Advice on energy research, development, demonstration and deployment in FP7 and EURATOM programs for 2012-13 and beyond

The present AGE advice deals both with specific recommendations for the last two years of the Seventh Framework Programme (2012-2013) and offers strategic advice for the preparation of the next multiannual framework for energy related R&D. The AGE has considered the Green Paper: From Challenges to Opportunities: Towards a Common Strategic Framework for EU Research and Innovation funding(COM(2011)48) and has noted the intended broader scope of such a new Common Strategic Framework (CSF) to be used as the basis for EU support to future RD&D activities in the Member States. The advice will also contain answers to some of the explicit questions raised in the Green Paper.

General context

The overall political context for the community supported energy R&D is outlined by the EC communications on Innovation Union, Energy 2020 strategy, the SET Plan, the Low Carbon Road Map to 2050, Energy Efficiency Plan 2011, the communications on the European Research Area and the above mentioned Green Paper. This impressive range of recent EU documents signal commitment to innovation as driver of European growth, competitiveness and a low carbon future.

AGE has noted and concurs with the analysis behind the Low Carbon Road Map to 2050 and the indicated pathway towards an 80% reduction of greenhouse gas emissions by 2050,

(EC COM (2011)112 Final):

“...The analysis also shows that a less ambitious pathway could lock in carbon intensive investments, resulting in higher carbon prices later on and significantly higher overall costs over the entire period. In addition, R&D, demonstration and early deployment of technologies, such as various forms of low carbon energy sources, carbon capture and storage, smart grids and hybrid and electric vehicle technology, are of paramount importance to ensure their cost-effective and large-scale penetration later on. Full implementation of the Strategic Energy Technology plan, requiring an additional investment in R&D and demonstration of € 50 billion over the next 10 years, is indispensable. Auctioning revenue and cohesion policy are financing options that Member States should exploit. In addition, increasing resource efficiency through, for instance, waste recycling, better waste management and behavioral change, as well as enhancing the resilience of ecosystems, can play an important role.”

Events over the last year have reinforced the need for changes in the global energy systems. A year ago, the outlook included new oil and gas reserves from deep-sea reservoirs and nuclear fission for the medium to long term and stability of supply from the Middle East for the short term – plus growing share of renewables as they become cost-competitive. Now all of this has to be rethought after the Gulf of Mexico, the Fukushima disaster, and the new political situation in the Middle East. These events may have a direct impact on the oil derivatives and their prices in the world exchanges, they may also result in more strict safety measures and regulations, but they will hardly affect the fundamentals of energy production and consumption. Energy demand will continue to increase due to the increase of human population and its trend to live in mega-cities
with growing dependence of energy services. This will undoubtedly lead to emphasis on safer
technologies and processes and on making renewables competitive faster. And – as a consequence –
more expensive energy supply for the foreseeable future.

The energy sector is at a turning point, where large energy investments are needed for the
development and deployment of new energy technologies and their technical and economic system
integration in order to reduce the costs and improve the performance of energy efficient
technologies, generating new solutions and facilitating widespread market take-up. The SET-Plan
has provided an envelope European Master Plan with goals and road maps for the different
technologies and a list of initiatives to be supported by the Commission. It is now time to increase
the rate of implementation of the SET Plan. However, care should be taken to adapt the strategy and
instruments to the special features of the energy sector and its technologies, services and
commodities as compared to other industry and business sectors.

Energy and innovation

AGE concurs with the general analysis behind the Innovation Union policy paper: Under-
investment in our knowledge foundation, unsatisfactory framework conditions and too much
fragmentation and costly duplication. This is particularly true in the energy sector, which is faced
with the triple challenge of climate goals, security of supply and sustainable growth. The sector is
characterized by very long innovation and business cycles, and a joint European strategic approach
to innovation with a medium to long-term perspective is the answer. This must involve a broad
range of stakeholders from end-consumers, industry and utilities to policy makers at local, national,
regional and European levels, in a geographically balanced way.

Low carbon energy innovations go beyond the usual innovations: First, consumers can
hardly differentiate between “low carbon” and “dirty” energy. Low carbon innovations involve
neither a more productive, more reliable, better looking, easily identifiable nor less expensive
product that consumers are eager to adopt. The market risk for firms that invest in low carbon R&D
can be very large. Second, low carbon innovations require not just incremental or even radical
innovations, but paradigm shifts in several sectors and the transformation of the way economies,
industries, cities and individuals produce or use energy. Third, the energy-industry players have an
extremely conservative approach to modifications, and any new equipment installed will define the
nature of the system for typically 30 to 50 years. This has a direct impact on viable migration and
evolution paths towards the newer systems envisaged for the future. This aspect needs to be
addressed as an integral part of R&D efforts.

Economists and innovation experts who have studied transformative innovations and
changes in multiple industries found that such fundamental transformations in the area of advanced
technologies require:

- sustained, substantial and well managed public support for RD&D over an extended time
  period. Such public support builds fundamental research capacities, human resources and
  institutions and, thus, induces subsequent, corporate engagement and private sector RD&D,
- rapid market deployment helped by the innovation, policy- and support systems and
  infrastructure, and
• a competitive private sector and a market environment with entrepreneurial opportunities accessible to new entrants.

Social and political scientists add yet another requirement in the case of “system” transformations such as water, transport, communication or energy and highlight the importance of

• socio-political beliefs and cultural values that influence the speed of transformation and the adoption or rejection of technologically possible innovations,

• enhancing the 'inherent attractiveness' of the low carbon technology, to gain societal acceptance wherever and end-user product or procedure is concerned,

• firm and broad educational system with adequate incentives and opportunities for the young generation.

AGE would like to draw the Commission’s attention to these pre-requisites for any systems transformation when choosing long term competitive strategies and designing funding instruments and interventions for low carbon energy under the Innovation Union, the Common Strategic Framework, CSF, or implementing the low carbon roadmap 2050. Indeed, low carbon energy faces additional issues that require careful consideration, when designing public interventions along the entire innovation chain. Low carbon energy innovation is more difficult and different from all other transformative innovations the EU has dealt with to date because of the nature of low carbon technology as a hardly distinguishable product. Further difficulties stem from the fact that each EU Member State has inherently different natural resource bases, and is free to choose country specific energy mix. The support should therefore include early market tryouts in limited size (and if successful to be followed by a broader implementation support). The following paragraphs highlight these additional challenges as the different pre-requisites are addressed.

