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1 Energy Innovation: addressing the structural challenges

Rapid growth in global energy demand coupled with growing concerns about energy security and the environment, have raised questions about the sustainability of the current energy system. The development and deployment of innovative, low-cost, low-carbon energy technologies, energy efficiency (EE) and renewable energy (RE) are needed to reduce emissions, to help create new markets for EU industry and to secure adequate level of supply.

The energy innovation process, from conception to market penetration, suffers from structural weaknesses and barriers:

- long lead times to mass market due to the scale of the investments needed;
- technological and regulatory inertia inherent in existing energy systems;
- 'locked-in' carbon-based infrastructure investments, dominant actors, imposed price caps;
- changing regulatory frameworks and network connection challenges;
- competition from fossil fuels, where the price does not include the environmental and social costs;
- restricted market take-up for some new energy technologies due to social acceptance issues;
- often additional up-front integration costs to fit into the existing energy systems; and
- legal and administrative burdens.

In sum, there may be neither a natural market appetite nor a short-term business benefit for such technologies. This market gap between supply and demand is often referred to as the 'valley of death' for low carbon energy technologies.

The common assertion that governments should only set general frameworks to encourage sustainable innovations and avoid "picking winners" is being challenged on a number of grounds.[1] Firstly, the resources governments can devote to sustainable energy innovation are limited and risk to be spread too thinly. Secondly, carbon markets have yet to demonstrate that they are strong enough to promote low carbon innovation and markets may not bring fast enough needed changes. In addition, high carbon prices may prove not to be sufficient to develop technologies that are not close to commercial status.

Box 1: Key EU technology challenges for the next 10 years to meet the 2020 targets:

- Make second generation biofuels competitive alternatives to fossil fuels, while respecting the sustainability of their production;
- Enable commercial use of technologies for CO2 capture, transport and storage through demonstration at industrial scale, including whole system efficiency and advanced research;
- Double the power generation capacity of the largest wind turbines, with off-shore wind as the lead application;
- Demonstrate commercial readiness of large-scale Photovoltaic (PV) and Concentrated Solar Power;
- Enable a single, smart European electricity grid able to accommodate the massive integration of renewable and decentralised energy sources;
- Bring to mass market more efficient energy conversion and end-use devices and systems, in buildings, transport and industry, such as poly-generation and fuel cells;
- Maintain competitiveness in fission technologies, together with long-term waste management solutions;

Source: SET-Plan COM (2007)723

Against this background, in addition to making use of 'market pull' instruments such as the EU Emission Trading Scheme, the Commission (EC) has argued that public intervention to bring clean technologies onto the market is both necessary and justified[2]. A 'technology push' approach is currently also championed by the US, which has put in place large-scale R&D programmes.

1.1 EU's Strategic Energy Technology Plan

To strengthen the overall effort in Europe to accelerating innovation in low carbon technologies, a European Strategic Energy Technology Plan (SET-Plan) was presented by the EC in November 2007[3]. The plan identifies key EU technological challenges for the next 10 years (see box 1) and proposes to deliver: (i) a new joint strategic planning[4], (ii) a more effective implementation, through the launch of new European Industrial Initiatives (EII), (iii) an increase in resources, (iv) a new and reinforced approach to international cooperation.

[1] Setting priorities in Energy Innovation Policy: lessons for the UK (J. Watson October 2008 - Cambridge, Mass.).
[2] COM(2007)723 SET-Plan EC Communication "Towards a low carbon future".
[3] Idem note 2.
[4] Through the establishment of a Steering Group on Strategic Energy Technologies and organisation of European Energy Technology Summit in the first half of 2009.

In July 2008 the EP welcomed the SET-plan[5] and stated that a European energy technology policy with adequate financial support is fundamental to achieving the EU energy and climate change objectives. The EP also believes that to achieve the targets it is vital to reduce the cost of green energy and to boost innovation in the energy sector.

