

# PEER response to the stakeholder consultation on HORIZON 2020 Societal challenge 5

## Priorities for research and innovation of the work programme 2018-2020



## PEER – the Partnership for European Environmental Research

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PEER is a partnership of eight of the largest environmental research centres in Europe ([www.peer.eu](http://www.peer.eu)), founded in 2001 with the aim of combining forces to follow a joint strategy in environmental sciences, to enhance research on ecological sustainability and to further develop the European Environmental Research Area. This co-operation was confirmed by a Framework Agreement signed on the 25th June 2002 in Roskilde, and renewed in 2007 and 2012.

PEER members are mainly public funded national and European competence centres characterised by scientific autonomy and interdisciplinary expertise. They carry out basic and applied research combining different disciplines from natural and social sciences. Research covers all fields of the environment, particularly addressing the interactions between mankind and nature.

With a combined budget of about €600 million and approximately 5,800 staff members, PEER has a wealth of experience in participation in major international networks and programmes, and all members have been actively involved in numerous projects funded by the EU's Framework Programmes for Research and Development.

PEER aims to be a world leader in integrating knowledge and expertise for sustainable development. The partnership promotes interdisciplinary and innovative research in support of decision makers, industry and society.

The PEER members are:



Oslo Centre for Interdisciplinary Environmental and Social Research



National Research Institute of Science and Technology for Environment and Agriculture



Joint Research Centre, Institute for Environment and Sustainability



Finnish Environment Institute



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## General remarks

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PEER welcomes the initiative of the European Commission to open this public consultation in the preparation of the last work programme for Societal Challenges 5 in Horizon 2020. Fostering such an open dialogue with stakeholders is an important step in identifying the most relevant results required in Europe and related research needs.

**PEER** participated in the consultation on the work programme 2016/2017 for SC5 and thanks the European Commission for offering a consultation again on the last work programme of SC5. **PEER recommends to continue with a transparent consultation procedure in the preparation of all future work programmes**, i.e. in the next Framework Programme. Offering a public consultation in the preparation of all work programmes as a standard procedure will enable stakeholders to thoroughly prepare contributions of high quality. PEER also encourages the European Commission to further **increase transparency and to make the contributions to the consultation publicly available** unless a stakeholder explicitly disagrees.

Establishing the SC5 work programme 2018 – 2020 is a challenging endeavour, considering the fact that most results of Horizon 2020 projects of previous work programmes will become available only during the next years. Furthermore, the success of different types of actions, especially the new Innovation actions needs to be analysed. On one hand, a longer term research agenda (a work programme covering three years) is an excellent tool for planning research and innovation, on the other hand some room for adaption or revision should be given, in case results of Horizon 2020 show the necessity.

**PEER supports the policy priorities for the work programme 2018 - 2020** mentioned in the invitation letter to this consultation, e.g. the Juncker Commission's priorities for growth and jobs, the UN Sustainable Development Goals and the agreement at the climate change conference in Paris in December 2015 and **underlines the importance of collaborative European research for achieving these policy aims.**

**PEER considers four research areas of explicit and particular relevance in addressing these priorities:**

- Improving management of **water resources**, both regarding quantity and quality, and water technologies for guaranteeing the human right to water and sanitation on global level,
- Understanding and guaranteeing the provision of **ecosystem services** required for a growing population, for sustaining the economy as well as human well-being,
- Strengthening societal **resilience to extreme events** mankind is facing as consequence of climate change, and
- Identifying new approaches to tackling climate change and resource efficiency, including a **strengthening of a combination of the green economy with a circular economy.**

These areas are indispensable in achieving a resource – and water – efficient and climate change resilient economy and society as aspired by the Horizon 2020 specific programme.

PEER overall supports the detailed position on water research demands developed by EurAqua, the European Network of Freshwater Research Organisations.

It is well recognised that inter- and crossdisciplinary approaches are required for tackling societal challenges. PEER wants to stress one specific link that has not received sufficient attention in the past: the link between environmental and health research and more specifically the **benefits that nature provides for public health. Understanding these complex interrelations and using**

**this knowledge for lowering the costs of the health system should be addressed** as a joint task of SC1 and SC5 in Horizon 2020.

Having underlined the above described priority research areas, PEER will in the following present the results of four working groups that have analysed research and innovation needs on selected, more specific issues:

**“Cultural Ecosystem Services and Public Health”** where cooperation between environmental, social and health areas can bring important innovations;

**“Urban Environmental Equality”** because more people will live in cities, and establishing liveable, resilient and attractive urban areas will be essential for sustainable development;

**“Heat Waves and Droughts”**, as the impacts of flooding are clearly visible and it is well known that an improvement in predicting and managing floods still requires research and innovation, the impact of heat waves and droughts on ecosystem functions and resulting economic losses pose a less obvious but severe threat to our economy; and

**“Practical solutions to support the EU transition to Green Economic Growth”** that are essential for Europe as well as worldwide.

