SET Plan 2009 Conference

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FINAL REPORT

Swedish Energy Agency

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SEVENTH FRAMEWORK PROGRAMME

Background

In response to the goals of the European energy and climate change policy, the European Strategic Energy Technology Plan (SET-Plan)[1] was endorsed as a vehicle to accelerate the development and large scale deployment of low carbon technologies that draws upon the current R&D activities and achievements in Europe. The plan proposes a new innovation model based on a collective approach to research, development and demonstration planning and implementation with a focus on large scale programmes.

In order to boost the implementation of the SET-Plan, a proposal on "Investing in the development of low-carbon energy technologies" was presented on 7 October 2009. In the proposal the Commission estimates that an additional investment of €50 billion in energy technology research will be needed over the next 10 years. This means almost tripling the annual investment in the European Union, from €3 to €8 billion. Different sources of funding are considered, from public and private sectors at national and EU level, to be used in a coordinated way will also help to push forward a fast growing industrial sector and to create jobs.

Introduction

The conference on the SET Plan was organized by the Swedish Energy Agency in collaboration with the European Commission. Its primary objective was to give momentum to the implementation of the SET-Plan, which was adopted by the Commission on 22 November 2007. In particular, the conference sought to generate impetus for the proposed European Industrial Initiatives.

This report compiles the main messages from the plenary sessions, results from the parallel sessions, and general conclusions from the conference.

Parallel sessions in workshop format were held on each of the identified strategic energy technology areas for the European Industrial Initiatives (EII), i.e. Bioenergy, Carbon Capture and Storage (CCS), Energy Efficiency (Smart Cities), Smart Grids, Nuclear Fission, Solar Energy (Concentrated Solar Power (CSP) & Photovoltaic (PV)), and Wind. The aim of each session was to discuss the technology road-maps that had been developed for that technology area. The sessions started with presentations by stakeholder representatives of each sector. The discussions were open and moderated. The designated rapporteurs have written the summary reports.

The participants / target groups were European actors in the innovation system for energy technology: financial community, industry, customers, public policy makers, representatives of the European institutions and international partners.

[1] (http://ec.europa.eu/energy/technology/set_plan/set_plan_en.htm)

The organizers thank all participants for their valuable contributions and are sincerely convinced that the results from the conference will make a significant contribution towards relevant and high quality research and development in the energy area.

Please find presentations and further documentation at http://www.energimyndigheten.se/en/Press/News/SET-plan-Conference-in-Stockholm-in-October/

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1 Summary of Introduction by Maud Olofsson, Deputy Prime minister of Sweden and Minister for Enterprise and Energy

Mrs Olofsson pointed on the challenges of an economic recession and that demands on energy supply and effects on the environment are large and growing. This calls for immediate action at all levels of society. Essential components are the EU Climate policy and an agreement at COP15 in Copenhagen.

In describing the concept of an eco-efficient economy, Mrs Olofsson pointed out that there are opportunities to be seized. The challenges of the present economic down-turn and of climate change could – if met simultaneously –offer enormous opportunities and create a strong driving force for sustainable growth.

An Eco-Efficient Economy means creating more wealth while using less natural resources, causing less negative impact on the environment. It is about combining competiveness with environmental responsibility.

To bring this transition about most policy areas must contribute and pull in the same direction. *IF* we use all our instruments like research and innovation, infrastructure investments, eco-taxes, support to SMEs and other ways to stimulate the market, we can make things happen.

In order to make existing technologies more efficient and find new ways forward, all EU member states need to commit and make the necessary investments. The new communication from the Commission on the need for investments in the development of low carbon technologies is seen as an important input to the discussion.

The EU has already shown that it has the will and the power to invest in the future. The Recovery Plan includes funding for projects in the field of energy infrastructure, off-shore wind and CCS.

In closing, Mrs Olofsson stressed the need for an energy revolution in which low-carbon technologies have a crucial role to play. Energy efficiency, renewable energy sources, smart grids, hybrid and electric cars are all examples of technologies that need to be developed and spread if we are to reach our goals. Therefore, the European Strategic Energy Technology-plan thus needs to be on top of our agenda.

2 Summary of Key note speech held by Andris Piebalgs, EU Commissioner for Energy

Commissioner Piebalgs emphasised the **challenges** of emission reduction, which is a global problem. However, the responsibility is not evenly distributed and must be addressed by ambitious targets for the EU. An 80% greenhouse gas reduction will in practice mean that the EU will need to have a zero-carbon electricity system, a zero-carbon road and rail transport system, and zero-carbon heating and cooling for both homes and businesses. Despite the magnitude of the challenge solutions can be found. Some examples were illustrated from both energy efficiency and renewable energy technologies.

These examples of solutions also show **opportunities** for the EU, such as industrial development and job creation. The EU low-carbon energy industry today has produced 1,4 million jobs, a figure that could double by 2020, and exports of a value of 3,7 b€.

According to commissioner Piebalgs there is still serious concern that the EU is not doing enough to maintain its technological advantages. Three instruments that address this issue were described:
Firstly, spending on energy technologies in the 7th Framework Programme will increase.

Secondly, the EU has made a major commitment to invest in energy technology in the Energy Recovery Package for Europe. Over the next two years, an additional one billion Euros will be spent on carbon sequestration demonstration projects, 565 million Euros on cutting-edge offshore wind demonstration projects, and very large sums on catalysing the infrastructure necessary to bring the increasing levels of renewable energy to customers. The calls for these projects have been completed and are expected to give a real boost to this technology area in the EU.

Thirdly, in Commissioner Piebalgs' view the most important element of the 20-20-20 initiative, the Commission has tabled and the European Council and Parliament has endorsed, the Strategic Technology Plan. The SET Plan proposes firstly that the EU needs to better coordinate its low carbon energy research, to ensure maximal value out of the money spent, and secondly, the SET Plan emphasises the need to spend more.

The SET Plan has already led to real changes in the way that the EU pursues energy research. The Technology Platforms and Industrial Initiatives in Wind, Solar, Bio-energy, CCS, Nuclear, Smart Grids and Smart Cities are producing

results. They have led to the development of the technology road-maps that will be discussed later in the conference.

These represent a technology partnership between industry and citizens. They identify exactly what needs to be done to get the EU where it needs to be by 2020, what it will cost, and who should pay. They are unique in the world, and very, very important. But they are a process, not an end result. They need to be a dynamic tool; evolving as technology develops, and now need to have the courage to look as far ahead as 2050.

The second priority of the SET Plan highlights the need to spend more. On 7 October, the Commission adopted the SET Plan Financing Communication, which concluded that the EU needs to at least double the amount being spent on low carbon energy research; at EU, national and at industry level.

Commissioner Piebalgs concluded his presentation by encouraging the conference participants to continue addressing the challenges and opportunities ahead with determination.

3 Summary of Commissioner Janez Potočnik - Coming together, keeping together, working together for a low carbon future

Commissioner Potočnik opened with a short review of the past year and the challenges that still remain: climate change, energy security and building competitiveness. In this the role of investments into R&D and efforts to get innovations to the market are crucial. The solutions will depend on a combination of market forces, resource availability, public acceptance and political choices.

This set the background for the SET-Plan, which is the technology pillar of the EU's energy and climate change policy – the method of choice for speeding up the development and market take-up of low carbon technologies.

One important part of the plan is the European Energy Research Alliance between Europe's leading national research institutes, whose aim is to conceive and implement joint energy research programmes, by pooling their own talent and resources.

Another key part of the SET-Plan is the European Industrial Initiatives, or EIIs. These are focussing effort on the key challenges and bottlenecks and proposing concrete actions for the period 2010-2020. Working closely with industry and other stakeholders, the Commission has drawn up Technology Roadmaps for the implementation of the industrial initiatives. These were to be discussed in detail during the parallel sessions that afternoon. Commissioner Potočnik hoped that they would receive widespread support and that the Technology Roadmaps could be used as the basis for launching the initiatives in the coming months.

Commissioner Potočnik presented Joint Programming as a tool to make sure that the EIIs take off. This is a public-private-partnership style collaboration, where the public side, the Commission and the member states, reinforce their efforts to work together. In Joint Programming European and national research agendas complement and reinforce one another to achieve common goals. The SET-Plan is a pioneer for Joint Programming – a move away from a project by project approach towards the idea of 'co-investment' in programmes.

The next issue was the funding for the SET-Plan. Each Technology Roadmap includes an estimate of how much it will cost, but the risks must be shared by with all relevant actors, public and private according to their varying roles. The higher the technology risk the more public support is needed, particularly in the form of

grants. Where there is predominately market risk this more limited public support should move towards high leverage instruments such as loans and guarantees.

According to Commissioner Potočnik industry has to take greater technological and market risks, to accelerate the development and deployment of new technologies. Furthermore, banks and private investors need to become less risk-averse, to pump billions of Euros into the companies that will drive the transition to a low carbon economy.

Suggested sources of funding are i.e. the ETS Directive. This will allow, from 2013 onwards, auctioning revenues to be reinvested at national level in the development of more efficient and lower cost clean technologies. The use of the revenues is determined by the Member States, but at least 50% should be used for climate change related activities.

Or from the 300 million euro of EU Allowances set aside from the New Entrants Reserve of the Emissions Trading Scheme (ETS). This will be used to support carbon capture and storage and innovative renewables. These allowances will be made available by Member States for demonstration projects selected on the basis of criteria defined at Community level.

On the public side, Commissioner Potočnik would like to leverage more from the EU budget. The up-coming mid-term review of the current financial perspectives and reflections on the next financial perspectives could be the time to do that.

In summary Commissioner Potočnik wants combined public resources, both EU and national, and effective and flexible Public-Private Partnerships with industry. These are the future models for pan-European research cooperation.

At the same time, in order to get large-scale demonstration projects for SET-Plan technologies to work, resources from different actors and instruments need to be combined. There will be a need for grants, loans and loan guarantees for large projects, be they demonstration projects, first of a kind plants or market replication.

Commissioner Potočnik finished with a call for action.

4 Panel session – Financing low carbon technologies

The panel session on financing low carbon technology gave the Commission the opportunity to present the Communication on Investments in Low-carbon technology and for those who were representatives of important stakeholders to share their views and discuss their contribution towards the common European SET-Plan targets. The role of the moderator was to animate the discussion.

The participants were:
Andris Piebalgs, Commissioner for Energy
Janez Potočnik, Commissioner for Research
Birgitta Resvik, Business Europe's Climate Change Working Group
Ton Hoff, European Energy Research Alliance, EERA
Juan Alario, head of Division Energy Efficiency & renewables in the projects Directorate, European Investment Bank

The moderator was Mr Martin Ådahl, Director of the FORES Institute

Mrs Birgitta Resvik from the Confederation of Swedish Enterprises – a member **Business Europe** - gave the conference audience a global outlook and an overview of the industry's perspective on investments in energy technology.

Mr Ton Hoff represented the **European Energy Research Alliance**, EERA. The key objective of EERA is to accelerate the development of new energy technologies by conceiving and implementing Joint Research Programmes in support of the SET-plan by pooling and integrating activities and resources, combining national and Community sources of funding and maximising complementarities and synergies.

Mr Hoff conveyed the following key messages on financing the energy transition: benefits of a clean energy transition outweigh costs, but implementation costs are substantial and precede the benefits. Cumulative energy transition costs can be cut down by increasing R&D efforts, including international cooperation on R&D and deployment. Market prospects need to be there to ensure private R&D investments, but overheated markets should be avoided as learning effects need time to be incorporated in the production process. In conclusion, there is a need to monitor and manage the balance between R&D and deployment.

Mr Juan Alario presented the **European Investment Bank**'s perspective and contribution to financing Low-carbon Technologies in the EU. Issues of importance for financing renewable energy are a clear and stable policy and regulatory support framework, and financial sector capacity to assess and mitigate

project risk. Energy efficiency projects struggle with a unclear market potential for lending, despite high investment potential. There is a need to create an Energy Efficiency industry, based most likely on ESCOs (which is still an infant industry in the EU).
There is no standard model for financing EE projects, and unlike renewables, in general there is no clear policy/regulatory framework to support them. EE projects are exposed to energy price volatility. The EIB support to low carbon technologies consists of i.a. substantial lending in low carbon technologies (lending of 2.2 bn to RE and 0.7 bn to EE in 2008), support to less developed technologies (e.g. off-shore wind) and markets (e.g. EE in cities), as well as expanding support during the financial crisis.

The presentations can be found on the conference web-site (http://www.energimyndigheten.se/en/Press/News/Document-SET-Plan-Conference/)

The main messages of the key note presentations were confirmed and further underlined by a global perspective on innovation and competitiveness. Europe is losing pace in comparison with i.a. China and the USA.

On day 2, Mr Giovanni De Santi (Director, Institute for Energy, EC Joint Research Centre) presented the **SET-Plan Information System**, also called the SETIS initiative. SETIS serves as a reference to the evolving European Energy Technology Policy. It links complex and ever-changing technological information with EU policy targets and market reality; it uses a common assessment framework to evaluate the potential of key low carbon technologies towards EU policy goals, such as greenhouse gas reduction and fossil fuel savings; it helps monitor and assess progress of joint actions via Key Performance Indicators, developed within the SET-Plan. (http://setis.ec.europa.eu/setis-main)

5 Report on the parallel session of Bio Energy

The Bio energy parallel session was attended by around 50 participants from the industry sector, governments and research centres. After a short introduction by the EC Representative, in which the objectives and the foreseen actions of the Bio energy Roadmap (SEC(2009) 1295) were explained, Ms. Véronique Hervouet gave a presentation of the European Bio fuels Technology Platform proposal for the European Industrial Initiative on Bio energy. The presentations of the two discussants, Dr Hans-Harald Jahn of the European Investment Bank and Dr Ed de Jong, Leader of IEA Bio energy Task 42, followed.

An active discussion developed that allowed identifying strengths and weaknesses and recommendations to further improve the Bio energy Roadmap and the Industrial Initiative proposal. The meeting was chaired by Serge Galant – President of Greenovate! Europe and reported in the plenary by Mr Nicolae Scarlat, EC JRC, Ispra.

