EPA Submission on the IDC Consultation Paper for Successor to Strategy for Science Technology and Innovation (STI)

The Environmental Protection Agency (EPA) welcomes the plans for a successor strategy to the Strategy for Science, Technology and Innovation 2006-2013. It provides a clear opportunity for Ireland to develop a new whole-of-Government strategy for research and innovation. It can build on the progress made to date in developing Ireland's research and innovation system, as well as addressing identified innovative approaches to address the wider challenges that Ireland faces. Research plays a crucial role in tackling societal grand challenges and the development of a sustainable knowledge economy.

The EPA has statutory responsibility for development of environmental research and the overall coordination of environmental research in Ireland. Environmental research primarily promotes and supports the achievement of a healthy and sustainable environment and population which underpins economic development. A major emphasis of the EPA research programmes, since their commencement in 1994, has been to provide essential information in support and assessment of policy and decision-making at local, national and EU levels. It has also acted to support the effective implementation of EU and national environmental legislation.

This research, has been primarily conducted in Irish institutions, has greatly assisted Ireland in meeting national targets, e.g., on meeting Greenhouse Gas emissions targets, and in engagement with and addressing obligations arising at EU and international levels in the areas of climate change, water quality, waste, air quality and biodiversity. Its achievements are also critical to and underpin economic progress including work of Bord Bia Origin Green, tourism, and support quality inward investment.

EPA research has been both successful and strategically important for Ireland. However, as shown in Table 1 of the consultation document it only made up 1.2% of the national research spend in 2013.

Specific Comments in relation to Pillars in Consultation document

In the following section commentary is provided in relation to a number of the key areas listed for consultation

Pillar 1 Investment in STI and key goals/targets

The EPA agrees that ongoing and sustained investment in science, technology and innovation is central to Ireland's future economic and social development. This has been shown by a range of studies. The EPA considered that a primary rationale for Government investment in STI is to develop a competitive knowledge based economy that is also environmentally sustainable and resilient. The latter points will be increasingly important in resource constrained world which is facing major societal challenges. This reality has been recognised by the EU Horizon 2020 programme under which, 60% of the entire expenditure is aimed at sustainable development and 35% of the budget expenditure is to go towards climate change related projects

Spending on research should be at a level that is commensurate with our level of economic activity as measured by GNP and be at least being on par with the EU average. However, it is essential that

a more equitable distribution of national research spend is enabled under the new SSTI. The aim should bolster research in areas that were to an extent neglected under the 2007-13 SSTI. The EPA considers that the new strategy needs to also address directly and in substance key societal challenges that Ireland faces including environmental, sustainability and transitional challenges. In relation to the specific questions:

- The discussion document has provided ample justification for an enhanced level of ambition.
- In relation to innovation, it is recognised that Ireland cannot be a leader in all areas of R&D. However, the new strategy should enable the research community in Ireland to continue to lead in areas that were successful under the previous strategy. It should also enable work that was not included in the previous strategy and in which Ireland already has leading researchers, e.g., in earth observations and raw materials.
- As a national strategy it should also build on areas in which Ireland has specific interests/challenges or advantages due to scale location and geography. These have considerable potential for economic development and innovation as is outlined later

In summary the future SSTI and research funding should advance a broader strategic agenda to advance areas of national interest including areas that have largely fallen outside of the previous strategy.

Pillar 2 – Prioritised Approach to Public research Funding

The National Research Prioritisation report (NRPE) Report identified 14 priority areas for research funding. These were quite narrowly defined. That Report also recognised the vital role that policy-related research plays in ensuring that EU and national polices are implemented in a cost-effective manner. However, there was relatively low level of investment in these areas. This imbalance needs to be addressed in both the formulation of the new strategy and in its implementation, which should be structured to take a whole of government approach to advancing and using research to achieve key national and sectoral goals and objectives. There are already many good examples of how this can be achieved, e.g., in relation to the EPA work on co-ordination of Climate Change and Water research which works across a number of state agencies and departments in a cooperative manner. In relation to the specific questions:

- In particular the new strategy needs to position itself to address the grand challenges that we face and which will increasingly be a factor in economic and societal development. These challenges are recognised under Horizon 2020 (H2020) and are being advanced under a variety of policy fora. They have long time horizons and therefore should be treated in strategically in the new SSTI including through strategic development of national infrastructure and research capacity in these areas.

- The SSTI should therefore be developed in the context of a suite of national objectives, e.g., in the areas of Climate Change, Sustainable Energy, Natural Resources, employment, education, social inclusion and a number of flagship initiatives. This would enhance national objectives of a strong sustainable economy and a better society.