These topics are described in greater detail in this paper.

**The directors of the PEER institutes encourage a discussion on the topics suggested, and invite the responsible EU representatives** to a further exchange at forthcoming occasions like the PEER Directors’ Board Meeting.

<b>Topic Title:</b>	<b><i>Cultural Ecosystem Services and Public Health</i></b>
<b>Responding to questions of the consultation</b>	
<p><b>Q1.</b> What are the challenges ... that require action under the Work Programme 2018-2020? Would they require an integrated approach across the Horizon 2020...?</p>	<p>One of the Sustainable Development Goals (SDG 11) of the UN is making cities inclusive, safe, resilient and sustainable. Target 11.7 explicitly mentions providing universal access to safe, inclusive and accessible, green and public spaces as a goal in itself. Also in the New Urban Agenda, foreseen to be adopted in the fall of 2016, establishing an adequate provision of common goods such as streets and open spaces is likely to be prioritized. At the moment it is unclear what adequate provision of access to green space looks like. However, it is clear that, however defined, in many European countries access to green space is not equally distributed, usually with deprived urban neighbourhoods having lower access, especially to high quality areas. Reducing inequality within and among countries is also a goal as such (SDG 10).</p> <p>Providing access to green spaces may help to achieve other goals, such as to ensure healthy lives, community cohesion and promote well-being for all at all ages (SDG 3). Specific targets for this goal are to end preventable deaths of newborns and children under 5 years of age (Target 3.2) and to reduce by one third premature mortality from non-communicable diseases through prevention and treatment, and promote mental health and well-being (Target 3.4). Access to green space has been shown to be positively related to birth weight in several European countries, as well as to physical activity (and thus obesity), mental health and well-being. It is also positively associated with social cohesion and place-making. Moreover, nearby green space has repeatedly been shown to be stronger associated with the health and well-being among deprived people, thereby reducing socio-economic health disparities.</p> <p>The Expert Group on Nature-Based Solutions (NBS) and Re-Naturing Cities has defined NBS for improving well-being in urban areas as one of the seven priority nature-based research and innovation actions to meet societal challenges (EC, 2015). The Expert Group states that there is a need for projects which show how the multiple social benefits, and other co-benefits, of NBS can be most effectively realised through the systemic integration of NBS into urban planning.</p> <p>Knowledge on how exactly the (peri-)urban nature and green infrastructure produce health and well-being benefits and for whom is limited. This already starts with how best to define access to green space; an issue, WHO Europe is working on at the moment. There is even less known about the qualities that green spaces should possess to maximize their health and social benefits, especially when it comes to cultural ecosystem services. At the same time, there are indications that especially such cultural ecosystem services are responsible for creating health benefits, through mechanisms such as stress reduction and facilitation of social cohesion, perhaps even more so than by way of regulating ecosystem services such as improving air quality. All in all, links between the peri-urban green infrastructure and spaces and the cultural ecosystem services they offer, as well as links between the services offered, the use that is made of those services and the health and well-being benefits that are the result of this use, deserve more systematic research attention.</p>

This specific challenge will benefit from an integrated approach across the Horizon 2020 Societal Challenges, more specifically SC5 (Climate action, environment, resource efficiency and raw materials), SC1 (Health, demographic change and well-being), SC2 (Food security, sustainable agriculture, marine and inland water research and the bioeconomy) and SC6 (Europe in a changing world, esp. inclusive societies).

It should be noted that most Sustainable Development Goals combine human health and environmental aspects, many of them explicitly, and are linked with cultural ecosystem services. These include SDG2 (End hunger and promote sustainable agriculture), SDG3 (Ensure healthy lives and promote well-being), SDG6 (Ensure availability and sustainable management of water and sanitation), SDG8 (Ensure access to affordable, reliable and sustainable energy), SDG12 (Ensure sustainable consumption and production patterns), SDG13 (Take action to combat climate change and its impacts), SDG14 (Conserve and sustainably use the oceans and marine resources) and SDG15 (Protect, restore and promote sustainable use of terrestrial ecosystems). Cultural ecosystem services are essential also for SDG4 (Ensure inclusive and equitable education) due to their educational and awareness-raising aspects, and for SDG16 (Promote peaceful and inclusive societies) due to the central role of cultural appreciation of nature for this goal.

Significant services – cultural as well as provisioning, supporting and regulating – thus flow from ecosystems even beyond urban settings, also in ways that have great importance for human health. A resultant challenge is to understand and sustainably manage the functional linkages between cities and surrounding territories. Food production is also a case in point: essential for health and simultaneously a fundamental part of cultures, and linking rural and urban areas in complex ways and chains.