For most innovations that provide attractive, efficient or “new” product characteristics, rapid market deployment poses an important, but manageable corporate risk. For low-carbon energy, the “valley of death” does not end with generous public and induced private financing for demonstration, first of its kind or early market introduction of new technologies. The “valley of death” extends along the entire “supported commercialization” phase:

• As the example of the PV feed-in tariffs demonstrates, rapid market deployment requires major “supported commercialization” over an extended period of time to induce consumers to adopt PV installations and investors to invest in manufacturing/installation capacities. Further, market introduction support does not guarantee diffusion in the global market if other countries do not offer similar market introduction incentives unless or until cost competitiveness with alternative energy options in these other markets has been attained.

• As the example of on-shore and off-shore wind energy shows, in addition to market introduction incentives and supportive regulations for priority wind systems feed-in, investments in new transmission infrastructure and grid management changes have become the major barriers for scale-up of wind energy in Europe or the scale-up and transmission of solar electricity from Southern Europe or North Africa.

Furthermore, ensuring competitive markets for low carbon energy technologies is not a trivial matter. First, the energy sector consists of mature industries with powerful incumbents,
regulated utilities, natural transmission monopolies and network externalities. Second, the market incentives provided for low carbon technologies are country specific and induce established companies or new entrants to focus on “home markets” or markets with even “richer” incentives. Thus, major cost reductions through scale-up or learning-in-use cannot be taken for granted without the presence of vigorous market competition. The recent dramatic cost reduction for PV installations was driven by competition, albeit, apart from technology developments in EU and the USA, mostly from low-cost component manufacturers and suppliers from Asia and the US.

The “feed-in tariffs” policy created an opportunity window based on the money of European consumers not only for the European industry but also for its competitors who benefited from the offered subsidisation. It is thus evident that the European industry proved unable to transform the offered opportunity to long-term competitive advantage. It was also proved that no sufficient tracking mechanism existed capable to indentify the emerging loss of competition in this cutting edge sector, nor have policy and RD&D funding modifications been announced to reverse the situation. In future programs the focus on low carbon energy technologies should be widened much beyond wind and solar energy, with stronger consideration of the potentials of biomass, geothermal energy, expansion of large and small-scale hydropower, and also marine energy.

In cutting-edge technologies the production of innovative products requires a quite broad scientific and technological background that cannot be ignored or underestimated without losing competitiveness. Market up-take requires not only radical innovations but paradigm shifts in several sectors. And markets are very different for solar PV, bio-fuels and CCS, where there is no market. The main challenge is how to “create” new markets without falling too deeply into the “over subsidization” and infant industry traps. It is an up-hill battle to introduce market incentives and stimuli that would make anyone want to invest in developing such low carbon technologies or “products” that deliver the same electrons and benefits, but at lower efficiency, poorer performance, and very much higher costs than standard technologies. A shortcoming of the early implementation support systems and examples is that insufficient attention is given to the learning elements obtained from these activities and responding to the evolution of our competitors. There should be a mechanism that learning points are more widely available to the industry and specifically also to the technology development institutes as well as increased knowledge sharing among these actors. Such a system of required knowledge sharing would lead to further acceleration of the technology development, mostly meaning an accelerated reduction of (implementation) costs. IP should not be a principle problem as the early implementation schemes are usually financially supported by public money.

**Recommendation 1:**

AGE recommends that the focus of the Innovation Union and CSF include the market introduction phase as integral part of the innovation process for low carbon energy. However, care is needed that (i) this does not detract from substantial and sustained new funding of basic and applied low carbon R&D; (ii) support beyond the demonstration and immediate market introduction phase along the “learning-in-use” phase provides for efficient “knowledge sharing”; and (iii) “over subsidization” and the infant industry traps are avoided with the use of “investment grade” and predictable yet dynamic policies that support deployment at scale but also incentivise cost reduction and innovation, and (iv) establish a world wide tracking procedure on the development of competitive technologies with a parallel procedure of modifying our policies accordingly.

The latter points are major issues. As Europe will account for a mere 10% of the world’s carbon emissions, the focus of the road map 2050 is not just to supply Europe with low carbon
energy technologies but to be competitive in non-European markets that for the foreseeable future provide less market incentives than Europe.

Increased effort and funding

AGE is concerned that the combined level of SET Plan activities is insufficient at the current rate. The SET-Plan requires a dramatic increase in the European RD&D effort in energy with financing from many different sources to a coherent program, and a quicker ramp-up is needed. The SET Plan needs to be reflected to a much higher degree in the energy programs of the Member States and in the planning of individual institutions and industries. Instruments like Joint Planning, Strategic Alliances and new forms of Public-Private Partnership like EII’s are still in the early stages of development. A much higher level of activity is necessary in the coming decade in order to reach the SET-Plan goals in time. The current level is falling far short of the increasing commitments made since the launch of the SET Plan in 2008 by Europe’s competitors (US, Japan, China and Korea) and cannot be considered a “substantial commitment” to low carbon energy. The absolute amount of funding available for low carbon RD&D should be reconsidered not only as part of the Common Strategic Framework (CSF) but in discussions with Member States about the allocation of the 50% EU-ETS auction receipts and the portions of the Cohesion Funds to the SET-Plan or other low carbon energy RD&D programmes.