- In relation to identification of emerging areas, this is a cross government activity. A process by which a systematic assessment of trends and changes is provided from all government departments which is used to assess current, medium and long term issues. These should be considered in the context of research funding and prioritisation of research and subject to

regular review. The views of external actors including the major international research councils should also be used to provide and independent perspective.

In summary the new SSTI requires a more holistic approach that covers the continuum of research from basic to applied and captures various national objectives in advancing the research and innovation agenda. It should serve to enhance the delivery of a vibrant inclusive well-educated society with healthy citizens, a clean environment and a resilient and sustainable economy.

Pillar 3 – Enterprise-level R&D and Innovation Performance – Prioritised Approach to Public research

At and EU and Global level[1] there is a growing number of innovative and future orientated enterprises who are focused on the provision and deployment of sustainable and green solutions. This opportunity is recognised under H2020 which launched its flagship Roadmap for Climate Services[2] in March of this year. This complements similar initiatives e.g. under the KIC heading. The aim is to enable the EU to be a leader in the transition to a low carbon, sustainable and resilient economy and society. Under H2020, 60% of the entire expenditure is aimed at sustainable development and 35% of the budget expenditure is to go towards climate change related projects.

The EPA with limited resources has ensured that Ireland relevant issues and research groups are connected to these programmes. However, greater collaboration with enterprise agencies is needed to lever investments for significant economic impact as eco-innovation and the Green economy present significant opportunities to deliver employment opportunities.

EPA funded research primarily aims to develop, inform or improve implementation of policy in environmental areas. However, EPA research funding has resulted in the establishment of three spin-out companies and numerous patents and Invention Disclosure Agreements and is indicative of further potential.

- There are increasing opportunities for further development in the area the Green economy and sustainability from local to global levels.

- The SSTI should therefore have a strong strategic focus in this area with a specific support programme to further drive national innovation.

Pillar 4 – International Collaboration and engagement

International collaboration and engagement is essential to the development of research and innovation in Ireland. The SSTI needs to recognise this as a key element of the strategy. This included engagement with H2020, European Space Agency (ESA) and the Joint Programming Initiative (JPI) process as well as strategy that links to global research groups e.g. Global Research Alliance. The EPA actively supports the development of the European Research Area (ERA) and supports Ireland's engagement with a number of international research programmes.

Laura Burke, the Director General of the EPA, chairs the Advisory Group of Experts for Horizon 2020 Societal Challenge 5 (SC5). The EPA acts as National Delegate and National Contact Point for this Challenge, and as a member of the H2020 National Support Network led by Enterprise Ireland. In addition, the EPA participates at Governing and Management Board Level in both the Climate and

[1] See the New Climate Economy Report http://newclimateeconomy.report/
[2] http://ec.europa.eu/research/index.cfm?pg=events&eventcode=552E851C-E1C6-AFE7-C9A99A92D4104F7E

Water Joint Programming Initiatives, and as task force members on two European Innovation Partnerships (Water and Raw Materials), which could offer potential opportunities for increased engagement with H2020. It also supports engagement with ESFRI work on development of environmental research infrastructures.

A number of the European Innovation Partnerships (EIPs Water & Raw Materials) have proven to be useful tools (a) to facilitate the development and stimulate the uptake of innovative solutions, (b) to guide actions in removing barriers to innovation, (c) to address social challenges, to facilitate industrial leadership in water and raw materials, and (d) to contribute in raising competitiveness and economic growth. More resources are required in support of Irish researchers and/or Innovators to participle in action groups associated with the EIPs and to ensure a leading strategic role for our top researchers[3] in these initiatives which ultimately feed into H2020 research calls.

The EPA has established a catalogue of over 200 Irish research experts that are available to participate in H2020 programmes. This catalogue has been viewed almost **80,000 times** since its inception in December 2013 and has been expanded to include our research capacity in other EU programmes (e.g. LIFE) and actively supports North-South research.

Ireland can enhance its international engagement and collaboration with key European research activities and bodies. In this context the EPA would cite the growing importance of JPI processes and the opportunities that are arising from development of work and capacity on Earth Observations.

- The JPIs in certain areas have developed a strong dynamic with, and influence on H2020. This is likely to grow. In this context a more strategic approach to enhance Ireland's participation in influential JPIs and associated development and call processes is needed. This should be reflected in the SSTI.

- Ireland also has significant interests in progressing work in Earth Observations under both the ESA and Copernicus. There has been a narrow approach and somewhat limited engagement with these initiatives, as there is with linked work under the GEO/GOESS. These programmes provide data and information which is of interest at local levels and have global reach. These points are developed further in Pillar 7.