5.1 The roadmap for Bio energy, key characteristics

The strategic objective of the Bio energy Technology Roadmap of the SET Plan[2] is to address the technical-economic barriers to the development and commercial deployment of advanced bio energy technologies. The aim is to ensure that bio energy supplies at least 14% of the EU energy mix by 2020, while guaranteeing GHG emission savings of 60% for bio-fuels and bio-liquids according to the sustainability criteria of the RES directive.

The bio energy road map is based on three pillars. The first is to bring to commercial maturity the most promising technologies and value-chains allowing sustainable production of advanced bio fuels and highly efficient heat & power from biomass at large scale.

The related proposed action is the optimisation of the most promising value chains along various thermo-chemical and biochemical pathways in order to scale up and optimise process integration, with a focus on the improvement of feedstock flexibility, energy and carbon efficiency, capex efficiency, reliability and maintenance of bio energy plants.

The second pillar is to ensure sustainable biomass feedstock availability: realistic assessment of short, medium and long term potential, development of advanced

[2] Commission staff working document accompanying the Commission Communication on Investing in the Development of Low Carbon technologies (SET-Plan) "A technology roadmap", SEC (2009)1295.

feedstock production, management and harvesting, and of the scaling up of promising feedstock options. The third pillar is to develop a longer term R&D programme to support the Bio energy industry development beyond 2020. It should lay the scientific foundations for more radical innovation that will pave the way for new value chains. The total estimated budget for the implementation of the roadmap is 9 billion €.

5.2 The European Industrial Bio energy Initiative proposal of the EBTP

The European Bio fuels Technology Platform (EBTP) presented its proposal for a European Industrial Bio energy Initiative (EIBI) focussed on bio-energies and bio-energy carriers (solid, liquid, gaseous fuels, heat, electricity) corresponding to different types of energy-driven bio refineries[3].

The ambitious 2020 targets of the European Union cannot be reached within a "business as usual" scenario, using only existing commercial biomass feedstock and conversion technologies. A larger feedstock base and advanced conversion technologies are absolutely needed, in addition to existing ones, to meet the 2020 targets. Many of those innovative technologies (biomass gasification, pyrolysis, torrefaction, lignocellulosic ethanol/butanol, synthetic diesel, biohydrocarbons) most likely to bring significant contribution to the 2020 targets, are too risky and too costly to be developed for commercial and industrial deployment by private actors alone.

The proposed scope of EIBI is to **focus** on these **innovative** bio energy value chains (i.e. those which are not yet commercially available) and could capture a large market share (either with a large number of small to medium size industrial units or a smaller number of large industrial units). The core activity of the EIBI is the selection and funding of projects for demonstration or reference plants. Expected outcomes, on top of a portfolio of advanced bio energy technologies ready for large scale commercial deployment by 2020, are:

- the development of sustainable biomass resources,
- the creation of green jobs, local production of energy by a healthy bio energy industrial base,
- a focused R&D effort to support the deployment of innovative technologies and the stimulation of education and training in the related areas.

The focus of the EBTP proposal lies on an ambitious - in terms of advancement in technology and investment involved- programme of demonstration and reference (first-of-this-kind) industrial-size plants along thermo-chemical and biochemical pathways –of seven innovative bio energy "generic" value chains, to be developed

[3] Bio refinery: Bio refining is the sustainable processing of biomass into a spectrum of bio-based products (food, feed, chemicals, materials) and bio energy (bio fuels, power and/or heat) [IEA Bio energy Task 42 on Bio refineries]

and deployed according to their level of maturity[4]. Additional activities are foreseen to be carried out supporting the production and harvesting of biomass and the development of new value chains.

Within the **thermo-chemical pathways**, **four** generic value chains were proposed by the EBTP for the production of gas, liquids, heat and power from biomass:

- Synthetic fuels / hydrocarbons from biomass via gasification
- Bio-methane and other gaseous fuels from biomass via gasification
- High efficiency power generation via gasification
- Bio energy carriers from biomass via other thermo chemical processes like pyrolysis, torrefaction etc.

Within the **biological and biochemical pathways**, **three** value chains were proposed for the production of gas and liquids from biomass:

- Ethanol and higher alcohols from sugars containing biomass
- Renewable hydrocarbons from sugars containing biomass via biological and/or chemical process
- Production of bio energy carriers from CO_2 & sunlight through micro-organism based production (algae, bacteria etc.)

The overall estimated budget proposed by EBTP for the initiative is 6 - 8 billion € to fund between 15 and 20 Demonstration and/or Reference plants, based on different technologies and raw materials during a period of 10 years.

A preliminary set of criteria for the selection of Demonstration and Reference plant projects for funding has already been discussed with a group of experts, who suggested a 2 step procedure. In the first step, simplified proposals will be assessed against eligibility criteria, that represent the minimum conditions for a project to be considered, and are expressed as close questions, with a "go"/"not go" answer.

The suggested eligibility criteria focus on the plant development stage, (the plant must be a pre-commercial -for demonstration plant- or commercial scale -for reference plant/ first of its kind), the innovation of the technology/process or of the processes' integration , the sustainability (all projects must also comply with the sustainability criteria set in the Renewable Directive (2009/28) including the minimum 60% GHG emission reduction -for bio fuels and bio liquids produced in installations in which production started on or after 1 January 2017- over the

[4] Demonstration plants are considered the last non-economic step to demonstrate the performance and reliability of all critical steps in a value chain. The reference or first-of-this-kind industrial-size plants are the first commercial unit operating at an economically viable scale.

entire life cycle), the European dimension of the projects (partners should be involved from at least 3 countries).

In the second step, the fully detailed proposals will be evaluated against two sets of selection criteria with a range of scores and weights, one set preliminary called "reality check" and the other "differentiation". The financing decision shall be done taking into account the sum of the scores of both the "reality check" and the "differentiation check" with a minimum threshold in each of them and general ranking based on their technological and economic performances and depending on budget availability.

The suggested selection criteria are foreseen to take into account the economical performance of the concept in terms of cost per avoided CO_2 equivalent; economical performance of the commercial concept as cost per energy unit; energy efficiency to primary energy products; ultimate potential and contribution to reduce the GHG emissions in the EU; the existence of a realistic scenario for feedstock availability. The identified criteria are still under discussion, together with their weighting.

5.3 Recommendations on EIBI

The presentations of the two discussants and following discussions with session participants helped to identify potential improvements of the EIBI proposal:

- **About selection criteria:** The life time of a demonstration plant needs could be better considered in the selection criteria for demonstration units. For example demonstration units that could continue to operate profitably either as a test centre for bio energy technologies or could be turned into commercial production for other smaller scale, higher added value products. There was agreement that the selection criteria will need further elaboration.
- **About industrial integration and bio refinery concept:** as EIBI proposal is clearly focusing energy driven bio refineries, a discussion took place whether value chains targeting higher value materials as main drivers and having bio energy/bio fuels as by-product could be part of the initiative.
- **About longer term R&D programme**: since EIBI is clearly focused on industrial scale deployment by 2020, articulation of longer term R&D activities is not proposed yet by EBTP in the context of EIBI. EBTP is currently updating its strategic research agenda and will propose relevant longer term topics such as new feedstock, including aquatic biomass, with higher and more readily usable energy content and by-products, and advanced technologies, which are at their infancy.

5.4 Key strengths to build upon

The following main strengths were identified from the presentations of the two discussants and the exchanges with the session's participants:

- **Flexibility of the approach and focus of scope of EIBI vis à vis:**

  - ***Technical maturity*** of promising value chains: The earliest advanced bio energy technologies are near demonstration or even commercial stage for some of them, provided supportive framework is available to secure funding and to manage high cost and risk of industrial deployment. Other technologies will follow over the next 3 to 5 years.

  - ***Size of plants*** to be funded: No arbitrary limitation is imposed on the size of demonstration and reference plants to apply for funding. Recognizing the potentially very different specific situations as regards type and quantity of local feedstock availability and type of end product targeted, it is up to the investors to choose the most adequate plant size, and to present rational arguments about it. The demonstration plant should be at a scale high enough to be able to prove technical and economical performance and provide enough data so that the technology can be realistically scaled-up to industrial size after successful operation of the demonstration.

  - ***Identification of promising options***: the approach presented does not point to "good" technologies, any other ones being excluded. It offers clear, rational and relevant criteria allowing for "open and fair competition" between options. The decision to focus on several value chains, the most advanced and most likely to bring a substantial contribution to the markets, provides no limitations on proposing new raw materials, technologies or pathways, as there are significant variations within the value chains depending on the feedstock and conversion technologies. A combination of value chains is also conceivable.

  - ***The number of demonstration or reference plants to be funded***: proposed figures should be considered indicative, since the projects will be selected on the basis of the feedstock/technologies/pathways proposed and their envisaged performances. This will allow the best combination of demonstration and reference plants within and between different chains.

- **Balance of public and private financing:** There was a general opinion that there is a good ratio between public and private funding, while adjusting the specific type of public funding to the risk profile of projects: Public support as grants shall be given to cover the high costs for building and operating a non commercial demonstration; for first-of-kind plants expected to make profit, the public support should help secure financing via loan guarantees and possibly equity stakes so that public money does get an economic return on the financing and risk taken. Innovative mechanisms could be adjusted to help cover specific risks such as feedstock prices, changes in regulatory framework leading to lower market prices than anticipated at the launch of project, etc.

- **Feedstock issues:** Clear attention is paid to biomass availability and sustainability considering the main challenges for a large scale bio fuel/bio energy plant. Attention is given to comply with the sustainability issues required in the Renewable Directive, which are one of the criteria for the selection of a project.

5.5 Overall recommendations for the Bio energy Roadmap and EIBI

Consolidating on the very lively and positive discussion of this session, the following overall recommendations were proposed to contribute to the further development of the Bio energy Roadmap and EIBI:

- Indicative Key Performance Indicators (KPI) should be further elaborated on the basis of the outcome of the recent workshop organized by the EC. It should be based on clear assumptions (oil and energy prices, size of markets, regulatory framework, financial environment …).
- There is a need to better differentiate the selection mechanisms for demonstration and reference plants as they should meet different conditions
- More efforts shall target the development of reliable and sustainable supply chains that open up the feedstock potentials, certification schemes, for reducing the competition for raw material and potentially damaging disturbances in agricultural and forest commodity markets.
- The targets of longer term R&D programmes should be formulated. Research is needed to enlarge the feedstock base, to process new and more difficult feedstock and to enhance energy and economic content of the end-products per unit of feedstock and/or land used. Major R&D focus should be targeted at improving productivity, promoting new feedstock such as lignocellulosic feedstock and aquatic biomass. Risks related to the feedstock (availability, cost) must be reduced. EBTP is fully taking into account these themes in the ongoing update of its Strategic Research Agenda.
- There is a need to increase customer/public acceptance of bio fuels/bio energy production. Public acceptance of bio fuels/bio energy depends largely on sustainability. More efforts should be devoted to the development of new feedstock and increase productivity in order to reduce competition with food, feed or fibre markets. On the other hand, as the customer acceptance of bio fuels/bio energy depends largely on price, the largest challenge for bio fuels/bio energy deployment is the reduction of costs to be competitive with the fossil fuels. The bio energy costs dependency on the biomass feedstock price is critical.
- As recommended by EBTP in its proposal, the challenges which are not specific only to innovative bio energy should be addressed in a coherent effort shared with the relevant stakeholders and initiatives. Innovation is needed in shaping public private partnership to address specific challenges of all the Low Carbon Initiatives.

5.6 Confirmation or adaptation of the objectives

Based on the Bio energy Roadmap and the ETPB EIBI proposal, it is possible now to move forward and developing a coherent and flexible **governance structure** for the EIBI and the implementation mechanisms for the selection, execution, monitoring and evaluation of the projects.

In parallel to developing relevant governance mechanisms, it is now necessary to identify and adjust flexible **funding mechanisms** combining public and private funding instruments, in order to allow financial and market risks sharing between public and private actors.

A number of mechanisms were identified in the EBTP proposal which can be used for providing support of bio energy investments: private equity funding; regional programmes; direct public financing (direct grant, equity investment, loan, public guarantee on private loan); fiscal incentives (investment tax relief, production tax credit, blending tax credit).

One example of financing option presented at the meeting involves the EIB Risk Sharing Finance Facility funds, which complements other sources of debt capital available for low/sub investment grade Research, Development and Innovation (RDI) intensive companies.

EIB RSFF funds are highly attractive for potential beneficiaries because of various reasons, including highly attractive terms and conditions and long maturities of up to 10 years or more. EIB financing of more than €100m is possible, which is adequate for funding demonstration or first of a kind commercial plant, requiring high investment costs, like the projects proposed by the EIBI. EIB has also mandates for financing projects in countries outside Europe (e.g. Africa, Eastern Neighbourhood).

5.7 International cooperation

Relevant scientific and technological know how is available in Europe, on various bio energy technologies within industry, technology developers, research organisations and universities. The EIBI will contribute to reach critical mass of expertise and competences from EU partners for the breakthrough in the bio energy innovative technologies that cannot be reached at national level.

Projects are open to **international cooperation** with other regions of the world. There are various technologies (such as enzymes for lignocellulose treatment, yeasts for bio hydrocarbon production, algae, etc.) that could benefit from international cooperation, with US and/or Brazil in particular. International cooperation projects shall be encouraged to be built on the existing experience and know how of partners from different regions of the world and avoid duplication of work already done. However, the condition for obtaining public support from the EIBI is that the demonstration site should be in Europe.

6 Report on the parallel session of Carbon Capture and Storage (CCS)

6.1 The key characteristics of the CCS Roadmap

The EU has made the demonstration of technical and commercial viability of CCS technologies a priority in the context of the European Strategic Energy Technology Plan (SET-Plan) and has envisaged a European Industrial Initiative to facilitate this. As the first step to the implementation of the CCS-EII, the European Commission, together with the industry, the research community and the Member States have proposed a Roadmap for the development and commercialisation of CCS technologies in Europe.

