% in 2015, 25% in 2030 and up to 40% in the long term, while concentrator module efficiencies will reach 30%, 40% and 60% in 2015, 2030 and in the long term respectively. As a consequence, the cost of electricity is expected to be competitive with the price of retail electricity in 2015, reaching 15c/kWh, and be competitive with wholesale electricity (6 €c/kWh) in 2030. Ultimately, the long term objective of the sector is to generate electricity at 3 €c/kWh and reduce the system energy payback time to 1 year in 2015, 6 months in 2030 and 3 months in the long term in southern Europe. Obviously, the corresponding figures for Northern Europe will be longer. Crystalline silicon-based systems are expected to remain the dominant PV technology in the short term. In the top-10 PV system manufacturers there are 4 European companies. The annual

[8] This section draws heavily on the *Report on the Hearing of the Photovoltaic European Technology Platform*, EC-JRC, Institute for Energy-Energy Systems evaluation unit, May 2007, Brussels.

turnover of the European PV industry is 10-12 billion euros. It was noted however that in 2005, EU was a net importer of PV systems.

b. *Concentrated Solar Power*[9]

After 10 to 12 years of decline, the concentrated solar thermal power sector (CSP) is now reviving due notably to a favourable supporting framework in Spain and increasing investments in the US. The most mature technology today is the parabolic trough system. The technology is mature, with a lifetime of about 25 years. There is a supply chain industry already able to offer turn-key equipments for power plants in the range of 10 to 50 MWe. As a result, this technology attracts more and more investors in the power community. In Spain, for instance, 20 to 30 projects of 50 MWe size are planned, which if realised, would amount to 3 times the 500 MWe objective set by 2010. Depending on the solar irradiance (IR), the cost of electricity production is currently in the order of 20 c€/kWh (South Europe – IR: 2000 kWh/m2/a). This cost can be decreased by 20% to 30% if the IR is in the range of 2300 or 2700 as encountered in other world regions such as Sahara, the US and the Middle East. One important asset of CSP technologies is its ability to store thermal energy, which allows for levels of dispatching compatible with conventional medium load power generation technologies. In terms of margins of progress, if one targets 5 GWe installed worldwide by 2015, a cost reduction by a factor 2 can be expected for current technologies, yielding to electricity production cost of the order of 10 c€/kWh in the EU, and to 7 to 8 c€/kWh in the US.

c. *Wind energy*[10]

Today, installed wind capacity in the EU is roughly 50GW, about 2/3rd of global capacity. The annual growth rate for the sector has been approximately 25% over the last few years. The EU is at the forefront of innovation in the field of wind energy with a specialised and innovative chain of suppliers and a unique know-how (largest rotor, test facilities, etc.). European companies constitute 80% share in the global market. The component supplier industry in Europe includes some 1000 SMEs, and the majority of employment in the sector is in SMEs. A shortage of human resources is currently being experienced in this field within the EU. In recent years there has been increased wind deployment in other parts of the world, such as North America and Asia, mainly with European technologies. In terms of

[9] This section draws heavily on the *Report on Concentrated Solar Power Technology Platform,* EC-JRC, Institute for Energy-Energy Systems evaluation unit, May 2007, Brussels
[10] This section draws heavily on the *Report on European Wind Energy Technology Platform,* EC-JRC, Institute for Energy - Energy Systems evaluation unit, May 2007, Brussels

technological status of the sector, at present, on-shore technology represents the vast majority of the installed capacity. The main technological trend of the wind sector is towards up-scaling of present technologies, and moving towards increased deployment offshore. New overall turbine design concepts are not expected, but new technology components are expected for blades (materials), generators, bearings and power control electronics. Grid integration remains an important issue/barrier, which will be amplified with larger penetration of wind electricity in the near future. On-shore technology represents the vast majority of the installed capacity, but off-shore is steadily growing and is expected to constitute 50% of EU installed capacity in the long term. Based on the European Vision at the root of the Wind European Technology Platform (ETP), targets for the sector are 75 GW by 2010 and 180 GW (30% of which offshore) by 2020. Projections to 2030 are for 300 GW (150GW offshore) of installed wind capacity. After 2030, a stabilisation in the market is foreseen, with the market structure shifting from additional capacity to replacement capacity. At present 7 of the top 10 wind turbine manufacturers are European companies.

