*** Please note that this document ***

- only has a draft status (do not communicate with the European Commission about the content)
- is confidential (only share selected paragraphs of the text and not the whole document)

COUNCIL DECISION ESTABLISHING THE SPECIFIC PROGRAMME IMPLEMENTING HORIZON 2020 - THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION (2014-2020)

VERSION 12 SEPTEMBER 2013

WORK PROGRAMME 2014 – 2015

Energy Challenge

INFORMAL DRAFT DISCUSSION DOCUMENT

Important notice:
The present document is meant to facilitate the discussions towards the preparation of the work programme 2014 – 2015. It does not at this stage cover all relevant aspects and it does not prejudge the outcome of the on-going inter-institutional negotiations on Horizon 2020 or internal work on cross-cutting aspects. Hence, it remains subject to change. Information, such as indicative budgets per call/area, will be provided at later stage.

Table of contents

Introduction to [Name of the part/specific objective]

SECTION A: CALLS FOR PROPOSALS

CALL FOR ENERGY EFFICIENCY

Energy efficiency is a no-regret option for Europe, addressed by both short-term and long-term EU policies. The key objectives of EU action in the field of energy efficiency are:

(1) to hold **2020** energy consumption down to no more than 1474 Mtoe of primary energy consumption and 1078 Mtoe of final energy consumption[1][2]; and

(2) to hold **2030** energy consumption down to an appropriate level (which may be set as a function of the EU's economic performance).

In 2009, it was forecast that the policies and measures in force at European and national level would still leave EU primary energy consumption at about 1680 Mtoe in 2020. Since then, Member States have committed to energy efficiency as a key element in their energy policies and energy efficiency measures have started to function on a significant scale. It is now projected that primary energy consumption will progressively decrease in 2020 and 2030[3]. This is encouraging progress; but it should be noted that the poor performance of Europe's economy has also made a significant contribution, and that these projections still leave a gap in relation to the EU target for 2020. Moreover, it is clear that more ambitious action in energy efficiency will be needed to achieve EU objectives for 2030.

In the field of EU support for innovation package of activities is therefore needed to support 1) research and demonstration of more energy-efficient technologies and solutions; and 2) actions to remove market and governance barriers (financing and regulatory frameworks, improving skills and knowledge,).

Research and demonstration activities will focus on buildings (implemented also through the EeB PPP), industry (implemented also through the SPIRE and Factories of the Future PPPs), heating and cooling, SMEs and energy-related products and services. Market uptake measures, which should continue the type of activities supported under the Intelligent Energy Europe programme including ELENA Facility[4], should address market failures and governance gaps preventing progression energy efficiency across all sectors.

Where applicable, supported projects should also include a broader resource efficiency dimension, and pay due regard to gender issues.

This call covers the following areas:

A Buildings and consumers

B Heating and cooling

[1] EU27; 20% less than the energy consumption projected for 2020 at the time the objective was set

[2] With the accession of Croatia, the Union's 2020 energy consumption has to be no more than 1 483 Mtoe of primary energy or no more than 1 086 Mtoe of final energy (Directive 2013/12/EU).

[3] According to current data energy consumption will need to be no higher than 1535 Mtoe in 2020 and 1482 Mtoe in 2030

[4] www.eib.org/elena

C Industry and products

D Finance for sustainable energy

It includes topics that contribute to objectives in all sustainable energy fields (energy efficiency, renewable energy and Smart Cities and Communities).

These are: EE 3 on Construction skills, EE 6 on Capacity building of public authorities, EE 7 on Public procurement of sustainable energy solutions, EE 8 on Empowering the stakeholders, EE 17 on Driving energy innovation through large buyer groups, EE 19 on Project development assistance for sustainable energy investments and EE 20 on Development and market roll-out of innovative energy services and financial schemes for sustainable energy.

A – Buildings and consumers

Buildings account for 40% of EU final energy demand. Most of those existing today will still be standing in 20 years' time; the rate of new construction will remain generally low. The refurbishment of existing buildings represents more than 17% of the saving potential of the EU[5] up to 2050.

The biggest challenge reducing energy use in buildings is to increase the rate, quality and effectiveness of building renovation (currently only at 1.2%/year[6]).To do this it is necessary to reduce its costs and also to increase its speed to minimise disturbance for occupiers. To achieve an ambitious increase of the renovation rate (up to 2-3% per year), effective solutions need to be widely demonstrated and replicated.

Both, the recast of the Energy Performance Building Directive (EPBD) and the Energy Efficiency Directive (EED) contain provisions to increase renovation rates, especially for public buildings. However, of non-technological barriers hamper the implementation of these provisions in the public sector and prevent market actors in the residential and private sectors from following the example that the public sector sets.

Specific attention should be paid to protected or listed buildings given their number and the fact that specific refurbishment constraints often need specialised techniques.

Consumer behaviour can reduce energy consumption by 20%[7]. Consumption feedback systems, and building design that encourages and enables energy conscious behaviour, can help to fulfil this potential. The contribution of households' energy demand patterns of the energy system (demand response technologies) should therefore also be developed.

To deliver innovative, affordable and applicable technologies for energy efficiency, the Energy Efficiency in Buildings Public-private partnership (EeB PPP), established under the H2020's LEIT Pillar will channel its call towards a range of predominantly technology-related energy efficiency R&D topics such as materials for building envelopes, self-inspection techniques and quality check measures, design tools for refurbishment at building and district level, integrated solutions for buildings renovation and thermal energy storage for building applications. Also, the EeB PPP will address new methodologies to reduce the gap between predicted and actual energy performance of buildings.

This call will complement the call of the EeB PPP with both technology-related, and (mostly) non-technology related topics, focusing on removal of existing barriers through market uptake measures to build capacity, provide support for sustainable energy policy implementation, mobilise financing for sustainable energy investments and foster uptake of technologies relevant for energy efficiency in buildings.

A proposal could cover two or more topics at the same time, but should nevertheless be submitted under the main topic of the proposal and achieve at least the expected impact of that topic. Exceptionally, and if properly justified, proposals meeting the eligibility and selection criteria, but not directly responding to specific topics defined in the Call, may also be considered.

[5] http://www.isi.fraunhofer.de/isi-media/docs/e/de/publikationen/BMU_Policy_Paper_20121022.pdf

[6] Renovate Europe Campaign

[7] http://www.eea.europa.eu/publications/achieving-energy-efficiency-through-behaviour

EE 1 – 2014/15: Building materials and components:

Manufacturing of prefabricated modules for refurbishments of buildings

Specific challenge: Prefabricated components are more and more commonly used in the construction sector. Compared to traditional construction processes, prefabrication aims at reducing costs at constant quality and facilitating installation/dismantling/re-use of components. Building components could, when relevant, be prefabricated in factories to gain on construction time and to improve health and safety at work sites. Accelerate the time for installation is particularly suitable for refurbishments while being occupied. Prefabrication should be adaptable to individual refurbishment solutions as well as for mass manufacturing in adequate projects and be adjusted and linked to computer design tools.

Further research is needed to improve understanding of material and component behaviour in the whole life cycle and, consequently, to be able to produce better performing products. Innovative technologies for energy efficiency and renewable energy sources can also be integrated in the prefabricated modules and components. The elements are to be developed, prototyped, optimised and transferred from individual manufacturing to mass production.

Scope: Innovative mass manufacturing processes must be investigated to lower pre-fabrication costs and ease building integration processes, also taking into account the challenge of aesthetics of existing buildings. This requires the development of new controlled processes and cost-effective automated/robotised tools.

These innovations should be combined with integrated processes and the use of advanced computer based tools like Building Information Modelling which will facilitate the industrialisation of the whole construction process and integrate the value chain over the life cycle of the project. Durability of proposed solutions will have to be evaluated in real installation conditions, incorporating integrated and embedded reliable monitoring systems, as this is a crucial factor that influences final product performances.

During the development of technology and components for prefabricated facade elements, structural engineering aspects must be taken into account to enhance the automated and robotized construction technologies. A business model addressing cost-optimality aspects for given building types and geo-clusters across Europe should be addressed in the proposals.

SMEs involved in prefabrication modules manufacturing and their installation, represent an added value to the activities. The proposals should cover mainly demonstration activities. Prototypes and pilot implementations in real industrial settings represent a clear added-value.

Expected impact:

- Reduction in total (primary) energy consumption by at least factor 2 with respect to the current situation, and a cost-level better than traditional renovation activities.
- Significant reduction of refurbishment operations while ensuring low intrusivity and impact for users.
- Reduction in installation time by at least 30%, compared to a typical refurbishment process for the building type.
- Better quality standard and performance guarantee for the installed prefabricated modules while enhancing indoor air quality.
- Demonstration of the replicability potential.
- A maximum return on investment below 7 years.
- Generation of new high-tech SMEs specialised in refurbishment with prefabricated modules.

- High-skill jobs for workers that could master innovative construction tools.

Type of action: Innovation Action (70% funding),

EE 2 – 2014/15: Buildings design for new highly energy performing buildings

Specific Challenge: In the very near future the construction industry needs to be ready to deliver affordable new, 'nearly zero-energy' buildings using innovative, cost-optimal technologies with integration of renewable energy sources on site or nearby.

Scope: Projects should focus on development and demonstration of solutions which significantly reduce the cost of new buildings with 'nearly zero-energy' standards and significantly broaden the scope and speed of these buildings and their systems being taken up by the market. Focus should lie on solutions for appropriate indoor air quality and comfort, passive solutions (reducing the need for energy using technical building systems), buildings systems as well as on energy storage of renewable energy onsite and nearby. Projects should also provide solutions for automated and cost-effective maintenance of the installed equipment.

The applied solutions should address the challenge to move towards to a 'nearly-zero energy' buildings standard at large scale with demonstration projects that go beyond 'nearly-zero energy' buildings levels to 'plus-energy' levels, in particular when new districts are planned.

Projects should also focus on methods for on-site and nearby-generation of renewable energy for new buildings (mainly electricity generation, e.g. heat pumps or integrated PV) accompanying energy efficiency measures to achieve standards higher than those of 'nearly zero-energy' buildings.

Expected Impact: Significantly broaden the share of NZEB taken up by the market with the aim of 100% market uptake by the end of 2020. Demonstration for net-zero energy districts taking advantage of onsite or nearby-generation of renewable energy.

Type of action: Research and innovation action (100% funding)

EE 3 – 2014: Construction skills

Specific challenge: The large contribution expected from the building sector to the 2020 energy objectives is a challenge for the construction industry which needs to be ready to deliver renovations offering high energy performance and new, nearly zero-energy buildings using innovative technologies. Many craftsmen and building workers need up-skilling. Existing qualification schemes, accreditation structures and training incentives are not delivering enough training on energy efficiency and renewable energy and are sometimes insufficiently attractive to building workers (especially from SMEs). There is also a need to train architects, engineers, building managers and other building professionals. By promoting integrated design and good operational management practices, these professions can help in closing the gap between energy performance at design stage and operational performance.

Scope: Regarding craftsmen and other on-site workers, proposals should build on the results of the recent BUILD UP Skills initiative and should focus on upgrading or establishing large-scale qualification and training schemes in order to increase the number of skilled building workers. These proposals should be based on the national training roadmaps established in BUILD UP Skills. They may also address coordination and may include accompanying measures (e.g. voluntary certification schemes, accreditation, mutual recognition, incentives to encourage the participation of craftsmen). Regarding other practitioners, proposals should focus on improving the qualification and skills of middle and senior level building

professionals. For support to trainees, proposals should link to other sources of funding such as the European Social Fund, including Youth Guarantee Scheme.

Organisational and financial mechanisms should be established to sustain training activities for at least 3 years after the projects' end**.**

Expected impact: Reduced skills mismatch and increased managerial capacity to support innovation and sustainable energy use in buildings through new leadership and work practices.

Every million Euro of EU support is expected to increase the skills of at least 2000 craftsmen[8], or 500 construction sector managers[9], resulting in savings and/or renewable energy production of at least 25 GWh per year and increasing the employability of the building workforce. In addition projects should explain how they will result in increased investments in innovative sustainable energy technologies.

Type of action: Coordination and support action (100% funding).

EE 4 – 2014/15: Increasing energy performance of existing buildings through process and organisation innovations and creating a market for deep renovation

Specific challenge: The Energy Performance of Buildings Directive and the Energy Efficiency Directive contain provisions to increase renovation rates, especially for public buildings. However non-technological barriers hamper the implementation of these provisions Directives and also prevent other market actors in the residential and private sectors from following the example expected of the public sector.

The heterogeneity of the construction industry, the large number of companies and the relative lack of quality standards and inspection mechanisms limit demand and hinder the achievement of large-scale investments in, and ambitious, energy savings and the effective integration of renewable energies. Many buildings are not commissioned and/or operated properly and energy performance certificates have not yet gained full public acceptance. The pressure to build or renovate towards nearly zero-energy buildings means that the building sector needs to significantly upgrade its working practices.

Therefore, there is a need to develop a marketplace for deep renovation packages. Currently, there is limited articulated demand from building owners for significant energy performance improvements in existing buildings. Supply side, demand side and public authorities need to cooperate and find solutions that drive compelling offers for building owners, and lift as many barriers as possible simultaneously.

Scope: Proposals should focus on removing market barriers. They should focus on coherent interventions across issues and across actors to drive structural improvement in market conditions (i.e. those able to significantly influence buildings energy use in different sectors including building owners/operators, public authorities, construction and maintenance industry, housing associations, developers, financiers, etc.). All building types may be covered; however the main focus should be on existing buildings as they represent the largest savings potential. Proposals should create synergies by incorporating at least one of the following three elements:

[8] Conservative estimate based on the FEEBAT scheme (see BUILD UP Skills France status quo analysis).

[9] EUREM.NET and IDES-EDU projects.

- *Driving product and process innovation in the construction sector* to improve product offerings by creating an early market.
- *Development, testing and implementation of regulations, property valuation techniques, quality standards, and/or inspection and monitoring mechanisms* to bridge the gap between expected and actual energy performance.
- *Enabling conditions to finance deep renovation of buildings (including through process and organisation innovation).*

Optional additional activities may include:

- *Support for the implementation of the recast Energy Performance of Buildings Directive* in Member States by promoting dialogue and exchange of best practices; complementing activities of the EPBD Concerted Action.
- *Support to the implementation of the Energy Efficiency Directive* as regards its provisions on 'long-term strategies for mobilising investment in the renovation of the national stock of residential and commercial buildings' (Article 4) and the renovation of central government buildings' (Article 5); complementing activities of the EED Concerted Action.
- *Methods to increase the share of on-site and nearby-generated renewable energy in order* to achieve nearly zero-energy buildings performance levels (or better).

Expected impact: projects triggering the renovation of existing buildings towards high energy performance, or raising quality and compliance, should result in savings of at least 25 GWh/year per million EUR of EU support. Impacts should also be measured in terms of investment made by stakeholders in sustainable energy; better implementation of energy-efficiency policies; and number of policy makers or building owners/operators influenced.

Type of action: Coordination and support action (100% funding)

EE 5 – 2015: Demand response in blocks of buildings

Specific challenge: demand response enables end use consumers to participate actively in energy markets and profit from optimal price conditions, making the grid more efficient and contributing to the integration of renewable energy sources. At the building level, increasing use of energy management technologies will act as an enabler for the deployment of demand response in particular in residential and commercial buildings. Considering the important contribution of buildings to energy efficiency, there is a need for ensuring that commercial and residential buildings have proper energy management systems in place to ensure demand response activations.

Scope: At the level of a block of buildings, the focus should be on real time optimisation of energy demand and supply using intelligent energy management systems with the objective of reducing the difference between peak power demand and minimum night time demand. Cost-effective and interoperable solutions should be demonstrated for a block of buildings consisting of at least 3 different buildings in real life operating conditions.

Expected impact: Projects showing that demand response can be implemented at residential level with the help of intelligent energy management systems and without unreasonable effort and complexity while triggering substantial energy and cost savings. Moreover, projects that shed light on the added value of installing demand response facilities for building blocks vis-

à-vis for individual dwellings/buildings and on the willingness of consumers to participate in demand response solutions. Impacts should be measured in energy and cost savings per household and per building block. Impacts should also be measured for the willingness and capability of consumers to participate in demand response solutions.

Type of action: Innovation Action (70% funding),

EE 6 – 2014/2015: Enhancing the capacity of public authorities to plan and implement sustainable energy policies and measures

Specific challenge: Public authorities play a key role in the reduction of EU energy consumption and the increase of renewable energy capacity. For instance Member States must produce and implement National Energy Efficiency Action Plans (NEEAPs) and National Renewable Energy Action Plans. They also have the obligation to produce detailed action plans in specific sectors such as the renovation of buildings or the application of high-efficiency cogeneration and efficient district heating and cooling systems. Local and regional authorities are also developing plans at their own level. Other public authorities play an important role too; national energy regulatory authorities for instance should provide incentives for grid operators to enable network users to implement energy efficiency measures.