The aim of the CCS-Roadmap is two-fold. Firstly, it aims to set the strategic and technology objectives of the CCS-EII, describe the actions required for meeting these objectives, preliminarily assess their costs and describe key performance indicators (KPIs) to monitor the progress achieved by the EII. Secondly, it aims to recommend a way forward in a way that it makes the most out of ongoing activities in the area of CCS demonstration.

6.2 Strategic and Technology objectives

The strategic objective of the CCS-EII is to demonstrate the commercial viability of CCS technologies in an economic environment driven by the Emissions Trading System. In particular, to enable the cost competitive deployment of CCS technologies in coal-fired power plants by 2020 and to further develop the technologies to allow for their subsequent wide-spread use in all carbon intensive industrial sectors.

The EII has two main technology objectives: (i) to prove the technical and economic feasibility of CCS using existing technology, and, (ii) to develop more efficient and cost competitive CCS technologies. More specifically, the aim of the first objective is to test the most promising CO_2 capture, transport and storage technologies at large scale in a fully integrated chain and optimise their operational performance; and to reduce the costs of CO_2 capture through learning effects. The aim of the second objective is to further improve power-plant efficiencies, develop new capture processes with improved performance, further optimise CCS technologies and develop alternative technologies for CO_2 transport and storage.

Proving the technical and economic feasibility of CCS using existing technology will be achieved through the realisation of up to 12 large-scale, first-of-a-kind power plants that capture, transport and store the CO_2 generated during their

operation. Early demonstration in industrial processes is also sought. The operation of the projects will commence in 2015 to allow a sufficient track record to be established by 2020 and to yield the necessary knowledge for the next generation of CCS plants to come on stream in power generation and industrial sectors soon after 2020. The demonstration projects will be supported by the CCS Project Network, which will link them together to benefit from joint activities concerning public awareness, international cooperation and knowledge sharing. Through structured and coordinated knowledge sharing, future R&D priorities will be identified, information on the progress of CCS demonstration will be disseminated, and evidence of the safety of geological storage of CO_2 will be accrued for the purposes of public communication.

The benefits from the development of more efficient and cost competitive CCS technologies will be maximised through a dedicated R&D programme focused on efficiency improvements of fossil fuel conversion technologies, new capture technologies for power plants and carbon intensive industries, advanced transport, storage and monitoring concepts and detailed assessments of storage capacities.

The cost of the CCS-EII is estimated to be in the range of € 10.5 to 16.5 billion, of which € 8.5-13 billion will be used for the demonstration programme. Finally, six KPIs have been proposed to assess progress in the actions described above

6.3 Recommendations for the improvement of the Roadmap

The overall reaction to the Roadmap of the stakeholders attending the CCS Workshop was very positive. The objectives, actions and timelines were confirmed at large. It was recommended that some Actions should be further accelerated and others expanded to address additional key issues.

In particular, the industry recommended that:

- Deployment of CCS technologies should become part of the Roadmap (during the discussion it was acknowledged that this is an activity beyond the scope of the SET-Plan).
- With regards to efficiency improvements, the Roadmap should include activities to enable the design of capture systems integrated in the power plant from the onset of any project conception; and to study the response of CCS plants to load fluctuations.
- Three additional technology objectives should be included (this is discussed in the following section of this report).
- Two more actions to complement the demonstration programme should be included in the Roadmap:
    - The assessment of a transport infrastructure and storage capacity.

    - A programme to enable the operation of commercial power plants by 2020.
- One more action to complement the R&D programme should be included in the Roadmap:
    - R&D programme on full characterisation and development of the EU saline aquifer storage potential, and the assessment of infrastructure capacity.
- The proposed KPIs should be complemented as follows:
    - The storage atlas and infrastructure capacity assessment should be completed by 2012 instead of 2020.
    - Transport and storage infrastructure should be demonstrated in at least 2 major industrial clusters by 2020.
- It was noted by the Industry that the strategic KPI of cost reductions by 30-40% is conditional to the commercialisation and take up of the technology by 2020, the installation of at least 5 GW capacity in 2020 and the continuation of the ongoing R&D programmes.

It was agreed that in follow up meetings it will be decided which of the recommendations will be included in the roadmap for CCS.

6.4 Key strengths of the Roadmap

The proposed Roadmap captures all the key elements of the forthcoming EII:

- R&D and demonstration activities are integrated.
- The issues of public awareness are addressed.
- A structured and inclusive international cooperation activity with regards to the demonstration component of the EII is envisaged.
- The CCS Project Network will facilitate structured and coordinated knowledge sharing and the development of joint activities concerning the identification of future R&D priorities, as well as international cooperation and public awareness. The first members are expected to enter in early 2010.

Finally, the proposed objectives are in line with the industrial vision; and the proposed Actions address all the key challenges surrounding CCS technologies, i.e. efficiency improvements, cost reductions, enhancement of knowledge of storage capacities.

Overall, it is accepted at large that the proposed Roadmap is a solid basis for further developing and implementing the CCS-EII.

6.5 Overall recommendations

6.5.1 Objectives

The industry agreed with the strategic objective of the CCS-EII, as it has been formulated in the Roadmap. They also commented that the strategic objective could have been more forward-looking to include deployment activities, in such a way that the EII would aim to make the technology 'ready for deployment' by 2020, which is the objective of the Zero Emission fossil fuel Power plant (ZEP) technology platform. It was acknowledged however that technology deployment is beyond the scope of SET-Plan.

Furthermore, the industry agreed with the proposed technology objectives in the Roadmap and made concrete recommendations for their further enhancement. In particular, the proposed objectives should be complemented with the following:

A. Demonstration programme

- Should share knowledge gained from the CCS demonstration projects- this can be mainly achieved through the CCS Project Network.
- Should validate storage monitoring technologies and procedures- this could be undertaken by the EERA.
- Should prepare for the full deployment of CCS technologies in 2020.

B. R&D Programme

- Should minimise capital and operating costs of all components of the CCS value chain through performance improvements.
- Should improve the efficiency and operational flexibility of CCS power generation.
- Should improve methods of storage capacity assessment, storage monitoring, well integrity, etc.
- Should study technical requirements for a full infrastructure deployment by 2020.
- Should explore and develop the full storage potential of saline aquifers in the EU.

6.5.2 Financing options

Financing at EU-level is currently limited. At present, financing sources include corporate investment, the European Energy Programme for Recovery (EEPR), FP7, Structural and Cohesion funds and possibly the EIB. However, in the frame of the EEPR, € 1.05 billion have been made available for CCS demonstration projects. Up to 7 projects will receive finding of up to € 180 million each. On 9 December 2009 the Commission awarded € 1 billion to six CS demonstration

projects. Furthermore, 300 million allowances from the New Entrants Reserve (NER300) could be used to finance CCS demonstration projects. It is noted that the funding from NER300 is fully complementary to EEPR financing. It was further pointed out that the successful and timely implementation of CCS demonstration is dependent on the timely transposition of the CCS Directive into national law.

6.5.3 Scope and nature of the EII

In the frame of maintaining a constant dialogue between the CCS stakeholders, a Workshop with the Member States, the industry and the European Commission was held on 1 July 2009 to develop a common understanding of the scope of and expectations from the CCS-EII. The Commission stressed the need for the EII to be realistic with regards to expectations, since the EII does not intend to replace existing, ongoing activities. The EII should be seen as an umbrella initiative to promote and accelerate further the development of CCS technology.

During the CCS Workshop, the industry agreed that the EII is the right vehicle for the timely commercialisation of CCS in Europe. They proposed that the EII should be a flexible and functional cooperation between the industry, the Member States and the Commission. They stressed the point that the EII should not become a legal entity. Finally, the ZEP TP agreed to take the lead in the implementation of the EII. The role of the European Energy Research Alliance (EERA) will be important for implementing the R&D Actions of the Roadmap through their proposed joint programming. A concern was however raised by many workshop participants that EERA may evolve to a ‘club’ of selected organisations and that this should be avoided.

6.5.4 International cooperation

One of the key aims of the CCS-EII is to foster international cooperation on CCS demonstration and policy. In particular, the CCS-EII will enhance synergies with USA, Japan, Canada and Australia, strengthen the ongoing collaboration with China, and extend the collaboration of European stakeholders to other main coal users, such as India and South Africa. It was stressed however that IPR issues need to be addressed before further engaging with non-European countries.

7 Report on the parallel session of Energy efficiency – Smart cities

7.1 Overview and general considerations

Following the request of the European Parliament and of the Council during the process of adoption of the SET Plan, **a new initiative on energy efficiency** is proposed as part of the Communication on investing in the development of low carbon technologies.

During the SET Plan Conference in Stockholm, the Smart Cities session offered the possibility to discuss the initiative with the representatives of the EU programmes and initiatives on which this one can build upon (CONCERTO Programme, PPP on energy efficient buildings, Covenant of Mayors, CIVITAS, European Investment Bank).

7.2 Key characteristics of the Smart Cities

Unlike the other European Industrial Initiatives and associated roadmaps, the Smart Cities is not an action to develop the technologies but to accelerate the market uptake of the energy efficiency, renewable energy source applications already available and to pull further sustainable transport solutions. Therefore, the content and approach this initiative is different from the other 7.

The motivation to frame this initiative on cities is obvious. Cities represent 80% of the final energy demand in EU. At the same time cities produce 85% of the EU GDP.

This initiative was primarily developed based on the experiences of the existing EC Programmes and initiatives, most notably: CONCERTO, PPP on energy efficiency in buildings, CIVITAS and the Covenant of Mayors.

7.3 Summary description of the roadmap

The Smart Cities Initiative objective is to progress by 2020 towards a 40% reduction of greenhouse gas emissions through sustainable use, production and distribution of energy in those cities.

To achieve this objective, a systemic approach and organisational innovation towards energy efficiency, use of low carbon technologies and the smart management of energy supply and demand is required.

The initiative focuses on:

- **Buildings** sector – market uptake of energy efficiency measures for new and old buildings. The measures used should lead to the deployment of new zero energy requirements buildings and on identifying refurbishment techniques, technologies and materials which should also ensure more comfort for their residents
- **Energy networks** covering both electricity, heating and cooling applications and based on the use of innovative RES, energy efficient production options and appliances
- **Transport** covering sustainable mobility aspects as well as the use of alternative fuels and electricity

The initiative proposes to test and assess in the next 10 years up to 200 zero-energy buildings in different climatic zones whilst encompassing different strategies for the refurbishment of existing buildings. It considers also 10 development and deployment programmes for smart grids in cities, demonstration programmes for large scale deployment of RES heating and cooling and their integration in buildings, the set up of development and testing programmes for the large deployment of low carbon transport systems and alternative fuel-electric vehicles.

The **methodology to implement** the smart cities initiative will vary according to the level of ambition and scale of risk involved

- Ambitious cities, which can receive technical assistance to facilitate access to loans and risk sharing mechanisms
- Pioneer cities (25-30), which are taking much greater risks to meet more ambitious strategies, will be receiving funding in the form of grants

The initiative aims to reach through its implementation about 5% of EU population

The cities will be selected through open call for proposals, possibly in sequential steps and making use of criteria (technical, managerial and financial); the pool of cities in the Covenant of Mayors will be the first target for candidate cities.

7.4 Strengthen and further considerations on the smart cities initiative and the technology roadmap

7.4.1 Strengths

The Smart Cities Initiative was well received and the Commission's proposal for boosting the energy efficiency and the market uptake of low carbon technologies in urban areas is highly appreciated. It is recognised that such an initiative is necessary to further progress from established, successful projects, like those carried out with the CONCERTO, CIVITAS initiatives, to fully integrated strategic programmes along with the SET Plan vision.

7.4.2 Further considerations

Buildings
Energy efficiency measures should concentrate on *existing buildings* both *residential and non residential.* The net zero emission buildings concepts have been extensively demonstrated and therefore this element of the initiative should be toned down. The actions for building sector however, should be closely associated with the citizens. Therefore, *social aspects* should be considered**.** Market *mechanisms, feasible funding schemes and capacity building* at local level are of utmost importance. *Coherence* between the Smart Cities initiative and the roadmap of PPP on energy efficiency in buildings should be ensured.

Energy networks
Heating and cooling as well as the electricity networks are considered as the part of the initiative which should have the highest priority. The approach to be used is to maximise the integration benefits of the energy demand and supply.

Transport
Regarding transport sector both proposed main actions sustainable mobility and alternative vehicles and fuels are needed. Nevertheless is considered that preference should be given to measures moving towards the electrification of transport. The following elements are considered to be relevant: congestion charging scheme/parking policy, clean and efficient vehicle fleet programs, land use planning favouring public transport, strong sustainability, traceability and GHG emission reduction criteria for the use of bio-fuels primarily, but as well as for the employed electricity generation, storage and use paths.

Monitoring system
Although highly appreciated the Smart Cities Initiative will need better defined and more specific Key Performance Indicators to enable its effective monitoring and measuring of progress towards its goals.

7.5 Challenges and recommendations for further development

7.5.1 Challenges

The initiative is facing strong challenges in terms of implementation:

- As it is focused on cities, the actions will be carried out at local level. Therefore, the EU intervention logic should be focused on integration and transition strategies
- The deployment of different technologies should consider the integration aspects and the implications for the different sectors and their specificities applicable to the strategies for the cities
- It has a strong financial component but it also depends on available technology uptake and its further development

7.6 Recommendations

7.6.1 Approach to overcome the challenges

The Smart Cities initiative should have a *longer time perspective* than the envisaged decade in terms of milestones and expected results. The previous experiences from CONCERTO and CIVITAS projects show that 6-7 years on average are needed to develop an urban project before its maturity cycle.

The *integration strategies* in urban systems should give further consideration to: governance, the level of involvement of the different stakeholders (local and regional government, citizen groups, technology providers, energy service companies, finance community etc..). The high level of investments required necessitates the set up of effective partnership with the private sector.

The initiative should benefit from a *wide demonstration campaign* building on the CONCERTO/CIVITAS programmes, the methods employed by these and the lessons learnt. In particular, the knowledge acquired in managing complex urban scale projects by utilising and aggregating different urban initiatives should be used.

