



Interim Evaluation of Horizon 2020
**Societal challenge 2: Food Security,
Sustainable Agriculture and
Forestry, Marine, Maritime and
Inland Water Research and the
Bioeconomy**
Expert Group Report



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Agriculture and Forestry, Marine, Maritime and
Inland Water Research and the Bioeconomy**

Final Report

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1. EXECUTIVE SUMMARY

Introduction

This report addresses the interim evaluation of Horizon 2020 Societal Challenge 2 (SC2): Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research, and the Bioeconomy. The SC2 interim evaluation was carried out with the assistance of an independent Expert Group and this report is based on their findings. It critically examines the rationale, design and current state of implementation of the programme and presents the SC2 Expert Group's assessment of the relevance, effectiveness, efficiency, coherence and EU added value of the programme.

The specific objective of SC2 is to secure sufficient supplies of safe, healthy and high quality food and other bio-based products by developing productive, sustainable and resource-efficient primary production systems, fostering related ecosystem services, and the recovery of biological diversity, alongside competitive and low-carbon supply, processing and marketing chains. This will accelerate the transition to a sustainable European bioeconomy, bridging the gap between new technologies and their implementation.

This programme has a financial envelope of EUR 3.85 billion¹ for the period 2014-2020, of which, EUR 800 million has been allocated to the Bio-Based Industries Joint Undertaking (BBI JU). By the end of 2017, approximately 43% of the total SC2 budget will have been allocated. The SC2 programme is developed and managed jointly by DG RTD and DG AGRI. The implementation of calls and the day-to-day management of grant agreements has been delegated to EU Executive Agencies (mainly REA, to a limited extent EASME and INEA).

How relevant has the thematic programme been so far?

SC2 is addressing a well-defined and important set of societal challenges. There is a clear scientific rationale for investing in Research and Innovation (R&I) in the activity areas covered by SC2. The programme is supporting R&I on important and pertinent issues. There is strong justification and stakeholder support for a challenge-based approach to EU funded R&I. Overall, the SC2 programme is highly valued and appreciated by stakeholders.

The policy relevance of SC2 is generally high. All SC2 activity lines are underpinned by a strong EU policy framework, encompassing major policies such as the Common Agricultural Policy (CAP) and the Common Fisheries Policy (CFP), as well as a specific thematic policy on the Bioeconomy. SC2 is well aligned with the European Commission's policy agenda; for instance, 72% of the non-SME projects mapped are expected to contribute to Europe's economic and industrial competitiveness. Furthermore, as far as reaching the targets of the 3Os (Open Science, Open Innovation, Open to the World) is concerned, SC2 is performing well by Horizon 2020 standards.

Significant improvements have been made to the SC2 programme design and implementation to improve its relevance and impact. The introduction of the Strategic Programming process has improved the intelligence base underpinning programming choices and has helped define the focus of the programme. An extensive and increasingly participatory dimension of this process, involving broad consultations with Member States (MS) and stakeholders at large, has been a distinguishing feature of SC2.

Anecdotal evidence however, suggests that: i) the translation of high level challenges and objectives into specific call topics is not always clear to external stakeholders; ii) the tendency

¹ This figure was later reduced to EUR 3.70 billion following the 'taxation' of H2020 to provide budget resources to the European Fund for Strategic Investment (EFSI) set up in 2015.

to fund larger projects/consortia might not necessarily be associated with better research, and iii) some topics seem to be regarded as too broad, making it difficult for participants to respond appropriately and contributing to a high level of demand to some calls.

A stronger involvement and greater coordination with relevant policy DGs, including co-management with DG AGRI has also been an important development. There are some practical challenges in reconciling the perspectives of policy DGs with R&I perspectives, but overall DG RTD and DG AGRI have successfully established management capabilities which have maintained coherence. Significant developments and novelties include: i) increased relevance of research for farmers and farm-related value chains notably through the multi-actor approach, ii) the development of the Blue Growth focus area for cross-cutting marine and maritime research, iii) the focus on Sustainable Food Security (40% of resources over 2014-17), and iv) the creation of the BBI-JU, developing new integrated value-chains.

How effective has the thematic programme been so far?