Doing this requires multidisciplinary skills to e.g. assess different cross-sector sustainable energy options, according to both technical, environmental, economic and social criteria. It also requires skills to engage stakeholders in both the definition and implementation of the solutions, and to secure funding.

The situation regarding the availability of these skills depend from country to country; e.g. while certain public authorities have a long tradition of using energy performance contracting, others have not tried yet; or while a few Member States impose to large cities to develop urban mobility plans, such plans are not common practice in other countries.

Scope: Proposals empowering public authorities in targeted territories to plan, finance and implement ambitious sustainable energy policies and plans, on the basis of reliable data and analyses. Public actors should be encouraged to look at sectors with high energy saving potential such as buildings and urban mobility. Capacity building should be an integral part of project proposals.

The following actions are part of the scope:

- Raising the capacity of Member States to fulfil their obligation under the new Energy Efficiency Directive.
- Enabling national energy regulatory authorities to address demand issues (e.g. demand response, tariff design, assessment of generation adequacy assessment)
- Capacity building on integrated energy, transport mobility and land-use planning at community and city-level.
- Supporting public authorities in better linking up local, regional and national levels for delivering integrated sustainable energy action planning and projects to achieve economies of scale.
- Establishing new or exploiting existing networks and other mechanisms to spread knowledge and facilitating the exchange of experiences and best practice on energy efficiency.

- Large-scale capacity building on innovative financing to specific groups of public authorities, such as national, local and regional authorities, energy agencies, structural and cohesion funds managing authorities.
- Defining and implementing standard energy saving packages for households, public sector and industry in particular under Article 7 of the Energy Efficiency Directive.

Expected impact: Impacts must be measured in terms of number of public officers influenced and number of new or improved policies and plans. The number of final consumers impacted should also be measured in millions of people. In addition, projects targeting governments should also demonstrate that they accelerate the implementation of the new Energy Efficiency Directive.

Type of action: Coordination and support action (100% funding)

EE 7 – 2014: Public procurement of innovative sustainable energy solutions

Specific challenge: Considering the large volume of public spending (19% of EU GDP, or roughly EUR 2,200 bn in 2009[10]), the public sector constitute an important driver to stimulate market transformation towards more sustainable energy products, buildings and services. To this regard, the recent Energy Efficiency Directive requires for instance that central governments purchase only products, services and buildings with high energy-efficiency performance. However, there are many operational barriers related to sustainable energy public spending such as the lack of knowledge, practical training and tailored guidelines; the lack of willingness to change procurement habits; or perceived legal uncertainties.

Scope: Proposals should support public authorities in purchasing sustainable energy products, buildings or services with a focus on innovative solutions. Project proposals should address the lack of practical training, lack of experience in implementing sustainable procurement practices and strategies, lack of sharing and co-operation among procurers or the use of cost – benefit analysis using a life-cycle approach. Actions should target countries where procurement practices are the less advanced and should involve large multipliers such as central purchasing organisations.

Expected impact: Every million Euro of EU support is expected to trigger the launch of public tenders for the purchase of sustainable energy products, buildings or services resulting in savings of more than 25 GWh[11] per year of energy savings and/or renewable energy production. Proposals should also increase the skills of public procurers and the market uptake of innovative solutions.

Type of action: Coordination and support action (100% funding)

EE 8– 2014/15: Empowering stakeholders to assist public authorities in the definition and implementation of sustainable energy policies and measures

Specific challenge: While public authorities have an important role to play to develop energy efficiency policies and plans, the latter require the full involvement of private stakeholders and the civil society for their effective implementation. However there is a general lack of capacity and coordination among those stakeholders to guarantee their full involvement and to effectively convert policies and plans into concrete actions.

[10] COM staff working paper, Annexes to the impact assessment of Directive 2012/27/EU

[11] Based on results from previous IEE projects such as BUYSMART (IEE/08/488/SI2.528388)

Scope: Projects should target specific actors among a wide spectrum of stakeholders (utilities, industry, financing institutions, non-governmental organisations, consumer associations, interest groups, trade unions, etc). They should provide large-scale capacity building or engagement activities to those specific groups playing a key role in the definition and/or implementation of sustainable energy policies and measures initiated by public authorities. Projects should demonstrate a strong European added value and put in place mechanisms ensuring the continuation of the activities beyond the project duration.

Expected impact: Each project must prove to influence hundreds of stakeholders playing a key role in the definition and successful implementation of national, regional or local policies. As a result the number of final consumers impacted should be measured in millions of people.

Type of action: Coordination and support action (100% funding)

EE 9 – 2014/15: Consumer engagement for sustainable energy

Specific challenge: residential use of energy is responsible for 28% of EU energy consumption[12]. The barriers to consumer energy saving have been known for more than 30 years[13], in particular split incentives (e.g. tenants vs. landlords), lack of information, high initial investment in energy-efficient equipment and habits of energy users. While awareness of the existence of renewable energies has improved considerably in the last years, there is still a lack of understanding of how to use them in practice.

Scope: Project proposals should focus on changing the behaviour of consumers in their everyday life (e.g. at home, at work, at school), using market segmentation and focussing on "action", the last step of the AIDA (Awareness – Interest – Desire – Action) framework. Equipment responsible for main energy consumption (e.g. heating and cooling, lighting, domestic appliances, and consumer electronics)[14], as well as products from the small scale renewable energy market, should be addressed in priority. Educational activities or tools (such as comparative ones) may be necessary, e.g. to help consumers read and understand their energy bills or labels; to help them take advantage of ICT devices to monitor and analyse their energy use; or to help them participate in community renewable energy projects (e.g. RES consumer cooperatives, community-owned projects, etc.). Actions should take gender issues into account and involve manufacturers, retailers and consumer associations when these can play a decisive role. The use of social innovations and innovative technologies (e.g. smart meters/appliances/ICT) should be considered when it brings added value. More fundamental activities aimed at a better understanding of consumers' and other stakeholders' perception, motivation and behaviour are part of the scope (e.g. understanding of product labels and building certificates) provided their results can directly lead to improvements in the effectiveness of consumer-driven initiatives.

Expected impact: Bigger market share of the most energy-efficient products (from the highest energy class) and/or of high quality renewable energy products. For example, each million € of EU support in energy efficiency actions is expected to deliver annual energy savings of around 10% for at least 5,000 households[15] (around 8 GWh/year of savings[16]). In any case

[12] Ballu, M. & Toulouse, E. (2010) Energy savings in practice. Potential and delivery of EU ecodesign measures.

[13] Crossley, D. J. (1983) Identifying barriers to the success of consumer energy conservation policies. *Energy*, 8, 533-546.

[14] Bertoldi, P., Hirl, B. & Labanca, N. (2012) Electricity consumption and efficiency trends in the EU-27.

[15] Energy savings in this order have been achieved in former IEE projects (e.g. ACHIEVE, EC-LINC, Energy Neighbourhoods, Eco n'Home).

projects should demonstrate significant impacts in terms of number of people changing their behaviour and taking informed investment decisions.

Type of action: Coordination and support action (100%)

EE 10 - New ICT-based solutions for energy efficiency

Specific Challenge: to motivate and support citizen's behavioural change to achieve greater energy efficiency taking advantage of ICT (in particular gaming and social networking) while ensuring energy savings from this new-ICT enabled solutions are greater than the cost for the provision of the services.

Scope: the focus should be on the creation of innovative IT ecosystems that would develop services and applications making use of information generated by energy consumers (e.g. through social networks) or captured from sensors (e.g. smart meters, smart plugs). These applications range from Apps for smart phones and tablets to serious games to stimulate consumers' participation in the market. The proposed solutions should be deployed and validated in real life conditions in publicly owned buildings (including administrative offices, social housing) and buildings in public use or of public interest. Validation should provide socio-economic evidence for ICT investment in the field and include detailed plans for sustainability and large-scale uptake beyond the project's life time.

Specific attention should be also given to development and testing of 'cleanweb' solutions, which not only bring opportunities for consumers, but also represent a promising investment field.

Specific attention should be given to development and testing of 'cleanweb' solutions, which not only bring opportunities for consumers, but also represent a promising investment field.

Expected impact: Systemic energy consumption and emissions reduction between 15% and 30%. Accelerate wide deployment of innovative ICT solutions for energy efficiency. Greater consumer understanding and engagement in energy efficiency.

Type of action: Research and Innovation action (70% Funding, Prizes)

EE 11 – 2014: Socioeconomic research on energy efficiency

Specific Challenge: Energy efficiency is playing a growing role in local, national and European policy development. It is a complex issue spanning different disciplines like engineering and social sciences. To formulate long-term strategies and define cost-effective policies, policy makers need to better understand the macroeconomic impacts of energy efficiency, the influence of consumer behaviour and the implications of trends in society and technologies.

Scope: Foresight socio-economic activities informing the debate on the development of energy efficiency strategies, taking a forward looking approach to the horizon 2030 and beyond. Projects may also research the multiple benefits of energy efficiency or look at the evolution of social, economic, cultural and educational barriers. They may also study major trends in society and their implications or advance knowledge of consumer behaviour. They can either adopt a cross-sectorial approach or be specific to certain relevant sectors. Projects may feed the development of energy efficiency strategies, policies and programmes at all

[16] Considering 1.46 toe of energy consumption per capita and per year and an average household size of 2.4 capita, as indicated in Bertoldi et al. 2012 (quoted above).

governance levels. They should take into account gender issues and build on existing macroeconomics models as well as on the results of socio-economic sciences and humanities. A specific priority will be given to the development of micro-economic analysis of the updated energy efficiency measures.

Expected impact: Positive impact on energy efficiency policy development, evidenced for instance by their reference into impact assessments, strategy papers or other policy documents.

Type of action: Research and innovation action (100% funding)

B – Heating and cooling

EE 12 – 2014/15: Technology for district heating

Specific Challenge: District heating and cooling systems need to be more efficient and cheaper. It is necessary to develop and deploy intelligent systems exploiting multiple energy resources, including waste heat recovery, cogeneration and renewable energy integration, and to roll-out solutions for the integration of intelligent thermal network with smart electricity grids.

Scope: Project proposals should address one or more of the following areas:

- Develop, demonstrate and deploy a new generation of highly efficient, intelligent DH systems which are capable of integrating multiple efficient generation sources, including cogeneration, waste heat from industrial or other sources and storage. Such systems might combine hybrid technologies to improve the overall efficiency; with be compatible and connected with intelligent electricity and gas networks; and utilize surplus electricity from the grid. Such systems should be compatible with and capable of integration with low-energy buildings, including nearly zero energy buildings (low-temperature district heating).
- *Bring down heat distribution losses* through the use of innovative pipe design, high performance insulation materials and reduced operating temperatures.

Expected Impact:

- Reduce the energy consumption of space and water heating 30 to 50% from today's level.
- Contribute to wider use of intelligent DH systems and integration of waste

Type of action: Research and innovation action (100% funding)

EE 13 - 2014/15: Removing market barriers to the uptake of efficient heating and cooling solutions

Specific challenge: Action is needed to set the right market conditions, to exploit the full potential of district heating/cooling and address the major bottlenecks. This involves the integrated planning and integration of heating/cooling into the territorial context, adaptation and compatibility/connectivity with low energy building standards, inclusion of

heating/cooling in building renovation strategies and empowerment of consumers through innovative metering, billing and complaint handling processes.

Scope: Project proposals should focus on one or more of the following areas:

- *Individual heating and cooling:* Innovative measures to accelerate the replacement of old, inefficient fossil fired space heaters and packaged cooling systems with products having A+++ to A+ energy labels. The replacement should not lock out energy savings from other energy measures in the rest of the building/system. In the case of cooling, activities should take into account the phase-out of refrigerants with high ozone-depletion potential.
- *Inspection of heating and cooling systems*: support for the implementation of inspection in heating and cooling systems as indicated in Articles 14 and 15 of the EPBD. This includes actions using monitoring and ICT as ways to reduce the need for physical inspections. Actions could also support the provision of advice to users as well as monitoring the results of advice as an alternative to inspections and monitoring.
- *For industrial heating/cooling*:
    - deploy effective heating/cooling solutions in industry that integrate demand and supply.
    - contribute to identifying, developing, and promoting new markets for the recovery of heat from industry by putting stakeholders together, including activities aiming at supporting public acceptance of waste heat recovery projects.
    - exchange of information and knowledge.
- *Energy supply systems*[17]: Projects should lead to the opening up of new markets for the most efficient large, medium or small scale systems. They should build on experience from existing best practice examples. Projects could address the development implementation of: a) support and incentive schemes, b) organisational, managerial and business innovative models and c) new regulatory frameworks and codes that lead to substantial growth and improved transparency. Projects could include activities improving the performance of existing systems, or as an example to encourage further use of these technologies.
- *For DH/cooling industry:* develop good practice, licensing criteria, efficiency benchmarks and consumer protection codes to improve the transparency of the market and increase consumer trust. Ensure exchange of information and knowledge using best practice examples.

Consortia should include or engage with the relevant market actors such as industry (equipment and fuel suppliers), installers, real estate developers, public authorities, energy services companies, designers and end user groups / consumer associations.

Expected Impact: More favourable market conditions for efficient heating and cooling solutions and opening up of new markets.

[17] Energy supply system: high efficiency co-generation (large, small and micro) and efficient district heating and cooling. Such systems may use waste heat or renewable energy sources. Conventional fuels should not be excluded, but waste heat and RES should be encouraged.

Every million € of EU support should in the short term lead to the reduction of at least 30 GWh/yr of fossil fuels for heating and cooling. Significant impacts should also be measured in terms of investment made by stakeholders in sustainable energy; number of policy makers influenced; number of people with increased skills; or number of people changing their behaviour.

Type of action: Coordination and support action (100% funding)

C - Industry and products

To deliver innovative, affordable and applicable technologies for energy efficiency in the process and manufacturing industry, Public-private partnership SPIRE and Public-private partnership Factories of the Future (FoF) established under the H2020's LEIT Pillar will channel its call towards a range of predominantly technology-related energy efficiency R&D topics. For SPIRE, topics will include improved downstream processing, methodologies and tools for cross-sectorial sustainability assessment of energy and resource efficient, new adaptable catalytic reactor methodologies for process intensification and energy and resource management systems for improved efficiency. The FoF topics will include manufacturing processes for complex structures and geometries with efficient use of material and global energy and other resources in manufacturing enterprises.

This call will complement the call of the SPIRE and FoF with both technology-related, and (mostly) non-technology related topics focusing on removal of existing barriers through market uptake measures to build capacity, provide support for sustainable energy policy implementation and foster uptake of technologies relevant for energy efficiency in industry.

EE 14 – 2014/15: Ensuring effective implementation of EU product efficiency legislation

Specific challenge: Full implementation of the EU product efficiency legislation would be one of the most important contributions to the EU energy efficiency target. The Ecodesign Directive alone would yield yearly savings of up to 600 TWh of electricity and 600 TWh of heat in 2020, as well as net savings for European consumers and businesses of €90 billion per year – 1% of EU's current GDP – in year 2020 (meaning net savings of €280 per household per year)[18]. Previous initiatives have illustrated the need and relevance of market surveillance activities[19]. However to ensure full implementation of product efficiency legislation, previous initiatives have illustrated the need and relevance to improve market surveillance activities.

Scope: Proposals should focus on building up the monitoring, verification and enforcement of the EU's energy-related products policy, in particular for those products that represent the highest energy saving potential (e.g. electric motors, water and space heating and cooling equipment, lighting). Projects should support higher level of surveillance activities and go beyond product testing activities. They should not replace activities that are under the

[18] Molenbroek, E. Cuijpers, M. & Blok, K. (2012) Economic benefits of the EU Ecodesign Directive. Improving European economies.

[19] e.g. by testing the pan-EU compliance of energy-related products (see http://www.eaci-projects.eu/iee/page/Page.jsp?op=project_detail&prid=2613) with the legal requirements.

responsibility of Member States[20] but add European value to these activities (e.g. execution of joint activities, exchange of information, development of common methods, protocols or checklists, etc.). Actions must involve the relevant market surveillance authorities and consumers' associations as appropriate, and demonstrate a high transnational added value.

Expected impact: for market surveillance projects every million Euro of EU support is expected to generate savings of at least 15 GWh/year of energy losses avoided from non-compliance[21]. In addition, projects should result in an increase of confidence among purchasers, manufacturers and retailers. They should also contribute to the enforcement of EU product legislation.

Type of action: Coordination and support action (100% funding)

EE 15 – 2014/15: Organisational innovation to increase energy efficiency in industry

Specific challenge: Between 2000 and 2010, energy efficiency in industry has on average improved by 1.3% per year[22]. However by using existing cost-effective energy solutions, the industry sector could further reduce its consumption by at least 13%[23], thus gain in competitiveness and save nearly 40 Mtoe a year. Obtaining larger savings in industry can also be achieved by introducing new affordable intelligent energy solutions that secures uptime in production chains.