The cities should consider *global financial and budget plan*s. A broader perspective taking into account social aspects, life cycle costs of various applications and opportunity costs should be the elements, on which these global financial plans should be developed.

7.6.2 Financial perspective

To boost the uptake of energy efficiency and use of RES in the cities large investment programmes should be developed. The traditional approach used until now implying the development of small projects or programmes in an uncoordinated way, although useful in kick-starting innovation, it has to be revised to reduce transaction costs and efforts in securing and utilising grants. The Smart Cities initiative offers a good starting point and the framework which, is believed to lead to the necessary change for urban sustainable energy developments.

What is needed? Possible options which, may be envisaged are:

- *Create special entities* in the cities which should be capable for developing such large and integrated programmes.
- The needed large scale of investments requires the participation of the private sector besides the public intervention. An option would be to *involve the Energy Service Companies*.

- *Develop new financing* instruments which should play a catalytic role in supporting this type of programmes. The EIB supports already the development of large programmes such as in the Province of Barcelona (investment of 500 M€ and 330 municipalities), Province of Milano (30 municipalities and 90 M€), city of Paris, etc.
- Increase the effectiveness of the actions by *combining financing instruments with other elements* such as: technical assistance (e.g. EIB ELENA facility), grants and loans combined with the use of energy audits, financing instruments which, involve a higher level of risk, such revolving funds, public-private equity funds etc.

Size of the cities

The initiative should cover not only big cities but also smaller cities. Small cities have different opportunities for implementation, which could influence the choice of technologies. Therefore the cities should reflect most of the European realities. The proposal is to consider including:

- 50 small cities < 50 000 inhabitants
- 20 medium cities: 50 000 – 500 000 inhabitants
- 10 large cities > 500 000 inhabitants
- 5 very large cities > 1 000 000 inhabitants

7.7 Conclusion

The Smart Cities initiative is very different in scope than the other initiatives and it will require a complete different path for its implementation. It encompasses many sectors, relies on integration of different technologies and involves already ongoing actions at local level but requiring even more integration of these and renewed commitment. The initiative should be further developed by:

- Taking a preparatory action assessing and evaluating needs, instruments and priorities
- Defining in detail the actions, including the synergetic paths for the three sectors which are targeted: buildings, energy networks and transport
- Proposing a robust set of associated Key Performance Indicators
- Developing support actions for integrated strategies
- Defining the green economical criterion for The Smart Cities initiative addressing to buildings, transport and energy networks part such as business model.

8 Report on the parallel session of Smart Grids

8.1 The road-map for European Electricity Grid

A leading group existing of seven TSO's and seven DSO's have drawn the roadmap for the European Electricity Grid of the future consisting of both smart grids as well as adequate transmission structures. In this way a new content for the smart grid approach is enabled, which will encompass coherent actions at TSO, DSO and customer levels.

This roadmap has been recognized by the workshop participants as a thorough plan for the research, development and demonstration projects needed to realise the EU energy policy 2020 targets on sustainability, efficiency, security of supply and affordability. This roadmap foresees in the prerequisite accommodation of the grid for the realisation of all other energy EII's, resulting in an electricity system that connects large scale renewable resources to the transmission system and integrates renewables and other decentralised generation in the networks.

The roadmap paves the way for a smarter system in terms of integration of intermittent sources and energy management, storage applications and active consumer response while maintaining security of electricity supply.
The plan is detailed into the R&D projects needed, planning and required budget. On the selected RD&D projects as such no criticism was at all given.

8.2 Key characteristics

- The roadmap covers all relevant issues (technical, market design, social acceptance, organisation & data exchange, regulations)
- The EII is open to all European TSO's and DSO's but also other interested stakeholders will get access through a Stakeholder Advisory Board
- Focus is the research, development and demonstration needed for the transmission and distribution grids

8.3 Key strengths to build upon

- SmartGrids is no longer a goal in itself, but an important means to achieve the ambitions targets of the SET plan
- The roadmap is based on the EU energy policy goals towards a carbon free electricity system and an Integrated Electricity Market and pragmatically

elaborated into what needs to be done when starting from the presently implemented smart grids elements.

8.4 Weaknesses and recommendations to correct them

The roadmap as such shows no elements of weaknesses. However the plan is drawn by a limited number of TSO's and DSO's and is based on the assumption that the EU energy policy goals are leading. Weak points to correct mentioned during the workshop are:

- Governance
  The European Electricity Grid Initiative (EEGI) has clearly expressed that it is open to all TSO's and DSO's, regulators and other Stakeholders. It is now time to realize that and get connected in time to ensure contributions from these parties during the finalisation of the roadmap. The decisions of the European Electricity Regulatory Forum will play a key role
- Market assumptions
  Two elements play a role in the grids design:
  Development of electricity demand
  It is not clearly defined what the assumptions are on the demand of electricity. Key question is: will there be an increasing or decreasing demand? Two elements play a role here: existing functions are expected to become more efficient due to the EE policy measures (e.g. the Eco Design of EuP Directive) thus lowering the electricity demand. Some other functions will shift to electrical, e.g. mobility by electric vehicles or heating by electric heat pumps. This will lead to an overall energy efficiency improvement hand in hand with an increase of electricity consumption. This issue should be addressed in the roadmap.
  Generation and fuel mix
  The roadmap is based on the realisation of the EU energy policy on sustainability. At this moment the non regulated market parties have massive investment plans in non RES generation. It was suggested to address this in the roadmap or in the SET-plan as such.

8.5 Recommendations for further development of the EEGI road-map

The EEGI road map is crucial element in all other energy EII roadmaps, hence the recommendations for further development has a horizontal character and requires more coordination between the EII's

8.5.1 Objectives, ambition

The objectives of the EEGI road map were not under discussion during the workshop. However some discrepancy with the other EII roadmaps was recognized. It was concluded that the ambition of the other roadmaps must be

aligned with the view of the grid roadmap. In particular the EII Wind roadmap is more ambitious in the speed of deployment.

The EEGI has already analysed and reported the discrepancies. This analysis is a good start for further alignment. Some of the technologies involved show different geographical spreads in resources (e.g. offshore wind in North West Europe; Solar PV and CSP in the south)

The EEGI initiative has to consider how to addresses these geographical spread in a pan-European approach

8.5.2 Financing sources and conditions

The budget needed for the roadmap is relatively small, 2 bn. €, but still excludes deployment costs. The system operators operate as monopolists in a regulated market, hence financing covering all risks must come from a combination of public funding (EC an MS') and on-charged expenses in the transmission and distribution tariffs. This will lead to a confrontation with the regulatory framework. For the realization of the roadmap this will need some 'light' adaptations in the national regulatory frameworks as already described in the 3rd Energy Package. Moreover, the role of the individual MS' research agenda's could be more specifically addressed.

During the workshop greater concerns about financing were on the deployment phase. The current regulatory framework is aiming at low costs for end users. The deployment phase of the future European Electricity Grid requires the adaptation of sustainability criteria in the regulatory framework.

The regulators were not present during the workshop, but during an EII European Electricity Grid workshop on October 14st 2009, an analysis of the roadmap and regulators' view from an expert group on SmartGrids of the Council of European Energy Regulators (CEER) was presented. CEER is thus already proactively involved in the further development of the roadmap.

8.5.3 Scope and nature of the EEGI

The well defined scope of the roadmap was welcomed. However there were some reservations beyond the scope of this EII brought under discussion:

- Deployment
  Deployment is not in the scope of this EII. In other EII's deployment (elements) are included. This incoherence should be analysed as horizontal issue. To prevent misinterpretation of the budget claims of the different EII's budgets for deployment should be specified. Otherwise the relatively small budget for the EII European Electricity Grid road map could give the (wrong) impression that this road map is les important than the others.
- Hardware and ICT
  Equipment, or more in general hardware from the component and ICT industry

as well as generation and storage facilities are not in the scope of this EII.

9 Report on the parallel session of Nuclear Energy

9.1 Key elements of the Roadmap of the European Sustainable Nuclear Industrial Initiative

Within the EU SET Plan, as recalled by the Commission representative in opening the nuclear session, reference is made to the role of nuclear fission in meeting targets and objectives on the 2020 and 2050 timescale. To meet 2020 targets, the plan states the need to maintain competitiveness in fission technologies together with long-term waste management solutions. On the 2050 timescale, the need to complete the preparations for the demonstration of a new generation (Gen IV) of fission reactors for increased sustainability is stated.

Based on the need for nuclear fission to meet the long term sustainability objectives as defined in the SET plan, it is also noted that a priority activity from 2009 onwards is the launch of the sustainable nuclear fission initiative that will focus on the development of Gen IV technologies.

As a result of this, the European Sustainable Nuclear Industrial Initiative (ESNII) has been proposed and developed by a Task Force operating under the umbrella of the Sustainable Nuclear Energy Technology Platform (SNETP). SNETP was launched in 2007 and involves industry, research organisations, technical safety organisations and academia, from a wide range of European nations.

The SNETP Strategic Research Agenda (SRA), in line with the SET Plan objectives in the nuclear area, has been built on three technology pillars that cover (i) Gen II and Gen III lifetime management and deployment, and improved fuel performance, (ii) the use of nuclear energy for non-electricity applications and co-generation of heat and power, and (iii) advanced reactor systems.

The ultimate goal is to allow nuclear fission energy to remain a major contributor to the energy mix from now (1/3 of the EU electricity is generated today by nuclear fission) until the end of the century and beyond. Research associated with Gen II and Gen III systems as defined in the SRA is predominantly determined and financed by industry as they are the beneficiary of such research due to the relative short-term return on investment. A specific initiative under the SNETP SRA may develop, but this will be dependent on industry investment.

Regarding co-generation it is important to clarify the end-users needs and requirements plus the need demonstrate the coupling of a nuclear reactor, eg a High Temperature Reactor, with an industrial process. A specific initiative is

under consideration by SNETP and might lead to more rapid market penetration, if indeed industry shows clear interest and is ready to contribute. Work associated with advanced Gen IV reactor development with commercial deployment foreseen in a 2040 timescale is beyond the commercial time-horizon of industry and therefore public sector support and funding will be required as the main contributor.

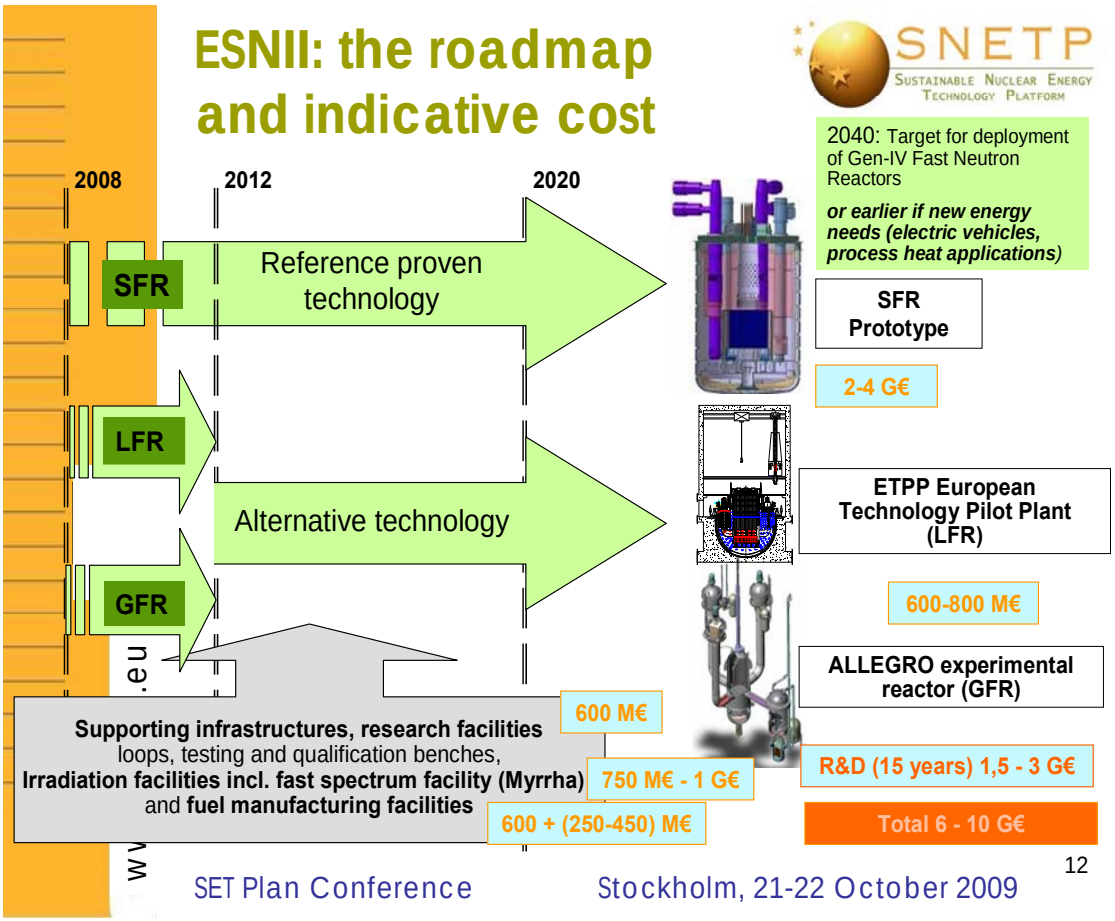
The development and deployment of advanced reactor systems and fuel cycle technology is the objective of ESNII. Advanced systems such as the Gen IV concepts are aimed at enhancing and improving resource utilisation through recycling, economics, safety, waste minimisation, security and resistance to proliferation. This will lead to increased sustainability of nuclear energy as a contributor to the low carbon energy mix over the long term.

Of the current Gen IV concepts the ones most appropriate for further research as part of ESNII are Fast Breeder Reactors. The Sodium cooled Fast Reactor (SFR) is considered the most feasible for deploying a prototype on a 2020 timescale. Two other systems (Lead cooled and Gas cooled Fast Reactors (LFR-GFR)) are regarded as possible alternatives technology routes worth to be tested via the deployment of a demonstrator around 2020.