On top of this AGE shares a general concern over the many signs that Europe is losing competitiveness and market share on the world market for energy technologies. Europe used to be ahead in nuclear technology in 2002-2003, less so in 2007 and probably behind now compared to the leading global competitors. A similar picture seems to be developing for wind energy and solar PV. In some cases the policies to promote low carbon energy technology in Europe have created profit centres for our international competitors. The justification for increased public funding for low carbon energy RD&D goes well beyond the knowledge creation and market failures in order to accelerate the uptake of new technology. Corporate RD&D investments face shifting government RD&D priorities, changes in incentive policies and carbon prices, uncertain markets outside the EU and uncertainties about social acceptability of low carbon technologies from nuclear, CCS, HV transmission lines, wind parks, smart meters etc. AGE urges the Commission and the EU to fully implement the pledge made in the Energy Efficiency plan 2011:

“To support technological innovation, the Commission will continue to foster the development, testing and deployment of new energy-efficient technologies, e.g. through the Strategic Energy Technology Plan (SET Plan), in order reduce the costs and improve the performance of energy efficient technologies, generating new solutions and facilitating widespread market take-up. This will help the EU become more energy-efficient and open new markets for EU industries.” (EC COM(2011)109 final)

AGE has noted that the funds for energy RD&D in FP7 will increase in the period 2012-13. But this may not be sufficient to stimulate matters in the immediate future nor is it a useful guide beyond 2013. The total budget for non-nuclear energy research in 2013 is approximately 380 M€ (excluding contribution to the JTI). The increase is mainly due to the back loading of FP7. If the EU decides to remain within the original SET-Plan frame, it will be crucial that funds for the continuation in CSF increases further so that the public contribution outlined by the SET Plan, i.e.
2-3 times increase, is reached. While the private sector is to provide the bulk of the SET-Plan 50-70 B€ financing, the EU and national public programmes need to provide a commensurate increase to remain credible. If, however, the EU is reconsidering its relative competitiveness in the RD&D and the recently announced RD&D initiatives in China, Japan, Korea and the US, a further increase of funding will be needed in view of the significant increases in those countries. The EU cannot wait beyond 2020 to match its competitors in the area of low carbon energy RD&D and remain frozen in the mind-set of 2008 when the SET-Plan was launched. The relative commitment to low carbon energy in the world has changed since the SET-Plan was sketched out and any planning beyond 2013 need urgently take account of these changes.

**Recommendation 2:**

AGE strongly encourages the Commission to seek more funding for energy RD&D and to use the additional resources for low carbon RD&D and enhanced collaboration between SET Plan activities and other programmes including both research infrastructure and testing platforms and other EU funding sources such as Structural Funds and the EIB Risk Sharing Finance Facility. The Commission should develop ambitious recommendations for the 2014 Multiannual Financial Framework and suggest at least a doubling of EIB financing for clean energy. However, AGE recommends that any increase in funding is accompanied by close scrutiny of on-going programmes to weed out elements that have proven less effective or where the rationale for funding at the European level has vanished. European programmes need to be able to show resolve in this respect: that unsuccessful programmes will be shut down in a timely manner. In this context, management of the programmes/projects and the supervision of the Commission should shift its focus from coordination and monitoring to a sharper focus on results.

AGE have on earlier occasions pointed to the danger of scientific desertification in EU member states that can not afford participating in cutting-edge RD&D activities and advocates that a geographically balanced solution should be developed and implemented to avert this.

**Social acceptance**

The severe nuclear accident that followed the recent earthquake disaster in Japan has revived public concern about the risks associated with nuclear energy all over the world. The issue will be under renewed public scrutiny and a vivid debate on the lessons to be learned can be foreseen. Many of the safety issues will be revisited and the current wisdom and procedures will be challenged. In these circumstances it will be justified to devote more effort to safety related R&D as outlined below in the specific section on nuclear energy. It is essential that European nuclear stress tests are conducted with adequate peer review and independent scrutiny and that the highest standards of transparency are employed; the Commission must guarantee a methodology that delivers these elements. The ability of European governments to maintain and enhance public confidence will have implications not just for the future of nuclear power in Europe, but all advanced energy technologies and infrastructure more broadly. Europe should also become a champion of public safety and transparency globally.

The SET-Plan’s success depends upon the public acceptability of projects on the ground, not just the political consensus around its goals. AGE is of the opinion that the coming years will also be crucial for other technologies (a case in point is CCS) to be accepted or to become
negatively perceived by the general public. Therefore it is justified to intensify work in this area as part of socio-economic R&D. Not only on the importance of public acceptability issues but also their integral role in determining transition pathways and rates. The acceptability is not only about new technology as such but new practices and uses of established systems. Social acceptability is a key issue. It should be an object of concern in every project, and sustainability issues should also be present in all projects (economic, environmental and social). Achieving social acceptability should also be a priority for each of the EIIs and other large scale SET Plan initiatives, and the success should be monitored as a key performance indicator (KPI). This will influence not only the uptake of nuclear, CCS or bio-fuels but also the scale-up of renewables, hydrogen and energy efficiency. The extensive, new HVDC and AC transmission infrastructure required for the expanded use of intermittent renewables will have to overcome the prevailing NIMBY attitude in Europe. This may be achieved gradually all over Europe or in at least some countries. However, if the present barriers are not overcome, alternative, new technologies or decentralized choices will have to be developed in the medium and long-term.

Recommendation 3:

Social acceptance should be considered early in the development phase and joint programme developments. Research in low carbon technologies should address public concerns substantively, and not simply at the level of communications. Raising awareness and increasing energy efficiency will also play an important role. In addition to addressing social acceptance, the environmental impact of technologies including their impact on and resilience to the depletion of natural resources, i.e. no over-dependency on specific materials should result in those cases where a technology development is widely applied (e.g. rare earth compounds in PV applications). So work in this area is important and should be reinforced even in the remainder of FP7.

AGE supports for the remainder of FP7 and the CSF/SET-Plan to 2020 the present approach of firming up costs and technological designs for the known spectrum of low carbon technologies while at the same time supporting basic research and new frontiers research. This will improve the information base and provide input in the ongoing socio-political debate in its Member States. While events and socio-economic trends may change societal beliefs and cultural values over time, the Commission may want to monitor closely developments during the SET-Plan implementation and to integrate more fully the social acceptance factor in future scenario exercises. Options should be explored for winning acceptance by technology design. It is also considered necessary to explore new innovation policies and regulatory frameworks which might be alternatives to the current ones in order that effective measures could support European and regional coordination of national clean energy policies. The effectiveness, as well as economic efficiency, of support measures for research and innovation is very heterogeneous across Member States. The most effective and relevant policy instruments in the SET-Plan should be identified and shared.