There is little evidence of outputs and effects at this early stage of programme implementation. Of the 273 projects falling within the scope of the evaluation, 163 are still ongoing and although 110 projects have closed, 109 are SME phase I projects and 1 is a Coordination and Support Action (CSA). However, the evaluation found several examples of promising projects which can be expected to contribute to the following longer term impacts:

- The development of low-carbon, resource-efficient and competitive European agri-food and bio-based industries, with the creation of new integrated value chains;
- Improved competitiveness, resilience and sustainability of the European agriculture and forestry sector;
- Reduced greenhouse gas emissions and positive impact on climate change;
- Improved food security and safety;
- Ocean observation and mapping, sustainable and smart use of marine resources; and
- Higher growth and employment.

The initial outcomes of this thematic programme indicate an important impact on innovation. For instance, expected direct impacts of 55 SME Phase I and 26 Phase II projects include EUR 1.5 billion / EUR 1 billion of additional turnover for the next five years, and the creation of 1500 / 1000 jobs over the next three years respectively. These impacts do not include indirect impacts generated through supply chain and multiplier effects.

Furthermore, major achievements of the programme to date include:

- Setting up of the BBI JU, with flagships and demonstrators delivering new bio-based products along five new integrated value chains;
- Significant technological advances - 88% of the mapped SC2 projects are developing technologies which have been assessed at Technology Readiness Level (TRL) 5 and above (reflecting the innovation spirit of Horizon 2020);
- Strategic international cooperation, e.g. Atlantic Ocean Research Alliance.

How efficient has the thematic programme been so far?

The thematic allocation of funding is very close to that envisaged in the work programme 2014-15, and the take-up of budgetary instruments is as envisaged. The programme has been quite efficient in attracting newcomers (22% in SC2 calls, 84% in SME topics, 34% in BBI). Moderate progress has been made in widening participation from new MS in SC2 with respect to previous programmes. On several cross-cutting indicators, SC2 performs better than Horizon 2020 overall: 92% of the EU financial contribution is sustainability-related (vs 46% average for Horizon 2020), 35% is climate-related (vs 24% average) and 21% is biodiversity related (vs 3% average).

The programme has a complex management arrangement which has made coordination challenging and resource intensive. At the same time, several simplifications introduced under Horizon 2020 have contributed to improving efficiency. The use of two-stage evaluation schemes has also helped to improve the overall success rate. Part of the SC2 implementation was delegated to REA at the end of the first year of the programme, and mechanisms have been put in place to ensure close interactions between the Executive Agency and the DGs, while issues such as feedback to policy making and dissemination still deserve further attention.

How coherent has the thematic programme been internally and with other (EU) actions?

Internal coherence of the programme is strong. Moreover, the thematic allocation of funding is appropriate given the objectives of the programme. There are links between SC2 and other parts of the programme, particularly other SCs and Leadership in Enabling and Industrial Technologies (LEIT), mainly through internal co-ordination mechanisms to enhance synergies, for example in the case of Blue Growth. There is potential scope to strengthen links between SC2 and the European Research Council (ERC), as well as the European Institute of Innovation & Technology (EIT).

SC2 shows a high degree of coherence, complementarity and synergies with several other EU policies, particularly the CAP, the CFP, maritime and climate policies, but also environment, energy, industry and competitiveness, public health and consumer protection. Several actions have supported the links with the EU MS/regions' plans and smart specialisation strategies using European Structural & Investment Funds (ESIF), for instance those targeting development of new bio-based industries. The ERA-Net co-fund actions included in the calls are potentially highly effective strategic investments in the European Research Area, with structuring effect and ensuring coherence between EU and national research programmes in the bioeconomy.

What is the EU added value of the thematic programme?

Overall, there is strong qualitative and quantitative evidence of the added value of the SC2 programme. Project additionality is also strong: 42% of SC2 projects would not have gone ahead without EU funding, while 32% would have gone ahead in some form, but with significant modifications.

The main elements of programme added value include:

- Supporting the development and deepening of collaboration between partners which would not have been possible without EU funding;
- Developing research capacity;
- Positive impact on Institutions' ability to attract researchers and other staff, as well as on development of relationships and networks, training capacity, researcher mobility and career development; and
- Leveraging of resources for follow-up activities and/or spill over effects from other public funding sources.

Project participants associate added value with the programme scope and focus. As compared to national or regional funding, SC2 is seen to add considerable value in areas such as “ability to address the needs of EU citizens and other final users”, “tackling global challenges”, “transfer of technology and knowledge”, and “delivery outputs targeting policy making”. At policy level, SC2 provides structure and reference for the development of national research programmes, creating synergy and ensuring complementary in research funding.