As part of the ESNII programme which is focussing on the prototype and demonstration system, it is also necessary to ensure supporting infrastructure and R&D activities are progressed. This requires research facilities such as experimental fast neutron flux devices, test-loops, fuel fabrication facilities, spent fuel handling and hot laboratories, etc. Some facilities exist already but need upgrades, others may have to be built.

The overall cost of ESNII has been preliminary evaluated between 6 and 10 Billion Euros over ten years. Beyond 2020, the experience gained with deployment and operation of a demonstrator, will then be highly beneficial in supporting the design of first of kind commercial fast reactors. This will open the path for commercial deployment around 2040 when they be required and a recognised part of utilities portfolio of energy technologies to meet the long term sustainable supply of nuclear power.

The following slide presents the ESNII elements in a nutshell, including a simplified timescale with a decision making point in 2012, and a range for the preliminary costs.



The ESNII Task Force is presently refining the technical scope, costing, planning, and with the support of an expert Consultant the potential financing mechanisms and legal structures. At this stage of the project to ensure the most appropriate use of resources by interested parties, the intention would be to establish ad-hoc mechanisms and Consortia for the different subprojects of ESNII. This work is expected to be well advanced for the possible launch of the ESNII during the second quarter of 2010.

9.2 Risks for the ESNII

Mr N Camarcat, from the EDF, gave the view of a utility. This covered a range of interests from the immediate need to operate a fleet of Generation II Light Water Reactors (LWRs) to deployment of Generation III plants and eventually the need to build and operate sodium cooled fast reactors. In view of preparing for the time when U resources might become scarce, EDF is currently financing its own research programme on SFR (5% of EDF's nuclear research budget – equivalent to 30 man-years) with the main aim to define Utility Requirements. In particular, the Generation IV SFR will need to be as safe and secure as Generation III LWRs, have high availability and performance and be easy to operate (ie maintenance and in-service inspection, supply chain and materials,…), be competitive for commercial operation (investment and operation costs similar to Gen III plants),

be proliferation resistant from a fuel cycle perspective, while allowing the transmutation of high level waste. The above "challenges" apply to commercial SFR deployed in the future which will demonstrate significant improvement through innovation compared to the plants built and operated in the 80 and 90s.

Fulfillment of these challenges will not all apply to the prototype to be started in 2020 (in line with the French Programme following the French law of 2006). In particular the prototype does not need to be competitive per se, even if coupled to the grid, but needs to be able to demonstrate the potential competitiveness of the future commercial SFR plant.

Looking to ESNII as described today, Mr Camarcat noted two risks which will need further attention: the licensability of the prototype and the costing. Based on the past experience, it is critical to engage with the Safety Authorities if the timeline of 2020 is to be achieved. He also insisted to have a prototype of high enough power level (a core of minimum 5 m3 corresponding to a power level above 400 MWe), in order to be representative and allow the building of a first-of-a-kind plant at the next stage. The costing has to be revisited and refined taking this into account, as well as the results of ongoing R&D fixing the main technological options.

Mr R Clegg, from the University of Manchester, provided an insight into the UK past experience in designing, building and operating Fast Reactors.

During the discussion, the "risk" of the timeline and possible delays was raised: if the perspective is to have commercial plants available around 2040, how will ESNII contribute to the 2050 objectives of the SET Plan (EU Energy Policy Vision of 80% GHG reduction and Strategic Energy Review goal of 100% electricity coming from zero carbon source)?

The aim of ESNII is to demonstrate, within the next decade, the technical and industrial feasibility and the competitiveness of future Generation IV Fast Reactors, so as to ensure their availability at commercial conditions when Utilities and Industry might need them, in particular when U resources might become scarce, as a very long term sustainable low carbon source of energy. *Knowing the long lead times necessary to bring innovation to market in the nuclear area, based on the past experience, it is necessary to launch ESNII now and to proceed without undue delays.*

Another risk, associated with any nuclear projects, is its acceptance at political and public opinion level. It was agreed that an action plan need to be tailored to the objectives of ESNII. A coupling with the activities of the European Nuclear Energy Forum might be useful.

Summary of "risks": licensability, costing, delays, public acceptance

9.3 Opportunities for ESNII

Mr A Bucaille, from Technology Supplier AREVA, discussed the role of ESNII in the wider global and international energy context. The demand for energy and even more for electricity will drastically increase in the next decades, ie if plug-in hybrid and electric cars are coming to the market at large scale.

The maximum must be done to improve energy efficiency and demand side management, to develop the use of renewables (but integrating their limitations such as intermittency and related costs in terms of grid adaptation, storage capacities, backup plants,…). Base load will continue to be needed, based on coal (associated with CCS) and nuclear. Due to the limitations in Uranium resources, it is necessary to start developing the better use of the U energy content by breeding and recycling.

Programmes of industrial scale are engaged in major nations such as the US, Russia, China, India, Japan,… with technologies offered to the wider market of countries looking at launching a nuclear programme. *In Europe only France has today the potential to be part of the process. But it seems much more effective to engage as Europe. ESNII is a unique opportunity for Europe, as a whole, to keep its nuclear technology leadership and to engage a new generation of people into the process. It is not too late but it is time. Otherwise, Europe may rapidly become dependent on others for advanced nuclear technologies, without having the capacity to set the standards.*

Mr D Haas, from the EC Joint Research Center, presented the international cooperation framework for research on Generation IV Systems *(GIF – Generation IV International Forum)*. France and Euratom are part of GIF. The Euratom Framework Programme is a contributor via dedicated research projects – some already in the frame of ESNII. *There is therefore already an existing wide international cooperation framework for elements of ESNII related to pre-commercial research.*

Summary of "opportunities":
- EU leadership and knowledge building,
- Existing French Programme as an anchor for a wider European endeavor,
- Existing International cooperation via GIF which needs to be further developed via ESNII where appropriate.

9.4 Overall Evaluation and Recommendations for further development of the ESNII roadmap

Within the wider scope of the SNETP Strategic Research Agenda, which fits with the broad objectives of the SET Plan to focus on competitiveness, waste management and increased sustainability, the ESNII roadmap is well designed to support the longer term contribution of nuclear energy in the low carbon economy of the future.

Although Advanced Reactor Systems proposed by ESNII will not come on line commercially before 2040, considering the lead times for bringing innovations to the market in the nuclear area, it is necessary to proceed in a timely fashion for the design and construction of prototypes and demonstrators. Therefore the ESNII should be launched in the course of 2010. The 2012 timeframe should be kept for decisions on the open options, allowing a further focus and concentration of means and resources.

In order for ESNII to keep the ambitious 2020 timeframe for the startup of the prototype and demonstrator, it is necessary to engage the Safety Authorities regarding the licensability, and Utilities regarding end-users requirements.

Diverse financing mechanisms and legal structures are presently studied for ESNII with the support of an Expert Consultant. A Memorandum of Understanding is ready to be signed by the ESNII Task Force Members – opening the path for future ad-hoc legal entities (Consortia) tailored to the different subprojects of ESNII. Financing mechanisms will also be tailored to the different subprojects. In the case of the SFR, being a prototype reactor to be coupled to the grid and supported by the French Programme, a combination of public support and public-private-partnership via own financing or loans, might be possible. For other subprojects, the funding will mainly have to come from public funding and further innovative means (ia nuclear energy as a CO2 free source of electricity).

International Cooperation is already ongoing in areas covered by ESNII through the GIF (Generation IV International Forum). This should be optimized, striking a good balance between effectiveness and best use of resources, while maintaining European leadership.

Public acceptance is an integral part of the successful implementation of ESNII. Enhanced efforts in this aspect should be pursued.

- In order to support the launch of ESNII in 2010, further work is required to better define the cost of the Initiative, the financing options, the legal aspects, intellectual property issues, and how to best integrate research at EU level (Joint Programming).

10 Report on the parallel session of Concentrated Solar Power (CSP)

10.1 The road-map for CSP

The main objective of the road-map is to demonstrate the competitiveness and readiness for mass deployment of advanced concentrating solar power (CSP) plants, through scaling-up of the most promising technologies to pre-commercial or commercial level. The goal of the industry is to contribute around 3% of European electricity supply by 2020 with a potential of at least 10% by 2030 if the DESERTEC[5] vision is achieved.

To achieve a large-scale, sustainable deployment of advanced CSP plants with better performance and lower costs a series of technical issues have to be resolved. This has to go hand in hand with a series of R&D and demonstration activities designed to better exploit the inherent strengths of CSP technology. The following four main issues were identified to achieve the goal:

a. Reduction of construction, generation, operation and maintenance costs

- To improve the conversion efficiency at system level as well as the reliability and efficiency of individual components.
- To develop advanced plant monitoring and control technologies.

b. Improvement of operational flexibility and energy dispatchability

- To develop and improve thermal energy storage, as well as hybridisation of the power plant with natural gas and potentially with bio-mass renewable energy.

c. Improvement in the environmental and water-use footprint

- To reduce the cooling water consumption through innovative cycles, by developing dry cooling systems and optimising land use through new and innovative designs.
- To demonstrate CSP-specific sustainable water desalination processes.

d. Advanced concepts & designs

- To address advanced components, concepts and systems.

For each of these main issues a number of concrete R&D actions are described in detail. The road map lists an indicative R&D budget of about € 7 billion for the next ten years to realise the rod map and gives some key performance indicators.

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5 The concept of DESERTEC is a massive deployment of solar technology, mainly CSP, in MENA countries and the export of electricity to Europe. (MENA = Middle East, and North Africa)

10.2 Weaknesses and recommendation to correct them

A coherent SWOT analysis of the road-map done by PricewaterhouseCoopers revealed the following main weaknesses in the political, social, economic and technology areas.

10.2.1 Political

- Ambition – why is this target set at only 3% of electricity supply?
  Recommendation: This is perception and can be changed by better communication and information.
  Due to the solar resources only five member states have potential for installing CSP plants. The planned CSP capacity represents up to 72.5% of the total 2007 electricity generating capacity in some countries. In addition, it has to be made clear, that the achievement of 2020 targets is only a stepping stone which creates the possibility of importing larger amounts of clean electricity beyond 2020
- Technology delivery requires favourable EU policy
  Recommendation: Strong involvement of all stakeholders to make sure CSP and a Super Grid are key elements in the SET-plan and the relevant National Renewable Action Plans. Active engagement of the fossil fuel lobbies will also be needed to deliver on favourable EU policy.
- Elevate sense of urgency needed for the next 10 years
  Recommendation: The next ten years are crucial for the achievement of the climate change goals, and the creation of a viable CSP industry and this needs a sufficient market pull to attract sufficient private investment.
- Integration with initiatives not clear especially provision for the full realisation of Desertec?
  Recommendation: The various initiatives, like SET-Plan, Mediterranean Solar Plan and DII should be better coordinated and the interdependence of the different initiatives should become clearer. Consideration should also be made for other CSP roadmaps and toolkits in development e.g. IEA, KfW.
- Need for a single integrated plan across renewables
  Recommendation: The individual SET-Plan European Industrial Initiatives have to work closer together to develop an integrated plan how to decarbonise our power supply and develop a viable strategy how to build the necessary infrastructures within the next ten years which allow to distribute the then available power in Europe.
- Benefits of a more direct EU approach?
  Recommendation: For commitment towards the realisation of the CSP SET-Plan initiative one should make sure CSP is a key element in the relevant National Renewable Action Plans. The EU may also wish to prescribe other elements that are mandatory in any NRAP e.g. development of a Super Grid, and associated timelines.

10.2.2 Social

- Guidance on geographical split of funds – uneven capacity building and skills between countries
  Recommendation: Although only five member states are mainly concerned with the installation locations of CSP plants, all European Member States can benefit from the CSP industry value chain as a whole if properly implemented.
- Involvement of industry to deliver training
  Recommendation: The Industry Associations should come up with a plan what kind of training is needed, who should deliver it and how industry would be involved. If supported by coherent technology information from SETIS, and a communications plan, this could help address local NIMBY resistance to the overall plans.
- Increased focus on capabilities in MENA
  Recommendation: To utilize the solar resources in MENA countries for the benefit of local development and energy exports, the Industry Associations should identify what kind of capacity building and technology transfer is needed, to enable MENA partners to take ownership in such projects and cooperate with European industry consortia..

10.2.3 Economic

- Link between technology and market instruments / financial incentives
  Recommendation: The different CSP technologies are in different stages of maturity and therefore require different levels of government support and represent different risks for potential investors. Categorising the technologies would allow for targeted support and increase transparency of risks for financial investors.
- Reduction in overall emissions (lcoe) and costs / kW/hr
  Recommendations: Until costs / kW/hr decrease further, CSP will struggle to gain any foothold in electricity generation across Europe. An intensive programme of R&D is needed to take forward cost reduction opportunities, coupled with greater sharing of information and lessons learned from projects by SETIS.
- Lack of agreed baseline industry data / KPI's
  Recommendation: The industry has to establish an agreed technology/production data baseline against which progress of future developments can be benchmarked. This is essential to introduce clear KPI's for stop and go decisions for future technology developments.
- EU support post 2020? Investment time horizons
  Recommendation: The SET-Plan initiative only looks as far as 2020 as an important stepping stone to the future. European and Member State policy makers will have to offer market perspectives beyond that to enable the development of a viable industry. Discussions about post 2020 targets for CO_2 reduction and Renewable Energy shares should start immediately and become binding as soon as possible to offer the long term investment certainty needed to attract the necessary private investment.

- Introduce a feasibility / likelihood measure?
  Recommendation: After the establishment of a technology/production data baseline, clear KPI's for stop and go decisions for future technology developments have to be implemented.
- Emphasis also on reduction of construction costs?
  Recommendation: The road-map only focuses on the CSP technology cost reduction. However, the whole plant costs including all necessary infrastructure and support measures have to be taken into account to reduce plant costs, e.g. viability of alternatives to the steel mounting of troughs or mirrors; reduction of cement use, etc.