The EP resolution strongly supports all the proposed EII (see box 2). In particular, the EP calls for biofuels research to be intensified and stresses the importance of developing large-scale biomass to gas conversion to produce hydrogen and liquid synthetic fuels for sustainable transport technologies. The EC is called upon to investigate the possibility of extending the EIIs to other sectors with significant emissions reduction potential such as cogeneration, hydrogen, the construction and housing sector, heating and cooling systems, better energy storage and distribution infrastructures and interconnection of networks. The EP calls on the EC to facilitate the realisation of up to 12 proposed CCS full-scale demonstration projects within the EIIs.

Box 2: European Industrial Initiatives proposed in the SET-Plan

- *European Wind Initiative:* focus on large turbines and large systems validation and demonstration (relevant to on and off-shore applications).
- *Solar Europe Initiative:* focus on large-scale demonstration for photovoltaics and concentrated solar power.
- *Bio-energy Europe Initiative:* focus on 'next generation' biofuels within the context of an overall bio-energy use strategy.
- *European CO2 capture, transport and storage initiative:* focus on the whole system requirements, including efficiency, safety and public acceptance, to prove the viability of zero emission fossil fuel power plants at industrial scale.
- *European electricity grid initiative:* focus on the development of the smart electricity system, including storage, and on the creation of a European Centre to implement a research programme for the European transmission network.
- *Sustainable nuclear fission initiative:* focus on the development of Generation-IV technologies

Source: SET-Plan COM (2007)723

1.2 Current EU innovation initiatives

European Technology Platforms (ETP) were first proposed in December 2002[6]. Their aim is to bring together industrial and academic research communities in specific technology fields with a significant economic and societal impact, to coordinate their research agenda and tailor a common long-term strategic plan for R&D, in a "strategic research agenda" (SRA). The SRA aims to mobilise a critical mass of national, public and private resources and to overcome barriers to the development, deployment and use of new technologies.

In December 2007, 34 ETPs representing a wide range of technological fields were up and running, including ETPs for wind energy, for the electricity networks of the future, for hydrogen and fuel cells, for photovoltaics, for zero emission fossil fuel power plants and for biofuels.[7]

Building on the hydrogen and fuel cells ETP, the Joint Technology Initiative (JTI) on fuel cells and hydrogen (FCH), was established in May 2008.[8] The FCH JTI will run until 2017 and will drive the technology towards commercialisation in the next decade. Between 2008 and 2017, the JTI will have a budget of €1bn with investment shared by its two founding members, the EU (via FP7) and Industry Grouping (NEW IG).

Climate change and energy have been identified as primary areas of focus of the European Institute of Technology, the work of which aims at contributing to the acceleration of commercialisation of innovative technologies.

2 Financing energy innovation

2.1 Public funding mechanisms

Public and private energy research budgets in the EU have declined substantially since peaking in the 1980s in response to the energy price shocks, and this has led to an accumulated under-investment in energy research capacities and infrastructures.[9] If EU governments invested today at the same rate as in 1980, the total EU public expenditure for the development of energy technologies would be four

[5] EP resolution of 9 July 2008 on the European Strategic Energy Technology Plan (2008/2005(INI)).
[6] COM (2002)714 "Industrial Policy in an enlarged Europe".
[7] "Evaluation of the European Technology Platforms" - Final Report for DG Budget (EC) by Idea Consult (December 2007).
[8] Council Regulation setting up the Fuel Cells and Hydrogen Joint Undertaking (8541/08).
[9] Idem note 2.

times the current level of investment of around €2.5bn per year.[10] This declining trend can be observed also in the US[11] although the US's annual allocations are substantially higher than those of the EU.

The Seventh Framework Programmes (FP7) for Research and Development (2007-2013)[13]; the Intelligent Energy Europe (IEE); and the Entrepreneurship and Innovation Programmes under the Competitiveness and Innovation Framework Programme (CIP)[14] are the main sources for EU funding of technological innovation projects.

On 27 October 2008, a European Energy Research Alliance (EERA)[15] was established as one of the outcomes of the SET-Plan. Leading research institutes have committed to use their combined annual R&D budget (>€1.3bn) to strengthen and optimise EU energy research capabilities.

Key research areas promoted include wind, solar energy, second-generation biofuels, smart grids and carbon capture and storage. The first joint EERA programmes are foreseen to be launched in 2009. Cooperation is due to expand and intensify, as other research organisations are welcome to join once the project is properly up and running.