**A key challenge in both urban and rural environments is to align such varied goals and ecosystem services and benefits in the field of environmental management with those in human health care.** Specifically, synergies and co-benefits between environmental and health care need to be identified and improved, while reconciling conflicting goals and enabling intelligent tradeoffs. But even more profoundly, understanding and appreciation of the importance of nature for humans, and vice versa, needs to be developed e.g. in ethical and philosophical respects for efficient policies and actions.

<p><b>Q2.</b> What is the output/impact that could be foreseen? Which innovation aspects could reach (market) deployment within 5-7 years?</p>	<p>The knowledge generated by this research will be an important contribution to develop and implement effective and efficient Nature-Based Solutions to improve the well-being of citizens, in particular citizens in urban areas, and the quality of life in cities. Knowing which type of green space that generates specific services and potential health benefits and what the local demand for these services is, will help to determine which changes in the green infrastructure are required. It will allow focusing on the active components of the green infrastructure, using the limited space in the urban context in an efficient way. Insight in dose-response relationships will offer valuable input for social cost-benefit analyses. It may offer counterarguments for densification, may lead to altering existing green infrastructure or may influence the development of new residential areas.</p> <p>Likewise, the impacts of focused and actionable R&amp;I in the importance of cultural ecosystem services for human health in settings beyond the urban can be decisive for achieving SDGs. Especially as health is understood as a broad entity encompassing and underlying all facets of well-being and as a dynamic social process, unpacking and innovating cultural (and other) ecosystem services can be a game-changer in both environmental management and health care, even in economic and general policy.</p> <p>Innovations both in technologies (including ICT) and in social processes, especially those led by the public sector (including economic steering mechanisms and policy institutional development) can be realistically deployed within 5-7 years, especially by capitalizing on the interest in rapid development of institutional and other contextual conditions for key Nature-Based Solutions promoting human health and well-being (in many cases promoting One Health goals by improving the health of non-human animals and ecosystems).</p> <p>The generated knowledge will also contribute to finding treatment options and effect sizes of such options for life-style related illnesses such as obese as well as mental illnesses including depression. The research outputs will also provide knowledge to policy makers when identifying costs and benefits of certain green infrastructures in cities, particularly as the health effects of urban green spaces are usually not accounted for as of now.</p> <p>In addition, the generated knowledge will promote linkages between physical health benefits and social improvements in cities, including better governance, reduction of inequality and stronger communities.</p>
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<p><b>Q3.</b> 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?</p>	<p>Drastically changing the existing urban form and fabric usually is not feasible, due to costs being prohibitively high. This makes an efficient use of existing green spaces especially important. Up till now the research on nature and health has focused largely on access and availability, using crude indicators. Research on the importance of preconditions and required qualities of green space to fulfil its health-benefits generating function effectively may be of more practical use. However, this research is in its infancy.</p> <p>Urban green spaces are often public spaces. As holds for most public goods, financing the creation and maintenance of such goods is problematic, due to beneficiaries not directly bearing the costs. Local authorities need to be able to legitimize public expenditures on public green spaces. More insight in their benefits, health and otherwise, will help them to do so. Also within local authorities themselves, different departments are usually responsible for the green infrastructure on the one hand and public health on the other, with the former being held accountable for expenditures on green space and the latter not being fully aware of the benefits. Moreover, the specific quality and location of public green spaces that will promote the health of urban citizens still need to be determined in relation to diverse urban contexts.</p> <p>Within and beyond urban settings and local solutions, important knowledge gaps exist in the functional relationships of ecological and other biophysical entities on one hand and the societal entities and processes influencing these entities. The interactions of ecosystems and humans at all scales thus need to be analyzed. Moreover, many of the societal drivers themselves, such as those from migration, global connectedness and communication, inequalities and cultural variability, are poorly known also with regard to health implications and particularly when interacting with usages of urban green spaces, requiring that R&amp;I not only accounts for their influences but addresses them as topics of research and experimentation in their own right (cf. Q4 below). For instance, the cultural divisions and dynamics in ecosystem services for well-being need to be better understood.</p> <p>Health in All Policies (HiAP) acknowledges that health determinants cannot be influenced by health policy on its own, and should also be paid attention to in e.g. environmental policies. At the same time, access to well-designed green spaces and/or contact with nature may be a health determinant that has received relatively systematic attention within the health domain thus far.</p>
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<p><b>Q4.</b> Which areas could benefit from integration of horizontal aspects such as social sciences and humanities, responsible research and innovation, gender aspects, international cooperation?</p>	<p>In line with the One Health and Health in All Policies initiative, and the corresponding integrative initiatives in the environmental policy area such as the Cardiff process, addressing the above challenge will benefit from the inclusion of a wide range of disciplines, from the environmental as well as from the health, social and policy domain. Disciplines to be considered are: spatial and city planning, landscape architecture, ecology, human and medical geography, epidemiology, health sciences, environmental psychology, political and policy science, urban sociology, and economics including health economics. As already mentioned above, there is also a clear link with SC1 and SC6.</p> <p>Moreover, it is not only about integration of scientific disciplines, but more extensively and profoundly about the integration and coordination of applied activities in the corresponding societal sectors (e.g., environmental and health care), levels of governance (from local to global, including international dynamics) and actor networks (including private and civil society actors). In all these dimensions, integration needs to take place between research and other means of information production (e.g. from testing and monitoring) and processes where information is evaluated and acted upon (including the ethical and political questions involved). Integration therefore needs to pay attention to co-generation of knowledge, and trans-disciplinary and participatory approaches to social innovation and learning are inherently important.</p>
<p><b>Q5.</b> In view of the recent evolution of the socio-economic and policy context (see point 3 of the consultation letter), what are the emerging priorities for Societal Challenge 5?</p>	<p>As mentioned, the identified challenge within SC5 is linked to several priorities in terms of the Sustainable Development Goals as defined by the UN (SDG's 3, 10 &amp; 11), as well as to some of the specific targets mentioned within these goals. It is also linked to priorities in the foreseen New Urban Agenda, especially the operational enablers urban planning and basic services &amp; infrastructure. With regard to the strategic agenda of the European Union in times of change the proposed research topic fit in topic 2 'A Union that empowers and protects all citizens'. With regard to the policy areas set out by the Juncker Commission on which the EU needs to focus its efforts, it fits in 'A deeper and fairer economic and monetary union' by reinforcing the global attractiveness of the EU as a place of living, and delivering benefits for all by promoting a climate of societal fairness. This is intimately linked with environmental and health justice. The fairness aspects include the concern for meaningful occupation and future generations. Thus, in addition to focusing on monetary policy contexts and instruments, R&amp;I should elucidate more profoundly how protection and management of nature and natural resources can be simultaneously an answer to health, demographic and well-being challenges as well as part of a green growth strategy and a sustainable model for civil societies and businesses. This will lead to social and policy institutional innovations, systems and processes, based on an socially inclusive, democratic and transparent policy perspective, and will promote the health and well-being of all across age and socio-economic status.</p>