10.2.4 Technology

- What not just how
  Recommendation: The road-map focuses more on how cost reductions should be realised than naming the concrete technologies and the relevant improvement steps there. At the moment the road-map is open to all technologies which is a strength, but clear stop and go criteria and milestones have to be introduced to decide what technology development projects should be pushed through and which ones should be stopped.
- Need for large projects and critical mass
  Recommendation: In order to realise cost benefits resulting from economy of scale, large projects and smart duplication of proven concepts have to be pushed to realise a critical mass in production volumes for the critical components.
- Hybridisation may be a distraction?
  Recommendation: It was pointed out, that hybridization should not be an excuse for a small solar add on to a conventional thermal power station, but should be seen as an opportunity to optimize solar energy use, dispatchability of electricity and economic performance of a CSP plant. Hybridization with other renewable energy sources like bio-gas would be the preferred option.
- Exploiting scale and supply chain capacity
  Recommendation: The CSP industry is at an early stage and needs volume and a critical mass to develop further and exploit the full scale of cost reduction potential offered from a well functioning and competitive supply chain.
- What are the other dependencies / triggers?
  Recommendation: As already mentioned earlier, the availability of the necessary electricity transmission infrastructure is a key element to utilize the solar potential of CSP electricity. Due to the ability to deliver electricity when it is actually needed, CSP technology is an important element of any renewable energy supply scenario. Therefore, a more integrated approach how to implement the different renewable energy technologies together and how to ensure a stable electricity supply are important triggers for future CSP capacity demand.

10.3 Key strengths to build upon

The emerging industry of Solar Thermal Electricity (STE) has strong European roots. It is growing mainly due to the technical and economic success of the first projects and to the stable green pricing or support mechanisms that bridge the initial gap in electricity costs (i.e. feed-in tariffs) although member country reviews of these regimes are now causing some uncertainty in the industry.

European countries are world leaders in this technology as demonstrated not only by the number of plants under construction, but also by the ownership and construction of new plants in the USA, and the international tendering of plants in northern Africa or the Middle East that are awarded to European companies.

Regarding components manufacturing, there are factories in many EU countries. Regarding parabolic mirrors, absorber tubes, collector structures, heliostats, steam turbines, alternators, transformers and other components, the European solar plant constructing industry and engineering are world references.

Today this emerging sector accounts companies from 12 EU-countries, more if we take into account non specific STE components manufacturers that are, however, part of the normal equipment of electricity generation trough thermal processes. Furthermore, the number of R&D activities promoted and developed by research centres and by the industry are also key indicators. In short, the European industry is perfectly prepared to lead the development of these technologies worldwide. It is a world leader and should remain so. It is the challenge for the coming years.

10.4 Overall recommendations for further development of the CSP road-map

The participants of the CSP session voiced their strong support of the SET-Plan Roadmap as well as the launch of the European CSP Industrial Initiative and pledged to help to develop it further. It was strongly encouraged to develop SETIS into a one-stop-shop knowledge repository and information hub.

One of the key recommendations was to define more detailed Milestones and Priorities within the road-map as well as the Industrial Initiative based on, where possible, common principles and approaches between technologies. In order to accelerate the technology development it was agreed that new funding mechanism to cover the whole cycle from concept to commercialization are needed.

These mechanisms should include clear stop and go milestones at defined project stages, which then would decide about a further financing round without re-submitting the project. Such an approach would not limit creativity at a concept stage, but would eliminate projects, which are not able to meet the technology development milestones. In addition, the need for more crosscutting material research amongst various energy technologies was stressed, e.g. high temperature resistant materials; advanced cooling technologies; etc.

The participants emphasized the need of an integrated approach for accelerated large scale deployment of all renewable energy technologies, where CSP plays a crucial role. The technological option of thermal storage and hybridization has the capability to deliver electricity when it is needed and helps to accommodate the access of more other fluctuating energy sources on the grid. Therefore, the participants called for more interaction between the different Industrial Initiatives and a need for coordination.

Due to the fact that 2020 was only seen as a stepping stone for the further development and deployment of CSP technology it was stressed, that a capacity building initiative and partnership with MENA counties is crucial for the longer term perspectives of this technology.

11 Report on the parallel Session of Photovoltaic Solar Energy

The parallel session on Photovoltaic Solar Energy was attended by around 30 participants from industry, government, research and utilities. After a short introduction by the EU Commission representative, in which the objectives and actions of the Technology Roadmap SEC(2009) 1295 regarding photovoltaic energy were explained, A. Milner (CEO of Q-Cells, DE) and W. Sinke (ECN, NL) presented the ***Solar Europe Industry Initiative (SEII)***. The presentations of the two discussants, H. Wicht (Senior Director; iSuppli, DE) and G. Agostinelli (Senior Technology Associate; Good Energies, CH), followed.

An active discussion developed that allowed identifying strengths and weaknesses in particular on the R&D part of the initiative.

11.1 The Solar Europe Industry Initiative of EPIA– key characteristics

The major and strongly visible element of the Initiative is its most ambitious scenario of achieving a 12% share of Europe's electricity supply, from less than 1% today. It is seen as a major contribution for the more than 35% share of renewable sources for electricity, required to achieve Europe's overall target of providing 20% of consumed energy by renewable sources, by 2020.

For the ambitious scenario the initiative starts from firm grounds, namely from a currently annual turnover of more than 10 Bio. € and an average compound annual growth rate (CAGR) of 75% for the last 5 years. At the end of 2008 the overall installed capacity in Europe is almost 10000 MW, 64% of world's PV capacity, generating about 0.4% of Europe's electricity.

The main reason for this remarkable growth is certainly the availability of very efficient incentive systems in DE, ES, and IT, which allow the PV-system owner to sell electricity at premium rates (Feed-in Tariff), ensuring payback times of less then 20 years. The second reason is the European leadership in research and technology which allowed for a continuous reduction in production cost.

Consequently, the SEII builds on a strong market support by asking for a European-wide feed-in tariff, and in parallel an enhanced R&D programme which ensures acceleration of cost reduction trend. The SEII points out as well that an about 25 fold increase in PV deployment in Europe will have an massive financial pay-off in terms of innovation, job-creation and export opportunities.

Regarding the cost and price development along the way to the 12% electricity share of photovoltaic energy, the SEII points out that the technology of PV module follows consistently a price experience curve since 1979, which results in a 22% price decrease whenever the cumulative production doubles, indicating that at the anticipated 380 GW (corresponding to 12%) of cumulative installation in Europe module prices will be well below 1.00 €/W_p, and corresponding system prices below 1.50 €/W_p. This would allow ”grid-parity" [6] at least in the sunniest regions in Europe, depending on the price development of conventionally generated electricity.

Further, the SEII assumes that more than 6% of PV electricity penetration in Europe's electricity grid would require major investments in grid infrastructure and fast progress in the operation of ”smart grids".

11.2 The R&D Roadmap for PV

In 2007, European R&D spending for PV amounted to about 4% of the annual turnover of this industry. In light of this figure, the initiative is calling for an overall 9 billion € for the period until 2010, which, at least on a 10 year average, is well corresponding to a continued an expenditure of 4% of the expected revenue.

The Initiative proposes a comprehensive R&D roadmap, focusing on cost reduction and a flexible electricity grid.

11.2.1 Cost reduction:

A PV-industry-led collaborative technological development programme aimed at reducing PV System costs below 1.5 €/kWp by 2020, allowing PV electricity generation at below 0.10€/kW) for both conventional and concentrated PV systems*:*

- Enhancing performance (conversion efficiency >25%) and lifetime of more than 30 years and reducing manufacturing, operation and maintenance costs of PV modules and Balance-of-System components.
- Developing advanced manufacturing processes for cells and modules focusing on high “throughput” and automation, including realising pilot-lines ("From LAB to FAB") for advanced concepts.
- R&D on next generation nonmaterial, cells, modules

11.2.2 System integration:

A coordinated RTD programme involving PV, Grid and Storage industries aimed at the progressive integration of PV into the European grid, encompassing both centralised and decentralised PV systems:

[6] Grid parity: cost of energy generated by PV is equal or below the electricity retail price

- Developing PV system components which allow better system integration, including inverters, controllers and dedicated energy management tools (models, software and hardware).
- Developing active distribution systems, with improved functionality regarding voltage regulation, power management and use of distributed energy storage
- Developing prediction models and enhancing codes, standards and regulations for grid components and –access

11.2.3 Demonstration and Deployment projects

A portfolio of demonstration projects aimed at supporting the large-scale deployment of PV through the comparative implementation of candidate solutions, exchange of experience and best practices:

- Pilot lines for advanced manufacturing
- Large scale integration in urban environments (10 "Solar Cities") and small peripheral communities, and development of products for building integration.
- Demonstration of distributed power generation in smart "compound-power plants" to allow together with other renewable sources a 100% renewable electricity supply.
- Five ground-based centralised PV power plants (50-100 MW) as demonstration of new concepts.

11.2.4 Additional supporting activities

- A public research R&D programme aimed at supporting the longer-term PV industry development (beyond 2020) focusing on advanced PV concepts and systems.
- A coordinated university/research/education programme aimed at developing competences for the PV industry in the short and longer term.
- An EU-wide programme aimed at enhancing the exchange of experience and co-operation on standards, norms, regulatory measures and promotion and awareness campaigns.

11.3 Discussion

11.3.1 Market Analysis

The first discussant provided a market analysis aiming to indicate how realistic a 12% share of PV electricity would be. One requirement is a continuing CAGR of about 32%..35% per year for the next decade, yielding a cumulative installed capacity of about 390 GW at the end of 2020. Deployed in the irradiance rich zones of Europe, 460...480 TWh of electricity could be delivered to an adequately enhanced grid. This would be 12 % of 4000 TWh annual electricity consumption.

An outlook for the major markets, in Europe (DE, ES, IT, FR and CZ, BG, GR), United States and Asia (JP, CN) makes a worldwide deployment of 30 GW by 2013 very likely, of which 18 GW could be in Europe. The analysis showed also that the required increase of industrial capacity up to 2020 is possible, with thin-film technologies continuing to have lower production costs than silicon.
The outlook to continue for the remaining 7 years assumed a constant add-on of 35%, arriving for the year 2020 at 120 GW deployed, and a cumulative capacity of 390 GW.

11.3.2 Investor

The second discussant represented the investors' point of view, emphasizing in particular how important stable support mechanisms are. As a large fraction of the required R&D capital will be provided by loans, the bankability of certain technologies will be a key issue. Also, much of the capital will be required at the beginning of the initiative, paying back not earlier than 5 or even ten years later. Loan guarantees would be a very effective complement to grants.

The SET-Plan information system is seen as a major reference for stakeholders, but it requires also to point out the differences between a variety of models, assumptions and scenarios provided by different stakeholders. The investor was also sceptic about the early availability of adequate and significant Community financing before 2013.

11.3.3 Weaknesses and corrective recommendations

- The key assumptions of scenarios are based on a continuous market push. Whilst this is certainly a requirement for maintaining the growth rate and to attract stable financing, it depends to a large extent on the National Renewable Actions Plans due by mid-2010, and the share member-states will allocate to PV. Only a supporting policy action to implement EU-wide Feed-in Tariffs would in fact be an instrument ensuring that investors (both private and institutional) would finance such ambitious growth scenarios.
- There are too many activities in parallel. Maximum impact would require a degree of technological focus and selection. Electricity storage may require an initiative of its own, as it will be a key technology as well for the realisation of smart grids, and most of all for future electric cars.
- Much of the R&D financing is required practically immediately, to have results in the factory at latest in 2015. This requires a financing system which bridges the 10 year time span between now and the expected return 2020.
- The initiative is not specific as to how to position itself in the global context. How to keep the technology leadership in Europe and to what extent production would be localized outside Europe is not addressed. It also does not give indications about the amount of cost-offsetting one would expect by job-creation.
- The 12% scenario assumes a 2020 electricity consumption of 4000 TWh in Europe, an almost 25% increase on electricity consumption compared to 2008.

This contradicts current Community policies of also reducing energy consumption and to achieve below 3000 TWh consumption in Europe. However, would such consumption goal be achieved, 12% PV penetration would require a deployment of only 290 GW instead of 390 GW.

11.4 Key strengths to build upon

- There is a very strong industry base, committed to finance R&D with significant amounts.
- The industry has demonstrated mature products and manufacturing, deployed on millions on roofs and hundreds of larger installations.
- A clear vision of how to achieve the 12% by a combination of market development, and R&D both into aggressive cost reduction and system integration.
- A strong ”Pay-off" thinking to ensure that R&D investments return by 2020.
- An excellent governance, with a clear vision (12%), a roadmap (SET for 2020), with good instruments (the broadly based SEII) and an already established and successful EU PV technology platform.
- A very capable and global R&D community, making solutions to the issues within the next 10 years very likely.

11.5 Overall recommendations for further development of the Road-map

11.5.1 Objectives

EU to involve pro-actively shaping a coherent policy on Feed-in-Tariffs (FiT) to avoid stop/go markets. The absolute level of such tariffs is less important than the long-term security, as investors need a stable framework. This includes as well avoiding artificial "caps" on the maximum amount of capacity which create heated market demand.

11.5.2 Financing sources and conditions

Innovate financing to make higher risk technology research bankable (Guaranteed loans at low cost) and to bridge into 2020. Loan or loan guarantees would provide an instrument, which allows rapid access to capital, with Return-on-Investment perspectives in the order of 10 years. The possibilities of the European Investment bank should be assessed, in particular regarding financing of pilot lines for innovative manufacturing and solar cities.

11.5.3 Scope and nature of partnership

There is a strong industry base for R&D often in strong co-operation with research institutions. The role of manufacturing industry in technology transfer

should be further exploited. EU-funding is essential to assemble teams of excellence throughout Europe to give new avenues critical mass and disseminate knowledge further.

11.5.4 International positioning

Launch a basic research initiative including international cooperation. Much needs still to be understood and entirely new concepts for ultra-high efficiency or ultra-low cost photovoltaic cells can be better developed in an international context.