Scope: Activities should focus on removing market barriers, in particular the lack of expertise and information on energy management. Proposals should primarily address the uptake of cross-cutting innovative technologies, such as energy efficient electric motor driven systems and steam/hot water generation, because these represent 75% of the potential savings in industry[24], as well as total-site energy management schemes to identify saving potentials and monitor progress. Projects should put in place mechanisms to secure funding for energy efficiency investments and facilitate the continuation of the activities beyond the project lifetime**.** Energy-intensive industries should be prioritised as they account for 70% of industrial energy use.

The following areas or their combination are also eligible for funding:

- *Industrial systems efficiency benchmarking*: Devise methods and tools including ICT to compare and benchmark the energy performance of industrial systems, processes and develop guidelines for tailored measures, in particular in energy-intensive industries.
- *Development of sector-specific technology pathways* towards 2050 to target the most energy-intensive industrial sectors
- *Energy management in SMEs and industry*: Improve the availability of skilled energy auditors and energy managers and the diffusion of energy management systems and

[20] Article 18 of Regulation (EC) N°765/2008, article 3(2) of the Ecodesign Directive 2009/125/EC, and article 3 of the Labelling Directive 2010/30/EU.

[21] Conservative estimate based on the study from Paul Waide (Navigant), quoted above.

[22] Odyssee-MURE project (http://www.odyssee-indicators.org/)

[23] http://www.isi.fraunhofer.de/isi-media/docs/e/de/publikationen/BMU_Policy_Paper_20121022.pdf

[24] Although this might depend on the industrial sector. Electric motors, for example, might be embedded in process-specific machines.

best practices. Develop instruments to ensure availability of updated, comprehensive and usable information on energy efficiency relevant for industries.

Expected impact: for capacity building projects, every million Euro of EU support is expected to increase the skills of hundreds of people working in the sector, resulting in savings of at least 30 GWh per year. All projects should demonstrate a significant impact in terms of improved competitiveness; larger investments made by stakeholders in sustainable energy; primary energy savings; better implementation of energy-efficiency policies; number of policy makers influenced; number of people with increased skills; and/or number of people changing their behaviour.

Type of action: Coordination and support action (100% funding)

EE 16 – 2015: Development and demonstration of energy-efficient products, processes and services by SMEs

Specific challenge: Many energy-related products are designed and produced by small and medium size enterprises (SMEs). Even in a field like lighting which is dominated by large companies for the production of light sources, SMEs have an important role to play to develop components such as ballasts and luminaires. SMEs can also come up with innovations in the field of intelligent control systems and accessories to optimize energy use. Furthermore SME's have the potential to exploit information and communication technologies or new models of energy contracting to offer innovative services that are both competitive and reduce energy consumption. These services can give them access to new markets or new clients and result in higher profits. However SMEs lack resources for the assessment of the technological and commercial potential of their project, for research and demonstration work, and for moving towards commercialisation.

Scope: The SME instrument consists of three separate phases and a coaching and mentoring service for beneficiaries. Participants can apply to phase 1 with a view to applying to phase 2 at a later date, or directly to phase 2.

In phase 1, a feasibility study shall be developed verifying the technological/practical as well as economic viability of an innovation idea with considerable novelty to the industry sector in which it is presented (new products, processes, services and technologies or new market applications of existing technologies). The activities could, for example, comprise risk assessment, market study, user involvement, Intellectual Property management, innovation strategy development, partner search, feasibility of concept and the like to establish a solid high-potential innovation project aligned to the enterprise strategy and with a European dimension. Bottlenecks in the ability to increase profitability of the enterprise through innovation shall be detected and analysed during phase 1 and addressed during phase 2 to increase the return in investment in innovation activities.

In phase 2, innovation projects will be supported that address the above specific challenge and that demonstrate high potential in terms of company competitiveness and growth underpinned by a strategic business plan. Activities should focus on innovation activities such as demonstration, testing, prototyping, piloting, scaling-up, miniaturisation, design, market replication and the like aiming to bring an innovation idea (product, process, service etc) close to deployment and market introduction, but may also include some research. For technological innovation a Technology Readiness Levels of 6 or above (or similar for non-technological innovations) are envisaged.

In addition, in phase 3, SMEs can benefit from indirect support measures and services as well as access to the financial facilities supported under Access to Risk Finance of this work programme.

Successful beneficiaries will be offered coaching and mentoring support during phase 1 and phase 2. This service will be accessible via the Enterprise Europe Network and delivered by a dedicated coach through consultation and signposting to the beneficiaries. The coaches will be recruited from a central database managed by the European Commission and have all fulfilled stringent criteria with regards to business experience and competencies. Throughout the three phases of the instrument, the Network will complement the coaching support by providing access to its innovation and internationalisation service offering. This could include, for example, depending on the need of the SME, support in identifying growth potential, developing a growth plan and maximising it through internationalisation; strengthening the leadership and management skills of individuals in the senior management team and developing in-house coaching capacity; developing a marketing strategy or raising external finance.

Expected impact:

- Enhancing profitability and growth performance of SMEs by combining and transferring new and existing knowledge into innovative, disruptive and competitive solutions seizing European and global business opportunities.
- Market uptake and distribution of innovations tackling the above specific challenge in a sustainable way.
- Increase of private investment in innovation, notably leverage of private co-investor and/or follow-up investments.
- The expected impact should be clearly described in qualitative and quantitative terms (e.g. on energy efficiency gains, energy savings, turnover, employment, market seize, IP management).
- A strong focus should be on impacts in terms of reduction of energy consumption

Type of action: SME Instrument (70% funding)

The special conditions related to this topic are provided along with the general conditions for this call.

EE 17 – 2015: Driving energy innovation through large buyer groups

Specific challenge: Buyers of energy-related products can foster innovation by specifying energy performance levels that are higher than the best levels available on the market. The larger the group of buyers, the higher is the potential market and therefore the greater is the interest of manufacturers to meet these ambitious product specifications and deliver new more energy-efficient products. This market-transformation tool, commonly referred to as 'technology procurement', has been applied successfully to a few products such as copiers, electric motors and cold appliances but it could be applied to many more energy-related products if more buyers knew how to use it.

Scope: Actions whereby groups of buyers (e.g. retailers) are established and together set higher-than-available performance levels which manufacturers of sustainable energy products are called to meet through product innovation. Products should represent a large potential for meeting the EU energy policy targets and have the potential for a large market demand. Buyer groups should be large and influential and/or composed of market leaders. Technical specifications should be ambitious but achievable without large investments in research and development. It is important that the technology procurement process is associated with

communication activities to encourage manufacturers to participate and to make their results more visible.

Projects addressing the procurement of products that already exist on the market should be submitted under the priority on public procurement.

Expected Impact: New energy-using or -producing products with at least 25% better performance than best available products. Improved competitiveness of manufacturers. Creation of influential buyer groups able to transform the appliances market.

Type of action: Coordination and support action (100% funding)

D - Finance for sustainable energy

EE 18 – 2014/15: Improving the financeability and attractiveness of sustainable energy investments

Specific challenge: Suboptimal level of investments in sustainable energy (in particular energy efficiency) is linked to a lack of trust of investors and financiers in the financial viability of sustainable energy measures, lack of capacity of the public and private sector in their structuring, and the lack of large-scale successful flagship projects. New bank capital requirements[25] have decreased banks´ lending capacity and willingness to invest in the sustainable energy sector, still deemed by many to be risky.

The financial sector needs to be drawn to develop new financing products and practices that can respond to the constraints of the market.

Scope: Project proposals and activities should foster dialogue with and between financial market actors, standardisation and valuation entities, industry, public authorities, consumers and property owners. They should lead to development of new business models and financial products, ensuring synergies of public and private finance.

- Proposals focusing on the development of frameworks for standardisation and benchmarking of investments, such as labelling and standardisation of sustainable energy investments / portfolios, or valuation techniques integrating the 'green value' of buildings. Proposals integrated in a broader approach such as socially responsible investment or “green buildings” should focus on the energy component.
- Proposals targeting public institutional investors (e.g. public or semi-public pension schemes) in order to increase the share of their funds invested into sustainable energy, or to develop specific funds or investment products.
- Proposals aiming to create EU and national sustainable energy financing platforms to organise dialogue with the relevant stakeholders and (among others) develop roadmaps, propose improvements in the legal frameworks and develop template documents and contracts leading to better understanding of the retail energy market fundaments.

Expected impact: Reduced uncertainty, increased investors' confidence, trust towards and reliability of energy efficiency investments. Valuation methodologies agreed by the market.

[25] Basel III

Standardised descriptions of sustainable energy investments or measures/contracts. Labelling schemes or harmonised frameworks for sustainable energy investments. National strategies for financing sustainable energy investments.

Type of action: Coordination and support action (100% funding)

EE 19 – 2014/15: Project development assistance for innovative bankable and aggregated sustainable energy investment schemes and projects

Specific challenge: Significant efforts are required to mobilise all relevant stakeholders, carry out investment inventories, develop appropriate property valuation techniques, feasibility studies, financial engineering instruments, and to address legal and procurement issues.

In this context, it is necessary to support project promoters through dedicated project development assistance facilities and capacity building and thus demonstrate the viability and positive impacts of large-scale, sustainable energy investments.

Scope: Project development assistance support will be provided to public and private project promoters such as public/private infrastructure operators, retail chains, cities and SMEs/industry, leading to innovative, bankable and aggregated sustainable energy investment schemes and projects. The support will be conditional to mobilized investments. The focus should be on public and private buildings, retail energy market infrastructures, commercial and logistic properties and sites. The major objective of supported projects will be to demonstrate the financial viability and sustainability of large-scale sustainable energy investments. Proposals must have a lighthouse dimension as well as deliver organisational innovation in the mobilisation of the investments and/or the financial approach. Single country applications are eligible, but proposals must also include a clear action plan to communicate across Europe towards potential replicators. Further, supported project will be required to participate in the monitoring and evaluation exercise run by the Commission (see part B for details).

Project development assistance activities implemented through this topic will be complemented by the continuation of the ELENA facility[1] implemented by the EIB (see part B of the WP for details).

Expected impact: Development of credible pipeline of bankable large-scale projects and financial schemes and display of innovative financing solutions, leading to improved investor confidence. Every million € of H2020 support is expected to trigger investments worth at least €15 million.

Type of action: Coordination and support action (100% funding)

EE 20 – 2014/15: Development and market roll-out of innovative energy services and financial schemes for sustainable energy

Specific challenge: The public sector has an exemplary role to play (in particular as regards the management of public assets) in addressing the market deficiencies[26] by setting the stable

[1] www.eib.org/elena.

[26] Energy Efficiency Plan, 2011 (COM(2011)109 final) and Energy Efficiency Directive 2012/27/EU

regulatory environment and engaging in dialogue with the key stakeholders to improve the legal and financial framework and to put in place innovative financing schemes. However, the deployed public funds have to be matched and multiplied by the private sector capital, to address the financing gap.

The energy services industry together with the financial sector also needs to develop new business models in order to better monetise future energy savings and tackle new sectors to reach its potential turnover of some EUR 25 billion per year[27].

Scope:

- Projects focusing on the roll-out of business models for innovative energy efficiency services (e.g. energy performance contracting), enabling to fully monetise the resulting energy savings
- Projects replicating successful innovative financing solutions already implemented across the EU as well as successful innovative energy services. Particular attention should be given to innovative solutions enabling aggregation, securitisation, project bundling, structuring of clearing houses, or developing new investment mechanisms (e.g. crowd-funding for sustainable energy).
- Projects implementing large-scale capacity building for public authorities and SMEs to set-up or use innovative financing schemes for sustainable energy.

Expected impacts: Every million Euro of EU support invested into the relevant activities is expected to deliver savings of at least 25 GWh/year. All projects should demonstrate a significant impact in terms of larger investments made by stakeholders in sustainable energy; primary energy savings; generated renewable energy; better implementation of energy-efficiency policies; number of policy makers influenced; number of people with increased skills; and/or number of people changing their behaviour.

Type of action: Coordination and support action (100% funding)

[27] JRC 2007, EEP

CALL FOR COMPETITIVE LOW-CARBON ENERGY

H2020-LCE-2014/2015

One of the major challenges Europe will face in the coming decades is to make its energy system clean, secure and efficient, while ensuring EU industrial leadership in low-carbon energy technologies.

To help achieve such ambitious objectives, this Focus Area aims to develop, and accelerate the time to market of, affordable, cost-effective and resource-efficient technology solutions to decarbonise the energy system in a sustainable way, secure energy supply and complete the energy internal market, in line with the objectives of the Strategic Energy Technologies Plan (SET-Plan)) and of the related energy legislation (notably the Renewable Energy Directive) and energy policies designed to deliver the 2020 targets and to shape energy market frameworks for 2030 and 2050.

The scale and ambition of research and innovation needed requires enhanced cooperation between all stakeholders, including the EC, Member State administrations at national, regional and local levels, the industry, the research community and society at large.

The EU is committed to reduce its greenhouse gas emissions 20 % below 1990 levels by 2020, and intends a further reduction to 80-95 % by 2050. In addition, renewables should cover 20 % of final energy consumption in 2020, and a large part of it by 2050, as identified in the Energy roadmap 2050. A reduction of at least 60% of GHGs by 2050 with respect to 1990 is required from the transport sector, while by 2030, the goal for transport will be to reduce GHG emissions to around 20% below their 2008 level.

Time is pressing. The solutions that will be developed and rolled out to the market in the next ten years will form the backbone of the energy system for the many years ahead. Besides, the energy system needs to evolve to accommodate, among others, much higher levels of integration of renewable energy. It is essential that energy market stakeholders from both the public and private sectors should understand, accept and implement market up-take measures and procedures cost-effectively at national, regional and local levels. It is also important for society to understand the existing challenges and the implications of their possible solutions, so as to build confidence amongst investors and to ensure sustained public acceptance.

LCE 1 - 2014: New knowledge and technologies

Specific challenge: The technologies that will form the backbone of the energy system by 2030 and 2050 are still under development. Promising technologies for energy conversion are being developed at laboratory scale and need to be scaled up in order to demonstrate their potential value in our future energy system. These new technologies should provide the flexibility to the energy system to adapt to changing climatic conditions. Therefore, new knowledge and more efficient and cost-competitive energy technologies, including their supply chains, are required for the long term. It is crucial that these new technologies show evidence of promising developments and do not represent a risk to society. Developments in sectors other than energy may provide ideas, experiences, technology contributions, relevant knowledge, new approaches, and skills that are of relevance to the energy sector. Cross-fertilisation of the sector could therefore offer mutually beneficial effects.

Scope: Activities will focus on accelerating the development of transformative energy technologies or enabling technologies that have reached TRL2, and which are not covered by the other topics in this call. The proposals should bring the proposed technology solutions from TRL 2 to TRL 3-4. A multidisciplinary approach bringing expertise from different

scientific disciplines and/or different technological sectors (other than energy or within different areas of energy), in order to cross traditional boundaries is expected to bring forward these game-changer technologies. Innovative solutions and their supply chains such as materials and advanced manufacturing will also be supported as long as the application is clearly energy. Activities should also focus on the early identification and clarification of potential problems (for example environmental, resource efficiency aspects and safety issues), or concerns to society, and on the definition of a targeted and quantified development roadmap. Proposals should also indicate the current Manufacturing Readiness Level (MRL) and the activities needed to keep the MRL aligned with the future advances in the TRL of the technology solution proposed to ensure the potential for exploitation.

Novel technology solutions for grid integration, storage, fuel cells and hydrogen, energy efficiency and smart cities will not be supported under this topic but in the relevant parts of this work programme.

Expected impact: The results are expected to move the technology to higher TRL and to provide better scientific understanding and guidance enabling the players concerned (e.g. policy makers, regulatory authorities, industry, interest groups representing civil society) to frame strategic choices concerning future energy technologies to integrate them in the future energy system. It is also expected that new, out-of-the-box or advanced innovative ideas will emerge that will provide new impetus to technology pathways, to new solutions, and to new contributions to the energy challenge.

Type of action: Research & Innovation Action (100% funding)

Renewable electricity and heating/cooling

Renewables should cover 20% of the final energy consumption in 2020 and a large part of the final energy consumption in Europe by 2050 as identified in the Energy roadmap 2050. In this context, Europe has been witnessing a significant growth in the contribution of renewable energy sources to the overall energy mix, fostered through the Renewable Energy Directive, the internal market and the infrastructure package. In addition, the requirements of the EU's Energy Performance of Buildings Directive (2010/31/EU) for future net zero-energy buildings is expected to be a major driver in opening the market for novel renewable energy applications in the residential sector. However, to sustain this growth and achieve the EU energy and climate change targets, and to ensure EU industrial leadership in low-carbon energy technologies, thereby contributing to growth and jobs in Europe, energy security and affordability, and global GHG emissions reduction, a number of important challenges need to be solved:

a) Technology performance needs to increase further, resulting in a decrease of the cost of renewable energy production in order for renewable energy to be attractive in the market and cover a large part of the final energy consumption by 2050.

b) Resource efficiency needs to be addressed taking a life-cycle perspective.

c) In order to increase the performance of the energy system as a whole, the particular renewable energy conversion device or renewable energy system will have to address a number of enhancements in delivering energy to the increasingly smarter grid.

d) Renewable energy technology supply chains and manufacturing processes able to compete globally need to be developed and consolidated.