- The EPA previously indicated to the PAG (High Level Group in Sept 2014) a critical issue in terms of research capacity to apply for H2020 funding in the first instance. In light of the challenging national targets set for H2020 drawdown, and linked to the importance placed by the Commission on complementary funding through the various structural funds, it is critical that the National Smart Specialisation Strategy in some way captures the environmental, climate and resource efficiency agendas as key elements of the strategy.

In summary there is an evolving EU and global research landscape in which Ireland needs have an active role on areas of strategic interest. The SSTI should address this.

Pillar 5 Organisational/Institutional arrangements

The EPA considers that the future SSTI needs to more fully address cross government issues and national developmental goals and challenges. These need to be appropriately supported and addressed through research and innovation. The future strategy should therefore be positioned within an overall national framework that links with and better enables a broader research agenda

[3] Ireland has excellent research capacity such as in Materials science (6th in world)

that is being carried out across government Department and Agencies. This need arises from the increasingly cross-cutting nature of the policy agendas. The SSTI strategy would support cross departmental dialogue and identify where opportunities for synergies exist. This would improve the return on investment and the potential for data connectivity/utilisation and leveraging.

A model for this already exists in relation to a number of research areas in the environmental field. However, an enabling framework which recognises the multi-dimensional perspectives, and the need for targeted research support in these areas, is required. This should not be burdensome process. It could for example use the thematic approach which was successful in progressing the EPA's Climate Change & Water research programmes on a cross agency basis.

In this context a mapping of national and EU goals and objectives with avenues for institutional supports and funding should also be a component of the future SSTI. It cannot be assumed that support for areas of national interest, issues of policy and society goals area are adequately supported by existing structures, and steps should be included to insure that this is the case. This should be an intrinsic component of the national research strategy.
The work and contributions of research bodies, institutions and centres also needs to be assessed on a regular basis. This should ensure that their work and outputs are being communicated, used and where feasible "platformed" in real world situations. In this context the development of laboratories or practice at scale which will serve to pilot and validate technological and other solutions may provide effective avenues for enabling transition to real world solutions including commercial products and services.

In certain cases this will require enhanced support and cooperation of state agencies and similar. However, limited resources may be a barrier. Innovative institutional and hybrid structures may be developed to overcome these barriers. These should allow for constructive engagement between the research, innovation communities and experts in state Agencies/Departments to enable strategic benefits for Ireland which would enhance opportunities for development.

Horizon 2020 recognises significant societal challenges need to be addressed by multi-disciplinary research that encompasses the humanities and brings citizens on board. The new strategy should seek to identify what structures or incentives will bring multi-disciplinary teams together

The Mace Head Observation Station on the Galway coast exemplifies how use of Ireland's strategic location can attract leading researchers and funding to Ireland. Ireland's scale location, geography and environmental quality can be used to further develop Ireland as a location for such research. It is a priority for the EPA to work with other agencies and the research community to realise this potential and develop Ireland as leading location for environmental research and for innovation on sustainable solutions. These are considered to include state of the art systems for; measurement, reporting and verification systems in areas such as carbon management and accounting while noting that there are particular challenges for this area in relation to agriculture and land use. Ireland can be a leader in providing such solutions. The EPA and Teagasc are already working together in advancing such work. The EPA has advocated for such an approach in areas which advance solutions to environmental and societal challenges, but also considers that similar opportunities exist in other areas. In this context

- The SSTI should support a strategic approach to utilisation of Ireland's advantages of location, scale, environmental quality and governance systems, is needed to test bed, pilot and fast track solutions from the laboratory to the real world.

Pillar 6 Dynamic systems to transfer knowledge and technology into jobs

The EPA recognises that knowledge transfer is a key stimulus for innovation and job creation. While the latter is not a core responsibility for the EPA it is cognisant of it role in enabling a secure and high quality and stable environment which underpins economic and social development and creation of employment.

The EPA considers that open and free access to environmental and related data provides an important stimulus for the provision of added value information systems and services. Research based on these data area also generates economic and social benefits.

- Open and free access to data and information is a feature of EPA funded research which does not preclude the registry of patents or other IPR rights.
- The SSTI should as far as is practical ensure that policies and infrastructures are in-place to provide access to such data and underpin knowledge transfer.

Pillar 7 – Government wide goals on innovation in key sectors for job creation and societal benefit

The consultation paper rightly recognises that research supporting policy also generates economic and social benefits and particularly in areas where there is little commercial incentive and that there may be opportunities to lever this investment for commercial impact. This concept needs to be recognised and embedded in the future SSTI.