Recommendation 4:

AGE recommends that the Commission stimulate the socio-political debate in the Member States and convene a series of workshops involving SET Plan stakeholders including environmental NGOs, consumer groups, local government representatives and planning professionals together
with representatives of the EII’s, to identify the best approaches to achieving public understanding of the SET-Plan goals and broad acceptance of the planning and siting implications to the extent possible. A continuous, prolonged, consistent approach is required to arrive at the desired energy transformation.

**New instruments and new management processes**

EU and the EC have addressed for some time the unique European challenge of improving the capacities and cohesion of the energy innovations systems among the Member States. EU-wide capacity building for low carbon technologies merits further support during the remainder of FP7 and in CSF to strengthen the depth of the European energy innovation system. The Innovation Union correctly sets out to address the interoperability of Member States’ innovation systems to tap synergies and to encourage high-performance innovation clusters. AGE supports this approach but draws attention to the specifics of energy and low carbon technologies. First, while Europe as a whole is dependent on fossil fuel import, security supply externalities vary greatly among countries because of their very different resource bases and historical energy mix decisions; second, as energy choice mixes, including low carbon technology choices remains the prerogative of the Member States, and the low carbon resource base differs among Member States, interest and capacities in RD&D for specific low carbon technologies necessarily differ. As the concept Common Strategic Framework develops – and the SET Plan is such a framework - it is important that the instruments for implementation and EU support are modified accordingly. Joint programming and joint programmes are the natural tools to implement common strategies among stakeholders across the EU. The focus of EU support measures needs to move from projects to programmes in line with the common strategies. The future CSF support schemes should recognize this and be used to encourage these new modes of collaboration in a manner that also promotes geographically balanced distribution of participation and work. Joint R&D projects are no longer sufficient alone to ensure strategic alignment and large scale pooling of resources in new strategic partnerships and alliances.

The European Energy Research Alliance (EERA) represents a very powerful type of partnership and is well under way to achieve objectives of the SET-plan. Together with the EII’s it may set new standards for such types of strategic alliances. It is important that the EERA and other such associations remain open to outside participation on the programme and project levels. Such co-operations require special attention to management of RD&D programmes in order to harvest the potential synergies. European RD&D activities supported by the Commission programmes in general and EERA, KICs and EII’s in particular will compete with the RD&D machinery of DOE, NEDO, the Chinese or Korean S&T organizations to deliver cutting edge technologies that will succeed in the market place. The new management instruments should be designed specifically to perform in a competitive RD&D world. This can be illustrated by the following observations: - when BP decided to spend 95% of its biofuel RD&D money in the US, the reason given was that the projects and programmes were "better managed". Abengoa gets more RD&D funding for biomass and solar from the DOE than the entire European schemes and is refocusing its R&D. GE who had its wind headquarters in Munich is moving major parts of RD&D to China.

AGE underlines the importance of close cooperation between industry and academia not only in the demonstration and market deployment, but also in the earlier stages of RD&D. The SET Plan should embrace cross sectional R&D activities, which strengthen the innovation of the EU energy sector. AGE supports the intention laid out in the “Energy 2020” communication (COM (2010)639 final) to implement a research programme for energy materials as a key action for the
competitiveness of the EU energy sector. AGE notes that the establishment of relevant schemes of cooperation between academia and business can be decisive for knowledge transfer on clean technologies and new low carbon market mechanisms both in less developed member states and neighbouring countries. At the same time it is important to keep the open character of EII, EERA and other such associations underlining the necessity of active involvement of the new Member States representatives through special initiatives, through organizing open meetings and discussion, elaboration of strategies for enhancement the role of new technologies in EU, with focus on sub-strategies specific for regions in Europe.

Recommendation 5:

AGE recommends that the Commission focus collaboration on manageable EU based clusters of variable content and mission, covering not only EU but also collaborating economies, that promise win-win synergies and enable cutting-edge and competitive technologies.

EERA is well underway to develop an efficient pooling of projects and establish a joint programme structure, management and funding, for the different technology areas in the SET Plan. This represents quite a challenge because of the very different funding regimes in different countries and institutes. Other challenges include knowledge sharing from very different size projects by several “owners”. The question of IP versus competitiveness should be clearly addressed. What is really needed is education regarding IP, so that researchers can recognize an invention when they have made one and do not rush to disseminate it before the IP issues have been analysed. Support by management is important because without it inventions in the making may no longer be pursued. Also an adequate balance between invention and public funding should be clearly and objectively assessed. The move from projects to programmes and the move to a higher degree of interaction between industry, academia and entrepreneurship, combined with the challenge to achieve synergy and European coherence in the plethora of national energy initiatives in the Members States and abroad call for radical new approaches to the management of networks.

AGE encourages the Commission to develop a robust and state-of-the-art monitoring and evaluation system for the new modes of collaboration like the EIIIs to support real-time quality assurance and accountability. The Commission should consider a special set of criteria for FP7 and CSF projects linked to an EII or another large scale SET Plan initiative in order to ensure good coordination and effective use of the results. The backbone of such coordination efforts could be a bottom-up strategic partnership resulting in commitment to a common strategy combined with new types of management modes like “virtual legal entities”. Successful applications should be able to use additional funds to cover the strategic management and coordination of such partnerships and development of new management models. Research infrastructure is another area where the EERA and similar consortia have a natural role and where synergies could be developed with the EIIIs.

Recommendation 6:

AGE recommends that the remainder of FP7 and the preparations for CSF should support the development of new types of public-private-partnerships and strategic alliances to enhance coordination. Experience has shown the success of highly qualified industry/academia research teams not only for demonstration and deployment projects but also for applied and fundamental research.
Recommendation 7:

AGE recommends special attention to IPR challenges and knowledge sharing and that a reporting/communication structure via the SET-Plan Steering Committee is set up to check if they are met successfully.

International Cooperation

AGE considers that the EU competitiveness should be developed first, on science-based knowledge, and second, on scaling up and diffusion of low carbon technologies worldwide. Science and knowledge have a global dimension and international cooperation constitutes one of the building blocks of the SET Plan, which deserves its own strategy. In a highly competitive environment the EU policy for international cooperation has to have a clear understanding of its competitors and potential partners. The development of a well thought through policy on international RD&D cooperation could be of decisive importance for the European competition in the world markets.