Each market will establish its own, optimum mix of renewables solutions based on, inter alia, geography, geology, weather conditions, market acceptance, public support schemes, accessible industrial capabilities, and pricing conditions. The purpose of this topic is to assist in readying technologies, the associated business cases, and industry for these markets and consider all supply-side issues of relevance, including the evolving requirements of the grids.

Each area of renewables has its own challenges, potential, history, level of maturity, risks, and competitive situation that requires specific and considered approaches. SET-Plan priorities together with the derived technology roadmaps from the European Industrial Initiatives and the foreseen Integrated Roadmap provide further guidance for the development of all of the renewables potential. The Energy Challenge will strive to provide an appropriate support to all new and existing renewable energy sources over the framework programme period, but not everything in every year.

A broad portfolio of activities covering different renewable energy technology areas will be supported taking into account potential as well as targeted efficiency, performance, and costs. In addition, elements of industrial competitiveness and security of supply will be considered.

In order to ensure that a balanced portfolio of activities covering different renewable energy technology areas will be supported, the share of the EU contribution benefitting one single technology area shall not exceed 25% of the budget for the present topic.

The overall approach is to develop a pipeline of research and innovation from basic research (addressed in LCE 1), technology development (addressed in LCE 2), technology demonstration and supply-side market readiness (addressed in LCE 3), demand-side market up-take (LCE 4), as well as support for first market replication of renewable energy plants with appropriate strategies in each area.

LCE 2 – 2014/15: Developing the next generation technologies of renewable electricity and heating/cooling

Specific challenge: Complementing the global challenges outlined above, the following technology-specific challenges have to be addressed in 2014:

a. **Photovoltaics**: *Developing next generation high performance PV cells and modules* – Highly efficient PV technologies based on innovative approaches to better match the solar spectrum or modifying the solar spectrum need to be developed. The challenge is to bring practical performance close to theoretical limits.

b. **Concentrated Solar Power** (CSP): *Making CSP plants more cost competitive* – Reducing the construction, operation and maintenance costs of CSP plants is the main challenge. Innovative solutions and concepts are necessary in order to increase plant performance and reduce cost through improved components, improved plant operation, and innovative plant configurations.

c. **Wind energy**: *Substantially reduce the costs of wind energy* - There is a need for i) control strategies and systems for new and very large rotors ii) innovative integrated offshore systems with a significant lower mass; and iii) new innovative substructure concepts, including floating platforms, to reduce production, installation and O&M costs for water depths of more than 50m.

d. **Ocean energy**: *Develop emerging designs and components* – In order to ensure efficient and effective long term cost reduction as well as achieve high levels of reliability and survivability for at least 20 years in harsh conditions innovative designs and components are needed.

e. **Hydro power**: *Boosting peak power through sustainable hydropower* – Existing hydropower stations need refurbishment and this opportunity should be used to modernise the power plants, with new improved turbines having a more robust design allowing higher heads to increase power output.

f. **Geothermal energy**: *Development of new drilling technologies and concepts for geothermal energy* – New drilling technologies and concepts are necessary to increase the number of economically viable geothermal resources, including in hard rock and high temperature/pressure conditions, and have a demonstrably smaller environmental footprint by comparison to existing drilling methodologies. Cross-fertilisation with hydrothermal oil and gas technologies and operations shall be explored.

g. **Renewable Heating and Cooling**:

   i. *Solar cooling systems* [possible contribution to SPIRE] – Solar cooling systems reliability remains uncertain causing high installation and operation costs and hampering acceptance. Innovative solutions are needed to reduce the complexity of the installation, to improve components performance and reliability, and to ensure cost.

   ii. *Improving efficiency of biomass heating and CHP systems while widening the feedstock base* – Micro and small-scale CHP have a high potential for heat and electricity production for decentralized applications. Cost effective and environmentally friendly micro and small-scale CHP with high electrical efficiency need to be developed allowing the use of solid (e.g. wood chips), liquid (pyrolysis oil) or gaseous (e.g. biogas or syngas) sustainable biomass feedstock.

For 2015, the following technology-specific challenges have to be addressed:

a. **Photovoltaics**: *Developing super-low-cost PV cells and modules* – Proposals are requested to develop super-low-cost concepts either reducing constraints on the demand on natural resources (low material use) or using low cost materials, while having efficient manufacturing processes of cells and of modules. Proposals are also requested to explore innovative applications.

b. **Concentrated Solar Power** (CSP): *Improving the environmental profile of the CSP technology* – CSP plants rely on water for cleaning the reflecting surfaces, for power generation and for cooling. Innovative solutions are needed to significantly reduce or replace the water consumption while maintaining the overall efficiency of the CSP plants, and limiting their environmental impacts.

c. **Wind energy**: *Substantially reduce the costs of wind energy* - There is a need for i) control strategies and systems for new and very large rotors ii) innovative integrated offshore systems with a significant lower mass; and iii) new innovative substructure concepts, including floating platforms, to reduce production, installation and O&M costs for water depths of more than 50m.

d. **Ocean energy**: *Ensure efficiency and effective long term cost reduction and high levels of reliability and survivability* - There is a need to gather, at full scale experience in open sea operating conditions, performance data of emerging wave and tidal energy convertor designs and components. For the overall development cycle a better resource assessment is needed as well., .

e. **Hydro power**: *Increasing flexibility of hydropower* – Hydropower is still amongst the largest sources of renewable energy. The challenge is however to make hydropower in the >100MW range available in a time as short as possible. New technologies need to

be developed to allow start-stop-cycles to reach up to 30 per day depending on head and volume.

f. **Geothermal energy**: *Testing of enhanced geothermal systems in different geological environments* – Widespread deployment of enhanced geothermal systems (EGS) needs new and improved models and innovative solutions are needed to routinely create EGS reservoir with sufficient permeability, fracture orientation and spacing. Cross-fertilisation with hydrothermal fields and cross-fertilisation with tight oil and gas fields shall be explored.

g. **Renewable Heating and Cooling**:

   i. *Solar heating for industrial processes [possible contribution to SPIRE]* – The potential benefit of using solar heat above 250°C in industrial processes has been already acknowledged. Innovative concepts, processes and technologies for these applications are needed which can be easily integrated into existing industrial plants and processes.

   ii. *Improving efficiency of biomass heating and CHP systems while widening the feedstock base* – Boilers can combust only one type of feedstock (e.g. wood chips, wood pellets). New flexible residential-scale boilers allowing the use of a wider range of sustainable feedstock with high ash content (up to 5%) such as agricultural residues, new biocommodities (e.g. pyrolysis oil and torrefied biomass) and industrial by-products need to be developed.

Note: Research and innovation on biofuels for production of pyrolysis oil and torrefied biomass may be addressed under XXX whereas biomass mobilisation and logistics under XXX or in the BRIDGE PPP.

Technological innovation related to the integration of renewable generation in the industrial and residential sectors can be addressed in the Energy Efficiency call or Smart Cities and Communities call. Improving the energy efficiency of district heating and cooling networks is addressed in the Energy Efficiency call.

Scope: Proposals should address one or more of the respective sub-challenges described above, including between renewables areas, where new, innovative ideas are welcome. They should bring technology solutions to a higher TRL level, from TRL 3-4 to 4-5 (see Annex).

Issues of grid interface, synergies between technologies (including those for storage), regional approaches, socio-economic and environmental aspects from a life-cycle perspective (including public acceptance, business cases, pre-normative and legal issues, pollution and recycling) need to be appropriately addressed where relevant.

Environment, health and safety issues shall be considered in all developments and appropriately addressed.

An important element for the entire area of renewables will be the need for an increased understanding of risks in each area, (whether technological, in business processes, for particular business cases, or otherwise), risk ownership, and possible risk mitigation. Proposals shall therefore include appropriate work packages on this matter.

Proposals shall explicitly address performances and costs targets together with relevant Key Performance Indicators, expected impacts, as well as provide explicit exploitation plans. Proposals should also indicate the current Manufacturing Readiness Level (MRL) and the activities needed to keep the MRL aligned with the advances in the TRL that will be undertaken in the proposal to ensure the potential for exploitation.

Expected impact: The projects are expected to have one or more of the general impacts listed below:

- Significantly increased technology performance.
- Reducing life-cycle environmental impact.
- Making variable renewable electricity generation more predictable and grid friendly and thereby allowing larger amounts of variable output renewable sources in the grid.
- Bringing cohesion, coherence and strategy in the development of new renewable energy technologies.
- Nurturing the development of the industrial capacity to produce components and systems and opening of new opportunities.
- Strengthening the European industrial technology base, thereby creating growth and jobs in Europe.
- Reduce renewable energy technologies installation time and costs.
- Increasing the reliability and lifetime while decreasing operation and maintenance costs.

Type of action: Research & Innovation Action (100% funding)

LCE 3 – 2014/2015: Demonstration of renewable electricity and heating/cooling technologies

Specific challenge: Complementing the global challenges outlined above, the following technology-specific challenges have to be addressed in 2014:

a. **Photovoltaics**: *Accelerating the development and time to market of the EU Inorganic Thin-Film (TF) technology* – Inorganic TF technologies offer new application possibilities and additional benefits, such as flexibility, low weight, partial transparency, short energy pay-back time, and integrated manufacturing. To fully benefit from these, however, TF technologies need to achieve higher module efficiencies of up to 20% while reducing costs of manufacturing and utilising materials better.

b. **Wind energy**: *Substantially reduce cost of wind energy* - There is a need for i) demonstration and testing of new nacelle and rotor prototypes, with a significant lower mass and material intensity and applicable to several types of large-scale wind turbines; ii) demonstration of innovative bottom-fixed substructure concepts for water depths of 30 to 60m capable of reducing costs; and iii) demonstration of innovative floating wind turbine concepts.

c. **Ocean energy**: *Demonstration of ocean energy technologies* - Demonstrate advanced full scale devices in order to gain further understanding and certainty over installation, operations and decommissioning costs, as well as of high levels of reliability and survivability.

d. **Renewable Heating and Cooling / Geothermal energy**: *Improved vertical borehole drilling technologies to enhance safety and reduce costs [possible contribution to SPIRE]* – Shallow geothermal energy systems are ideally suited to meet the ambitious energy saving targets of the European Union. They can provide heating and/or cooling or both. Further improvement of the efficiency of shallow geothermal systems and

reduction of installation costs are needed to increase deployment of these geothermal systems for the heating & cooling market.

In 2015, the following technology-specific challenges have to be addressed:

a. **Photovoltaics**: *PV integrated in the built environment* – Building integrated photovoltaic (BIPV) systems will become essential elements in future net zero energy buildings, provided a number of challenges are solved, e.g. integration with other functional building components, flexibility in system design and standardisation, smart interaction with the grid, extension of the lifetime of system components, and cost reduction.

b. **Concentrated Solar Power** (CSP): *Improving the flexibility and predictability of CSP power generation* – The major asset of the CSP technology is to be able to produce predictable power, which provides the flexibility to adapt the demand from the grid. Only a few CSP technologies allowing this predictability have reached commercial maturity. The challenge is to demonstrate solutions that can significantly improve the dispatchability of CSP plants.

c. **Wind energy**: *Substantially reduce cost of wind energy* - There is a need for i) demonstration and testing of new nacelle and rotor prototypes, with a significant lower mass and material intensity and applicable to several types of large-scale wind turbines; ii) demonstration of innovative bottom-fixed substructure concepts for water depths of 30 to 60m capable of reducing costs; and iii) demonstration of innovative floating wind turbine concepts..

d. **Ocean energy**: *Demonstration of ocean energy technologies* - Demonstrate advanced full scale devices in order to gain further understanding and certainty over installation, operations and decommissioning costs, as well as of high levels of reliability and survivability.

Note: Technological innovation related to the integration of renewable generation in the industrial and residential sectors can be addressed in the Energy Efficiency call or Smart Cities and Communities call. Improving the energy efficiency of district heating and cooling networks is addressed in the Energy Efficiency call.

Scope: The proposals should address one or more of the specific challenges described above bringing the proposed technology solutions to a higher TRL level, aiming at "demonstration" of those solutions, accompanied, where appropriate, by support research activities and activities targeting market uptake. The proposals should bring the proposed technology solutions from TRL 5-6 to TRL 6-7 (see Annex).

Environment, health and safety issues should be considered in all demonstrations and appropriately addressed.

An important element for the entire area of renewables will be the need for an increased understanding of risks in each area, (whether technological, in business processes, for particular business cases, or otherwise), risk ownership, and possible risk mitigation. Proposals shall therefore include appropriate work packages on this matter.

Proposals shall explicitly address performances and costs targets together with relevant Key Performance Indicators, and expected impacts. Industrial involvement in the consortium and explicit exploitation plans are a prerequisite. Therefore, all proposals will have to include a work package on 'the business case' of the technology solution being addressed. This work package has to demonstrate the business case of the technology solution and has to identify potential issues of public acceptance, market and regulatory barriers including standardisation needs, financing and other supply-side issues of relevance. It should also address, where

appropriate, synergies between technologies (including those for storage), regional approaches and other socio-economic and environmental aspects from a life-cycle perspective (e.g. pollution and recycling). The current Manufacturing Readiness Level (MRL) and the activities needed to keep the MRL aligned with the advances in the TRL that will be undertaken in the proposal to ensure the potential for exploitation should also be indicated.

Opening the project's test sites, pilot and demonstration facilities, or research infrastructures for practice oriented education, training or knowledge exchange is encouraged.

Expected impact: The projects are expected to have one or more of the general impacts listed below:

- Bringing costs of renewable energy down by increasing technology performance, installation time and costs, decreasing of operation and maintenance costs, and increasing reliability and lifetime.
- Reducing life-cycle environmental impact.
- Making variable renewable electricity generation more predictable and grid friendly and thereby allowing larger amounts of variable output renewable sources in the grid.
- Nurturing the development of the industrial capacity to produce components and systems and opening of new opportunities.
- Strengthening the European industrial technology base, thereby creating growth and jobs in Europe.

Type of action: Innovation Action (70% funding)

LCE 4 – 2014/2015: Market uptake of existing and emerging renewable electricity, heating and cooling technologies[28]

Specific challenge: The legal framework established by the Renewable Energy Directive (2009/28/EC) sets binding targets for all Member States to contribute to the overall 20% target for renewable energy in EU final energy consumption by 2020, and the 'Energy Roadmap 2050' shows that renewables will have to play a much greater role in all future scenarios beyond 2020. As well as putting in place legal obligations, the RES Directive also makes recommendations for specific actions to be taken by the public and private sectors across the EU. However, in many areas, it leaves open the ways in which Member States may implement policies and support measures aiming to increase use of renewable energy at national, regional and local levels.

Consequently, although some Member States have already made good progress in incentivising renewable energy, there are still many opportunities for common learning and sharing of best practices on the cost-effective mobilisation of new investments in renewable energy across the EU. Moreover, such investments contribute to the European 2020 strategy for growth, job creation, industrial innovation, and technological leadership as well as reducing emissions, improving the security of energy supplies and reducing EU's energy import dependence.

Since the adoption of RES Directive in 2009, most Member States have experienced significant growth in renewable energy consumption. However, currently, we are seeing a

[28] Market uptake measures for all types of bioenergy are dealt with under LCE 17.

deceleration of this growth , partly due to the economic crisis, but also because there are a number of market uptake barriers that remain or persist for both established and innovative renewable energy technologies.

Scope: To ensure the level of growth needed to deliver the EU targets for renewable energy, and to create the appropriate business environment for EU industrial leadership in low-carbon energy technologies, a number of important market-uptake challenges still need to be addressed, notably:

- Ensuring sustained public acceptance of renewable energy projects and renewable energy overall, while taking into account the implications of the substantial increase in RES share in the final energy consumption;
- Ensuring speedy and user friendly permitting procedures;
- Implementing renewable energy policies, codes and legislations at EU, national, regional and local levels in a coordinated manner using best practice examples with significant replication potential;
- Capacity building and contributing to the further development of renewable energy policy, legislation and regulation, and informing the debate on post 2020 horizons;
- Capacity building and facilitating the deployment of improved business models and innovative financing schemes for mobilising investments in innovative and established renewable energy systems and services.

Proposals should address one or several of the sub-challenges mentioned above for technologies and systems which are at TRL 7-9. Regional specificities, socio-economic and environmental aspects from a life-cycle perspective shall be considered. For all actions, the consortia should involve and/or engage relevant stakeholders and market actors who are committed to adopting/implementing the results.