Research in support of environmental policy plays a vital role in ensuring that EU and national policies and legislative requirements are implemented in the most cost-effective manner through providing an authoritative scientific basis for decision-making, thus minimizing costs. In addition, such research has been critical in improving Ireland's ability to negotiate on international agreements and EU legislative developments. The economic returns for investment in research were well demonstrated through an estimated cost saving of €50m arising from analysis of greenhouse gas emissions as well and in a number of infringement cases against Ireland.

For the STI strategy itself, an enabling framework which recognises the multi-dimensional perspectives of the Departmental/Agency research activities and their outputs and outcomes is required. A number of governance arrangements associated with the STI agenda have evolved over the past number of years (e.g. Inter-Departmental Committee, Priority Action Group and its Priority Area Action Plan groups, H2020 High Level Group, Horizon 2020 Strategic Research Proposals Group, etc.). It would be appropriate as part of the new strategy to review the mandates and membership of the various committees, in the context also of the other existing sectoral coordination arrangements that exist, and seek to clarify, streamline and enhance the effectiveness and efficiency of the governance structures

The research community in Ireland is world leading in Materials Science (6th in world) and is competitive internationally in the Climate, in which 6 authors from Ireland contributed to the work of the IPCC during its 5th Assessment Cycle, and Water areas (36% above world average). The EPA are strategically well aligned in the fields of Climate Change, Water and Raw Materials (see Under Pillar 4 above). There is a strong potential in Nationally-funded research to address local/national/global challenges and simultaneously provide economic opportunities. These have been supported through significant research investments by EPA, SFI and others over the past number of years. Further details on these are included in Appendix 1.

In this context

- The future SSTI needs to recognise that research supporting policy generates economic and social benefits and particularly in areas where there is little commercial incentive. These

also give rise to opportunities to leverage investment for commercial impact. It should also identify enabling structures and processes to advance this as an opportunity area for Ireland.

- The enabling structures and processes should explicitly address key national and EU policy goals in areas such as climate change, water quality, health, energy and sustainable agriculture and food production and establish an effective interface between the research policy and practitioner communities in identification of solutions and promoting and advancing these. This should be a synergistic process which builds on existing structure and processes as well as sectoral exemplars that can provide a template for wider development.

National challenges largely constitute local versions of Global challenges in areas such as climate change, energy, biodiversity, health and resource limits. One way or another, issues such as climate change imply global transformation. Transformation is always a time for opportunity. There are positive opportunities for national development and for the development of local solutions which have global markets in areas such as; urban and rural sustainability and resilience, for energy independence and for sustainable agriculture and enhanced provision of eco-system services.

- The SSTI Ireland needs to embrace National and Global Challenges in its overall goals, and in its structures and implementation processes, or run the risk of a sub-optimal response to the management of transition and transformation and the opportunities it entails.

Approaches such as those used in the H2020 programme where 60% of the entire expenditure is aimed at sustainable development and that 35% of the budget expenditure to go towards climate change related projects may be considered, however, a more elegant and tailored approach may be appropriate for Ireland.

Globally and at EU level there is an ongoing and major investment in advanced Earth Observation systems under programmes such as Copernicus. The European Space Agency is also leading on advancing research in Earth Observations. Globally the work of GEO/GEOSS which is being advanced by DG Research provides an important platform for development at a global level. As noted there has been a narrow approach and somewhat limited engagement with these initiatives. However, the data provided are of interest across a range of sectors and to complement areas of strength in in-situ sensor development. A more pro-active strategic approach is urgently required for this area.

- The future SSTI should enable a strategic cross government approach to advance development and use of EO, and provide an effective platform for its development. This should involve the research and enterprise communities and key public sector actors.

Pillar 8. Research for knowledge and the development of human capital

The development of the human capital element of the research system, the career structure for researchers and the necessary incentives to attract and retain excellent people will be critical elements of the future strategy. The need to create growth, which is environmentally, economically and socially sustainable, raises new, interconnected challenges. Creating the knowledge base necessary to tackle these interrelated issues will require breaking down barriers between disciplines and strengthening the connection between the sciences and the humanities. The trans-disciplinary nature of these societal challenges requires the research capacity across the full range of science, humanity and other disciplines to be harnessed to provide the necessary innovative technological and non-technological solutions to these challenges. Therefore, the identification of the key linkages with other research players outside the traditional STI area, should be an important element of the new strategy.

The identification of enabling supports to enhance the impact of the investment in STI would be an important element to be included in the strategy. The European Environment Agency's SOER report (2015) states the need to strengthen the science-policy-society interfaces and citizen engagement are important elements of the transition process. The EPA research team are currently working on strengthening this area of work in the new research programme Citizen engagement with the science agenda is crucial, both in terms of nurturing the future talent pool of researchers and in influencing the narrative and directing people to accurate sources of information to allow buy-in to novel and emerging safe technologies and innovations. Strategies to enhance the science-policy-society interface should be part of the enabling framework for the new STI.