<b>Topic Title:</b>	<b><i>Urban Environmental Equality</i></b>
<b>Responding to questions of the consultation</b>	
<p><b>Q1.</b> What are the challenges ... that require action under the Work Programme 2018-2020? Would they require an integrated approach across the Horizon 2020...?</p>	<p>The world has stepped into the urban age, where urbanisation prevails and cities increasingly surface as places of heterogeneities and complexities, of risks and opportunities, and as main actors of regional development. Consequently, cities have moved high on research and policy agendas. The interplay of complex urbanization processes and global environmental change puts increasing pressure on environmental and human resources, ecosystems and their services. These processes interact with demographic, social, political, cultural, technological and economic changes, and manifest themselves strongly in cities. An outcome of this interaction with wide social and economic impacts is social, economic and environmental urban divides which are increasingly acknowledged as existing within and between urban areas in Europe. This will challenge the democratic dimension of policy implementation.</p> <p>In aiming to understand these interactions and impacts, research has tended to focus mainly on single-stressors and/or local case studies, treating inequalities linked to the environment in cities in a rather fragmented way. Therefore, more research will be needed on dividing drivers, processes and structures, particularly on how they appear in terms of environmental inequalities in European cities under conditions of global environmental change, economic stress, societal dynamics, trade patterns, at multiple scales and differing local development pathways, also acknowledging that environmental inequalities raise concerns about social and environmental justice issues which are still marginal issues on research and policy agendas in Europe, notably in cities.</p>
<p><b>Q2.</b> What is the output/impact that could be foreseen? Which innovation aspects could reach (market) deployment within 5-7 years?</p>	<p>The knowledge generated by this research will be an important contribution to address the intertwined challenges of social equality and environmental challenges in cities. This will help to unravel urban complexities and interactions by including and specifying links between the environment and urban issues, in and across specific city contexts, and widening the scope for knowledge on dynamics and systems in urban societies. It will provide more evidence on how different ongoing processes in cities interact and reinforce each other, and how this relates to inequality in terms of the distribution of and access to environmental resources, amenities, information, and services as well as exposure to environmental risks and hazards. This will inform and assist policy-makers and planners at local, national and European levels to put into practice integrated innovative solutions in policy implementation, increasing urban sustainability and social and environmental justice. It will help to improve notably human health and quality of life. urban coherence, balanced introduction of technologies and territorial attractiveness for diverse population groups and businesses. Research will also provide a body of precompetitive knowledge which can be used by (small) innovative firms working with citizens on sustainable solutions which contribute to equality in urban contexts.</p>