For RES electricity, actions which address exchanges of information or cooperation among different actors (e.g. on future business models for aggregators), must demonstrate that they are promoting best practices. Actions which are developing new recommendations (e.g. for RES planning at cross-border / multi-regional level), or which are contributing to the debate on costs and benefits of specific options must provide quantified indicators of the market impacts of future policy options.

For RES heating and cooling, proposals must demonstrate that they are adopting an integrated approach which fully respects the requirements and recommendations given in the energy efficiency and EPBD directives. Actions aimed at promoting the use of geothermal, bio and/or solar heating for individual or district heating applications must involve / engage with the responsible policy makers and regulators as well as industry and potential financing bodies, and must include relevant capacity building and adoption of best practices.

Expected impact: Increasing the share of renewable electricity, heating and cooling in the final energy consumption. Reductions in the time taken to authorise the construction of renewable electricity plants and related grid infrastructure. Substantial and measurable reductions in the transaction costs for project developers as well as for the permitting authorities, whilst still fully addressing the needs for environmental impact assessments and public acceptance. Development of better policy, regulatory, market support and financing frameworks, including at regional and local level.

Type of action: Innovation Action (70% funding)

Modernising the single European electricity grid

The fast growing share of variable and/or decentralised renewable generation requires a fast adaptation of the grid, both on a European and local level.

The new grid needs to include flexibility, capacity demand response and active user involvement (managing the complex interactions among millions of active consumers and micro-generation). The new integrated energy market be achieved through the integration of balancing opportunities offered by generation, demand response and storage at different levels and scales.

Particular technology challenges are posed by the urgently needed development of offshore grids in the Northern Seas and electricity highways, by the integration of a fast increase of variable RES supply and by stronger variations in the demand.

New business models will be needed to develop new market architectures and rules and provide the information, services, and privacy guarantees. They support open markets for energy products and services and activate the participation of consumers and new market actors (e.g. aggregators) in energy markets and system balancing while ensuring a fair sharing of the newly generated benefits, including the citizens.

SET-Plan priorities together with the derived technology roadmap from the European Industrial Initiative and the foreseen Integrated Roadmap provide further guidance for the development of the potential of grid technologies and their integration.

The integration of the latest generation of information and communication technologies and services is expected to play a key role in planning, optimisation, monitoring, control, etc. R&D on new generic ICT should be covered through the LEIT part of the programme.

LCE 5 – 2014: Meshed off-shore grids in the Northern Seas

Specific challenge: Regulation 347/2013 on guidelines for trans-European energy infrastructure identifies Northern Seas off-shore grids among the energy infrastructure priority corridors. Its design, development and deployment includes technical, financial, management, regulatory and policy viewpoints.

The first commercial projects have implemented point-to-point connections, point-to-point and multi-terminal deep off-shore grids. Meshed off-shore grids linking several wind parks with on-shore grids in different countries and with other available generation resources are urgently required to provide additional flexibility, efficiency, security and market access to off-shore wind resources. Its deployment is delayed through a number of barriers: lack of agreement among operators and manufacturers on architectures, control structures and interfaces to ensure interoperability and multi-vendor compatibility of equipment, lack of market rules and revenue streams allowing the build-up of a suitable financial package, permitting and environmental compatibility, and operation and management of these grids from legal, technical and market point of view.

Initial technology elements leading to meshed off-shore grids shall first be trialled at full scale as additions to planned off-shore projects (cables and hubs). Appropriate mechanisms to cover risks and potential losses to the commercial operation of these underlying projects shall be investigated.

Scope: The projects shall prepare the first phase for deployment of innovative components of interoperable meshed off-shore HVDC network technologies, services and tools architectures (bring them from TRL 7 to TRL 8 with a path to TRL9 in follow-up projects).

Projects shall include also a part to develop the appropriate policy, regulatory and financial framework. The project shall include a focused and short part to seek agreement among network operators and major equipment suppliers on a technical architecture and on a set of multi-vendor interoperable technologies.

The project shall be seen as a "phase one" project; therefore it shall include a compulsory plan that clearly defines all the actions needed to lead towards "phase two" leading to full commercial operation ideally before 2020. Consortia shall include a limited number of key partners from manufacturers, TSOs, and wind farm operators, and shall cooperate also with relevant regulators and authorities.

Expected impact: The projects are expected to cover all the general impacts listed below:

- Accelerating the deployment of meshed HVDC off-shore grids, with particular emphasis on the Northern Seas, before 2020.
- Ensuring plug-and-play compatibility of all equipment of the key suppliers.
- Preparing for corresponding priority infrastructure projects identified under the trans-European energy infrastructure regulation.
- Facilitating the efficient connection of off-shore wind resources to on-shore loads and with other available generation resources for balancing, covering the main 7 Northern Seas countries (ideally seven or more).

Type of action: Coordination and Support Action (100% funding)

LCE 6 – 2014: Transmission grid and wholesale market

Specific challenge: Demonstration and R&D are needed in interoperable technologies, services, tools, system integration, co-ordination schemes, business models, cost-benefit analyses, market architectures and rules and regulatory regimes to plan, build, monitor, control and safely operate end-to-end networks across national borders.

Scope: Integrating and validating solutions to grid challenges, concentrating on field demonstration of system integration, up-scaling at industrial scale and supporting R&D. Preparing first replication of the solutions in different contexts and/or countries. Appropriate market models, business cases, user and general public acceptance, regulatory, market up-take (e.g. regulatory issues, capacity building and access to finance), social, environmental and resource efficiency aspects should be included. Opening up demonstration facilities for targeted practice-oriented education and training is encouraged.

The priorities for demonstration projects are focussed on:

- Demonstration and validation of emerging power and ICT technologies to increase transmission network flexibility, capacity and operational security
- Demonstration of new approaches to the wholesale electricity markets
- Demonstration of integration of active demand response connected at distribution level to operations at distribution and transmission levels.
- Market-uptake studies need to be integrated into the demonstration projects. Potential risk of lock-in effects of early deployment should be taken into account. A particular aspect is the sharing of approaches and experiences with smart metering systems, novel ICT tools or innovative business models.

- Societal research needs to be integrated into the market uptake part. Societal research shall address concerns about data security, public acceptance and ensure that citizens see the clear financial benefit.

Particular priority elements for R&D include:

- Joint modelling and simulation of power systems and the underlying ICT infrastructure.
- Methods and tools for grid asset maintenance and management to mitigate the costs of grid maintenance, replacement, upgrade and development in the presence of very large share of renewable generation, also taking demand response into account.
- Advanced architectures and tools for pan-European markets for ancillary services and balancing; Integration of advanced power electronics technologies into subsystems that enhance available network capacity and flexibility

Expected impact: The projects are expected to:

- Opening up the deployment of solutions for improving flexibility and available capacity of European electricity grids at high voltage levels to integrate renewable and other new electricity producers and users, while managing their balancing and maintaining or enhancing service quality, reliability and security of the power system.
- Demonstrate advanced grid technologies and system architectures and further developing the competitiveness of European industries.
- Devising new market architectures and business models, disseminating effective architectures and models across Europe, demonstrating the infrastructures, processes and information management to develop the active participation of demand, and new players in energy markets.
- Mitigating capital and operational costs of the grid modernisation required for the energy transition, and minimising environmental impact.
- Better using scarce resources by maximising the up-scaling and replication of lessons learned from demonstration projects in Europe and by sharing of knowledge and practices.
- Better coordination among activities promoted by Member States and at European level.

Type of action: Innovation Action (70% funding); Research & Innovation Action (100% funding)

LCE 7 – 2015: Distribution grid and retail market

Specific challenge: Demonstration and related R&D are needed in system integration, services, tools, co-ordination schemes, business models, cost-benefit analyses, market architectures and rules and regulatory regimes to plan, build, monitor, control and safely operate end-to-end networks. Smart Grids and smart metering require the support from an ICT infrastructure with stringent requirements on e.g. availability and low latency. Different options are possible, in particular whether to exploit as much as possible the "public" telecommunication infrastructure and its future developments, or whether to develop specific telecommunication infrastructure to cover parts of the architecture. In both cases, important investments need to be made. There is no conclusive analysis of the various options and

whether dual-use of telecommunication networks would allow savings for consumers versus deploying a parallel infrastructure.

Scope: Integrating and validating solutions to grid challenges concentrating on field demonstration of system integration and supporting R&D. Preparing first replication of the solutions in different contexts and/or cities integrating retail markets, demand response, new business models, advanced ICT. Appropriate market models, business cases, user and general public acceptance, regulatory, market up-take (e.g. regulatory issues, capacity building and access to finance), social, environmental and resource efficiency aspects should be included. Opening up demonstration facilities for targeted practice-oriented education and training is encouraged.

Preparing the development of the next generation ICT infrastructure for smart metering and smart grids, analysing capital costs, operational costs, business models and benefits of different options. The analysis has to be done in the context of the present regulatory frameworks (both for energy and telecommunications) in the EU Member States.

The demonstration priorities are focussed on:

- Demonstration of proof-of-concept of technical, market, and social aspects of methods and technologies for the processing and exploitation of smart metering data
- Incorporation of a substantial increase of micro-generation and local renewable generation within the local grid
- Validation intelligent active control, active loads (demand response) and eventually distributed storage in a secure and economic way.
- Demonstration of new solutions to improve low voltage network monitoring and control.
- Deployment of innovations in the electricity grids to lower the cost of novel ICT tools, smart metering and smart grids deployment and to respond in a timely way to the challenges facing grid operators and users.
- Demonstration projects shall include a part of market uptake measures accelerating the implementation of new policies, market rules, legislation and/or incentives schemes, which will reduce the overall costs of supplying renewable electricity to end users and facilitate the transport of higher fractions of renewable electricity across EU electricity grids.
- Societal research needs to be integrated into the market uptake part. Societal research shall address concerns about data security, public acceptance and ensure that citizens see the clear financial benefit.

Expected impact: The projects are expected to:

- Opening up the deployment of solutions for improving flexibility and available capacity of European electricity grids at medium and low voltage levels to integrate renewable and other new electricity producers and users, while managing their balancing and maintaining or enhancing service quality, reliability and security of the power system.
- Demonstrate advanced grid technologies and system architectures and further developing the competitiveness of European industries.
- Devising new market architectures and business models, including through aggregators, demonstrating the infrastructures, processes and information to develop

the active participation of prosumers, demand response and new players in energy markets.

- Mitigating capital and operational costs of the grid modernisation required for the energy transition, and minimising environmental impact, thus ensuring lower electricity prices for all. New benefits be generated; these benefits be shared in a fair way between all actors, including the citizens.
- Better using scarce resources by maximising the up-scaling and replication of lessons learned from demonstration projects in different Member States and by sharing of knowledge and practices.
- Accelerating the implementation of new policies, market rules, legislation and/or incentives schemes for smart grids infrastructure
- Accelerating the deployment of innovations in the electricity grids to lower the cost of smart metering and smart grids deployment and to respond in a timely way to the challenges facing grid operators and users in view of the agreed 2020 objectives.
- Enabling an open market for services deployment.

Type of action: Innovation Action (70% funding)

Providing the energy system with flexibility through enhanced energy storage technologies

With the rapid growth of the share of electricity produced by variable renewable sources, the need of storage increases significantly if other flexibility alternatives for the grids will not be sufficient or too expensive. Storage is not an aim in itself; it is one new link of our very complex energy chain. Therefore all close-to-market projects should address this complex integration including the wholesale or retail markets, societal problems, novel business models, regulatory, legal or energy policy aspects. The aim of all projects is to ensure that storage finds its right place in the energy system of the future, with very large shares of variable Renewables on both sides of the energy chain, with a growth of our electricity consumption and a more dynamic variation of the future demand.

Storage is the only solution for reducing the curtailment of excess renewable electricity production.

However, present energy storage makes limited business sense as wholesale and retail markets do not reward all services that storage can provide (the markets only reward the supply of kWh).

Today energy storage systems make limited business sense; existing storage systems see their profits fading and start to be closed down. One of the main reasons is the fact that energy storage is not rewarded for providing flexibility, security or ancillary services.

The prospects for profitable storage operation further suffer from fragmented and in some cases impending regulation in different Member States.

Energy storage includes:

direct electricity storage (electricity in - electricity out).

or indirect electricity storage (electricity in - heat or cold or gas or other energy vectors out).

Integration of direct and indirect storage and other technologies providing flexibility

In the case of local storage, it is desirable to include the interaction between the electricity grid and the application or a district heating/cooling network, CHP, micro-generation, local renewables and to include the most advanced ICT for optimising the whole system from a technical, demand response and financial point of view.

R&D activities addressing enhanced performance of chemical storage with hydrogen is not in the scope of this activity area

Activities addressing thermal storage with no interaction with the electricity grid will be supported in the Energy Efficiency focus area.

LCE 8 – 2014: Local / small-scale storage

Specific challenge: This topic will aim to progress energy storage and reduce the barriers associated with new storage concepts integrated into the distribution grid and at building/house level.

Scope: Activities should focus on integrating solutions that reached already TRL 5 to TRL 6 and above. This includes anticipation of potential market and regulatory issues with due consideration to the social, socioeconomic aspects and improved models to demonstrate energy storage systems.

The direct/indirect storage must take into account grid interfaces and synergies between electricity, heating/cooling and final applications when they enable a clear benefit to be validated in this context. When appropriate, synergies between technologies could be used.

The priority is:

- Demonstration and validation of electrochemical and other storage technologies that are connected with low voltage substations or variable distributed electricity generation or in individual houses. This would include community storage systems in residential areas or storage in industrial parks. The activities should include issues on safety, socioeconomic and business models.
- Demonstration and validation of compact electricity-grid connected heat and cold storage systems with enhanced performance. This would include integrated systems with e.g. heat pumps and/or micro CHP or the integration of existing heating/cooling grid storage with the electricity grid.
- Demonstration projects shall include market uptake measures for integrating energy storage in the electricity network and power system management

Expected impact: The projects are expected to:

- Demonstrate the technical and economic synergy between local storage, smart grid management, demand response and their integration with advanced ICT.
- Demonstration of the integration of storage services in network management, particularly exploiting storage with electronic interfaces to facilitate the integration and back-up of highly variable renewable generation and dispersed demand response.
- Increase the grid security and stability, and reduce grid congestion e.g. through appropriate integration with ICT tools for the control and management of electricity networks.
- Cover a wider use of storage technologies in the energy system through validation of solutions with reduced cost, increased efficiencies, and lower environmental impact.
- Increase competitiveness of European industries in the area of energy storage.

- Reduce energy costs for all, including for end users.
- Significantly reduce barriers for high penetration rates of distributed energy resources (e.g. micro-generation) and variable renewable energy.
- Accelerating innovation and business models for deployment of storage at local level.
- Deferred investment for grid reinforcements and lower societal costs associated with high penetration of distributed variable renewable energy resources.

The impacts are expected to be linked to either energy balancing or improved grid congestion management at local level.

Type of action: Innovation Action (70% funding)

Additional information: This topic addresses stationary storage; integration of electric vehicles in the grid are covered in other calls.

LCE 9 – 2015: Large scale storage

Specific challenge: The Demonstration activities in this topic will aim to progress energy storage and reduce the barriers associated with new storage concepts. An important market uptake challenge is to reduce the barriers (technological, economic, regulatory, acceptance, etc.) associated with the deployment of existing or new storage concepts.

Scope: Activities should focus on storage systems that reached already TRL 5 and bring them at least to TRL 6-7. This would include anticipation of potential market and regulatory issues with due consideration to the socioeconomic aspects and improved models to demonstrate energy storage systems.

Activities should pursue direct electricity or indirect storage. The activities must take into account grid interfaces and synergies between electricity, storage and final applications when they enable a clear benefit to be validated in this context. When appropriate, synergies between technologies could be used.

The priorities are demonstration and validation of:

- pumped hydro storage in new locations such as underground storage concepts, storage using seawater or similar concepts addressing large scale applications aiming at GW scale
- storage with compressed air, liquid air, and similar concepts aiming at the GW scale
- integrated management of existing or retrofitted pumped hydro storage (with variable pumps/turbines) also across national borders (e.g. smart grid concepts across alpine (or other) borders and enclosing many existing facilities)
- Linking such storage projects with the development of the Northern Seas grid concepts may be envisaged.

Demonstration projects should include market uptake measures for integrating energy storage in the electricity network and power system management. They shall focus on a limited set of specific issues that currently prevent an up-scaling or the realization of the concept. They should also include research on environmental, economic, legal, societal and public acceptance issues and recommendations for future energy policy by the industrial stakeholders involved. These results should be compared with the results of research oriented projects on the same or similar topics.

Organising targeted practice-oriented education and training activities at the project's pilot or demonstration facilities is encouraged.

Expected impact: The projects are expected to cover the general impacts listed below that are relevant for the proposed demonstration:

- A wider use of storage technologies in the energy system through validation of solutions with reduced cost, increased efficiencies, and lower environmental impact.
- Increased competitiveness of European industries in the area of energy storage.
- Significantly reduced barriers for high penetration rates of variable renewable energy.
- Energy cost reduction, including for end users.
- Reducing the need for curtailment of wind
- integration with ICT tools for the control and management of electricity networks
- Additional services for increased renewable energy integration provided through energy system actors

The impacts are expected to be linked to either energy balancing or improved grid congestion management at transmission level.