2. INTRODUCTION

This report is the Thematic Annex of Societal Challenge 2 (SC2) to the Interim Evaluation of Horizon 2020 and it is based on the final report of the Expert Group for SC2 Interim Evaluation. It critically examines the rationale, design and current state of implementation of the programme and presents the SC2 Expert Group's assessment of the relevance, effectiveness, efficiency, EU added-value and coherence of the programme. Although all of these evaluation criteria are covered by the evaluation, given the early stages of programme implementation and considering that limited evidence on actual outputs and results is available, this report focuses on design and implementation issues, relevance and coherence. Moreover, it should be noted that this Report focuses on the projects funded through the main SC2 calls. This evaluation does not examine the SME instrument and the BBI-JU in detail as these topics are the subject of two, parallel, ongoing evaluations.

2.1. EVALUATION METHODOLOGY

The evaluation was designed to respond to a specific set of evaluation issues and questions. The overall design of the evaluation was based on a mixed methods approach comprising:

- *Desk research* which, inter alia, covered the legal base for Horizon 2020 and SC2, work programmes and documents produced as part of the Strategic Programming process, BBI Annual Work Plans, Annual Activity Reports, Calls for proposals, Project Deliverables, Project Periodic Reports (these were available for 10 projects at the time of writing this Report), Past evaluations and impact studies etc.;
- *Composition analysis* which entailed a quantitative analysis of CORDA data relating to SC2 proposals and projects such as the number and type of participants, EC contribution, cross cutting indicators etc.;
- *Semi-structured interviews with 11 key Commission and REA officials, 13 key informants/stakeholders and 20 project participants* to address programme level questions particularly those relating to its relevance, EU added value, alignment with national activities, main achievements and impacts;
- *An online survey of Horizon 2020 project participants* focusing on EU added value;
- *Mapping of (non-SME) projects characteristics* (such as their TRLs, expected outputs and contribution to 3Os, target users etc.) using a pre-defined template. Almost all non-SME projects that were approved by the end of January 2016 were mapped i.e. 111 out of 115 (including 13 BBI projects).
- *Mapping of SME project characteristics and expected impacts* using a predefined template. The scope of the exercise was as follows:
 - Phase I proposals and feasibility reports: all projects which were completed and for which feasibility study reports were available as of August 2016 (N=67);
 - Phase II proposals: projects approved by the end of January 2016 (N=26).

Further details on the methodology are available in Annex 1 of the Expert Group Report.

2.2. CONTEXT

The Societal Challenge pillar within Horizon 2020 seeks to find solutions to the major challenges facing Europe (as well as the world) as identified in the Europe 2020 Strategy and its flagship initiatives, while reflecting the concerns of Europe's citizens as well as demands to tackle these major challenges expressed by Member States and other public and private actors of the European Research Area. As articulated in the various Commission documents and

policy statements, Societal Challenge 2 specifically addresses the following inter-related challenges and opportunities:

- *Feeding a growing world population: the challenge is not only to produce more, but also to produce safe and healthy food with fewer resources, less negative environmental impacts and in more difficult conditions. Improving food security requires not only increasing food production, but also:*
 - *Reducing food waste*
 - *Producing safe, healthy and high quality food that is accessible, nutritious, contains minimal or no allergens and chemical contaminants, and free of food-borne pathogens and toxins.*
 - *Reducing demand for animal protein*
 - *Taking account of the impact of urbanisation*
- *Harnessing the huge potential of Europe's oceans, seas and coasts for jobs and growth*
- *Reducing the EU's heavy dependence on seafood imports*
- *The need to shift to a bio based economy not only because of climate change, but also to reduce Europe's dependence on fossil resources and to create jobs and green growth.*
- *To get more feed, energy, and biological raw materials from forests while ensuring their sustainability.*

Addressing these challenges will require new knowledge and technology, and investment in R&I will be essential.

2.3. OBJECTIVES AND INTERVENTION LOGIC

2.3.1. Programme objectives and structure

With a budget allocation of EUR 3.85 billion over the period 2014-2020^{2,3}, SC2 aims “to secure sufficient supplies of safe, healthy and high quality food and other bio-based products by developing productive, sustainable and resource-efficient primary production systems, fostering related ecosystem services and the recovery of biological diversity, alongside competitive and low-carbon supply, processing and marketing chains. This will accelerate the transition to a sustainable European bio economy, bridging the gap between new technologies and their implementation”.⁴ Investments in R&I under SC2 are expected to contribute to food security; environmental sustainability; support the transition from a fossil fuel-based economy to a bio-based economy; and enable Europe to take a leading role in the development of global agri-food industry and bio-based industries, including blue biotechnology.