<p><b>Q3.</b> 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?</p>	<p>In order to achieve more sustainable urban areas, cities need to be recognised as complex environments, in the acknowledgement of the interlinkages of social, economic, and ecological processes at different scales in time and place. A gap exists in integrated approaches that go beyond investigating single-stressors in terms of a) the distribution of and access to environmental resources, amenities, and services such as clean water, clean air, urban green areas, and sustainable mobility, b) the exposure to environmental risks and hazards such as flooding, heat, pollution and noise, and c) the access to information and capacity of influence on environmental policy and planning in the form of e.g. participation, collective action and knowledge. To capture general dynamics, trends and drivers, research on urban environmental equality should go beyond investigations that associate inequality aspects with the ‘urban poor’ or specific, often ethnic, minorities in the context of socio-spatial disparities, vulnerabilities and health issues and mostly oriented on single case studies.</p> <p>It is especially the limited evidence on how different current processes in cities interact and reinforce each other, and how this relates to inequality in terms of the distribution of and access to environmental resources, amenities, information, and services as well as exposure to environmental risks and hazards that needs further consideration. Also, studies of the implementation and the evaluation of explicit innovative solutions and strategies are sparse. Specific focus is moreover needed the particularities of cities.</p> <p>Case-based investigations of urban environmental in-/equality as well as transferable results that go beyond urban case studies and context-specific indicator-approaches, thus reflecting the broader picture, are needed. Comparative studies can give insights to whether and to which extend diverging paths of environmental inequality in European cities exist. Transferring lessons between and from cities in Europe, and possibly also in the non-European context, is crucial and needs to be part of the research agenda.</p> <p>In order to determine the capacity of city governments and communities to design options for more environmental equality in European cities, research on existing governance structures is needed, and social, policy innovative, economic/financing and technological solutions have to be developed, and serve as basis for policy recommendations. The evolvement of urban environmental policies needs to be studied in order to understand how the European social models alleviate urban environmental inequalities.</p>
<p><b>Q4.</b> Which areas could benefit from integration of horizontal aspects such as social sciences and humanities, responsible research and innovation, gender aspects, international cooperation?</p>	<p>The suggested research needs strong interdisciplinary and transdisciplinary approaches with a set of mixed (quantitative and qualitative) methods that take advantage of the rich expertise and knowledge of urban decision-makers, private companies and citizens. The urban environmental equality agenda could contribute positively to embrace the emerging interest in the environment-equity nexus and by bringing together separate environmental problem formulations and policy fields through a spatial lens. At European level, data collection and monitoring efforts could be used for developing a distinctly European perspective to urban environmental equality, enabling also environmental equality comparisons between cities and, at the sub-city level, to understand intra-city disparities. As already mentioned, transferring lessons between and from cities also in the non-European context is important for a systematic analysis of the broad range of urban processes and should be part of the research agenda.</p>