Type of action: Innovation Action (70% funding)

LCE 10 – 2014: Next generation technologies for energy storage

Specific challenge: The R&D activities in this topic will aim to develop new or improved storage technologies with higher performance, availability, durability, performance, safety and lower costs.

Economic modelling for use of energy storage technologies needs to be enhanced. Generally, energy storage has to progress in the innovation chain so that the barriers associated with new storage concepts are reduced. This would include adaptation of new materials and developments for improved safety.

Scope: Activities should focus on developing the next generation of storage technologies by bringing them from TRL 2 or above towards TRL 5. They cover storage technologies of all sizes relevant to energy applications and all types of locations.

The activities need to take into account grid interfaces and, when appropriate, use synergies between technologies. Research should also address environmental, economic and public acceptance issues or develop recommendations for future energy policy.

Expected impact: The R&D projects are expected to cover the general impacts listed below that are relevant for the proposed R&D:

- Enlarging the portfolio of effective storage technologies with potential for European wide usage.
- Lowering the cost, increasing the efficiency and durability, lower the environmental impact and reducing location constraints on energy storage systems.
- Contributing to solutions for high penetration rates of distributed energy resources and intermittent renewable energy.
- Energy cost reduction, including for end users.
- Increased grid security and stability, e.g. through appropriate integration with ICT tools for the control and management of electricity networks.

- The impacts are expected to be linked to either large scale energy balancing or improved grid congestion management or self-consumption at local level.

Type of action: Research & Innovation Action (100% funding)

Sustainable biofuels and alternative fuels for the European transport fuel mix

Renewables should cover 10% of the final energy consumption in transport in 2020. Decarbonising the transport sector is a major challenge in the Energy Roadmap 2050. This can be achieved by several means, notably through the electrification of the transport sector, or the use of alternative, non-fossil fuels.

In the long-term perspective, electrification or hydrogen and fuel cells can provide solutions to the decarbonisation of the transport sector. However, certain sub-sectors such as aviation, and to lesser extent heavy duty road and maritime transport, will still rely on fuels that should be produced from sustainable, non-fossil feedstock.

Bioenergy will play a crucial role in the achievement of the overall 2020 targets. It currently provides more than 2/3 of the renewable energy in the EU, and is expected to account for more than half the EU's renewable energy in 2020 and for about 11% of the total EU energy consumption. However, actions are still needed to foster the development of this key sector and to ensure its sustainability.

LCE 11 – 2014/2015: Developing next generation technologies for biofuels and sustainable alternative fuels

Specific challenge: Europe has scarce biomass resources to cope with an increased demand for fuels and other uses. Thus, in the long-term perspective, new technologies of sustainable fuels need to be developed that radically improve the state-of-art, notably in regards to the following sub-challenges:

- Reducing the constraints related to feedstock supply, e.g. through improved resource-efficiency, enlargement of the biomass feedstock basis, or through use of new, renewable and sustainable feedstock from non-biomass sources;
- Improving the economic, environmental and social benefits, notably regarding cost reduction, minimisation of demand on natural resources (land and water in particular), GHG abatement and development of rural areas;

Scope: Proposals focusing on the long-term perspective should aim at developing the next wave of alternative and sustainable fuels by moving technologies from TRL 3-4 or to TRL 4-5. In each case, they should address the sub-challenges described above.

Environment, health and safety issues shall be considered in all developments and appropriately addressed.

An important element will be an increased understanding of risks, (whether technological, in business processes, for particular business cases, or otherwise in each area), risk ownership, and possible risk mitigation. Proposals shall therefore include appropriate work packages on this matter.

Proposals shall explicitly address performances and costs targets together with relevant Key Performance Indicators, expected impacts, as well as provide explicit exploitation plans. Proposals should also indicate the current Manufacturing Readiness Level (MRL) and the activities needed to keep the MRL aligned with the advances in the TRL that will be undertaken in the proposal to ensure the potential for exploitation.

Opening the project's test sites, pilot and demonstration facilities, or research infrastructures for practice oriented education, training or knowledge exchange is encouraged.

Expected impact: The new developed technology pathways should permit the use of new feedstock sources, or a more efficient use of the current ones. A significant cost reduction potential is also expected, that would permit these fuels to compete favourably with fossil or older-generation equivalent fuels. The development of new technologies will permit robust and reliable assessment of the environmental and social benefits with respect to current technologies, notably in terms of GHG savings, better use of natural resources and job creation in rural areas, as well as secure and affordable energy supply.

Type of action: Research & Innovation Action (100% funding)

LCE 12 – 2014/2015: Demonstrating advanced biofuel technologies

Specific challenge: In the short-term and medium-term perspective, due to the limited distribution infrastructure of the electrification option, biofuels are expected to be the main contributors to this transport de-carbonisation. In order to achieve the EU targets regarding renewable energy in transport (set out in the RES and Fuel Quality Directives), and to address concerns regarding indirect and direct environmental impacts of biofuels, new and advanced biofuels using sustainable feedstock need to reach the market. To this end, the following sub-challenges should be addressed:

- Proving that advanced biofuels technologies, as identified in the Roadmap of the European Industrial Bioenergy Initiative (EIBI), are technically and economically feasible, as well as environmentally and socially sustainable, at commercial scale.
- Developing logistic systems for a sound and sustainable feedstock supply.

Scope: Proposals should address the medium-term challenges for market penetration of advanced biofuels as presented above. In each case, they should address one of the respective sub-challenges, or a combination of them. They should bring technology solutions to a higher TRL level, in line with the Implementation Plan of the European Industrial Bioenergy Initiative (EIBI)[29].Proposals shall aim at moving technologies that reached already TRL 5-6 to TRL 6-7 through industrial demonstration projects.

Environment, health and safety issues should be considered in all demonstrations and appropriately addressed.

An important element for the entire area of renewables will be an increased understanding of risks, (whether technological, in business processes, for particular business cases, or otherwise in each area), risk ownership, and possible risk mitigation. Proposals shall therefore include appropriate work packages on this matter.

Proposals shall explicitly address performances and costs targets together with relevant Key Performance Indicators, expected impacts. Industrial involvement in the consortium and explicit exploitation plans are a prerequisite.

All proposals have to include a work package on 'the business case' of the technology solution being addressed. That work package has to demonstrate the business case of the technology and identify potential issues of public acceptance, market and regulatory barriers,

[29] http://setis.ec.europa.eu/set-plan-implementation/european-industrial-initiatives-eiis/eii-implementation-plans . Note that an eligibility criterion sets a **minimum bioenergy content**: at least **70%** of the bioproducts produced by the plant shall be bioenergy (biofuels, heat, power) calculated on energy basis.

including standardisation needs. It should also address, where appropriate, synergies between new and existing technologies, regional approaches and other socio-economic and environmental aspects from a life-cycle perspective.

The current Manufacturing Readiness Level (MRL) and the activities needed to keep the MRL aligned with the advances in the TRL that will be undertaken in the proposal to ensure the potential for exploitation should also be indicated.

Opening the project's test sites, pilot and demonstration facilities, or research infrastructures for practice oriented education, training or knowledge exchange is encouraged.

Expected impact: Testing advanced biofuel technologies at large industrial scale reduces the technological risk associated to these, paving the way for a subsequent first-of-a-kind, commercial-scale industrial demonstration project. For this purpose, the scale of the projects should permit obtaining the data and experience required so that a first-of-a-kind, commercial-scale industrial demonstration project can be envisaged as a next step. The industrial concepts demonstrated should have the potential for a significant social and economic impact, notably in terms of job creation, economic growth and safe and affordable energy supply.

Type of action: Innovation Action (70% funding)

Note: Some research challenges for biomass feedstock could better be addressed under the call of Societal Challenge 2: Food security, Sustainable Agriculture, Marine and Maritime Research and the Bioeconomy. Proposers are advised also to consult the work programme of the BRIDGE JTI.

LCE 13 – 2015: Partnering with Brazil on advanced biofuels

Specific challenge: Decarbonising the transport sector is a major challenge in the global fight against climate change. As such, it is a crucial element in the EU Energy Roadmap 2050 and [to be completed with reference to Brazilian regulations / policy initiatives].

In the short-term and medium-term perspective, biofuels are expected to be the main contributors to this de-carbonisation. In order to achieve the EU [and Brazil] policy targets in this domain, and to address concerns regarding indirect and direct environmental impacts of biofuels, new and advanced biofuels using sustainable feedstock need to reach the market.

Brazil is an essential partner in this sector: it has outstanding expertise, a well-established and highly competitive first-generation industry, as well as optimal conditions for the development of an advanced biofuel industry.

Hence in the framework of the EU-Brazil S&T Cooperation Agreement, the European Commission representing the European Union (EC) and the Ministry of Science and Technology (MCT) of the Government of Brazil, are working together to benefit from the complementarities in research and innovation, in order to foster the development of advanced biofuels and accelerate their commercialisation both in Brazil and in Europe.

Scope:

The following sub-challenges should be addressed:

- Exploiting synergies between Brazil and Europe in terms of scientific expertise, industrial capacity and resources.

- Proving that advanced biofuels technologies are technically and environmentally feasible, cost competitive and environmentally and socio-economically sustainable at commercial scale.
- Developing or improving logistic systems for a sound and sustainable feedstock supply.

Proposals should address the first bullet point mentioned above, and at least one of the other two. They should bring technology solutions to a higher TRL level.

Proposals should aim at moving technologies that reached already TRL 5-6 to TRL 6-7 (see annex) through industrial demonstration projects, which may include supporting R&D activities if needed.

All proposals have to include a work package on 'the business case' of the technology solution being addressed. That work package has to demonstrate the business case of the technology and identify potential issues of public acceptance, market and regulatory barriers, including standardisation needs. It should also address, where appropriate, synergies between new and existing technologies, regional approaches and other socio-economic and environmental aspects from a life-cycle perspective.

Expected impact: Testing advanced biofuel technologies at pre-commercial industrial scale reduces the technological risk associated to these, paving the way for a subsequent market replication. For this purpose, the scale of the projects should permit obtaining the data and experience required so that a first market replication can be envisaged as a next step. The industrial concepts demonstrated should have the potential for a significant social and economic impact, notably in terms of job opportunities and wealth creation in rural areas of Brazil or Europe. Clear environmental benefits should also be obtained.

Projects should appropriately exploit the complementarities between the EU and Brazil, and pave the way for significant enhancement in the cooperation between key researchers, institutions and industries that are active in biofuel research and innovation in the EU and Brazil.

Type of action: Innovation Action (70% funding)

Additional eligibility criterion: Proposals which do not include coordination with a Brazilian project will be considered ineligible. Therefore, the EC proposals must unambiguously identify the coordinated Brazilian proposal to be submitted to the Brazilian authorities, and include a detailed description of this proposal.

Additional selection criterion: Proposals will be only selected under the condition that the corresponding coordinated project is also selected for funding by the Brazilian authorities.

Additional information: Discussions with the Brazilian authorities are still on-going. Details of the topic will be confirmed once discussions have been finalised.

LCE 14 – 2014/2015: Market uptake of existing and emerging sustainable bioenergy[30]

Specific challenge: Bioenergy will play a crucial role in the achievement of the 2020 targets: it currently provides more than 2/3 of the renewable energy in the EU, and is expected to account for more than half the EU's renewable energy in 2020 and for about 11% of the total

[30] In the context of this topic, the term bioenergy covers raw or transformed biomass, biogas, biofuels (gaseous or liquid) and bioliquids.

EU energy consumption. However, actions are still needed to foster the development of this key sector and to ensure its sustainability (Renewable Energy progress Report [COM(2013)175]). Decarbonising the energy (heat, electricity and transport) sector is a major challenge in the Energy Roadmap 2050. One way to do it is to use more and sustainable biofuels, biomass and bioliquids. However, the EU needs to expand the supply of bioenergy produced in the EU, by transforming the EU farmers to producers of food, feed and energy.

In the short-term and medium-term perspective, bioenergy in all its forms is expected to be the main contributor to this de-carbonisation. In order to achieve the EU targets set out in the RES and Fuel Quality Directives, and to address concerns regarding indirect and direct environmental impacts, sustainable bioenergy technologies (both existing and emerging) need to further penetrate in the market.

Scope: The following market uptake sub-challenges should be addressed:

- Setting up or strengthening sustainable local bioenergy supply chains complying with sustainability criteria and quality standards;
- Ensuring development and / or implementation of quality and sustainability standards for bioenergy in all its forms;
- Creating a market for intermediate bioenergy carriers to enable better technology competitiveness through economies of scale;
- Provide European farmers with incentives to produce bioenergy alongside food and feed, by transforming the agricultural policy to serve also the renewable energy objectives.
- Development of methodologies for the traceability of biomass from which bioenergy is produced (e.g. to distinguish first-generation from advanced biofuels);
- Removing barriers to widespread production and use of biogas/biomethane as one of the most sustainable fuels available today for use in transport and for incorporation into the grid;
- Ensuring sustained public acceptance of sustainable advanced biofuels;
- Regulation, policies and, where appropriate, support schemes specific to biofuels need to be implemented in Member States in a coordinated manner using the best practices of the forerunning Member States.
- Cooperation between different policy areas at national / regional level (e.g. energy, agriculture, environment, waste, transport, etc.) needs to be increased to optimise the regulatory framework and implementing measures for the bioeconomy;
- All Member States must possess the necessary capacity to enact the EU legislation, while the businesses must make full use of the opportunities that these new markets create for them. Therefore specific capacity building activities targeting the main stakeholders (e.g. biomass suppliers and users, decision makers, financial institutions, auditors and verification bodies) are needed.
- Tailored financing schemes for supporting investments in innovative and established bioenergy technologies must be implemented, and the most successful schemes replicated.

Proposals should address one or several of the bullet points mentioned above using technologies and systems which are already at TRL 7-9. Regional specificities, socio-economic and environmental aspects from a life-cycle perspective shall be considered.

Expected impact: Increasing the share of sustainable bioenergy in the final energy consumption. Substantial and measurable reductions in the transaction costs for project developers as well as for the permitting authorities, whilst still fully addressing the needs for environmental impact assessments and public acceptance. Development of better policy, market support and financial frameworks, notably at national, regional and local level.

Type of action: Innovation Action (70% funding)

Enabling the sustainable use of fossil fuels in the transition to a low-carbon economy

LCE 15 – 2014/2015: Enabling decarbonisation of the fossil fuel-based power sector and energy intensive industry through CCS

Specific challenge: The EU is committed to an overall reduction of greenhouse gas emissions of at least 80% by 2050. Nonetheless, fossil fuels will continue to be used in Europe's power generation as well as in other industrial processes for decades to come. Therefore, the 2050 target can only be achieved if the emissions from fossil fuel combustion are eliminated from the system. This will require the application of Carbon Capture and Storage (CCS). The assessments made in the context of the EU's Roadmap for the transition to a competitive low carbon economy in 2050 and the Energy Roadmap 2050 see CCS as an important technology contributing to decarbonisation scenarios in the EU, with 7% to 32% of power generation using CCS by 2050. The application of CCS to industrial sectors other than power (e.g. steel, cement, refining) is expected to deliver half of the global emissions reduction from CCS by 2050. In the near future, these industrial applications will open up new opportunities and avenues for CCS that can accelerate its deployment. For all applications, the demonstration of CO2 storage is of major importance. Therefore, two key challenges in the short-term for driving CCS to deployment are geological storage and the industrial application of CCS.

Scope: Proposals should address one of the respective key challenges as presented above, or a combination of them. Focus should be on progressing technologies that already reached TRL 4-5 to TRL 6-7. For geological storage, projects should enable, under "real life" conditions, the development and demonstration of best practices for the entire storage cycle, from site characterisation to operation, monitoring and mitigation/remediation of leakage, and including education and training. Knowledge sharing as well as early and sustained engagement of the local community is essential. Collaboration activities between EU project(s) under this topic and non-EU projects (e.g. from Australia and/or North-America) will be encouraged. For industrial applications, projects should aim at integrating CCS technology in the best possible way so as to optimise the use of heat in the capture process, minimise process efficiency losses, achieve a suitable CO2 purity for transport and storage, and maintain the quality of the industrial end product. Piloting under realistic conditions is required to significantly lower the energy penalty and capture costs. Collaboration with industrial end users is essential. Knowledge sharing as well as early and sustained engagement of the local community is essential.

Expected impact: Demonstration of safe and environmentally sound CO2 storage will play a key role in optimising the safe operation of storage sites and in fine-tuning regulatory issues, in promoting confidence in CO2 storage and building public awareness of CCS. The cost- and resource-effective application of CCS in industrial processes, including bio-CCS, will expand the available options for CCS and provide a stepping stone to its wider deployment. Demonstration projects should contribute to accelerating the development and deployment of CCS through an enhanced and effective cooperation in research and innovation between various stakeholders and Member States, thereby allowing a more efficient use and stronger leverage of financial resources and promoting knowledge sharing.