Box 3:	**Budgets dedicated to energy research and innovation**
EU	• €886m/year under FP7 (€574m/year under FP6) - non-nuclear energy research (RE and EE) €168m/year (19%) - nuclear research 40% • €730m over 2007-2013 under "Intelligent Energy Europe" • €30m over 2007-2013 for "eco-innovation" under "Entrepreneurship and Innovation"
US	• $4.4bn for 2007 • $5.3bn per year for 2008 and 2009
OECD[12]	• $9.6bn in support to R&D on energy in 2005, of which: - $1.1bn on energy efficiency and conservation - $1.1bn on renewables - $1bn on fossil fuels - $3.9bn on nuclear

Further resources are required to finance the proposed EII and the EERA. A EC Communication on financing low carbon technologies is expected in early 2009 and will address resource needs and sources, examining all potential avenues to leverage private investment, including private equity and venture capital, enhance coordination between funding sources and raise additional funds.

In particular, it will examine the opportunity of creating a new European mechanism/fund for the industrial-scale demonstration and market replication of advanced low carbon technologies and will consider the costs and benefits of tax incentives for innovation.

The EP SET-plan resolution pointed out that the plan should not be financed through the reallocation of funds made available for energy under FP7 and CIP, and that at least an additional €2bn per year should be allocated as of 2009 to provide adequate financing and support for new low carbon and zero carbon technology R&D, demonstration and commercialisation, independently from FP7 and CIP.

2.2 Private financing mechanisms

Recent studies show that there is still room for substantial growth in private capital investments in European clean energy[16]. The financial sector, including private equity and venture capital, needs to adapt their risk profiles to invest more in potentially high-growth SMEs and spin-offs active in the field of low carbon technologies.

The European Investment Bank is increasingly dedicating resources to energy projects (€7bn/year for 2009 and 2010) and has reinforced its contribution in the areas of RE and EE. It aims to develop less

[10] Idem note 2.
[11] US energy research and development: Declining investment, increasing need, and the feasibility of expansion Gregory F. Nemet, D M. Kammen, University of California, Berkeley 2007.
[12] OECD World Environment Outlook 2030.
[13] Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-13).
[14] Decision 1639/2006/EC of the European Parliament and of the Council of 24 October 2006 establishing a Competitiveness and Innovation Framework Programme(2007-2013).
[15] http://www.eera-set.eu/index.html.
[16] 'Global Trends in Sustainable Energy Investment 2007', United Nations Environment Programme and New Energy Finance Ltd.

mature markets in and outside the EU and to favour the deployment of less-developed RE sources (such as solar power, biomass or biofuels)[17]. Initial results from the Risk Sharing Finance Facility established in 2007[18] for financing research and innovation, confirm that the EIB is opening up wider financing opportunities for research and demonstration projects in the RE and EE sectors.

Box 4: EIB targets for EE & RES

- Annual target of min. €800m lending to RE projects
- 50% of lending to electricity generation associated with RE technologies
- Raise financing share of total costs for projects from 50% to 75%, for "emerging RE technologies" and investments contributing significantly to EE
- Update of the selection criteria for RE technologies
- Develop financial instruments for smaller-scale investments
- Introduce a systematic review of EE issues when assessing projects

3 Policy measures for bringing innovative energy technologies on the market

Turning existing and available technological or systems innovation (for instance in buildings, industry and transport sectors) into business opportunities can bring significant improvements in energy efficiency conversion, supply and end-use. These EE improvements represent the largest and least costly potential energy savings. Next in the hierarchy of importance come measures to substantially de-carbonise power generation - this the IEA advocates could be achieved through a combination of RE, nuclear power, and use of CCS at fossil fuel plants.[19]

Efforts to develop and deploy new and improved energy technologies that can support sustainable energy systems are undertaken through different policy mechanisms but need to be enhanced. Further measures are needed to allow more significant systems innovation in the different sectors of the economy.