Formulate pro-actively policies which address international competition, in particular by replacing labour-intensive processing steps by increasing automatization or by dislocating such processes in regions with lower labour costs.

11.5.5 Other

Manage on a University level the upcoming bottleneck of Human Resources. The required growth of PV industry needs increasingly skilled personnel of University grade. Already now bottlenecks are visible, in particular in development of new manufacturing lines and quality control. This required curriculae and their implementation could be well shared with industry.

Develop transparent up-date and review mechanisms for the SET-Plan Information System (SETIS). The growth rates in PV technologies are much higher than in other Energy technologies, and the reference information has to be continuously updated and analysed for R&D trends, obstacles, finance information, cost development and geographical scope

12 Report on the parallel session of Wind energy

On October 7th, 2009, the Commission adopted a Communication on investing in the development of low carbon technologies[7]. In this context, the Commission, together with industry and the research community, has drawn up technology 'roadmaps'[8] for seven technology areas: wind, solar, electricity grids, bio energy, carbon capture and storage (CCS), sustainable nuclear fission, energy efficiency in cities ('Smart Cities Initiative') as well as for the European Energy Research Alliance (EERA). An estimate of the cost of implementation of these roadmaps has also been proposed, that covers the necessary basic and applied research, demonstration and early market take up, excluding deployment activities.

On 21-22 October 2009, in the context of the second European Energy Technology Summit held in Stockholm, the Technology Roadmaps have been reviewed and discussed in parallel sessions. This report presents the conclusions from the parallel session held on the wind energy roadmap.

12.1 Technology Roadmap on wind energy

12.1.1 Concept and methodology

The technology roadmaps have been drawn up by the Commission services from the ongoing work to define the proposed European Industrial Initiatives. The wind energy roadmap is the fruit of a collective endeavour that started in 2007. It has involved the European Commission, the Information System of the SET-Plan (SETIS), the Member States, Industry and Academia. This roadmap is based on industry proposals through the Technology platform on Wind Energy (TPWind), and has advanced through continuous discussions and consultations between the different actors.

The roadmap is built around a vision of wind energy contributing significantly to the meeting of the European Energy and Climate goals by 2020 and beyond. It contains technology objectives that are critical for making wind energy technologies fully cost-competitive, more efficient and proven at the right scale for market roll-out. For these technology areas, concrete research, development, demonstration and market replication activities are proposed, for which there is a clear EU added value and willingness of actors to join forces.

[7] COM(2009) 519
[8] SEC(2009) 1295

12.1.2 Summary description of the roadmap

The Strategic objectives of the wind energy roadmap are to improve the competitiveness of wind energy technologies, to enable the exploitation of the offshore resources and deep waters potential, and to facilitate grid integration of wind power. It supports the Industrial sector objective to enable a 20% share of wind energy in the final EU electricity consumption by 2020.

The roadmap is structured around four main key technology objectives. **New turbines and components** to lower investment, operation and maintenance costs, **Offshore technology** with a focus on structures for large-scale turbines and deep waters (> 30 m), **Grid integration** techniques for large-scale penetration of variable electricity supply and **Resource assessment and spatial planning** to support wind energy deployment.

It proposes to develop a more accurate mapping of wind resources and capacity potentials in Europe including hostile and complex environments, through coordinated measurement campaigns and the development of spatial planning tools; to build 5-10 new testing facilities for new turbine systems; up to 10 demonstration projects of next generation turbines including a 10-20 MW prototype; at least 4 prototypes of new offshore structures tested in different environments; demonstration of new manufacturing processes; testing the viability of new logistics strategies and erection techniques in remote and often hostile weather environments; and to demonstrate at an industrial scale, grid integration techniques to manage wind farms as "virtual power plants".

All of this will be underpinned by a comprehensive research programme to constantly improve the technical and economic performance of wind turbines. The cost of such a European programme is estimated at €6 billion over the next ten years. More details can be found in the supporting document to the Communication SEC (2009) 1295[9].

12.2 Strength and weakness of the wind energy roadmap

An assessment of the content and scope of the wind energy roadmap has been conducted in the context of the parallel session and reported in the following sections

12.2.1 Strength

There is strong support from the sector for the wind energy roadmap both on its content, objectives and estimated cost. The sector strongly recommended to

[9] available at: http://ec.europa.eu/energy/technology/set_plan/doc/2009_comm_investing_development_low_carbon_technologies_roadmap.pdf.

launch the Wind Industrial Initiative as early as possible. In doing so, careful attention should be put on keeping a programmatic approach.

It is recognized that the wind energy roadmap provides a concrete and transparent plan for the achievement of the 20% renewable energy production target by 2020, and prepares the sector for its future developments and technologies beyond 2020 (wind energy is expected to produce 33% of EU electricity by 2030, when the total installed capacity will reach 350 GW, of which 150 offshore). It gives confidence to the sector as it puts into perspective the impact of future R&D efforts on the sector development.

Overall it is considered that the wind energy roadmap is a clear step forward as it proposes a development model that goes beyond business as usual, an imperative to maintain Europe's industrial position as a wind energy global technological leader. In particular, relevant issues along the entire value chain are addressed in the roadmap with the exception of infrastructures aspects, i.e. harbours, vessels and cables (see weaknesses).

Furthermore, it is emphasized that the proposed roadmap departs from the fragmented approach at the project level pursued so far, by proposing a new innovation model based on programme management at the European level, a key aspect to ensure the timeliness and the effectiveness of the efforts on the sector evolution. In addition, the roadmap offers a framework for enhanced cooperation between wind energy operators and other relevant stakeholders such as networks and ocean energy actors, allowing the pursuit of an integrated and systemic approach.

Finally, the concerted process established for the preparation of the wind energy Roadmap is considered remarkable and it is recommended to continue such approach for its implementation.

12.2.2 Weaknesses

One of the main weaknesses of the roadmap that was expressed during this session is the lack of definition of an implementing structure and clear indications on the funding sources and how the coordination between all relevant funding instruments proposed will be performed. It is voiced that these issues need to be resolved as soon as possible to enable a quick implementation.

Similarly, it was stressed that the collaborative approach developed for the roadmap preparation should be pursued in the implementation phase; hence the industry and R&D community should be involved in its management, a point that is not clearly mentioned in the Communication and the roadmap.

Another weakness considered of significant importance for the sector, is related to the proposed developments on electricity networks within the SET-Plan. The implementation of the wind energy roadmap requires investments both in terms of

new connections and in terms of new grid management methods. The participants raised their concern that grid aspects are not sufficiently developed within the SET-plan. There is an urgent need for action to avoid that grid issues become a showstopper in the near future. It was reminded that more than 1/3 of the roadmap budget has been allocated to these activities, i.e. € 2,1 bn, whereas the budget allocated to the dedicated roadmap on the electricity grid is of similar level. Hence it was recommended that a higher degree of cooperation and synchronization between the different work programmes of the relevant roadmaps should be achieved rapidly.

More generally, it was further stressed that grid aspects should be a key priority within the overall policy framework at the European level and there should be a coherent and an integrated approach between all related initiatives such as SET-Plan, the regulatory framework and infrastructure support such as the Trans-European Energy Networks to ensure the delivery of the wind potential by 2020 and beyond.

Furthermore, the need for coordination between the wind energy roadmap and the up-stream research efforts as proposed by the European Energy Research Alliance (EERA) was emphasized by the participants. There is a need to develop a global approach to ensure that all efforts are synchronized including those pursued by the European Institute of Innovation and Technology (EIT) and Academia. Research organizations and Academia will play a key role in both further developing the competitiveness of wind energy and the necessary human capacity. It was further stressed that the EERA should be opened up to universities as well.

Finally, regarding the content of the roadmap itself, the missing elements identified by the participants, concern education and training and supporting infrastructures for deployment (i.e.vessels, harbours). Although it was noted that training aspects are addressed in a cross-cutting manner in the document, the participants emphasized the urgency to prioritize human resource developments as the wind energy sector could soon face a shortage of skilled workforce. Regarding the supporting infrastructures such as dedicated vessels, harbours and cables for the operation of offshore wind farms, although there is an understanding on their non inclusion in the work-programme of the roadmap due to their downstream nature, it is nonetheless stressed that these elements need to be considered in the overall European energy policy framework as key supply chain components for the deployment of wind energy.

12.3 Recommendation

12.3.1 Roadmap Implementation

To enable the implementation of the roadmap, the following implementation scheme has been proposed:

- The European Community Steering Group on Strategic Energy Technologies (SET-Plan Steering Group) would be responsible for the implementation of all Roadmaps to preserve the programmatic and integrated approach and coordination of financing sources.
- Technology specific advisory groups would be created to support the SET-Plan implementation. The role of these advisory groups would be to prepare annual work-plans and provide recommendation as to their implementations. Each Advisory group could be composed of the respective Technology Platforms, the European Commission, SETIS and the European Investment Bank as well as representatives from other roadmaps for potential for joint calls.
- Once accepted, the SET-Plan Steering Group would validate them and propose public funding sources for the different activities e.g. though FP7 calls, Member States willing to participate through their national programmes (Joint programming), or EIB instruments

12.3.2 Funding

The roadmap identified RD&D activities which by their nature imply technical risk. The preferred option by the sector for funding support as to the roadmap activities are grant schemes, while risk sharing loans and equity should more dedicated to deployment activities. The funding schemes and instruments used should reflect the risk associated with activities. Regarding Intellectual Property Rights, it was recommended to develop a light structure to ensure a quick implementation.

12.3.3 Coordination

There is a call from the sector for reinforced coordination between the different roadmaps. Strong coordination needs to be implemented as soon as possible on grid issues. Furthermore, synergies between the European Energy Research Alliance, the European Institute of Innovation and Technology and other sectors such as ocean energy should be developed.

12.4 Conclusion

The wind energy roadmap has received a strong support from the participants. The sector strongly recommended to launch the Wind Industrial Initiative as early as possible. In doing so, careful attention should be put on keeping a programmatic approach. An implementing structure has to be identified quickly, as well as clarity on the funding sources and the instruments for ensuring an effective coordination of all potential sources of funding. Overall it is recommended to implement the wind energy roadmap as a flexible rolling programme with clear quantified key performance indicators. Joint work with the Information System of the SET-plan is expected on the later.

Furthermore, clear coordination mechanisms between the wind energy roadmap, the electricity grid roadmap, the EERA and the EIT are needed to avoid any

showstoppers in the development of the sector such as grid developments and human resources.

13 General conclusions from the conference

The SET-Plan conference in Stockholm in October 2009 was an important milestone in the evolution of SET-Plan policy. Top level policy makers, the Swedish Deputy Prime-Minister, Maud Olofsson, the European Commissioners for Energy and Research, Andris Piebalgs and Janez Potocnik, personally gave their unequivocal support.

For the first time, the technology road-maps were presented publicly and discussed. The European Industrial Initiative teams discussed with interested parties and considered the planning options for the way forward. Furthermore, the Industrial Initiatives had a first opportunity to compare their approach and methods among each other.

The conference was attended by a broad spectrum of stakeholders and all EU member states were represented, which signifies that the SET-Plan is well anchored with relevant players. The open and self-critical approach of the conference assured that possible weaknesses in the road-maps can be identified and corrected before serious investments of several billions of € are committed.

The core of the conference was in the eight parallel sessions that addressed the road maps for the European Industrial Initiatives (EII's). Although these are different in several ways, and the previous sections have identified these points in depth, some overall conclusions can also be drawn.

1. The roadmaps were generally well received, signalling that the work on this part of the SET-plan is overall on the right track in each area. The participants in each parallel session have made ambitious contributions to the roadmaps.

2. For each EII more effort is needed to generate a more precise programme of work, which has a solid basis in both market needs and Europe's R&D potential.

3. The key performance indicators (KPI's) need to be addressed in all EII's and further developed. These will be the essential measure of success of the road-maps and should represent realistic and fair criteria, covering both the contribution to energy and climate policy of the road-maps as well as offering a means to assess market returns on the investments.

4. New technologies require that society at large accepts them and their engineering realisations, as the products and installations that emerge as a result. The nature and magnitude of the widespread introduction of low-carbon technologies is a sensitive case, as very powerful and visible technologies, with an evident impact on the environment will be put into place. The final environmental balance will be positive, but this needs to be proven and made public. Therefore work towards public acceptance needs serious attention and will need to be integrated into the road-maps in a number of the areas,

5. Governance and fund raising still needs to be addressed in each EII, although it is stressed that the legal structure of the EII's should be kept as "light" as possible. This will be a challenging and key part of the work to prepare the EII's for launch in 2010.

6. Some EII's see that measures need to be undertaken to deal with a potential shortage of human resources, especially as regards engineering and operations for deployment of the technologies, as the presence in Europe's energy sector of low-carbon technologies grows. It is not clear to which degree this should impact the road-maps themselves, but may constitute a prerequisite for the success of SET-Plan policy.

7. A strategy for international cooperation needs to be further developed in several IEE's. Here a concern especially for IPR issues can be noted. Following the conference, in a meeting for this purpose, each of the EII's agreed that international aspects must be integrated into the road-maps.

8. Some alignment/coordination issues between EII's have been pointed out, and more can arise during the progression of work within the areas. The SET-Plan conferences represent an ideal forum for dealing with these.

9. As recommended by EBTP in its proposal, the challenges which are not specific only to innovative bio energy should be addressed in a coherent effort shared with the relevant stakeholders and initiatives. Innovation is needed in shaping public private partnership to address specific challenges of all the Low Carbon Initiatives. Other areas also demonstrate this need – e.g. both wind and solar groups stressed the need for attention to grid aspects. This highlights the need for a coordination mechanism, that allows for expertise exchange across the EII's when this is useful.

The Stockholm SET-Plan conference was a step along the process of implementing SET-Plan policy to 2020 and beyond. Starting with the first conference in Paris in 2008, and two conferences planned for 2010, in Madrid and Brussels, these conferences provide a public and political forum to publicise and reflect on SET policy directions. In 2010 the focus will be on the formal launch of the European Industrial Initiatives. The 2009 SET-Plan Conference has created the basis for these conferences and more in the future.