<p><b>Q5.</b> In view of the recent evolution of the socio-economic and policy context (see point 3 of the consultation letter), what are the emerging priorities for Societal Challenge 5?</p>	<p>Understanding and mitigating urban environmental inequality will be essential to the New Urban Agenda, in particular the relationship between the environment, urbanization and social cohesion and inclusiveness, and will meet policy priorities set out by Juncker’s Commission. Firstly, it will provide crucial knowledge for the promotion of liveable, resilient and attractive European urban areas that integrate nature based solutions and healthy and socially strong communities and lifestyles. Novel research on urban environmental equality will underpin citizens, governing institutions and companies to thrive and progress in sustainable cities that develop into liveable places of production, education and multi-cultural living. Better knowledge of the processes and drivers behind urban environmental in-/equality will require and foster innovative cooperation between private bodies, civil society and public institutions, across member states and levels of policy making, creating new and integrated approaches and tools to circulate and implement innovative social and economic strategies. Secondly, allocating priority to urban environmental equality issues will foster more inclusive, democratic and resilient urban communities, and will also most likely foster healthier urban populations, in terms of physical and mental health, and across age and culture. Thirdly, the issues of urban environmental equality will contribute to the energy policy priority issues in the context of mitigating climate change and adapting to impacts. The fair access of populations to affordable and climate-friendly energy and its consequences on health, the impact of land use policies on local climate change (Paris Conference, 2015) and its core role for populations, e.g. reducing exposure through the use of land use planning to mitigate environmental risks like urban heat islands or transport induced degradation of urban air quality, will be important elements for public institutions in the definition of local options and policy paths, and in the identification of opportunities for innovative green businesses (and thus also for creation of new jobs) in this sector. Fourthly, in recognition of cities as main actors of regional and European development, new research and integrated analyses on urban environmental equality issues will contribute to promote the European Union as a strong and vital global actor in the field of urban sustainability. Fifthly, research on urban environmental equality will contribute to comprehensive observation and information systems by examining and documenting the social dimension of human-nature-built environment relationships. Sixthly, more knowledge in the field of urban environmental equality will assist improved and more equitable access to electricity, food and water, biodiversity and urban mobility systems.</p>
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Topic Title:	<i>Heat waves and droughts</i>
<b>Responding to questions of the consultation</b>	
<p><b>Q1.</b> What are the challenges ... that require action under the Work Programme 2018-2020? Would they require an integrated approach across the Horizon 2020...?</p>	<p>Extensive analyses of projected changes in essential climate variables (ECV) such as streamflow, soil moisture based on climate and land surface model projections have been carried out during the last decades. So far, however, no comprehensive picture of the anticipated changes has evolved. Furthermore, recent studies clearly emphasized the large uncertainties in both observed and projected changes, thus concluding statements cannot be drawn at the moment. This statement specially applies for droughts and heat waves (Trenberth et al. Nature, Climate Change: 2014).</p> <p>Nevertheless, there is clear evidence for the impact of potential changes: for example the heatwave / drought of 2003 had substantial effects on plant mortality and plant productivity in Central and Western Europe.</p> <p>Heat waves and droughts are creeping hydro-meteorological events that could bring societies and natural systems to their limits, inducing large famines (see effects on plant mortality and productivity above), health risks to the population, drinking and irrigation water shortfalls, natural fires, degradation of soil and water quality, and in many cases large socio-economic losses.</p> <p>Mutual enhancement between droughts and heat waves in transitional regions between dry and wet climate is common. A drought can make a hot day hotter, while a heat wave can make dry conditions even drier. A characteristic of these hydro-climatic extremes is that they may be the result of an accumulation of weather or climate events that are, individually, not extreme themselves - though their accumulation is extreme.</p> <p>A grand challenge in this case is to improve the skill of numerical weather prediction (NWP) models at middle and seasonal ranges so that the predictive uncertainty of hydrological models (HM) estimating key ECV (e.g., soil moisture) is minimised. Mobile monitoring of ECVs with proximal/remote sensing techniques (e.g., cosmic ray sensors) would be crucial to enhance HMs predictability everywhere and on the right time. This would require a mobile platform (e.g. airplane) dedicated for specific events which can collect land-surface information – with respect to hydrology and vegetation – on the basis of a suite of remote sensing sensors.</p> <p>These extreme events leave their legacy on ecosystems and their functions. Due to their singular properties, it is difficult to assess how these events exactly change ecosystem functions and their services (e.g. sustainable provision of food) and much better understanding and prediction is required, including of the economic consequences which can be tremendous (most obvious are e.g. direct losses in agriculture).</p> <p>Global Observing Systems Information Center. GCOS Essential Climate Variables (ECV) Data Access Matrix, <a href="http://gosic.org/ios/MATRICES/ECV/ECV-matrix.htm">http://gosic.org/ios/MATRICES/ECV/ECV-matrix.htm</a>.</p> <p>Trenberth, K.E., Dai, A., van der Schrier, G., Jones, P.D., Barichivich, J., Briffa, K.R., Sheffield, J., 2014. Global warming and changes in drought. Nature Climate Change 4, 17–22. doi:10.1038/nclimate2067</p>

<p><b>Q2.</b> What is the output/impact that could be foreseen? Which innovation aspects could reach (market) deployment within 5-7 years?</p>	<p>According to the IPCC (AR5), it is likely that the frequency and duration of heat waves since 1950 has changed in large parts of Europe, Asia and Australia. In some regions, it is likely that human influence has more than doubled the probability of occurrence of heat waves. Models project near-term increases in the duration, intensity and spatial extent of heat waves and warm spells.</p> <p>The frequency and intensity of drought has likely increased in the Mediterranean and West Africa. There is medium confidence that droughts will intensify in the 21st century in southern Europe, the Mediterranean region, and central Europe, due to reduced precipitation and/or increased evapotranspiration.</p> <p>These expected changes would bring unprecedented socio-economic consequences to Europe. A potential example is an increase of migration from Africa caused by drought induced hunger crises.</p> <p>Delivering a framework (see. event specific monitoring above) that will be able to analyse the impacts of heatwaves and droughts and their associated societal costs will be used to mitigate the impacts and hence save a considerably proportion of costs incurring otherwise.</p>
<p><b>Q3.</b> 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?</p>	<p>Improving skills of numerical weather prediction models (NWP), hydrological models (HM) and monitoring the current vegetation state (productivity/stress), and the linking of their predictive output to changes of ecosystem functions and services (EFS) is intrinsically related to four issues: 1) how to get close to reality initial conditions, 2) how to reduce the simulation errors associated with the spatial discretization, 3) how to link the information about potential changes in abiotic factors to potential changes in the ecosystems, and 4) how to assess the consequences for ecosystem functioning and services.</p> <p>The first challenge is ultimately a question on how to get real time observations to be able to assimilate them in the respective models. This implies designing intelligent monitoring networks that can be deployed fast and efficiently where they are mostly needed. This can more easily be done for abiotic conditions. Detecting and recording biotic changes, however, is inherently difficult since it is time-consuming, cannot be done in an automatized way and ideally can perform a “before-and-after comparison”.</p> <p>The second issue is a problem of computational capability and storage. NOAA and ECMWF expect to make 1-5 km resolution NWP systems by 2025 and by doing so improving model skill.</p> <p>The third issue address the challenge to turn the prediction of changes in abiotic parameters on prediction of changes of ecosystems (e.g. agricultural ecosystems) which is precondition to issue four the assessment.</p>

