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IMPACT Response to Stakeholder Consultation on Potential Priorities for Research and Innovation
in the 2018-2020 Work Programme of Horizon 2020 Societal Challenge 5 ‘Climate Action,
Environment, Resource Efficiency and Raw Materials’

Development of sustainable and environmentally friendly carbon use policy and research is essential to the climate change debate in Europe. The focus of this document is on the development of a sustainable carbon source, which is essential to the long-term growth and competitiveness of the European Union. Sustainable carbon as a term is intended here in terms of environmentally-beneficial, non-biomass-related, closed-loop carbon. Our current society is built upon carbon-based materials not only for energy generation but also for fine chemicals (e.g. for pharmaceuticals) and commodity materials (e.g. packaging for food preservation), to name a few. As such, this carbon needs to be captured and used effectively, an area where the EU can lead in terms of research. This issue clearly addresses two sub-challenges set out in Societal Challenge 5, namely: i) protecting the environment and sustainably managing natural resources, and ii) fighting and adapting to climate change.

What are the challenges in the areas of Societal Challenge 5 'Climate action, environment, resource efficiency and raw materials' that require action under the Work Programme 2018-2020?

Carbon dioxide is a leading cause of climate change that has a direct impact on the long-term resilience of the natural environment. Although this is a globally-recognised problem, carbon dioxide should also be recognised as a key source of sustainable alternative carbon to fossil and biomass resources. It is in view of this new role that the phasing out of high carbon dioxide-emitting sources should be re-evaluated both with longer-term thinking and shorter-term solutions that can immediately start to address emissions problems. In the short to medium term, carbon dioxide capture and reuse can help to reduce carbon emissions and also integrate emissions, materials and energy vectors through a closed-loop carbon source based on the reuse of carbon dioxide. In the longer term, this will lead to a reduction in the reliance on unsustainable, environmentally damaging sources of energy. A focus on carbon capture and utilisation materials, technologies and processes is feasible in the immediate, pre-2020 term, and should be supported in the Horizon 2020 Societal Challenge 5 work programme.

Developing an environmentally sustainable way of utilising carbon is an essential and realisable necessity for protecting the environment, limiting climate change and addressing the security of raw

materials, areas where the EU can take a leading role and where research is vital.¹ Supporting the development of such carbon reuse and using it as a source for raw materials will have multiple impacts on global warming mitigation, environmental exploitation and long-term resource availability. First, actions taken towards this challenge will reduce the reliance on unsustainable and environmentally unfriendly sources of carbon and fuel. Second, it will help the EU and its member states to meet its climate change targets agreed in Paris in 2015. Finally, and related, this will shift EU reliance on external sources of fuel and help to create an EU-centred source of energy.

This support requires three key areas of focus, all of which the EU's continued support of research can help to accomplish. First, carbon dioxide sorbent and catalytic materials need to be developed in order to transition Europe's fossil carbon-intensive energy, industry and infrastructure towards less environmentally harmful forms of energy, while keeping in mind the economic ramifications of these actions. Second, renewable and perennial sources of low-carbon energy – such as sun, wind, wave and tidal energy - must be further developed and deployed, while keeping in mind that peak energy could be stored in fuels derived from carbon dioxide. Third, the use of life cycle analytical tools needs to be required and further developed (and possibly simplified) to measure and assess the environmental impacts of these actions that are put into place.

The most obvious area in which research needs to be expanded is in the use of solar energy. Development in this area should not only focus on solar energy harvesting devices, however, but also in reusing carbon dioxide to store excess energy created from renewable sources. This will work to reduce carbon footprints both through increasing usage of renewable energy sources and in reusing carbon dioxide emissions for developing commodity and specialty materials. Sufficient research and funding is necessary to ensure that this is done efficiently and usefully. Full Life Cycle Assessments (LCAs) on any proposed actions are necessary in order to establish whether these approaches are sustainable and how they can best be used in a European context.

Would they require an integrated approach across the Horizon 2020 Societal Challenges and Leadership in Enabling and Industrial Technologies?

While development of carbon capture and low carbon energy technologies will necessarily involve industry and cut across numerous policy areas such as innovation and technology, there is a danger that further integration across other Horizon 2020 Societal Challenges will result in additional complexity and impede progress and uptake of solutions. Current Horizon 2020 calls already indicate the inherent complexity of the energy issues that are being tackled at the EU level. While this ambitious targeting should be applauded, care must be taken to maintain a focused and achievable target for researchers to enable timely delivery of real impact for these projects. For these reasons, a focussed approach on carbon reuse would maximise both the usefulness and short-, medium- and long-term success of potential Horizon 2020 research funding.

What is the output/impact that could be foreseen?

This area of research has both immediate and medium-term outputs and longer term impacts. Immediate outputs are the creation of a stronger and wider European knowledge base, especially through the submission of research project proposals and competitive funding of research, development and innovation projects that incorporate pan-European partners. In the medium term of 5-10 years, the aim is to further develop and utilise processes that can re-use carbon, moving the focus from carbon sequestration (which positions carbon as a waste product to be indefinitely

¹ See, for example, Styring, P. (2014). 'Supply Security – the Circular Economy' in USES 2014 – The University of Sheffield Energy Symposium, 24 June 2014, The Octagon Centre, University of Sheffield. Available at <http://eprints.whiterose.ac.uk/87972/>.

disposed of in a safe storage place) to carbon utilisation wherein CO₂ is transformed to useful products. Longer term, this will reduce the reliance on high carbon-emissions energy by promoting the use of renewable sources of energy, while also reducing carbon footprints by utilising the CO₂ that is produced through energy production and consumption.