AGE welcomes the expansion of the ongoing international R&D cooperation for energy technologies like the creation of the EU-US Energy Council with enhanced collaboration on renewable energies or additional initiatives such as the Solar Plan for the Mediterranean. AGE has repeatedly stressed that international collaboration should be conducted as part of a strategic approach that seeks to optimise the benefits to Europe, and not on an ad hoc, opportunistic or merely political basis. It should be selective to avoid resources being spread too thinly. To reflect the first of the criteria outlined above – science-based knowledge-, this requires that the countries selected for international cooperation should offer scientific and technical excellence. To reflect opportunities for scale-up and diffusion of low carbon technologies, international cooperation should seek out countries with appropriate resource bases and interest in low carbon technology adoption.

International cooperation with countries that provide secure energy supplies for Europe is yet another category of countries that merit enhanced collaboration. It is crucial that Europe does not only act as “buyer” or “exploiter” of still-needed fossil fuel but is willing to assist these countries in their own capacity building, R&D efforts and transformation towards a low carbon economy. A fourth group of countries that merit enhanced international collaboration are low-income developing countries that require access and less polluting energy to meet the Millennium Goals.

AGE considers it important that the Commission continues to take forward, in close cooperation with Member States, existing and recently established forms of cooperation in order to ramp up international cooperation and to improve coordination of the EU actions with key strategic partners in both developed and developing countries, as well as with international organizations, such as the IEA and IRENA. Increased international cooperation does not mean we foresee cooperation with many countries in every continent to be funded from the EU research budget. On the contrary, the Commission is well positioned to draw on all its financing and technical assistance instruments and optimize international cooperation depending on country circumstances to mutual benefit. Thus, international collaboration on low carbon energy technologies goes beyond DG RTD and DG ENER. At the same time it is important to realize that near-market activities enjoy different kind of framework conditions that typically favour local employment and market growth. Collaboration in this area is therefore less straightforward than in the fields of basic science and collaboration with developing countries.
Recommendation 8:

AGE recommends increasing international collaboration on low carbon technology and smart cities RD&D provided that such initiatives are strategically focused, develop effective low carbon technology capacities in partner institutions and enhance scientific and technical excellence. Knowledge sharing will be an important element. AGE also recommends the development and implementation of a consistent RD&D policy for both potential competitors and partners, especially for countries of high importance (like Russia and those of BSEC) for the security and diversification of EU energy of supply.

Smart Cities

Cities have advantages concerning energy efficiency compared to suburban or rural areas, but the renewable and efficient energy supply of the complex urban area remains challenging. The relevant parameters differ and are related to morphology of the city, energy performance of existing areas, energy infrastructure, available renewable resources, climate and other topics. Urban energy supply and demand side measures are closely linked to infrastructure development, and substantial investments are needed to implement innovation in a substantial manner and eventually realise breakthroughs. New, smarter and strengthened energy-related networks will be required including electricity, natural gas/biogas, heating and cooling distribution, and probably hydrogen, and possibly even CO₂ networks. The development and management of these networks will play a key role in the transition to a low carbon economy. Particular challenges are connected to integration of renewable energy sources, smart and energy efficient buildings, cost effective facility management and intelligent thermal grids. Tools for demand side management to shift loads and optimize economy needs to be developed. The development of a smart city is not only a technological challenge by also very much a planning and end-user involvement issue. For many municipalities this means a completely new approach to the handling of utilities.

Socio-economic acceptance of the smart city concept and investments is still an unexplored area. Past experience with “planned”, systemic and technically driven approaches show that social and public acceptability, generational issues and the “willingness and ability” to pay are the major barriers to such system driven initiatives. The basis for energy planning and urban energy management is the development of new scientific methods like theoretical modelling, analysis and optimisation of the energy performance characteristics (urban morphology, end use mixes, energy performance of buildings, energy distribution and storage, etc.) combined with modelling of energy distribution and hand in hand with experimental results from demo projects. AGE is of the opinion that such holistic understanding will show new potential for energy efficiency and integration of renewables. This will lead to new options for the management of thermal and electric grids and will result in a new role for energy management in the building stock (“building-to-grid”).

It has to be pointed out that in all European cities old building stock dominates; hence retrofitting will play a major role to increase energy efficiency. For the supply side using industrial waste heat is one additional positive option to be looked at in cities. To guide a successful innovation process it will be important to follow and interlink the complete chain from strategic oriented research to first demonstration projects and secure that results will be available vice versa. The involvement of stakeholders in all stages of the R&D process will help to focus research in
early stages and pave the way for innovation in market nearer projects. In addition, a streamlined implementation process involving the relevant stakeholders is crucial to ensure that research activities are reflected in high quality demonstration projects. In the spirit of the 'virtual power plant', cities are also prime sites for implementing networks of decentralized power generation. Decentralized storage options should be included to strive for a higher degree of self sufficiency not only with respect to integral energy, but also with respect to instantaneous power demand.

Recommendation 9:
AGE recommends early inclusion of a broad range of “Smart City Issues” in the research phase with a strong focus on energy efficiency, energy planning, integration of renewables and smart grids (focusing on city relevant aspects) and on supply and demand side management. Furthermore the urban energy system has to be designed and managed in a holistic manner integrating its interaction with other key systems such as waste and transport, with a view to improving these interactions. The new challenge is the integration of innovative new technologies into a new urban energy system and the combination of the technical, systemic and social approaches needed to understand and optimise the energy supply and demand of cities.