3.1 Energy efficiency and energy conservation

In 2005, the Green Paper on Energy Efficiency[20] pointed to the fact that the EU could save at least 20% of its present energy consumption in a cost-effective manner, equivalent to €60bn per year. In 2006, the EP promoted a target of at least 20% improvements in EE by 2020[21] while the Council in 2007 only proposed it as an objective to reach by 2020.[22]

Nevertheless, the EU Energy Efficiency Action Plan adopted in October 2007[23] outlines a framework of policies and measures to intensify the process of realising the 20% estimated savings potential by 2020. It proposes 10 priority actions to be introduced over a six-year period. Measures include labelling standards, building performance requirements, improving efficiency of power generation and distribution, cars fuel efficiency, facilitating financing of EE investments for SMEs and Energy Service Companies and a coherent use of taxation.

At the national level, Member States are required by the Energy Services Directive[24], to adopt an overall national indicative energy savings target of 9% by 2016, to be reached by way of energy services and other EE improvement measures. In June 2007, 17 Member States submitted their first National Energy Efficiency Action Plans, showing how they intend to reach the 9% target. A first review of the submitted NEEAP[25] indicated a gap between the political commitment and the proposals to face the challenges. However, 5 Member States adopted savings targets going beyond the minimum indicative target and several Member States have set out comprehensive action plans for demonstrating the exemplary role of the public sector. Numerous financial and fiscal incentives (in particular in the housing and construction sector or for purchase or production of energy efficient equipment) are being put forward.

[17] EIB Corporate Operational Plan 2008-2010 http://www.eib.org/about/publications/corporate-operational-plan.htm.
[18] http://www.eib.org/about/press/2007/2007-050-european-commission-and-eib-launch-new-instrument-to-finance-research-and-innovation.htm.
[19] IEA : Energy technology perspectives 2008 – Scenarios and strategies to 2050.
[20] "Doing More with Less" (COM(2005) 265 final of 22 June 2005).
[21] EP resolution on Energy efficiency or doing more with less - Green Paper, June 2006, P6_TA(2006)0243.
[22] European Council Conclusions March 2007 (7224/1/07).
[23] "Action Plan for Energy Efficiency: Realising the Potential" COM(2006)545 final.
[24] Directive 2006/32/EC on energy end-use efficiency and energy services.
[25] Communication from the Commission on a first assessment of national energy efficiency action plans as required by Directive 2006/32/EC on energy end-use efficiency and energy services - Moving forward together on energy efficiency (COM/2008/0011).

3.1.1 Buildings sector

The buildings sector accounts for 40% of the EU's energy requirements, and offers the largest single potential for EE. According to the EC more than one-fifth of the present energy consumption and up to 30-45 Megatons of CO_2/year could be saved by 2010 by applying more ambitious standards to new buildings and when refurbishing existing buildings.[26]

The aim of improved EE has previously been set out in several existing legal instruments (boilers, construction products and SAVE Directives)[27]. Building on those, a directive on the energy performance of buildings[28] came into effect in 2006. It provides a common methodology for calculating the energy performance of buildings and for creating minimum standards of energy performance in individual Member States. The directive applies to new buildings and to existing buildings subject to major renovations.

The recasting of the directive, expected in November 2008 is likely to extend the scope to cover a most of the 72% of buildings in the EU that fall below the current 1000m^2 threshold in the directive[29], expanding the role of the public sector so that it may lead by example and reinforce the role of energy performance certificates required. The revised proposal should also include measures to facilitate Member State financing of investments leading to energy performance improvements in the building sector.

Existing technological developments could contribute to the widespread construction of buildings that far exceed the EE requirements set by policy-makers today. Urban multi-residential housing developments that are best-practices not only from an energy savings point of view, but also from an urban planning and social organisation perspective have been developed in the EU.[30] These projects have achieved greater sustainability by using a combination of local public policy, planning, design and technology, whereby the use of "traditional" energy saving measures such as better insulation is only part of the solution. Large companies have also been taking interest in the sector and have developed materials, systems and other technologies to increase EE.[31] Advances in RE technologies, such as a "solar dye" for example, can further contribute to the "greening" of buildings.

3.1.2 Industry sector (product policies and ICT)

Apart from the user's behaviour, there are two complementary ways of reducing the energy consumed by products: a) labelling to raise awareness of consumers on the real energy use in order to influence their buying decisions and b) EE requirements imposed to products from the early stage on the design phase.