² This budget represents 5% of the total budget allocated to Horizon 2020

³ Of which EUR 800 million has been allocated to the BBI JU and EUR 3.05 billion to the rest of SC2. In accounting terms, the BBI has a separate budget line from SC2, although for practical purposes BBI JU is considered a part of the SC2 programme

⁴ Horizon 2020 Regulation: Regulation (EU) No 1291/2013, Annex 1

In line with the above objectives, SC2 is structured around five activity lines, as specified and defined in the Council Decision of 3 December 2013 establishing the specific programme implementing Horizon 2020 (2014-2020)⁵:

- *2.1 Sustainable agriculture and forestry*: developing knowledge, tools, services and innovations to support more productive, environmentally friendly resource-efficient and resilient agriculture and forestry systems that supply sufficient food, feed, biomass and other raw materials and deliver ecosystems services while at the same time protecting biodiversity and supporting the development of thriving rural livelihoods.
- *2.2 Sustainable and competitive agri-food sector for a safe and healthy diet*: addressing food and feed security and safety, the competitiveness of the European agri-food industry and the sustainability of food production, processing and consumption. It covers the whole food chain and related services from primary production to consumption.
- *2.3 Unlocking the potential of aquatic living resources*: developing new insights, tools and models to improve understanding of what makes marine ecosystems healthy and productive and to assess, evaluate and mitigate the impact of fisheries on marine ecosystems (including deep sea); developing competitive and environment friendly aquaculture; developing new harvest strategies and technologies; boosting marine and maritime innovation through biotechnology.
- *2.4 Sustainable and competitive bio-based industries and supporting the development of a European bio economy*: research, innovation and networking actions focusing on the development of environmentally friendly bio-based products and processes, the development of integrated bio-refineries and the opening of new markets for bio-based products.
- *2.5 Cross-cutting marine and maritime research*: addressing cross-cutting marine and maritime scientific and technological challenges with a view to unlocking the potential of seas and oceans across the range of marine and maritime industries, while protecting the environment and adapting to climate change.

In addition, a general category consists of

- *2.6 Specific implementation aspects*: supporting the implementation of the rest of the programme and including external advice, specific actions on communication, monitoring and evaluation, knowledge exchange and stakeholder involvement as well as pilot and demonstration activities.

The high level SC2 objectives and activities are implemented through biennial (or triennial) work programmes. The 2014-15 Work Programme comprised three calls: “Sustainable Food Security – SFS”, “Blue Growth – BG” and “Innovative, Sustainable and Inclusive Bioeconomy – ISIB”. The 2016-17 Work Programme continues SFS and BG, and adds a new call “Rural Renaissance - RUR”. It also replaces the ISIB call with the “Bio-based innovation for sustainable goods and services - BB” call.

Figure 1 shows the links between activity lines set out in the legal basis and the call themes as defined in the work programmes.

⁵ Council Decision of 3 December 2013 L347/965

Figure 1 Relationships between Activity lines set out in the legal basis and call themes set out in the Work Programmes



NB: The definition of which activity line(s) (legal basis divisions) are covered by a particular call topic (and consequently a project) is carried out during work programme drafting.

Table 1 provides an overview of the two work programmes covering the first part of the programming period.

Table 1: Objectives and scope of the first two SC2 Work Programmes

	2014-2015	2016—2017
Specific Objectives	<ul style="list-style-type: none"> To develop competitive and resource-efficient aquatic and terrestrial food production systems To harness the huge potential of Europe's oceans, seas and coasts for jobs and growth To support sustainable agriculture and forestry management processes providing public goods and innovative products for sustainable growth To foster innovation (including social innovation) in rural areas for inclusive growth 	<ul style="list-style-type: none"> To ensure food and nutrition security, by fostering resilient and resource efficient primary production and industry as well as sustainable and healthy consumption To demonstrate the innovative potential of the oceans, by bringing technology to market To improve current European marine observing, surveying and monitoring capabilities To foster innovation and business opportunities for rural and coastal areas, through new territorial approaches and business models To re-industrialise Europe, through