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Appendix 1: Opportunity areas to address societal challenges and simultaneously provide economic opportunities

Climate change & atmospheric research

In addition to direct investment in environmental observation and analysis infrastructures it is important to highlight the need for supporting structures in areas such as high end computing, data warehousing and analysis systems. It is also important that Ireland is proactive in engagement in key developments such as the EU flagship programme on Earth Observations, Copernicus, as well as underlying research activities as developed by the European Space Agency (ESA). Overall it is essential that an integrated approach is taken in these areas and that the enabling infrastructure for this is in place.

In the context of the challenges and opportunities that face Ireland, the establishment of a Centre for climate change and atmospheric research which combines expertise across various institutes and agencies, such as is done for the UK Tyndall Centre, would enable Ireland to work effectively in a complex and challenging area. This could encompass a range of disciplines and be structured in a manner to provide an effective interface with European initiatives in this area. It would also need to have a flexible structure which allows for utilisation of existing expertise and capacity while enabling development.

Water research

Strengthening innovations in water, will make companies more competitive, will contribute to solving global social challenges, will secure resources, and will contribute to climate change mitigation and adaptation, including the innovative solutions addressing the risks caused by extreme water events. For example, water is a crucial component for smart cities and creates new smart specialisation employment with more than 136,000 SMEs directly involved in the value chains of the water-related economy

While the Water and Wastewater Research Demonstration plant is a well-established facility in Tuam, Co. Galway, an extension and upgrade are necessary to enable more extensive testing of technologies & innovations. Key areas of focus should include (and test facility upgrades should enable):

a. Upgrading of facility to enable more extensive testing of tertiary technologies for wastewater reuse and water.
b. Nutrient recovery from wastewaters and sludge (key area for future innovation).
c. Potential for the facility to link, on a long-term and agreed basis, with the existing municipal wastewater treatment plant for piloting of sludge treatment technologies.
d. Facilitate research on emerging contaminants (e.g. pharmaceutical compounds, metals, pathogens etc.). This may require links to off-site facilities with specific problems in these areas.
e. Facilitate research on odour and gas emissions (contexts such as denitrification, sludge treatment processes).
f. Accreditation for the facility as a test bed for water and wastewater technologies through the Environmental Technology Verification (ETV) programme and develop links to other ETV centres (e.g. Water Research Centre in the UK). This can enable Irish companies more easily develop international markets.
g. Further develop links with the ICT sector to trial and demonstrate ICT innovations for the water/wastewater sector. Partner with ICT sector to enable real-time and remote project monitoring (remote monitoring capability is in place but requires upgrade).
h. Facility should also be used to develop best practice in wastewater plant management including benchmarking, use of real-time modelling to promote efficient and sustainable plant management.
i. Specific funding mechanisms for companies or other research institutes utilising the facility

j. Leveraging the facility as a key part of EU funded international training networks to support the development of highly skilled postgraduate and postdoctoral scientists and engineers.

Resource efficiency/Circular economy research

Ireland has excellent research capacity in the area of Materials Science (sixth in world) and there have been a number of recent significant research investments by EPA, SFI and others over the past number of years. Additionally, Irish researchers have had success at H2020 and also a number of leading Irish Universities and Industries are important strategic partners on the Knowledge Innovation Centre in Raw Materials. Building on these successes there is potential for the establishment of a test facility to bulk trial mineralogical / metallurgical technologies for research / demonstration of extraction processes for new minerals resources from mineral waste, including critical raw materials.

In 2014, the EU Commission identified 20 critical raw materials (i.e. identified as critical due to risks of supply shortage arising from the need to import from 'unstable' or 'increasingly protectionist' countries/regions and due to their high value and essential functionality for particular economic sectors) for priority attention to ensure on-going supply for EU companies. In Ireland, there are a number of key industrial waste streams (e.g. mining tailings, power station ash, electronic waste, Bauxite production residue 'red mud') that represent significant potential for hi-tech recovery of critical raw materials. There are co-location opportunities for the establishment of such a test facility at existing mineral processing sites where leveraging of co-located skills may assist (e.g. Tara Mine, Aughinish Alumina, Indaver Duleek). Another opportunity will present itself in the coming year as the Lisheen Mine progresses towards closure. The mine operators are keen to find follow-on uses for the site and plant.

It is likely that that the circular economy will initiate new models of commerce. Ireland, building on our world-class research capacity, could and should be at the forefront of developing these new business models.