Smart City Demo projects should be included as European lighthouse projects, showing their excellence including cutting edge technologies and methods in urban energy systems. In order to provide every chance of success, cities and communities should meet certain eligibility criteria:

- Broad political support: there should be a commitment to implementation and, where necessary, policy reform at both the political level and civil servant/technical level within government, as well as key non-governmental stakeholders
- Scale: quantitative benchmarks should be developed to ensure scale of impact. These metrics should include a minimum reduction of greenhouse gas emissions or energy consumption. However, the metrics should not be limited to energy-related outcomes but should endeavour to include improvements in quality of life and productivity as well
- Pan-European value through a combination of:
  - Representativeness: a typology of urban areas should be developed to ensure that the initiative covers the key characteristics of European urban areas, such as different densities, climatic conditions, demographics etc
  - Replication: funded programmes should identify the means of replication from the outset, for example by creating an active learning network amongst mayors in a given region

Recommendation 10:
AGE recommends that the remainder of FP7 support research to find practical criteria for buildings to act as innovative, active hubs in the energy system. New design and retrofitting concepts (including shape, envelope characteristics, storage characteristics, control strategies and suitable HVAC components and systems etc.) have to be developed.

Recommendation 11:
AGE supports the concept of the city as “Living Lab” to be developed to close the circle between research on the long-term urban and energy planning issues with close to market implementation. The remainder of FP7 should be able to provide support for such developments.

**New generation electricity grids**

Electricity grids are seen as a key enabler of the low-carbon energy future. Grid integration is highlighted as an important issue in many other areas and initiatives, such as solar and wind energy, electric vehicles, energy-efficient buildings, energy storage, which are seen as the “new users” of the grids. The question is how to make sure that the grids will provide the appropriate responses and interfaces to these new users while keeping a coherent, dependable and efficient overall system by limiting the investment costs. In particular, the R&D effort on electricity grids should be aimed at providing common integrated solutions for these new users, or it should devote substantial efforts for the particular needs of individual “grids users” - leaving any particular interface issues to be dealt with as part of the individual technology areas. These developments give new challenges for grid management. Today, balancing supply and demand on the grid is a complex exercise requiring already sophisticated equipment, automation and data management. Maintaining this balance is especially difficult during peak periods and it will become even more challenging in the future.

Electricity networks are an ageing infrastructure (most of the infrastructure was built in the 1960s and 1970s) and it is difficult to build new transmission overhead lines in particular because of local opposition. Thus, the technologies for grid surveillance and maintenance have to be improved. This can be achieved by increasing the quality and number of sensors that are providing information on the equipment status and on the electricity flows combined with a new over-layer of ICT-based communication, control and management tools. A second challenge is related to the increased share of renewable energy sources. Wind and solar power units as well as other renewable electricity generation units will generally provide both decentralized generation from smaller units and more centralized production from big units. This gives rise to varying and intermittent power generation, which is only scheduleable to a limited degree when linked to local weather forecasting. The units can be connected either to the transmission or to the distribution grid. In the short term only the transmission grid is a realistic alternative when substantial balance or backup capacity is required. This is due to the absence of any large-scale energy storage, except hydropower reservoirs. Efficient energy storage technology is urgently needed; also for distribution grids, and RD&D in this area should be a priority for FP7+2, in support of the corresponding SET plan and EII initiatives.

In future most of the production units need to be equipped with functionalities to provide more control options as a basis for an active integration in network operation to ensure the power quality. This can be illustrated by the observation that 20% average wind power and solar power would require installed capacity equivalent to 80-90 % of peak consumption, and that such a situation is planned for 2020. The current grid systems cannot handle this challenge.

A further challenge is the introduction of demand-response programmes. Such programmes combined with innovative devices can lead to significant electricity savings but also to more
fluctuating consumer demand. Decentralized generation, notably solar PV, will make consumers become occasional producers. Instead of receiving electricity from the grid they will inject it onto the grid. Today, the grid management is not designed to manage bi-directional flows in large amounts. Also, the present metering and billing systems are not able to manage client payments for the electricity not used or injected on the grid based on real time data. All this calls not only for smart grids, but also for smart metering and technologies of decentralised electricity generation. Smart grids can be seen as two-way traffic system connecting intelligent power production with intelligent consumption. Smart cities will use electrical smart grids as an important component in future sustainable infrastructure systems (power, gas, heating, cooling and transport). With the increase of interconnections, transmission grids will have progressively to be managed on a European level and no longer at national or regional levels alone. Closer grid management connections between TSOs will have to be developed (as in the recent CORESO initiative that is implementing a close coordination between Belgium, UK and France) resulting notably in increased data flow management. Local and regional grids with distributed production controlled with new ITC and software can act as virtual power plants (VPP). Such VPPs should eventually act as market players on the power market on equal terms with other power producers. The role of regulators would be to organize the system and set the market rules but not to act as a market player. The regulator should have the power to intervene and there should be a hierarchy of regulators from regional to European level. Balancing would be needed on all scales so that the future system would be an aggregation of local, national and regional sub-grids – each with some balancing capability. Grid on larger scales may provide balancing power and frequency control when needed (for technical or economic reasons) by the smaller scale grids.

Transmission networks are large, complex items of infrastructure developed over many years, with long equipment lifetimes of 30 – 60 years or beyond. They represent a high investment cost and, due to the power they carry, are potentially dangerous unless operated with great care. In consequence owners have evolved strict operating rules both to ensure safety and to protect the large equipment investment. Changes to components of the network are generally accepted only after exhaustive testing, and radical changes to the architecture and operating concept are rarely if ever made. In consequence the industry players have an extremely conservative approach to modifications, and any new equipment installed will define the nature of the network for typically 50 years. There is thus an inevitable conservatism when making investment decisions, which has a direct impact on viable migration and evolution paths towards the newer networks envisaged for the future. This aspect needs to be addressed as an integral part of R&D efforts. Hence, there is a strong need for interdisciplinary R&D to address the emerging large scale grid structure and operations required by 2050 to connect the new RE and CCS production regions with the consumer centers and to provide balancing capacity on a European scale. R&D is needed to provide understanding and solutions for a fully integrated system with many different types of market players acting in a hierarchy of scales.