	2014-2015	2016—2017
	<ul style="list-style-type: none"> To enhance innovation in the bio-based industry for smart growth 	new bio-based value-chains, while securing sustainable biomass
Scope	Three Call Theme, 49 topics, €482M <ul style="list-style-type: none"> Sustainable food security €251.5M (52%) Blue growth: unlocking the potential of Seas and Oceans €144M (30%) Innovative, sustainable and inclusive bio economy €86.5M (18%) 	Four Call Themes, 86 topics, €757M <ul style="list-style-type: none"> Sustainable Food Security-Resilient and resource-efficient value chains €461M (61%) Blue Growth – demonstrating an ocean of opportunities €130M (17%) Rural Renaissance - Fostering innovation and business opportunities €127M (17%) Bio-based innovation for sustainable goods and services - Supporting the development of a European Bioeconomy € 38.5M (5%)
Budget appropriations	SC2 budget allocated to above calls = €422M Allocation from another SC = €60M Allocation of SC2 budget to other SCs and other actions: €46M	SC2 budget allocated to above calls = €679M Allocation from another SC = €78M Allocation of SC2 budget to other SCs: €112M

Source: SC2 work programmes and DG RTD data. See Annex 2 for a detailed mapping of the two work programmes.

Table 1 does not include the Bio-based Industries Joint Undertaking (BBI JU) which accounts for a significant share of the SC2 budget: EUR 800 million or 20.8 % of the total SC2 budget.⁶ The BBI JU implements a Joint Technology Initiative aimed at promoting investment in the development of a sustainable bio-based industry sector in Europe. Specifically, it will:

(i) Demonstrate technologies that enable new chemical building blocks, new materials, and new consumer products from European biomass which replace fossil-based inputs;

(ii) Develop business models that integrate economic actors along the whole value chain from supply of biomass to biorefinery plants to consumers of bio-based materials, chemicals and fuels, including by means of creating new cross-sector interconnections and supporting cross-industry clusters; and

(iii) Set up flagship biorefinery plants that deploy the technologies and business models for bio-based materials, chemicals and fuels and demonstrate cost and performance improvements to levels that are competitive with fossil-based alternatives.

The BBI JU is expected to leverage at least EUR 2.73 billion of private investment.

⁶ The BBI JU is a public-private partnership between the European Commission and the Bio-based Industry Consortium (BIC). It was established on 6 May 2014 by Council Regulation No 560/2014, entering into force on 27 June 2014. The total EU funding allocated to the BBI JU is EUR 975 million of which EUR 800 million comes from SC2 and EUR 175 million from the LEIT KET Biotechnology programme.

Table 2: Overview of BBI annual work programmes

2014*	2015*	2016**
<ul style="list-style-type: none"> • One call • Budget = €50M + €1.5M EFTA appropriations • 16 topics (10 RIA, 5 DEMO and 1 Flagship) 	<ul style="list-style-type: none"> • Two calls • Call 2015.1 dedicated to 3 Flagship topics (Budget= €100M) • Call 2015.2 dedicated to 7 DEMO topics, 10 RIA topics, and 2 CSAs (Budget= €106M) 	<ul style="list-style-type: none"> • One call • Budget = €188M • 27 topics (12 RIA, 9 DEMO, 2 Flagship, 4 CSAs)

Sources: *Annual Activity Reports for 2014 and 2015; **2016 Work Programme

2.3.2. Evolution from FP7 (2007-2013)

SC2 builds upon the following parts of FP7⁷:

- Cooperation Theme 2: Food, Agriculture and Fisheries, and Biotechnology (FAFB), also known as Knowledge Based Bio Economy (KBBE);
- "The Ocean of Tomorrow" call (31 projects, €195M)^{8,9}, an initiative launched in the second half of FP7 to promote cross-sectoral research to address sea related challenges.

In comparison with FP7-FAFB, the budget increased by two-fold in Horizon 2020. The overall budget earmarked for funding of the Cooperation Theme 2 for the period 2007 - 2013 was indeed EUR 1.9 billion.

Blue Growth has also emerged as a distinct cross-cutting 'Focus Area' under Horizon 2020. Building on the results from FP7 "The Ocean of Tomorrow" and blue biotechnology projects, it expands towards a variety of marine-related fields of knowledge and economy sectors that bear a high potential and thus deserve further development¹⁰. This is in line with SC2 responsibility of implementing activity 2.5, cross-cutting marine and maritime research.