The impact of research in this area will be two-fold. First, developing a renewable carbon source sustainably made from perennial energy and carbon dioxide will have a positive impact in reducing the exploitation of other carbon-heavy sources. Energy processes that use CO₂ as a circular source – treating carbon emissions as a resource to be reused - will help to protect the environment from climate change by reducing carbon emissions immediately and buy time to develop longer-term solutions and new technologies for the recycling of other raw materials, including the purification of water. Second, by focusing on low-carbon and renewable energy sources, the work will reduce the EU's reliance on external, often carbon-heavy sources of energy and help the EU and member states to meet the climate protection goals developed in Paris in 2015. This will position European countries at the forefront of the field and cement the EU's reputation as a global leader in developing environmentally sustainable approaches to energy.

Which innovation aspects could reach (market) deployment within 5-7 years?

Innovation in producing more efficient, affordable and widely-used solar, wind, tidal harvest and derivate technology is conceivable in the next 5-7 years, especially in the installation of more renewable power plants and the development of higher energy density systems and first pilot systems of CO₂ conversion processes. Advancement in cleaner, ideally CO₂-neutral energy sources will allow for more efficient recycling of carbon resources. A 5-7 year time frame also allows for the development of more efficient CO₂ capture processes. Coupled with greener energy sources, this will greatly reduce the amount of CO₂ emissions with a made-in-EU technological solution that could also be utilised in external markets.

Which gaps (in science and technology, innovation, markets, policy, financing and governance, regulation etc.) and potential game changers, including the role of the public sector in accelerating changes, need to be taken into account?

The largest gap is in developing a critical mass of experts in CO₂ utilisation. While there is already some increase in the number of materials scientists, chemists, and engineers involved in the field, pooling of this expertise is not always sufficiently advanced. Further support is necessary in developing wider collaboration mechanisms between these experts, as well as training future leaders in this area. The EU can play an integral role in funding and developing this emerging network and supporting scientists already working in EU member states in further building their research. Furthermore, Life Cycle Assessment (LCA) tools should be embedded in any medium to long-term projects to assess the impact of this work and these tools need to be fully integrated into the research process and other activities related to sustainability. Expertise and access to these tools should be widespread and straightforward to ensure that there are no barriers to assessing the environmental impact of work in the area.

Which areas could benefit from integration of horizontal aspects such as social sciences and humanities, responsible research and innovation, gender aspects, international cooperation?

Additional expertise in the physical science fields, especially engineering, is essential in developing carbon reuse and low carbon energy technologies, but this issue is one that cuts across several research and policy areas. Most notably, carbon capture and utilisation requires stronger integration with environmental, business and policy experts who can capture the added-value benefits of these

technologies. These experts can illustrate the importance of supporting these initiatives at business and governmental levels in order to ensure strong uptake of new technology as it comes available. As a highly political issue, energy policy draws on the need for additional expertise in good governance, environmental stewardship and sustainable development. This is true both for use within the EU, and also in supporting the use of European expertise and technology in external contexts. This approach fits with pre-existing EU actions for addressing climate change. For example, a cross-cutting approach to development of carbon reuse and low carbon energy fostered through responsible governance fits with recent EU initiatives in Eritrea² that can be further developed in new regions. International research collaboration with high carbon-emission developing countries such as India and China, as well as the EU neighbourhood regions would not only spur growth in high technology sectors in the EU, but also support the EU's role in international cooperation and development.³

In view of the recent evolution of the socio-economic and policy context (see point 3 of this document), what are the emerging priorities for Societal Challenge 5?

While low energy prices have at least temporarily offset some of the economic repercussions of the reliance on high-carbon energy sources, environmental concerns and uncertainty and volatility in relations with non-EU energy-producing countries have highlighted both the dependence of EU member states on non-EU sources of environmentally unsustainable energy and the need to diversify the ways in which European energy needs are met. Following the climate change talks in Paris in late 2015, this has also created an opportunity for the EU to play a leading role in developing both intermediate and long-term solutions to these energy problems. This requires significant investment by not only the EU, but by member states and business as well, which requires reassurance about the economic viability and competitiveness of carbon reuse and low-carbon energy sources. This requires both horizontal integration across policy areas and public and private sectors, and vertical integration between governmental levels. Member state levels have often led in terms of developing sustainable energy policies, especially in nations like Denmark, the Netherlands and many others, and the EU has become increasingly significant in leading and coordinating in this policy area. At the same time, sub-national regions and local governments are playing an increasing important role in developing energy plans (see, for instance, the role of Scotland and Wales in UK energy policies) and this regional and local focus needs to be fostered by the EU and linked to regional development initiatives, most notably the ERDF and cohesion funding. This is already reflected in the ERDF's focus on the low-carbon economy but needs to be expanded beyond its current focus on improving energy efficiency to an approach that encompasses short-, medium- and long-term improvements in developing sustainable energy. Carbon reuse and utilisation is an area that can have both immediate effects and longer term impact, but this requires a more holistic approach that involves higher-education research, regional and local levels of government and other policymakers in pushing the use of alternative energy sources and carbon reuse.

² https://ec.europa.eu/europeaid/news-and-events/eritrea-and-eu-sign-landmark-agreement-future-development-cooperation-promoting_en

³ https://ec.europa.eu/europeaid/sites/devco/files/booklet-energy-19052015_en.pdf