Annex 1
Abbreviations

CCS	Carbon Capture and Storage
CEER	Council of European Energy Regulators
CIVITAS	Initiative for cleaner and better transport in cities supported by EC (www.civitas-initiative.org)
CONCERTO	Cities demonstrate energy and climate change policy solutions – initiative supported by EC (http://concertoplus.eu)
COP15	15th Conference of the Parties to the United Nations Framework Convention on Climate Change
CSP	Concentrated Solar Power
DESERTEC	Trans-Mediterranean industrial initiative for energy from the desert regions
DSO	Distribution System Operator
EBTP	The European Bio fuels Technology Platform
EC	European Commission
EDF	European Development Fund
EE	Energy Efficiency
EEGI	European Electricity Grid Initiative
EEPR	European Energy Programme for Recovery
EERA	European Energy Research Alliance
EIB	European Investment Bank
EII	European Industrial Initiatives
EIBI	European Industrial Bio energy Initiative
ELENA	European Local ENergy Assistance (EIB technical assistance facility)
EPIA	European PhotoVoltaic Industry Association
ESCO	Energy Service COmpany
ESNII	European Sustainable Nuclear Industrial Initiative
ETS	Emissions Trading Scheme
FORES	Forum for Reforms, Entrepreneurship and Sustainability (research institute)
GHG	GreenHouse Gases
ICT	Information and Communication Technologies
IEA	International Energy Agency
JRC	EU Joint Research Center
KfW	Kreditanstalt für Wiederaufbau (German government-owned development bank)
KPI	Key Performance Indicators
LFR-GFR	Lead cooled and Gas cooled Fast Reactors

MENA countries	Middle East & North Africa
NIMBY	"Not in my back yard"
NRAP	National Renewable Action Plan
PV	Photovoltaic
PPP	Public Private Partnership
R&D	Research and development
RDI	Research, Development and Innovation
RE	Renewable Energy
RSFF	Risk sharing Finance Facility
SEC	Commission document
SEII	Solar Europe Industry Initiative
SETIS	Strategic Energy Technology Plan Information System
SET-Plan	Strategic Energy Technology Plan
SFR	Sodium cooled Fast Reactor
SME	Small and Medium sized Enterprises
SNETP	Sustainable Nuclear Energy Technology Platform
SRA	Strategic Research Agenda
TSO	Transmission System Operator
ZEP	Zero Emission fossil fuel Power plant

Annex 2
Conference programme

See following pages

SET Plan 2009 Conference

PROGRAMME

Take an active part in forming Europe's future energy strategy

Welcome to the conference on EU's Strategic Energy Technology Plan, in Stockholm October 21–22, 2009.

The conference on the SET Plan is organized by The Swedish Energy Agency in collaboration with the European Commission. Its primary objective is to discuss how to further and realize the goals in the Strategic Energy Technology Plan.

Maud Olofsson, Vice Prime Minister and Minister of Energy, Sweden

Andris Piebalgs, EU Commissioner for Energy

Janez Potočnik, EU Commissioner for Science and Research

Bo Diczfalusy, Deputy Director General, Ministry of Enterprise, Energy and Communications

Birgitta Palmberger, Director, Energy Technology Department, Swedish Energy Agency

Michael Rantil, Senior Advisor, Swedish Energy Agency/Ministry of Environment

Martin Ådahl, Director of the Research Institute Fores (Forum for Reforms, Entrepreneurship and Sustainability)

Birgitta Resvik, Business Europe's Climate Change Working Group

Ton Hoff, European Energy Research Alliance, EERA

Programme October 21

09.00 REGISTRATION AND COFFEE/AT BERNS SALONGER, BERZELII PARK

10.00 OPENING SESSION

Chair *Mr Bo Diczfalusy*, Deputy Director General, Ministry of Enterprise, Energy and Communications

Ms Maud Olofsson, Vice Prime Minister and Minister of Energy, Sweden

Mr Andris Piebalgs, EU Commissioner for Energy

Mr Janez Potočnik, EU Commissioner for Science and Research

11.00 PLENARY

Chair *Ms Birgitta Palmberger*, Director, Energy Technology Department, Swedish Energy Agency

TOWARDS COPENHAGEN – THE STATE OF CLIMATE NEGOTIATIONS

Mr Michael Rantil, Senior Advisor, Swedish Energy Agency/Ministry of Environment, Sweden

11.20–11.50 COFFEE

11.50 PLENARY CONTINUED

PANEL SESSION: FINANCING LOW CARBON TECHNOLOGIES

Moderated by *Mr Martin Ådahl*, Director of the Research Institute Fores (Forum for Reforms, Entrepreneurship and Sustainability)

Mr Andris Piebalgs, EU Commissioner for Energy

Mr Janez Potočnik, EU Commissioner for Science and Research

Ms Birgitta Resvik, Business Europe's Climate Change Working Group and Director, Climate and Energy, Confederation of Swedish Enterprise

Dr Ton Hoff, European Energy Research Alliance, EERA

Mr Juan Alario, Head of Division Energy Efficiency & Renewables in the Projects Directorate, European Investment Bank

13.00-14.20 LUNCH

14.20 PARALLEL SESSIONS

Open discussion on the technology roadmaps in eight parallel sessions on:

- **BIO ENERGY**: *Mr Serge Galant*, President Greenovate! Europe and CEO TECHNOFI
- **CARBON CAPTURE AND STORAGE**: *Mr Jan Panek*, Head of Oil & Coal Unit, DG TREN
- **CONCENTRATED SOLAR POWER**: *Mr Cédric Philibert*, Senior Analyst, Renewable Energy Division, International Energy Agency
- **ENERGY EFFICIENCY – SMART CITIES**: *Ms Ulrike Janssen,* Director of Climate Alliance, representative of Covenant of Mayors
- **NUCLEAR ENERGY**: *Prof. Marianne Haug*, Universität Hohenheim
- **PHOTOVOLTAICS**: *Mr Thomas Nordmann*, CEO, TNC Consulting AG
- **SMART GRIDS**: *Prof. Michaela Albu*
- **WINDPOWER**: *Dr Susanna Widstrand*, Programme Manager, Swedish Energy Agency

17.30 CLOSING DAY ONE

19.10 BUFFET DINNER AT THE VASA MUSEUM

We offer transport by bus at 18.50 from city centre to the Vasa Museum. Please see the map for the buses' pick up points. Alternative transportation are local buses 47 or 69, or taxi. On arrival at the Museum there will be a short guided tour, followed by a welcome drink and then the buffet dinner.

Programme October 22

09.00 PLENARY SESSION

Chair *Mr Raffaele Liberali*, Director, DG RTD

THE SET-PLAN INFORMATION SYSTEM – SETIS
Mr Giovanni De Santi, Director, Institute for Energy, EC Joint Research Center

REPORTS FROM PARALLEL SESSIONS
Rapporteurs from each session

- **BIO ENERGY**: *Mr Serge Galant*, President Greenovate! Europe and CEO TECHNOFI
  Rapporteur *Mr Nicolae Scarlat,* Technical Support Officer, Institute for Energy, JRC
- **CARBON CAPTURE AND STORAGE**: *Mr Jan Panek*, Head of Oil & Coal Unit, DG TREN
  Rapporteur *Dr Vangelis Tzimas,* Action Leader, Institute for Energy, JRC
- **CONCENTRATED SOLAR POWER**: *Mr Cédric Philibert*, Senior Analyst, Renewable Energy Division, International Energy Agency
  Rapporteur *Dr Arnulf Jaeger-Waldau,* Renewable Energy Unit, Institute for Energy, JRC
- **ENERGY EFFICIENCY – SMART CITIES**: *Ms Ulrike Janssen,* Director of Climate Alliance, representative of Covenant of Mayors
  Rapporteur *Dr Estathios Peteves*, Institute for Energy, JRC
- **NUCLEAR ENERGY**: *Prof. Marianne Haug*, Universität Hohenheim
  Rapporteur *Mr Paul Howarth,* Director of Science, Technology and Project Delivery, National Nucelar Laboratory

10.10–10.40 COFFEE

10.40 PLENARY CONTINUED

REPORTS FROM PARALLEL SESSIONS

- **PHOTOVOLTAICS**: *Mr Thomas Nordmann*, CEO, TNC Consulting AG
  Rapporteur *Dr Heinz Ossenbrink,* Head of Unit Renewable Energy; Institute for Energy, JRC
- **SMART GRIDS**: *Prof.Michaela Albu*
  Rapporteur *Mr Ruud de Bruijne*, Expert, Renewable Energy, Senter Novem
- **WINDPOWER**: *Dr Susanna Widstrand*, Programme Manager, Swedish Energy Agency
  Rapporteur *Mr Arnaud Mercier,* Action Leader, Energy Systems Technology Modelling, Institute for Energy, JRC

Closing remark, *Dr Tomas Kåberger*, Director General, Swedish Energy Agency

Closing remark, *Mr Fabrizio Barbaso*, Deputy Director-General DG TREN

12.00–13.30 LUNCH

13.30 CONFERENCE ENDS

Raffaele Liberali, Director, DG RTD

Giovanni De Santi, Director, Institute for Energy, EC Joint Research Center

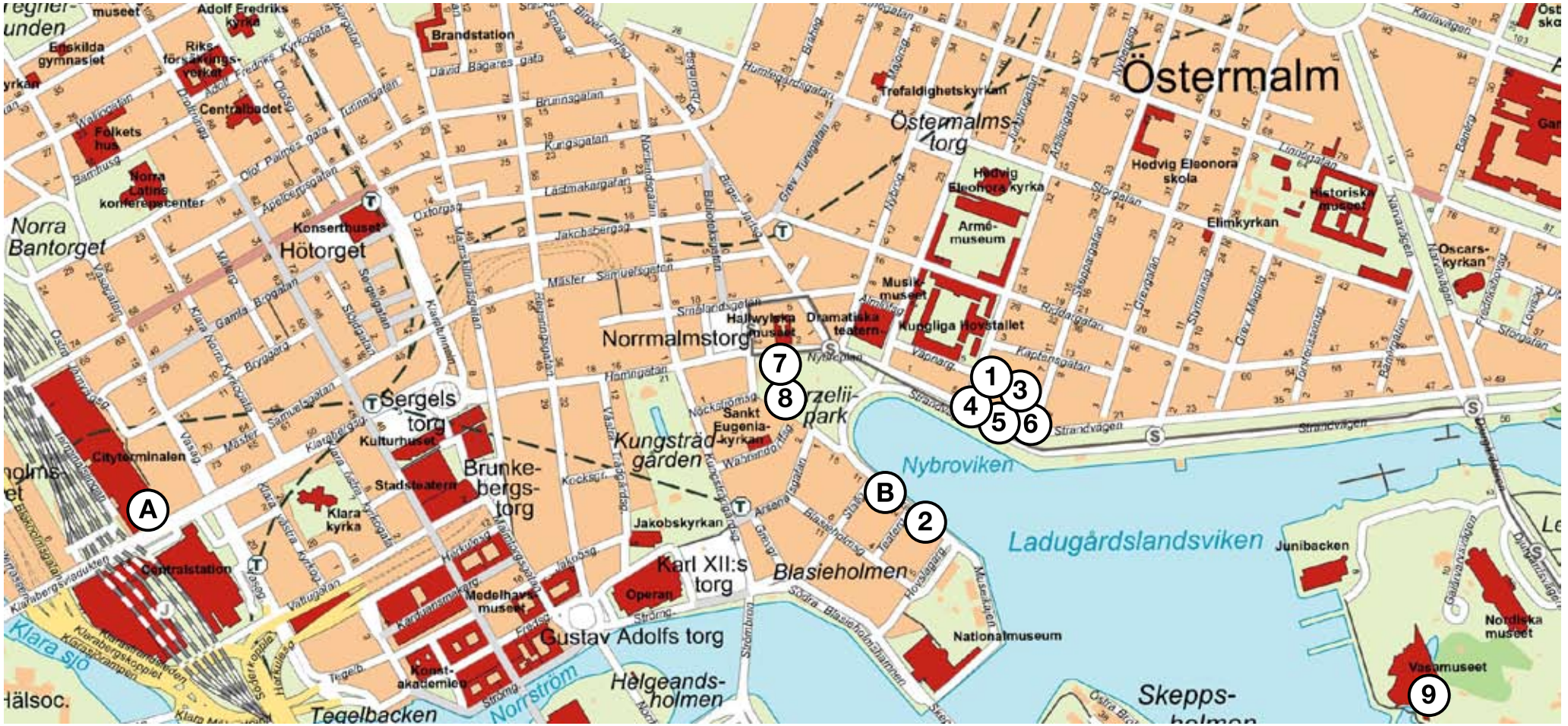
Fabrizio Barbaso, Deputy Director-General DG TREN

Tomas Kåberger, Director General, Swedish Energy Agency

Juan Alario, Head of Division Energy Efficiency & Renewables in the Projects Directorate, European Investment Bank

SET Plan 2009 Conference

Swedish Energy Agency



1 SESSION: **BIO ENERGY**
Address: Strandvägen 7 A, floor 3

2 SESSION: **CARBON CAPTURE AND STORAGE**
Address: Teaterskeppet, Nybrokajen 5

3 SESSION: **CONCENTRATED SOLAR POWER**
Address: Strandvägen 7A, floor 3

4 SESSION: **ENERGY EFFICIENCY – SMART CITIES**
Address: Strandvägen 7 A, floor 4

5 SESSION: **NUCLEAR ENERGY**
Address: Strandvägen 7 A, floor 3

6 SESSION: **PHOTOVOLTAICS**
Address: Strandvägen 7 A, floor 4

7 SESSION: **SMART GRIDS**
Address: China Teatern

8 SESSION: **WINDPOWER**
Address: Spegelsalen

9 DINNER: **VASA MUSEUM**
Address: Galärvarvsvägen 1

A BUS TO: **VASA MUSEUM**

B BUS FROM: Cityterminalen (A) and Strand Hotel (B)