The Eco-Design Directive[32] establishes a framework for setting eco-design requirements, such as EE requirements, for all energy-using products in the residential, tertiary and industrial sectors. The directive does not introduce directly binding requirements for specific products, but defines conditions and criteria for setting requirements regarding environmentally relevant product characteristics and allows them to be improved quickly and efficiently. In principle, the Directive applies to all energy using products (except vehicles for transport) and covers all energy sources.

A revision[33] of the Eco-design Directive is currently under discussion, and proposes to extend the scope to cover other energy related products than energy-using products. The resulting directive is seen as the essential building block for an integrated sustainable environmental product policy, complemented by the initiatives on labelling[34] and other incentives such as greening public procurement[35] and reducing taxation for green products.[36]

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[26] http://ec.europa.eu/energy/demand/legislation/buildings_en.htm#Overview.
[27] Boiler Directive (92/42/EEC), Construction Products Directive (89/106/EEC) and buildings provisions in the SAVE Directive (93/76/EEC).
[28] Directive 2002/91/EC on the energy performance of buildings.
[29] The EC on 18 September 2008 orally modified the above by specifying that the 1000m^2 threshold will be lowered or *possibly dropped altogether*; moreover the revision was said to now also include *a benchmarking system* which can further best practise exchange. Speech by Deputy Director General for DG TREN in EP at Conference on "Towards a European Policy for Sustainable Housing?".
[30] Vaubanexternal development in Freiburg, Germany, and the BedZED development in the south of London.
[31] https://buildingsolutions.honeywell.com/Cultures/en-US/.
[32] Directive 2005/32/EC establishing a framework for the setting of ecodesign requirements for energy-using products.
[33] COM(2008)0399 proposal for a Directive to extend the scope of the Framework Eco-Design Directive to cover other energy related products than energy-using products.
[34] Regulation (EC) No 106/2008 of the European Parliament and of the Council of 15 January 2008 on a Community energy-efficiency labelling programme for office equipment (recast version), Community Ecolabel scheme COM(2008)0401.
[35] COM(2008) 400/2 EC Communication on Public procurement for a better environment.

While CO_2 emissions of the digital technology industry are on the increase and are responsible for 2% of global emissions (the same share as the airline industry),[37] new technologies have also the potential to help reduce energy consumption. A EC Communication aiming to raise awareness and stimulate an open debate between stakeholders on potential impact of ICT on EE was put forward in May 2008[38]. It identifies 3 priority areas: (i) fostering research into ICT based solutions and stimulate their take-up, (ii) ICT industry to lead by example, (iii) encourage structural changes to fully realise the potential for instance in business processes and services. A further communication is expected in 2009 quantifying the potential and identifying possible actions.

3.1.3 Transport sector

Emissions from the transport sector in the EU-27 have risen by 26% from 1990 to 2005. Road transport accounts for approximately ¼ of total energy consumption of the EU.[39] The potential for reducing vehicle emissions and energy savings is substantial, but technologies needed remain more expensive than conventional vehicle manufacturing technologies.

With car manufacturers expected to miss their 2008 voluntary commitment to reduce CO_2 emissions, legislation is under adoption[40] requiring them to cut the average CO_2 emissions of new cars by 18%, from current levels of around 160g/km to 130g/km by 2012, by improving vehicle technology. A further 10g/km reduction is expected to come from improvements in other areas, including tyres, fuels, air-conditioning and eco-driving. Negotiations between EP and Council are still ongoing on the proposed legislation and EP's first reading vote is expected for the December plenary. In October 2008, a first reading agreement was reached on a measure to promote clean and energy efficient road transport vehicles, by introducing energy consumption, CO_2 and pollutant emissions as mandatory award criteria into public procurement of vehicles.[41]

However, the current focus on vehicle and fuel technologies alone will be insufficient to offset the steady increase in passenger volumes and growth in freight transport. In the EC's 2001 White Paper for transport[42] about 60 measures were proposed to develop a transport system capable of shifting the balance between modes of transport and contribute to the sustainable development strategy. In 2006, urban transport was also put forward[43] as an area that can significantly contribute to achieving policy objectives of climate change, EE, congestion, use of alternative fuels, modal split, road safety, industrial competitiveness, environment, health and social inclusion. In 2006-2007 plans for making freight transport in the EU more efficient and sustainable have been set forward[4445] to improve logistics and promote a more frequent use of cleaner modes such as rail and water transport.