**Recommendation 12:**

The EC should consider a process by which a consensus among the European super grid stakeholders could be developed. The process should ensure that a range of solutions is investigated with appropriate quality checks. The challenge is to find the optimal balance between security of supply, regulatory needs, technical feasibility and market based controls in a system that gradually evolves towards the 2050 vision, and which instruments can the EC and other
On the *distribution side*, one key component is the smart meter. The regulatory status of their deployment is variable from a European Member State to another. The third EU legislative package recommends that, by 2020, 80% of the European citizens be equipped with intelligent meters. The new world of smart grids will put pressure to Network Operators. The operator will have to develop new administrative procedures, interconnections, create connection capacity and improve grid in an optimized way. All this has to be done at a reasonable cost to consumers and allow return of capital. Tariff framework needs also to be predictable and stable. There is a growing need for storage capacity on many scales. Grid-to-Vehicle technologies and systems are being developed with credible business cases whereas it is more difficult to see an attractive general case for Vehicle-to-Grid except under special local circumstance. Thermal storage systems are already in use and will be further developed in conjunction with electricity at low marginal cost.

**Recommendation 13:**

*AGE recommends support to concerted efforts in RD&D in grid and renewable technologies to deal with the technical, organizational as well grid issues dealing with regulation and business models involving all stakeholders. Smart Grids are a concept that will reach success as long as we are capable of integrating in an organized and optimized way a set of different technologies and developing common standards across Europe to ensure the eventual inter-operability of different national systems.*

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**EURATOM Programmes**

**Fission**

AGE remains of the opinion that nuclear energy has a significant role to play in realisation of the objectives set out in the European Strategic Energy Plan (SET-Plan), i.e. reduced carbon emissions, increased security of supply, decreased dependence on delivery of energy sources from unstable world regions, and increased industrial competitiveness. Nuclear fission is currently supplying almost one third of Europe’s electricity. However, the severe nuclear accident that followed the earthquake disaster in Japan, has reminded the world of the need of continuous nuclear technology development. These events have stirred the political opinions in many European countries and have led to a general re-examination of the safety of the existing nuclear power plants, the so-called stress tests. The incidents offer an opportunity for an open and sincere discussion for the future of the European Nuclear Industry and the need to regain its competitive position in a global economy that will continue to use its nuclear power stations until at least the end of the present century. However, AGE is concerned by signals that the Member States are not even willing to coordinate the safety procedures and standards for the tests, that are being conducted in the aftermath of Fukushima and to include the EURATOM/Commission experts. Proper coordination and knowledge sharing could demonstrate the efficient implementation of research and development (R&D) results in the nuclear power plants following a better understanding of the accidents’ phenomenology. Therefore, the EURATOM programme with emphasis on safety could be an asset for nuclear programmes in Europe, Russia and USA combined
with continued rapid developments in the emerging economies (particularly in Asia). This could eventually create a huge market for nuclear industries, where the European nuclear industry will benefit from the support by EURATOM activities and programmes to recover credibility in the level of the safety in the installations.

In early March 2011 the Commission adopted a proposal for continuing EURATOM research activities in fission, fusion and JRC during 2012 and 2013. Budgets for fusion include 1.3 B€ to cover the increase in the European share of the ITER cost. The budgets for fission (53 M€/year) and JRC (116 M€/year) are maintained at about the current level of spending. During FP7 the EURATOM programme has developed important new initiatives that strengthened the collaboration across the Members States. This has led to the technical forums for sustainable nuclear technology (SNETP) and low dose radiation protection (MELODI) and most recently the launch of the industrial initiative for sustainable nuclear power (ESNII) with GEN IV reactor technology as the long-term goal. At present only about 10% of the small EURATOM fission budget is allocated to advanced reactor systems. This is a reflection of a constraint applied in the past that the fission programme has been narrowly focused on safety and waste management issues related to existing plants, and that work on advanced nuclear systems should relate only to assessing their potential. EURATOM research investments in nuclear fission technology have been modest, and nuclear fission research strategy has been mostly left to Member States coordinated by FP actions with limited scope. The analysis of the events in Japan shall be taken seriously in the EURATOM programme and a considerable increase in funding should be targeted to understand and implement the lessons learned from Fukushima.

**Recommendation 14:**

AGE is of the opinion that EURATOM nuclear fission research programme in FP7+2 should maintain its focus on the issues safety, fuel cycle and waste management in order to create a broader basis for public debate and acceptance of new nuclear plants and agreement on waste management. The support should be devoted to enhancing coordination issues at the European level like: (1) continued support to public education on nuclear energy but also coordination of, and sharing experience from, safety research, or research on waste processing, packaging and disposal; (2) sharing and spreading of research results such as those related to lifetime extension, so that benefits are accessible throughout Europe; (3) contribution to needed research infrastructures such as research reactors, irradiation facilities coordinated with the work of ESFRI including seed money for start-up research (for example hybrid reactors, new applications of nuclear fission, etc...).

AGE welcomes the progress made by the Sustainable Nuclear Energy Technology Platform (SNETP) and the launch of the European Sustainable Nuclear Industrial Initiative (ESNII). The technology forums have played a key role here in identifying priorities and subjects most amenable to a Community approach. EURATOM has given support to the GEN IV initiative, which has led to the constitution of the GIF, an international consortium devoted to a new generation of nuclear reactors that could be commercialized by the middle of the century. Nevertheless, funding (estimated at several billion Euros) for GIF is still unclear, and the first issue is the financing of a prototype by the early 2020’s. AGE is concerned that the small-scale effort in the long run will preclude EURATOM from participating in real work on high temperature or fast neutron reactors and hence from influencing the development of standards for these technologies, which are being actively developed elsewhere (e.g. Russia, China, Japan, and India). The Commission should seek
to increase the funding for fission research and to alter the balance of the fission research programme so as to reflect the SET-Plan with respect to work on advanced reactor systems to develop fully the technology of Generation IV reactor systems and explore the possibility of reducing actinides in waste by nuclear "incineration".

AGE is of the opinion that industry should also increase its research effort, particularly regarding lifetime extension of GEN II reactors, but also of that needed for the new build based on GEN III. On GEN IV, although this can be seen as riskier and longer term, industry should at least take into account the competitive edge it can provide, especially in view of active international competition. It is obvious that assuming successful potential for commercialisation, intellectual property issues will arise. Those better placed from this point of view thanks to earlier and substantial contribution to relevant programmes will benefit. European nuclear industry competitiveness in the medium and long term can be restored by (1) vigorous implementation of the nuclear chapter of the SET Plan (safety, non-proliferation and fuel cycle), (2) pursuit of the ESNII road map towards a leading European role in GENIV fission technology, and (3) successful realisation of ITER and the accompanying European programmes towards DEMO with growing industrial involvement. AGE finds that the Commission should seek to increase the funding for fission research and to alter the balance of the fission research programme to reflect the SET-Plan with respect to work on advanced reactor systems to develop fully the technology of Generation IV reactor systems and explore the possibility of reducing actinides in waste by nuclear “incineration”.