<p><b>Q4.</b> Which areas could benefit from integration of horizontal aspects such as social sciences and humanities, responsible research and innovation, gender aspects, international cooperation?</p>	<p>Socio-economic aspects need to be integrated in the modelling chain (NWP-HM-EFS) so that end-users get realistic assessments of the upcoming risks. Having outlooks for one to six months ahead, end-users would be able to develop appropriate mitigation actions.</p> <p>Furthermore, making use of long-term scenarios, stakeholder groups and different sectors can make use to modify their strategies, infrastructures and management plans etc. to adapt to or mitigate such events.</p> <p>International cooperation is highly relevant because heatwaves and droughts pose challenges in different parts of the world.</p>
<p><b>Q5.</b> In view of the recent evolution of the socio-economic and policy context (see point 3 of the consultation letter), what are the emerging priorities for Societal Challenge 5?</p>	<p>Considering that an increase of heatwaves and droughts can lead to unprecedented socio-economic consequences to Europe, the topic can linked directly to following two points of <b>strategic agenda for the Union in times of change</b><sup>2</sup>:</p> <p>The Union as a strong global actor (<i>be a strong partner in our neighbourhood: by promoting stability, prosperity and democracy in the countries closest to our Union, on the European continent, in the Mediterranean, Africa and in the Middle East</i>)</p> <p>A Union of freedom, security and justice (<i>better manage migration in all its aspects</i>)</p> <p>In practical, direct terms, the Copernicus Climate Change Service and the associate stakeholders will profit from this action. Projects like EDgE <sup>1</sup> will be able to deploy its upgraded modelling chains and provide almost in real time information to the end-user and decision maker.</p> <p><sup>1</sup><a href="http://climate.copernicus.eu/edge-end-end-demonstrator-improved-decision-making-water-sector-europe">http://climate.copernicus.eu/edge-end-end-demonstrator-improved-decision-making-water-sector-europe</a></p> <p><sup>2</sup> <a href="http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/143477.pdf">http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/143477.pdf</a></p>

<b>Topic Title:</b>	<b><i>Practical solutions to support the EU transition to Green Economic Growth</i></b>
<b>Responding to questions of the consultation</b>	
<p><b>Q1.</b> What are the challenges ... that require action under the Work Programme 2018-2020? Would they require an integrated approach across the Horizon 2020...?</p>	<p>Humans have changed our natural (eco)systems more rapidly and more extensively over the past 100 years than in any period before. These changes have generated various severe and lasting environmental problems and do limit the availability of our natural resources and the services they provide. These developments have been largely driven by our traditional one-way linear thinking and acting and economic models defined as resource – product – waste. Green Economy is considered an approach to achieve a more sustainable industrial development: one that improves both well-being and social equity (UNEP), prosperity (EEA), sustains the provision of resources and services (OECD) and resilience to natural and man – induced hazards such as climate change (World Bank). It is also fundamental for achieving the ambitious Paris agreement on climate change.</p> <p>The challenge in this development is to better understand and communicate the concepts and foundations for a future circular and green economy. Such a transition would potentially secure the maintenance of the full range of ecosystems services and natural resources on which our society relies.</p> <p>Some solutions are more compliant with the mainstream economy and require few changes (e.g. cleaner production), whereas other solutions are more system-oriented and based on profound transformations in the patterns of production and consumption (e.g. industrial ecology).</p> <p>This transformation in Europe and in other areas in the world to develop a green economy requires innovation in terms of technology, knowledge in terms of education and awareness, organisational support (policies and economic support), market development (financial support and investments) and societal conditions (consumer acceptance) and a overarching governance framework (with indicators, benchmarks and targeted policies or links to existing policy frameworks) and attractive and clear communication (infographics).</p> <p>Within Europe several regions and countries are front runners and other lag behind. A transition would benefit from cross sector and cross country learning within Europe. Many opportunities are not limited to Europe and relate to other continents as well. A global progress is also in Europe's interest as it is related to fundamental issues of sustainable development, resource scarcity and climate change. The progress in developing a green economy would benefit from harmonized monitoring and targeted communication and training across Europe and beyond. Development of a global green economy will help in combating poverty and creating environmental and social resilience at local and global scale.</p>