3.2 Policy measures on Renewable Energy Sources

3.2.1 RE sources

Several of the RE technologies, especially wind energy, but also small-scale hydro power, energy from biomass, and solar thermal applications, are already economically viable and competitive but their potential has not yet been fully realised.[46] Measures to meet the target of 20% RE sources in energy consumption, to which EU leaders committed in March 2007, are being proposed in the revision of the Renewables Directive[47], to be agreed upon before the end of the year. The directive is to be the main driver for those technologies for crossing the so-called "valley of death".

The Lead Market Initiative[48] is another initiative to encourage demand for RE by addressing high costs, low demand, market fragmentation as well as administrative and market barriers. RE is one of

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[36] Council Conclusions 14 March 2008 - 7652/08.
[37] http://www.gartner.com/it/page.jsp?id=503867.
[38] COM(2008)241, of 13.05.2008 Addressing the challenge of EE through ICT http://ec.europa.eu/information_society/activities/sustainable_growth/docs/com_2008_241_1_en.pdf.
[39] Climate for a transport change. TERM 2007: indicators tracking transport and environment in the European Union, EEA Report No 1/2008, March 2008.
[40] COM(2007)856 Proposal for a Regulation of the European Parliament and of the Council setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles.
[41] T6-0509/2008 EP Resolution on the proposal for a directive to promote clean and energy efficient vehicles.
[42] "European transport policy for 2010: time to decide" COM(2001) 370 final.
[43] COM(2005) 718 EC Communication "Thematic Strategy on the Urban Environment".
[44] COM(2006) 336 final, Freight Transport Logistics in Europe – the key to sustainable mobility.
[45] COM(2007) 607 final Freight Transport Logistics Action Plan.
[46] COM(2006) 848 EC Communication “Renewable Energy Roadmap”.
[47] COM (2008)0019 Proposal for a Directive on the promotion of the use of energy from renewable sources.
[48] COM(2007) 860 EC Communication “A lead market initiative for Europe”.

the identified six lead markets in which innovative solutions will be supported.[49] Policy areas for action identified by the EC in the creation of a lead market include: developing an anticipatory approach to product market regulation; stimulating and facilitating the timely development of standards by stakeholders; using public procurement in markets where public authorities can act as launch customers; improving and optimising IPR regimes; concerted actions between EU and Member States, and co-operation with industry.

3.2.2 Biofuels

The EC proposal for the Renewables Directive aims to raise the share of biofuels in transport to 10% by 2020. However, concerns have been raised that an increase in the production of biofuels based on current technologies, could have more negative implications for the environment than positive ones. Controversies include: the energy balance of biofuels production[50] (in particular ethanol); the real climate change reduction potential depending on land-use change, type of crop and end-use (transport or combined heat and power)[51]; impacts such as competition on land-use or raising commodity prices, etc. Biodiversity loss - especially in developing countries - is an important risk as forests and grasslands are cleared to plant the vast quantities of crops needed to make a significant contribution in the use of oil in transport.

The draft report voted in the ITRE Committee in September, proposes to introduce a 5% interim target by 2015, 20% of which must be met from "non-food and feed-competing" second-generation biofuels or from cars running on green electricity and hydrogen (40% by 2020). MEPs also support a "major review" of the whole EU biofuels promotion policy and of its social and environmental impact. On the binding "sustainability criteria" the draft report proposes that biofuels offer at least 45% carbon emission savings compared to fossil fuels –rising to 60% in 2015. The Council is on the other hand leaning towards a 35% CO_2 saving, which would then be scaled up to "at least 50%" in 2017.[52]

MEPs also insist additional social and environmental criteria are included to protect natural resources from both direct and indirect land use changes and to guarantee respect for human rights and adequate working conditions in biofuels plants, especially in developing nations.