**Recommendation 15:**

AGE recommends that the nuclear sector concentrates first on the most important issues of the 4th generation, i.e., the fuel cycle and safety issues. The EURATOM programme has to be part of a general expansion of energy RD&D efforts in the EURATOM chapter of the CSF using a variety of instruments with broader circles of stakeholders using common strategies and variable geometry approaches for joint programmes, research infrastructures, pilots, prototypes and demos. The CSF and the SET Plan implementation instruments should be used equitably to cover the whole spectrum of technologies as well as the whole chain of components in the energy system including system and market aspects, policies and regulation.

Increasing new Member States’ participation should also be addressed by the Sustainable Nuclear Energy Technology Platform (SNETP) and closely observed in the framework of emerging nuclear European Industrial Initiative. It has been observed that many new Member States have substantial nuclear experience and skills inherited from earlier developments and from the existence of substantial nuclear reactor fleets. FP7 should help set up networks of excellence between institutes and agencies in all member states so that such skills are developed and transferred from one generation of scientist and engineers to the next one. AGE has noted that a European nuclear education network already exists, based in France. Funding schemes to attract students not only from the Union but also from other countries should be developed so that the Union becomes a reference in nuclear education – this is also in the best.

**Recommendation 16:**

AGE recommends that the role of new and non-nuclear Member States continue to be stimulated in FP7 through networking and exchange of younger staff.
Fusion

AGE is still of the opinion that the potential of fusion energy should be actively pursued - at least to the point where it is clear whether or not it can be engineered to become economically viable. The costs, timescale and project risks inherent in the development of fusion energy R&D are large – so much so that it is unlikely that any European member state could contemplate undertaking it alone. In fact, the fusion programme represents a very well coordinated European strategic effort, which unites all Members State programmes in a globally leading European Programme.

ITER

The fusion research programme is dominated in the near to medium term by the construction costs of ITER. ITER is an international project to which EURATOM, as host, is contributing 45% of the hardware and costs. The recent review of the design and cost baseline for ITER construction is the basis for the new budget proposal from the Commission with an additional funding of 1.3 B€ to cover the EU share for the years 2012 and 2013. Significant additional funding will also be required during the following budget period relating to an overall cost of 6.0 B€ (in 2008 value €) for the European share of ITER construction, without the cost for operation of the European Domestic Agency (Fusion for Energy, F4E) as European agency. This compares to an initial cost estimate of 2.7 B€ (in 2008 value €). The reasons for this cost increase are (1) a consequence of the organizational and management structure and procurement methods chosen for the ITER project, including the system of sharing contributions by the participating parties in kind (rather than in cash), (2) cost increases from design changes and additions due to the incompleteness of the original design, and research and development carried out since the original baseline was established in 2001. AGE has noted that changes in management and structure at the ITER organisation and the F4E are being put in place. A revised project baseline has been agreed upon internationally (including scope, schedule, milestones and deliverables in hand with costs).

AGE endorses the commitment to delivering ITER as quickly as possible, but without any further cost increases by striving for an unrealistic timescale or too ambitious R&D capacities. AGE is of the opinion that further strict measures will be needed to realize ITER within the budget of 6 B€. AGE still considers that ITER is an essential step on the road to commercial realization of fusion energy and if we are to pursue fusion energy then funds based on the agreed ceiling for the European contribution should be made available. In case of further problems occurring with regard to cost increase for ITER AGE recommends a transparent political discussion on the balance of effort within the field of European energy R&D.

Recommendation 17:
The majority of AGE supports the redefined ITER project and share the view that EURATOM and its international partners should maintain and follow a global roadmap setting out a route to a commercially viable fusion energy reactor, with short- and medium-term objectives, including clear intermediate milestones. Any further increase in the cost of the ITER project, however, should lead to a political discussion on the overall balance of resource allocation for European energy R&D.
Fission/Fusion Balance

While the case for continuing the research into fusion energy production is clear, we must note the overall context within which the ITER magnetic confinement project is being pursued. Today the date by which this might reach the stage of commercial exploitation is generally accepted to be not earlier than 2060. However, given these long timescales and substantial engineering challenges to be overcome it is obvious that there remain considerable risks and uncertainties in whether nuclear fusion energy will prove a practical energy option with regard to technological complexity and future costs of fusion electricity. In contrast nuclear fission energy systems are known to perform reliably at commercial scale and there are a number of evolutionary development options, as well as new systems such as GEN IV, available to pursue. Both these will require R&D efforts in addition to commercial design and development to produce the scientific basis on which such plants might be both designed and, more importantly, approved.

In these circumstances it is imperative that support for the development of fission technologies should be decided on the basis of their potential contribution to energy systems in the timeframe to 2050 and then to 2100, and on the need for evidence with which to gain construction approval and public acceptance of safety. It is vital that fusion research is not regarded as the dominant priority, and that fission funding is not determined by the resources remaining once the large fusion projects are financed. The synergies between fission and fusion research should continue to be pursued, and in this context AGE points to the benefits of integrated knowledge management (IMS), in particular with regard to high-temperature materials and detailed modelling based on HPCC. Such synergies can be found on issues of nuclear safety, access to irradiation infrastructures, radiation protection, materials, modelling, etc. FP7 and the successor programme could set up appropriate schemes to detect and encourage joint research by the fission and fusion communities in these areas.

**Recommendation 18:**

AGE recommends that support for the development of fission technologies should be decided on the basis of their potential contribution to energy systems in the timeframe to 2050 and then to 2100, and on the need for evidence with which to gain construction approval and public acceptance of safety. It is vital that fusion research is not regarded as the dominant priority, and that fission funding is not set by the resources remaining once the large fusion projects are financed.