Type of action: Research & Innovation Action (100% funding)

LCE 16 – 2014: Understanding, preventing and mitigating the potential environmental impacts and risks of shale gas exploration and exploitation

Specific challenge: Gas shales have a very low porosity and permeability, and have to be fractured pervasively to create high-permeability pathways for the gas to migrate towards the wells. The fracturing process is subject to discussion, as it requires the injection of large amounts of water and chemicals, a part of which are eventually brought back to the surface. There are also concerns that the fractures may cause natural gas to leak into shallower aquifers that are used for drinking water supplies. In addition, the fracturing process can cause microseismicity, which - when felt at the surface - may give rise to public concerns. The most imminent challenge for shale gas extraction is therefore to address the associated environmental concerns, in particular through a better understanding and monitoring of the fracturing process and its environmental effects (including in the long term), treatment and recycling of flow-back and produced water, and mitigation of induced seismicity and emissions to air (including greenhouse gases).

Scope: Data collection and identification/assessment of environmental impacts and risks, and establishment of scientific recommendations and best practices. Knowledge sharing and collaboration with relevant US and Canadian partners is encouraged.

Expected impact: The resulting knowledge base, best practices and guidelines will contribute to efforts aimed at minimising the environmental footprint of shale gas extraction.

Type of action: Research & Innovation Action (100% funding)

LCE 17 – 2015: Highly flexible and efficient fossil fuel power plants

Specific challenge: The share of energy produced from renewable resources is growing rapidly. The output of wind and solar power is highly variable, and depends of factors such as weather conditions and time of day. With this growing share of renewable power, in particular when having priority access to the grid, fossil fuel power plants will have to increasingly shift their role from providing base-load power to providing fluctuating back-up power to meet unpredictable and short-noticed demand peaks, in order to control and stabilise the grid. Plants should be able to run both at the lowest part load possible at the highest possible efficiency. Moreover, plants will be required to operate across the entire load range with high load-change velocities, and even operate in start/stop mode with full turndown and very fast re-start, all at minimal fuel consumption. This forces base-load plants to operate closer to their design limits and through significantly more thermal cycles, leading to increased rate of wear on plant components. Operational flexibility therefore presents a significant challenge for fossil fuel power (and CHP) plants.

Scope: Focus on progressing solutions that already reached TRL 3 to TRL 4-6 and offer the highest potential for full integration into an energy system with ever higher shares of renewable energies. Solutions with lowest greenhouse gas emissions per energy unit are preferred. Collaboration with power plant operators and Transmission System Operators (TSOs) is strongly encouraged.

Expected impact: Projects should lead to new and cost-effective solutions for highly flexible new and existing fossil fuel power plants (including those using dispatchable renewable fuels), capable of meeting demand peaks and renewable output reductions, at minimal fuel consumption, while mitigating the effects of cycling operation to avoid excessive service life expenditure, and not impeding the potential CO2 capture readiness of the power plants.

Type of action: Research & Innovation Action (100% funding)

Supporting the development of a European research area in the field of energy

LCE 18 – 2014/2015: Supporting Joint Actions on demonstration and validation of innovative energy solutions

Specific challenge: Without a technological shift in our current energy system, the EU will fail on its 2050 ambitions to largely decarbonise the energy and transport sectors. The EU needs to accelerate innovation in cutting edge low carbon technologies and innovative solutions, and bridge the gap between research and the market. A European approach is essential to realise the ambition of seeing low carbon technologies effectively developed in view of bringing them to the market: it allows key players to come together on a continental scale; it helps to identify and to tackle the barriers holding back innovative products and services in the single market; and it allows different sources of private and public funding to be brought together. Today, EU funding remains a limited part of the overall funding across Europe. Implementation needs to be increasingly based on partnerships that build the necessary scale and scope, and achieve greater impact from scarce public and private resources

Scope: The proposals should aim at coordinating the research efforts of the participating Member States, Associated States and Regions in the areas and challenges targeted in this call and to implement a joint transnational call for proposals with EU co-funding to fund multinational innovative research initiatives in this domain. Proposers are encouraged to implement other joint activities including additional joint calls without EU co-funding.

Activities should focus on demonstrating and validating solutions that reached already TRL 5-6 and bringing them to TRL 6-7. Appropriate user and general public acceptance, regulatory, market up-take (e.g. e.g. regulatory issues, capacity building and access to finance), social, environmental and resource efficiency aspects should be included. Opening up demonstration facilities for practice-oriented education and training is encouraged.

Expected impact: Acceleration of the time to market of, affordable, cost-effective and resource-efficient technology solutions to decarbonise the energy system in a sustainable way, secure energy supply and complete the energy internal market. Reduction of the environmental footprint and the energy payback time. Strengthening the European industrial technology base, thereby creating growth and jobs in Europe.

Type of action: ERA-NET

LCE 19 – 2014/2015: Supporting coordination of national R&D activities

Specific challenge: Without a technological shift in our current energy system, the EU will fail on its 2050 ambitions to largely decarbonise the energy and transport sectors. The EU needs to accelerate innovation in cutting edge low carbon technologies and innovative solutions, and bridge the gap between research and the market. A European approach is essential to realise the ambition of seeing low carbon technologies effectively developed in view of bringing them to the market: it allows key players to come together on a continental scale; it helps to identify and to tackle the barriers holding back innovative products and services in the single market; and it allows different sources of private and public funding to be brought together. Today, EU funding remains a limited part of the overall funding across Europe. Implementation needs to be increasingly based on partnerships that build the necessary scale and scope, and achieve greater impact from scarce public and private resources

Scope: As a pilot case, the scope will be on competitive low-carbon energy in activities targeted under the areas 'Renewable Electricity and Heating/Cooling', 'Modernising the Single European Electricity Grid (tbc)', 'Providing the Energy System with Flexibility through Enhanced Energy Storage Technologies (tbc)', 'Sustainable Biofuels and Alternative Fuels for the European Transport Fuel Mix', and 'Enabling the Sustainable Use of Fossil Fuels in the Transition to a Low-Carbon Economy' of this call. Research and Innovation activities in the projects should focus on bringing technology solutions from TRL 2 to TRL 5. Activities should focus either on:

- reinforcing the European dimension of projects resulting from synchronised funding processes of at least 3 Member States through support to high risk, high cost, and long-term research for which there is a lack of critical mass at MS level, strong potential for economies of scale and a high demand for cutting-edge research capacities as well as to reinforcing the partnership with European industry, through e.g. transfer of knowledge and other dissemination activities, activities to foster the use of research outcomes by industry.
- Supporting the coordination of call for proposals of at least 3 Member States, for instance, through support to networking activities of public funding bodies, promotion of the use of single peer-reviewed evaluations, development and use of harmonised monitoring and review methodologies etc.

Expected impact: Increasing coordination and alignment of national research and innovation programmes, overcoming gaps, duplication and fragmentation, creating a leverage effect, enhancing coherence and efficiency of energy research in Europe.

Type of action: Open call with Coordination and Support Actions, Research and Innovation Actions, and Innovation Actions

Social, environmental and economic aspects of the energy system

LCE 20 – 2014: The human factor in the energy system

Specific challenge: To better understand the human factor: Managing the transition to a more sustainable energy system is a challenging task, going beyond mere technological aspects. Consumer's and other actor's awareness, attitudes, risk perception, consumption behaviour and investment decisions have a strong influence on the development of our energy system and are a crucial factor in the dissemination of energy relevant technologies. We need to explore the factors triggering the behaviour of the different stakeholders, in particular the consumers. Furthermore we need to develop appropriate means to facilitate and actively stimulate the public engagement in transforming our energy system and to foster the dialogue with the public on this matter.

Developing the skills needed: The ambitious goals of the SET-Plan require the mobilisation of appropriate resources. This applies in particular to the availability of skilled workforce. In line with the SET-Plan Education and Training Roadmap we need to foster European cooperation in this area by building European networks, both in the university based education sector and in the vocational education and training sector, establishing close links to business and research.

Scope: Proposals should cover one or several of the following aspects:

- Awareness, perceptions, attitudes to energy relevant technologies (including nuclear) and to transition pathways to a low carbon economy of actors in the energy system, including perception of risks and benefits
- Public engagement in the transformation process to a more efficient, low carbon energy system. Development of measures to launch and stimulate a dialogue with the public on energy policy and energy innovation on European level
- Development and support of a) vocational education and training networks in domains with potential shortages/domains needing new or upgrade of existing competences or b) networks of universities with links to business and research to address knowledge, skills and competences needs and gaps. Both types of networks need to be in line with the scope described in the SET-Plan Education and Training Roadmap and need to involve the relevant stakeholders along the technology value chain.

Expected impact: Support to the implementation of the SET-Plan by better understanding the complex links, interdependencies and interactions of the various actors in the energy system, their motivation, attitudes and perceptions. Development of options and strategies to address these factors with a view to facilitate and support the transition towards a sustainable energy system.

Development of strategies and measures to enhance public engagement in this transformation process and to establish a structured dialogue with the public on this matter including Europeanization of existing national energy dialogues.

Support the provision of appropriately skilled workforce to implement the SET-Plan by identification of needs and gaps, and by improving and accelerating the existing education and training activities in the vocational and in the university sector.

Type of action: Research & Innovation Action (100% funding)

LCE 21 – 2015: Modelling and analysing the energy system, its transformation and impacts

Specific challenge: Modelling the energy system and its dynamics: In order to enable rational policy decisions, the complex links, interactions and interdependencies between the different actors, the available technologies, the legal and financial instruments, and the impact of the different interventions on all levels from the individual to the whole energy system need to be better understood. Furthermore, due to the central role of energy for our societies, the choice of a particular portfolio of energy technologies, as well as the legal and financial framework conditions have far reaching impacts not only on the energy system, but also on the environment (including climate), the economy and the society.

Scope: Proposals should cover one or several of the following aspects:

- Comparative assessment of the impacts and the sustainability performance of all relevant energy technologies, including renewable, fossil, and nuclear technologies.. Comparative assessment of transformation paths towards a sustainable energy system and the related impacts on environment, society and economy.
- Analysing and modelling the impacts of technological development and innovation on the energy-system and its dynamics. Analysing and modelling of technology policy measures in the framework of the SET-Plan to promote the transition towards a sustainable energy system, including assessment of its impacts on society, environment and economy.

Where appropriate this will include development of new or refinement of existing modelling tools.

Expected impact: Support to the scientific underpinning for the implementation of the SET-Plan by strengthening the knowledge base for decision-making concerning feasibility, effectiveness, costs and impacts of related measures and options. The results should assist policy makers in identifying and analysing effective strategies for a transition to an efficient low carbon energy system.

Type of action: Research & Innovation Action (100% funding)

To be confirmed

LCE XX – 2015: Supporting first-of-a-kind, commercial-scale industrial demonstration renewable electricity, heating/cooling and sustainable biofuel plants

Specific challenge: XXX

Scope: XXX

Expected impact: XXX

Type of action:

Cross-cutting issues

LCE 22 – 2014/15: Exploiting the research and innovation potential of SMEs in a low carbon energy system

Specific Challenge: SMEs play a crucial role in the transition to a clean, secure and more efficient energy system. SMEs have been successfully participating in energy related framework programme projects and they will also to strongly contribute to the focus area "low carbon energy", in particular to the development of resource-efficient, cost-effective and affordable technology solutions to decarbonise the energy system in a sustainable way. However, the limited administrative resources of SMEs and some restrictions of traditional funding instruments may in specific cases hinder SMEs to apply for support of innovative ideas.

This additional, targeted funding instrument, easy to access and going beyond the restrictions of collaborative projects will contribute to fully exploit the research and innovation potential of SMEs in selected areas of low carbon energy supply.

Scope:

The SME instrument consists of three separate phases and a coaching and mentoring service for beneficiaries. Participants can apply to phase 1 with a view to applying to phase 2 at a later date, or directly to phase 2.

In phase 1, a feasibility study shall be developed verifying the technological/practical as well as economic viability of an innovation idea with considerable novelty to the industry sector in which it is presented (new products, processes, services and technologies or new market applications of existing technologies). The activities could, for example, comprise risk

assessment, market study, user involvement, Intellectual Property management, innovation strategy development, partner search, feasibility of concept and the like to establish a solid high-potential innovation project aligned to the enterprise strategy and with a European dimension. Bottlenecks in the ability to increase profitability of the enterprise through innovation shall be detected and analysed during phase 1 and addressed during phase 2 to increase the return in investment in innovation activities.

In phase 2, innovation projects will be supported that address the specific challenges of

- Renewable electricity and heating/cooling,
- Sustainable biofuels and alternative fuels for the European transport fuel mix,
- Enabling the sustainable use of fossil fuels in the transition to a low-carbon economy,
- Social, environmental and economic aspects of the energy system.

Projects should demonstrate high potential in terms of company competitiveness and growth underpinned by a strategic business plan. Activities should focus on innovation activities such as demonstration, testing, prototyping, piloting, scaling-up, miniaturisation, design, market replication and the like aiming to bring an innovation idea (product, process, service etc) close to deployment and market introduction, but may also include some research. For technological innovation a Technology Readiness Levels of 6 or above (or similar for non-technological innovations) are envisaged.

In addition, in phase 3, SMEs can benefit from indirect support measures and services as well as access to the financial facilities supported under Access to Risk Finance of this work programme. *[Link to the Access to Risk Finance Part]*

Successful beneficiaries will be offered coaching and mentoring support during phase 1 and phase 2. This service will be accessible via the Enterprise Europe Network and delivered by a dedicated coach through consultation and signposting to the beneficiaries. The coaches will be recruited from a central database managed by the European Commission and have all fulfilled stringent criteria with regards to business experience and competencies. Throughout the three phases of the instrument, the Network will complement the coaching support by providing access to its innovation and internationalisation service offering. This could include, for example, depending on the need of the SME, support in identifying growth potential, developing a growth plan and maximising it through internationalisation; strengthening the leadership and management skills of individuals in the senior management team and developing in-house coaching capacity; developing a marketing strategy or raising external finance.

Expected impact:

- Enhancing profitability and growth performance of SMEs by combining and transferring new and existing knowledge into innovative, disruptive and competitive solutions seizing European and global business opportunities.
- Market uptake and distribution of innovations tackling the challenges of a low-carbon energy system in a sustainable way.
- Increase of private investment in innovation, notably leverage of private co-investor and/or follow-up investments.

- The expected impact should be clearly described in qualitative and quantitative terms (e.g. on turnover, employment, market seize, IP management).

Type of action: SME Instrument (70% funding)

LCE 23 – 2014: Fostering the network of National Contact Points

Specific challenge: Facilitate trans-national co-operation between National Contact Points (NCPs) within this Societal Challenge with a view to identifying and sharing good practices and raising the general standard of support to programme applicants, taking into account the diversity of actors that make up the constituency of this Societal Challenge.

Scope: Support will be given to a network of formally nominated NCPs in the area of 'Secure, Clean and Efficient Energy'. The activities will be tailored according to the nature of the area, and the priorities of the NCPs concerned. Various mechanisms may be included, such as benchmarking, joint workshops, enhanced cross-border brokerage events, specific training linked to this Societal Challenge as well as to gender dimension of Research and Innovation, and twinning schemes. Special attention will be given to enhance the competence of NCPs, including helping less experienced NCPs rapidly acquire the know-how accumulated in other countries.

The focus of activities should be on issues specific to the Societal Challenge 'Secure, Clean and Efficient Energy'. Where appropriate, links to other energy relevant parts of Horizon 2020, and to the overarching framework of the Strategic Energy Technology Plan should be taken into account.

Proposals can only include NCPs from EU Member States, and Associated Countries, who have been officially appointed by the relevant national authorities.

The consortium should have a good representation of experienced and less experienced NCPs.

If certain NCPs wish to abstain from participating in the consortium, this fact should be explicitly documented in the proposal. These NCPs are nevertheless invited and encouraged to participate in the project activities, and are eligible for reimbursement of their participation.

Participation of NCPs from third countries is welcome, but these NCPs are not eligible for reimbursement for their participation, unless there is a clear benefit for the NCP network.

Building appropriate links to NCP networks of other societal challenges/parts of Horizon 2020, as well as to other relevant information and support networks is encouraged.

The Commission expects to receive and fund a single proposal under this heading.

Expected impact:

- An improved and professionalised NCP service across Europe, thereby helping simplify access to Horizon 2020 calls, lowering the entry barriers for newcomers, and raising the average quality of proposals submitted.
- A more consistent level of NCP support services across Europe.