3.3 Fossil fuels and clean coal technologies

Oil, coal and natural gas will remain the world's dominant sources of energy in the next decades, with resulting CO_2 emissions set to increase. As illustrated by a recent IEA report[53], CO_2 capture and storage (CCS) is considered a particularly promising technology that could help reduce CO_2 emissions from fossil fuels.

As part of the "climate package" of January 2008, a proposal for an EU legal framework governing CCS was proposed[54]. In its draft report adopted in October, the EP called for the introduction of a ceiling on the amount of CO_2 EU power plants may emit beyond 2015. The introduction of such "emissions performance standards" (EPS), already put in place in California, is backed by most experts as one of the incentives for industries to develop CCS.[55] Such a regulation would have a direct impact on Europe's existing and planned coal-fired power plants, the largest emitters of CO_2[56]. EPS will be on the agenda in 2009 when the Integrated Pollution Prevention and Control Directive is expected for revision.

3.4 Nuclear energy

Nuclear energy currently has an important role to play in the energy mix of several EU countries and is considered as a low carbon technology that can contribute to reaching the climate change targets. A relative "renaissance" of nuclear is underway in the EU[57].

The incentive effect of the FP6 and FP7 for nuclear research and training activities has maintained European nuclear research as a world leader, particularly in the field of controlled fusion with the

[49] Commission Staff working document Annex to COM(2007)860 EC Communication "A Lead Market Initiative for Europe" - Action Plan for renewable energies SEC(2007) 1729.
[50] http://www.newrules.org/agri/netenergy.html.
[51] Sustainable bio-energy: a framework for decision makers UN – Energy April 2007.
[52] Council Document 12157/08.
[53] IEA, October 2008 CO2 Capture and Storage -- *A Key Carbon Abatement Option*, ISBN 978-92-64-041400.
[54] COM(2008) 18 final Directive proposal on the geological storage of carbon dioxide.
[55] GlobeScan survey, sponsored by the European Climate Foundation.
[56] EURELECTRIC (EU electricity industry association): Views on New EU CCS Directive (3 Nov 2008).
[57] Two European Pressurized Reactors (EPR) being built in Finland and in France[57] and two further underway Finland is also starting the procedure for the possible construction of a 6th reactor, and France has announced it will construct a 2nd EPR.

establishment of joint undertakings set up for specific projects of fundamental importance: the Joint European Torus at Culham in 1978 and, more recently in 2006, the introduction of the European Legal Entity to implement the International Thermonuclear Experimental Reactor (ITER).

In 2007 a Sustainable Nuclear Energy Technology Platform (SNE-TP)[58] was launched aiming at coordinating research, development, demonstration and deployment in the field of nuclear fission energy. It gathers stakeholders from industry (technology suppliers, utilities and other users), research organisations including Technical Safety Organisations, universities and national representatives. Its "Strategic Research Agenda" will be agreed on 26th November 2008, with priorities addressing the deployment of Generation III reactors and the development of Generation IV systems, both fast neutron reactor systems with fuel multi-recycling for sustainable electricity-generating capability, and Very High Temperature Reactors for other applications of nuclear energy, such as production of hydrogen or biofuels. Important issues such as the safety of nuclear installations and the responsible management of waste will be also addressed.

4 International cooperation and technology transfer in the energy field

International cooperation, for example on research or the setting of international standards, is important to stimulate the global development, commercialisation, deployment and access to low carbon technologies. For emerging economies technology transfer is needed to ensure a steady energy supply for their rapid economic development. Energy demand is growing fast, particularly in India and China, and low-carbon technologies and technology avoiding negative impact on adaptation may help to ensure that the economic growth is not coupled with the high GHG emission growth.