Technology innovation and technology transfer: lessons learnt in Europe

A successful process of technological innovation entails at least four important actions that need to be undertaken in parallel to some extent: measures to reduce barriers that inhibit the innovation process, a flexible capacity building programme, measures for early adoption of promising technologies and allocation of financial resources tailored to the stage of development of the respective technology.

Technology transfer represents a concerted effort, often by both public and private sector actors, to enhance the transfer process for selected technologies for a particular purpose. In both, developed and developing countries, technology transfer efforts typically require a change of technology regime[11]. A technology regime can be defined as a set of parameters that establishes boundaries to possible solutions to the design of specific products but also includes the market and social context in which the technology operates and the dynamics of the required market transition. In this respect, the following factors could be important[12]:

- Available knowledge and expertise;
- The presence of early niche markets;
- Identification of possible competitions with other industries but also synergies;
- Scope for economies of scale to achieve cost reductions;

[11] David M. Kline, Laura V. and Ron B., *Clean energy technology transfer: a review of programs under the UNFCCC*, NREL, 2003

[12] Ibid 10

- Establishment of an actor network (suppliers, customers, regulators) whose semi-coordinated actions are necessary to bring about substantial shift in interconnected technologies and practices,
- Overcoming and accommodation of social opposition and consumer resistance.

Examples[13].

In the solar PV industry, the difficulty in starting to integrate thin films arises from the lack of interaction between architects/civil engineers and PV designers. Furthermore, construction and building codes need to be changed and the awareness of constructors and house designers in PV systems needs to be raised. Finally, the issue of the limited lifetime of thin films needs to be addressed. The limited availability of silicon feedstock has slowed down the production of modules and the penetration of the technology in the recent years. According to the experts however, the issue of silicon supply will be resolved by 2009-2010. The shortage of silicon availability has been a consequence of the lack of development of new silicon purification facilities in the past years. It is notable that just 5 companies produced 85% of the silicon needs worldwide in 2005, 4 of which are heavily involved in the microelectronics sector. With respect to CSP, the European industry has currently an important know-how, both in terms of plant construction and operation and component manufacturing. The European internal market with favourable environments such as feed-in tariff schemes in Spain is critical to enable the demonstration of EU technology and gain market shares abroad. It is worth noting that Member States, such as Germany with limited prospects for CSP implementation is one of the leaders in the component supply industry. When it comes to wind power, large scale penetration of wind electricity requires robust and compatible transmission and distribution grid infrastructures. Currently, the majority of effort for wind integration is done by the wind energy sector in complying with grid specifications. Grid standards are still defined with respect to conventional systems. Increasing shares of wind energy will require a change in the entire grid philosophy, and shared progresses from wind technology and grid systems. However, for enabling technologies such as those related to storage and grid management, shared mechanisms for investments should be found, as they are beyond the scope of wind energy alone.

There could be different delivery mechanisms for technological transfer, such as transfer of equity in a company possessing the desired technology, license agreements with owners of the technology, purchase of equipment containing the technology, paying directly for the know-how involved, hiring personnel who possess the knowledge about the technology, etc.,

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[13] See *Supra Note* 8, 9 and 10.

but in many cases, one of the major barriers is the transfer of protected or previously classified intellectual property in particular in competitive areas.

Good governance of the process is necessary to identify early on and act upon market failures, such as prohibitive cost of technology information, inefficiency of capital markets, particularly in developing countries, prohibitive costs of entering a new market and market inertia due to lock-in of existing technologies.

Enhanced international cooperation is crucial to achieve the “energy revolution”. In competitive areas in particular, major hurdle to international (and EU) cooperation remains the issue of intellectual property rights (IPR). With regards to pre-competitive areas, cross-cutting issues such as resources mapping and standards could be first priority for cooperation.