Funding scheme: Coordinated and Support Action

CALL FOR SMART CITIES AND COMMUNITIES

H2020-SCC-2014/2015

Cities across Europe are forerunners in the transition towards a low carbon and resource efficient economy. 68% of the EU population lives in urban areas, a proportion that is growing as the urbanisation trend continues, and using 70% of the energy. Sustainable development of urban areas is a challenge of key importance and requires new, efficient, and user-friendly technologies and services, in particular in areas of energy, transport, and ICT. These solutions however require integrated approaches, both at the level of research and development of advanced technological solutions, as well as at the level of deployment. The first part concerns enhancing the development and validation of the technology as such, whereas the second part concerns the need for validation of new business cases and financing models, standardisation, scalability and replicability of the solutions, user acceptance and engagement.

The focus on smart cities technologies will result in commercial-scale solutions with a high market potential in areas such as energy efficient and smart buildings and neighbourhoods; smart digital services for better-informed citizens; identification, optimisation and integration of flows (data, energy, people, goods); smart and sustainable digital infrastructures; smart and sustainable energy systems and smart mobility services. A powerful combination of tyhis focus area and the EIP as a deployment mechanism will thus develop a strong pipeline of long-term, sustainable urban solutions in the EU, reduce greenhouse gas emissions as well as in general improve the overall air quality.

As stated in the Communication on Smart Cities and Communities European Innovation Partnership, the EIP aims to:

- accelerate the roll-out of innovative technologies and services, organisational and economic solutions, for urban applications, which ask for a cross-sectorial approach to support the Europe-wide deployment of Smart Cities solutions
- disseminate the results of successful solutions to bridge innovation gaps and stimulate the convergence between value chains in the energy, transport and ICT sectors;,
- support market oriented measures to validate and accelerate commercial deployment; and
- build constructively on the existing portfolio of "Smart Cities" initiatives, rationalising and consolidating them to ensure coherence between regulation and standards policies and project financing.

The challenge of deploying solutions related to the energy, transport and ICT sectors, including those which are at the intersection of these three sectors, in an urban environment is to overcome the local specificities. Consequently actions and actors which can ensure the transferability of solutions and create the framework for replicability of solutions should be prioritised and rewarded.

Therefore EU action for Smart Cities and Communities, with inputs from the Strategic Implementation Plan of the European Innovation Partnership Smart Cities and Communities, will focus on providing support to partnerships created between municipalities and industries which propose solutions answering to the complexity of projects in the intersection of the three sectors and which take actions for large scale deployment of those solutions in other cities across Europe.

This focus area is part of the societal challenges. Solutions proposed here need to be driven by demand side actors, while the generic technological platforms e.g. for smart lighting, the Internet of Things and cyber-security are being developed with strong industry drive in LEIT part of the programme.

SCC 1 – 2014/2015: Smart Cities and Communities solutions integrating energy, transport, ICT sectors through lighthouse (large scale demonstration - first of the kind) projects

Specific Challenge: The EU policy and regulatory framework in the sectors of energy, transport and ICT supports the development of sectoral solutions, i.e. solutions with a limited degree of integration. However, for successful and accelerated implementation in real environments such as urban ones - that also have to take into account local specificities the test of integrated measures will pave the way for faster market roll-out of technologies. -. The key challenges for Smart Cities and Communities are to significantly increase the overall energy efficiency of cities, to exploit better the local resource both in terms of energy supply as well as through the demand side measures. This will imply the use of energy efficiency measures optimising at the level of districts, the use of renewables, the sustainability of urban transport and the needed drastic reduction of greenhouse gas emissions in urban areas - within economically acceptable conditions - while ensuring for citizens better life conditions: lower energy bills, swifter transport, job creation etc.

Scope: To identify, develop and deploy replicable, balanced and integrated solutions in the energy, transport, and ICT actions through partnerships between municipalities and industries.

These solutions at the intersection of the three sectors will have a holistic approach and are still facing first mover risk. These will be the lighthouse projects as identified by the Communication on Smart Cities and Communities. Lighthouse projects will target primarily large scale demonstration of replicable SCC concepts in city context where existing technologies or very near to market technologies (TRL 7 and more) will be integrated in an innovative way.

The projects should address the following main areas:

- *(Nearly zero) or low energy districts:* through the integration and management of: i) the supply of energy with predominant exploitation of local resources (waste heat, renewables, storage); ii) the cost-effective retrofitting of buildings without significant disruption for tenants (use of sustainable materials) iii) optimisation of mobility demand, iv) the cross-cutting ICT solutions for the design and overall management of energy/ transport systems,
- *Integrated Infrastructures:* through the integration of physical infrastructures such as core networks, street scenes, lighting, etc to create new forms of value through re-use and repurposing. This should lead to quantifiable benefits such as reduction of capital /operational expenditure as well as reduced carbon / energy footprints. This might also imply exploitation of synergies between requirements for smart grids, broadband infrastructures and in general poly networks.
- *Sustainable urban mobility:* through the integration of energy/ fuelling infrastructure with vehicle fleets powered by alternative energy carriers for public and private transport, including logistics and freight-distribution. Implications on energy management, and in the case of electromobility the impact on the electricity grid, of

the deployment of high numbers of vehicles and/or the alternative fuel blends performance must be assessed.

The proposed projects should address in addition to the main areas presented above a strategy that addresses the following issues concerning the *appropriate external environment* for these solutions to be exploited commercially. This includes (indicative list): optimising policy and regulatory frameworks; open, consistent data and performance measurements; citizens' engagement and empowerment; dissemination and unlocking the market potentials worldwide.

Consortia should:

- Include *industry, city planning authorities which should also reflect the view of the consumer* organisations from *2 – 3 cities and communities*.
- In addition these consortia should co-involve *2 - 3 follower cities* i.e. cities willing to contribute to the process though the replication of solutions at the end of the project. The involvement of the *follower* cities should be relevant (eg participating in definition of user requirements and methodology of transferability of solutions, data collection etc). The follower cities should aim at improving their energy performance or the share of use of renewables (eg. 60% reduction of primary energy for buildings, 20 - 30 % RES use for electricity as well as for heating and cooling) EU geographical coverage conditions should be also applied.
- All *activities must be part of ambitious urban plan*. For lighthouse cities these plans have to be finished (e.g. the sustainable energy plans, compiled for the Covenant of Mayors in combination with project plans committed to under the Green Digital Charter and positively evaluated by JRC). These plans shall be submitted with the proposal. The urban plan shall integrate buildings planning and transport/mobility planning; additional issues may be addressed as well if relevant for the city.
- In order to ensure the success of the lighthouse projects, the *funding for the other parts of the programme or initiative in which the lighthouse projects are embedded have be secured from other sources,* preferably private ones, but also other EU funding sources (cohesion or regional funds for example), national or regional funding.
- Projects should demonstrate and *validate attractive business plans based on already existing city planning*, that allow large scale replication of fast economic recovery in cities of varying degrees of economic conditions (from very poor to very rich), varying sizes but in any case significant urban centres[31]and varying climatic conditions.
- The industrial partners and municipality authorities should commit to replicate successful demonstration in their own and other cities, notably their 'follower cities'; the replication plans are compulsory and are part of the evaluation.
- Consortia must be compact with a clearly defined structure and with roles and responsibilities properly spelled out for all involved entities.

Besides economic sustainability, proposals must also commit to scientific and technical requirements in support to reliability. These are:

[31]This condition is to be interpreted flexibly, but a guiding figure for the larger MS would be around 250.000 inhabitants.

- Clear commitment from the consortium to the transferability of solutions to other cities, open standards and interoperability of systems.
- Clear commitment for the consortium to cooperate to the fullest extent with accompanying measures as well as their 'follower cities'.
- Interoperability of solutions.
- Open and consistent data.
- Common data collection, measurement and disclosure methodology, in order to facilitate a common footprint calculation methodology and other metrics (especially for energy saving; CO2 reductions, financial savings, number of jobs created, environmental impact etc.).
- long term performance monitoring to be obligatory for say 5-10 years and insertion in (concerto or other) central DB for study and analysis.

Expected Impact:

The projects are expected to have the impacts described below:

- Trigger large scale economic investments with the repayment of implementation costs in acceptable time lines (to facilitate the bankability of the projects).
- increase the energy efficiency of districts and of cities and foster the use of renewables and their integration energy system
- increase mobility efficiency with lower emissions of pollutants and CO2,
- lower the costs for utilities and service providers.
- decarbonise the energy system while making it more secure and stable
- create stronger links between Member States with various economical positions through active cooperation (with benefits for all).

It is envisaged that the projects will also bring societal benefits:

- reduction of energy bills for all actors and especially for citizens and public authorities.
- Increase quality of life by creating local jobs (that cannot be delocalised) in cities,
- increase air quality

These actions proposed under this topic will cross-fertilise and cooperate with support actions in topic SCC 2.

Type of action: Innovation Action (70% funding)

Enhancing the roll-out of Smart Cities and Communities solutions by stimulating the market demand

Specific Challenge: To drive structural changes and to catalyse development of new markets of smart city solutions, a number of support actions will be taken to deliver impact across-'silos' of policy areas, and groups of stakeholders.

SCC 2 – 2015: Development of system standards for smart cities and communities solutions

Scope: Today the standards are developed for specific components or areas such as smart meters, smart grids, ICT etc. With the development of integrated solutions of Smart Cities and Communities a system approach is needed. Furthermore through standardisation the solutions identified by smart cities and communities can envisage costs reductions. It is expected that this work is carried out by the industries cities and communities contributing to the Smart Cities and Communities European Innovation Partnership in cooperation with the European Standardisation Organisations (CEN, CENELEC, ETSI) as well as other Standard Developing Organisations (SDOs) responsible for technical specifications in the area of Smart Cities.

The process for developing smart cities and communities standards should ensure

- interoperability of solutions, i.e. adaptability of solutions to new user requirements and technological change as well as avoidance of entry barriers or vendor lock-in through promoting common meta-data structures and interoperable (open) interfaces instead of proprietary ones;
- open and consistent data, i.e. making relevant data as widely available as possible – including to third parties for the purpose of applications development – whilst using common, transparent measurement and data collection standards to ensure meaningfulness and comparability of performance/outcome measurements.

This action will cross-fertilise and cooperate with actions under topic SCC 1 – 2014/2015.

Expected impact:

The project should lead to

- accelerating the deployment of Smart Cities and Communities solutions by ensuring the up-scaling of the process and lowering their costs
- enabling the opening of market for multiple actors,
- ensuring the front run position for European smart cities solutions, at forefront worldwide.

Type of action: Coordination and Support Action (100%)

SCC 3 – 2014: Establishing networks of public procurers in local administrations on smart city solutions

Scope: These networks should aim at networking public procurement bodies in order to establish "buyers' groups" for innovative smart city solutions that improve the potential impact of the investment for cities and their citizens, and improve framework conditions for innovation. These networks will help public procurers to increase their capacity to undertake a better coordinated and articulated dialogue with suppliers about future needs by exchanging experience in procurement practices and strategies and by undertaking joint or coordinated actions. The networks must have core set of deliverables (additional actions can also be proposed):

- identifying procurement around a common need by European cities for which goods and services at the intersection of ICT, energy and transport in urban areas are bought as investment;

- prepare a number of formats/scenarios for possible future joint procurements; assessing the state-of-the art of potentially available solutions by developing different approaches for "market consultations" involving the supply chain (paying special attention to SMEs and locally-based businesses);
- carrying out legal work to ensure that the procurement of innovative solutions complies with European and national law;
- improving procurement capabilities by joint trainings, workshops and other networking activities.

It is envisaged that there will be a fairly small (about 10 organisations) that will form the core consortium of public procurers and these will commit to organise dissemination activities for a larger group of public procurers in order to spread the findings in all EU Member States.

The members of the consortia must be public procurers, i.e. contracting authorities in the meaning of the public procurement Directives at all levels (local, regional, national and supra-national) that plan to establish implementation plans for improving the quality and efficiency of their public service offering by procurement of innovative solutions for use in cities and communities. This includes both contracting authorities in the meaning of the public procurement directive for public authorities (2004/18/EC) and utilities (2004/17/EC), for example public transport operators, relevant ministries, utilities, communes and cities, police or fire brigades, e-government administrations etc.

The list of deliverables should include, among others, an analysis of procurement examples already executed in EU MS; an assessment of the most suitable cases for cross-border action; a set of generic draft procurements ready for adaptation to the particularities of the EU cities; an economic analysis on the benefits of simultaneous procurement from different cities. Work will also include the drafting of reports as well as dissemination activities to make these reports available to all interested parties.

This action will cross-fertilise and cooperate with actions under topic SCC 1 – 2014/2015.

Expected impact: The project should mainly

- boost the market demand for smart city solutions by increasing consumer awareness about technologies and processes used in implementing smart city solutions.
- act as lever through procurement and investment planning tools for local administrations and business, a
- create better public acceptance and engagement.
- ensure the framework conditions for the participating organisations for organising joint, cross-border public procurements
- encourage the public procurement bodies active in cities and communities through networks' activities, to increasingly become "launch customers" for innovative smart solutions which are not yet available on a large-scale commercial basis and which may entail a higher risk than purchasing products that are already commercially widely available.

Type of action: Innovation Action (70% funding)

SCC 4 – 2014: Establishing a challenge prize competition: Smart solutions for creating better cities and communities

Scope: A Smart cities and communities Challenge Prize competition invites in any ideas (businesses, notably start-ups and SMEs, gaming, arts, humanities, social innovation etc.) for transforming urban space into a more sustainable and liveable environment for citizens and businesses.

Incentive prizes provide incentives to innovators to take risks and develop new, sustainable, safe and better performing products and services for smart solution applications. Prize competitions can attract non-traditional players and reduce entry barriers, to create new partnerships, and to provide incentives to researchers and innovators to take risks and develop new, sustainable, safe and better performing products and services.

Prize winners will receive prize money and coaching for 1 year from business and public sector and civil society leaders. The competition itself will feature various stages with coaching of quarter/semi-finalists as well, follow-up and a strong push for sharing ideas and experiences.

The support action should organise a prize competition process that runs for 3 years, including developing the competition's concept, dissemination, jury work, follow-up, events. The prize competition should be designed such that: (1) the competition attracts non-traditional players, (2) have a low entry barriers, (3) each competition is completed in 6-9 months, unless justified otherwise, (4) create EU-wide visibility and access to new networks for all competitors and (5) provide a coaching trajectory during the competition and after the competition.

The competition should result in a ranking list of finalists. This list constitutes an advice to the European Commission for awarding 'direct grants' in the form of 'stand alone prizes'. The prize of 100.000 Euro should allow for converting ideas into business ventures around urban challenges (5 prizes each year, 2 years in a row). [The following award criteria for the prize apply: …..]

This action will cross-fertilise and cooperate with actions under topic SCC 1 – 2014/2015.

Expected impact: The Challenge Prize competition directly encourages innovation in new ventures – particularly from SMEs and start-ups. It will demonstrate – with great visibility – the range of innovative solutions possible. Prizes also represent a major opportunity to mobilise public and private investment for further development of the ideas presented in the entries.

Type of action: Prize

ANNEX: TECHNOLOGY READINESS LEVEL

TRL 0: Idea
Unproven idea or concept where no peer reviewed analysis or testing has been performed.

TRL 1: Basic Research
The initial scientific research has been completed. The basic principles of the idea have been qualitatively postulated and observed. The process outlines have been identified. No experimental proof and detailed analysis are yet available

TRL 2: Technology formulation
The technology concept, its application and its implementation have been formulated. The development roadmap is outlined. Studies and small experiments provide a "proof of concept" for the technology concepts.

TRL 3: Applied Research
The first laboratory experiments have been completed. The concept and the processes have been proven at laboratory scale, table-top experiments. Potential of materials and up scaling issues have been identified.

TRL 4: Small Scale Prototype Development Unit (PDU)
The components of the technology have been identified. A PDU has been built a laboratory and controlled environment. Operations have provided data to identify potential up scaling and operational issues. Measurements validate analytical predictions of the separate elements of the technology. Simulation of the processes has been validated. Preliminary LCA and economy assessment models have been developed.

TRL 5: Large Scale Prototype Development Unit
The technology has been qualified through testing in intended environment, simulated or actual. The new hardware is ready for first use. Process modelling (technical and economic) is refined. LCA and economy assessment models have been validated. Where it is relevant for further up scaling the following issues have been identified: Health & safety, environmental constraints, regulation, and resources availability.

TRL 6: Prototype System
The components and the process have been up scaled to prove the industrial potential and its integration within the energy system. Hardware has been modified and up scaled. Most of the issues identified earlier have been resolved. Full commercial scale system has been identified and modelled. LCA and economic assessments have been refined.

TRL 7: Demonstration System
The technology has been proven to work and operate a pre-commercial scale. Final operational and manufacturing issues have been identified. Minor technology issues have been solved. LCA and economic assessments have been refined.

TRL 8: First of the kind commercial System
The technology has been proven to work at a commercial level through a full scale application. All operational and manufacturing issues have been solved.

TRL 9: Full commercial application
The technology has been fully developed and is commercially available for any consumers.