The primary Community interest lies in helping developing and emerging economies develop and grow in a more sustainable manner, while building new market opportunities for the EU industry and ensuring effective collaboration in accessing and developing resources. Options include: (i) networking energy technology centres; (ii) setting up large-scale demonstration projects on technologies with the highest potential in those countries; (iii) increasing the use of innovative financing mechanisms, and (iv) reinforcing the use of the Kyoto Protocol mechanisms for investments in emissions reduction projects. A few examples of current status are presented below:

- In 2004, China and the EC adopted a five-year Energy Environment Programme (EEP), providing assistance to public authorities and funds for feasibility studies for clean technology projects.[59] In 2005 an Action Plans on Clean Coal Technologies and another on Industrial Co-operation on EE and RE were signed.[60] Between 2001 and 2006, the EU has spent approximately $65m in support of clean energy in China.[61] Some experts, however, warn that the right balance should be found between technology transfer and IPR policies.[62] After a decade of absorbing foreign know-how, Chinese companies are increasingly able to deliver qualitative products and seem to be successful in their first steps in overseas markets in particular in the wind and solar energy sector.[63] Hence, the EU may want to protect its know-how as a tradable good that suits China's commercial and environmental needs.
- A high share of CDM projects is located in emerging economies (75% of Certified Emission Reductions in India, China and Brazil). Although CDM does not have an explicit technology transfer mandate, technology transfer is often mentioned as an ancillary benefit. However, the actual scale of technology transfer achieved by CDM is lower than expected (less than 50% of CDM projects). Reasons for low involvement of technology transfer should be analysed by UNFCCC with a view to improve in the future international framework[64].

[58] http://www.snetp.eu.
[59] More information about the Energy Environment Programme (EEP), see: www.eep.org.cn/index.php.
[60] Towards a closer EU-China co-operation in the field of Energy, Speech 06/105, China-EU Energy. Conference, 20 February 2006.
[61] For an overview of all projects, see the website of the EU Delegation in Beijing: www.delchn.cec.eu.int/en/Co-operation/Project_Fiches.htm.
[62] China's energy policy in the light of climate change, and options for cooperation with the EU, Mr. Jonathan Holslag, IP/A/CLIM/NT/2007-12.
[63] Development of China's Solar Cell Industry Annual Report 2006-2007, FriedlNet and Partners, April 2007. Hug, Rolf and Schachinger, Martin (2006), Chinese solar modules penetrating the German market, *The Solar Server*, 10 November 2006, see: www.solarserver.de/solarmagazin/solar-report_0806_chinese_e.html.
[64] IP/A/CLIM/NT/2007-15 PE 401.005 Engaging other main actors: engaging emerging economies Removing barriers for technology cooperation.

- The EU's framework for dialogue and partnerships with developing countries in the field of energy is the EU Energy Initiative for Poverty Eradication and Sustainable Development (EUEI), a joint commitment by Member States and the EC for supporting improved access to sustainable energy services.[65] The Initiative mobilises public and private resources for specific actions and instruments promoting more efficient use of fossil fuels and traditional biomass and by increasing the use of RE. (see box 5).

- Established in 2008, the Global Energy Efficiency and Renewable Energy Fund (GEEREF)[66] is a fund of funds, supporting small and medium sized energy projects (below €10m) designed to support sustainable development in developing economies and economies in transition. It aims to maximize the leverage of public funds in raising finance for investment in EE and RE projects (mainly small hydro, biomass and on-shore wind), primarily in the ACP region. As a global public-private partnership, it aims to overcome existing barriers for investment by offering new risk-sharing and co-funding options for various commercial and non-commercial investors. In March 2008 the EP has called[67] on the EC to ensure that all support for projects and choice of technology is conditional on the fulfilment of comprehensive sustainability criteria and on a contribution being made to sustainable development.

Box 5: Development cooperation in energy under EUEI:

- ACP-EU Energy Facility : support the supply of energy services in rural areas. 75 projects selected with a total volume of €220 million, 40% of which will support RE.
- COOPENER programme: help to alleviate poverty through the promotion of sustainable energy. It includes 40 projects in Asia, sub-Saharan Africa and Latin America.
- Partnership and Dialogue Facility (PDF) funded by Member States.

GEEREF:

- Initial funding target of €100m
- Additional private risk capital of at least 300m€, up to €1bn, expected through regional sub-funds and at project and SME level.
- So far €80m from EC funding until 2010 and pledges of €24m from Germany and €10m from Norwav.

[65] EC (2007), EU action against climate change – Working with developing countries to tackle climate change.
[66] EC (2006), Communication "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.
[67] INI/2007/2188 Global efficiency and renewable energy fund.