<p><b>Q2.</b> What is the output/impact that could be foreseen? Which innovation aspects could reach (market) deployment within 5-7 years?</p>	<p>The concept of a green economy is related to a range of different economic theories, concepts and practical approaches. These all aim to provide environmental, economic and social benefits. This could be achieved through and along with the generation of new jobs and skills and development, promotion and implementation of cleaner technologies that reduce environmental risks and alleviate poverty.</p> <p>An up to date portfolio of both showcases of existing solutions and of transition pathways based on scenarios and storylines and scientific evidence with clear economically, socially and environmentally attractive benefits will facilitate the stakeholder and industry acceptance of solutions, challenges and risks.</p> <p>The progress of a green economy transition can be measured and monitored and further supported by a range and set of clear and harmonized indicators. Ideally this would be based on the few but existing national sets of indicators and be adapted to monitor and guide the development of the green economy.</p> <p>The results should secure a better and more holistic integration of innovations and existing knowledge in the green economy initiatives. Projects should be based on co-creation with different stakeholders from their beginning and conceptualization of the ideas through to the implementation in order to increase the transformative power of the research in terms of innovations and new economic opportunities. Results will enable industries as well as governments to implement resource management and technology systems which support mitigation of environmental deterioration and climate change.</p>
<p><b>Q3.</b> 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?</p>	<p>Transitioning to green economy is never purely based on win-win solutions and requires taking into account potential trade-offs among multiple goals, across sectors and international leakage as well. A solid and ‘agreed by all’ assessment framework would facilitate the across border, across sector and multiple goal analysis of activities and transitions. Relevant stakeholders include primary producers (e.g. agriculture), processing industry (e.g. building, food processing, chemistry) and consumers and consumer organisations (NGO’s).</p> <p>A detailed and harmonised documentation of successes in case studies – show cases – is not available yet. Such a set of case studies and story telling on successes and failures would benefit identification and development of sound investment plans and economic, social and environmentally sound business cases across the European continent and globally. This would pave the way to agree and share on solutions and pathways that allow industry to develop a market for green economy and consumer acceptance of the green economy solutions.</p> <p>The practical implementation of the green economy is related to a multiplicity of factors and causalities depending on the context. The complexity and multi-sectoral nature of the green economy calls for a broad co-integration of policies bridging the environment, innovation, transport, housing, energy, agriculture and spatial planning. A PEER case study analysis illustrates the need for comprehensive analysis of the effects of regulation and legislation. Many of these cases also illustrate the importance of stakeholder commitment, good leadership and coordination.</p>

<p><b>Q4.</b> Which areas could benefit from integration of horizontal aspects such as social sciences and humanities, responsible research and innovation, gender aspects, international cooperation?</p>	<p>So far the implementation of the green economy has not relied strongly on economic viability and stakeholder commitment. It would benefit from strong participation by the financial sector to guide and support sound economic investments and by consumer organisations to recognize the contribution to sustainable development and secure the lasting support of consumers at large. A green economy would likely have businesses and skills work together that have never worked together before. This does require strong investment in networking and social capital and requires to develop and operationalize supporting and incentivising technology and information. This includes working together in communities of practice, set up of (regional) knowledge and innovation platforms, developing easy to understand infographics and contributions to ‘life long learning’ activities in industrial design and industrial production.</p>
<p><b>Q5.</b> In view of the recent evolution of the socio-economic and policy context (see point 3 of the consultation letter), what are the emerging priorities for Societal Challenge 5?</p>	<p>The challenges in SC5 are clearly linked to the UN Sustainable Development Goals and targets set.</p> <p>Greening the economy clearly links the urban challenges with the rural areas and natural capital issues. As more people will live in cities and urban areas the risk of disconnection is real and this would jeopardize the connectiveness and willingness to contribute and partner in ownership of solutions.</p> <p>The economic crisis has slowed down the investment in greening technologies and solutions whereas transitions are more urgent than before as resources become more and more limited. In 2015, COP21 challenged the international community and policy makers to limit climate change to 1.5 degrees only. This clearly asks for more biobased and circular solutions to our food, chemistry and industrial production economy. Major threats to food and energy supply security are global problems. Europe can show leadership in developing and implementing novel solutions but also in providing resilient solutions to regions that face the greatest uncertainties in terms of resource access and availability.</p>

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