SC2 also places significant emphasis on bio-based industries with the creation of a BBI-JU and the allocation of about a quarter of the SC2 budget to this. Within bio-based industries, the main focus area is on new integrated value chains. This is a major difference compared to

⁷ Details on the themes addressed within FP7-FAFB can be found in the ex-post evaluation of the rationale, implementation and impacts of EU Seventh Framework Programme (2007-2013) Cooperation Theme 2: food, agriculture and fisheries, and biotechnology: https://ec.europa.eu/research/evaluations/index_en.cfm?pg=fp7

⁸ This cross-disciplinary call was launched under the Cooperation Themes: Food, Agriculture and Fisheries, and Biotechnology; Energy; Environment; Transport. "The Ocean of Tomorrow" call topics were designed to have a high technological impact by bringing together different scientific disciplines to deliver sustainable solutions for marine and maritime activities. Providing competitive advantage and leadership to European industry was an expected impact of this theme and to this end, the "The Ocean of Tomorrow" projects were implemented to deliver explicit commercial applications (novel automated system for in-situ monitoring; miniaturized immune-sensor) and boost marine technologies. Funded projects were also successful in achieving a high engagement of SMEs that are active technology developers and paved the way for the Blue Growth Focus Area within Horizon 2020.

⁹ European Commission (2014) The Ocean of Tomorrow Projects (2010-2013)

¹⁰ The recognition that marine biodiversity is largely unexploited and holds vast opportunities for new processes and products has made blue biotechnology part of the Blue Growth theme with specific calls in both WP implemented so far.

FP7, which was more clearly separated between the different stages of the value chain (feedstock – processing – products). Also the role of demonstration projects and flagships is high in BBI-JU, which is a major change compared to FP7 and appears well justified considering that scale up and commercialisation typically are the main bottlenecks in new bio-based value chains.

There is also more emphasis on applied agricultural, fisheries and aquaculture systems research, value chain development, and increasing access to genetic resources; R&I along the food value chain; and more targeted international cooperation (in particular with African countries and China and South -East Asia) on issues such as food security. In particular, the EU-China flagship on Food, Agriculture and the Bioeconomy (FAB) has resulted in the flagging of several research topics that were of common interest for the EU and China. This resulted in increased collaboration and participation of Chinese actors in several research projects.

Under SC2, international cooperation is planned and implemented through strategic approaches of programme-level co-operation. For example, in the marine sector, a strategic approach was developed for international cooperation, based on the Atlantic Strategy and the then planned Ocean Governance Communication. In particular the Galway Statement establishing the Trans-Atlantic Research Cooperation was signed with the USA and Canada and the Bluemed Initiative was started. Currently, efforts to increase research cooperation in the South Atlantic are underway and preparations to extend the BLUEMED initiative to the Southern Mediterranean countries are progressing. These actions are facilitating coherent and structured approaches, aligning R&I agendas, and undertaking expensive explorations such as seafloor mapping. They are being supported with a number of projects which were launched in the WP2014-15, such as AORAC and AtlantOS.

Agriculture research in SC2 is linked to the recent reform of the Common Agricultural Policy. The second pillar of the new Common Agricultural policy includes a commitment to foster knowledge transfer and innovation in agriculture, forestry, and rural areas. Three significant programme changes have supported this:

1. Management of agriculture research within Horizon 2020 is shared between DG Research and Innovation (DG RTD) and DG Agriculture and Rural Development (DG AGRI).
2. Increased relevance of research to farmers and farm-related value chains is implicitly expected from the link to the Common Agricultural Policy through a number of mechanisms, most notably the development of the multi-actor approach in almost all projects under ‘Agriculture’ and a set of challenging and innovative research targets that complement other programmes and private sector investment.
3. The link to and support of the European Innovation Partnership ‘Agricultural Productivity and Sustainability’ (‘EIP Agri’). The EIP Agri is a major element of efforts to include support for innovation in Pillar II of the Common Agricultural Policy, i.e., the Rural Development Policy. SC2 interacts with the EIP Agri in two major ways: in developing programme plans through the EIP Agri Focus Groups that bring stakeholders and sectoral experts together to discuss future R&I needs in specific areas of innovation activity; and the use of the EIP Agri to bring together and focus and deliver research results for specific groups of research users, especially farmers.

Overall across SC2, there is less focus on more basic / fundamental research as compared to FP7-FAFB which is in line with the philosophy of Horizon 2020. Basic research is

substantially funded through the first pillar of Horizon 2020 (Excellent science – ERC grants and Marie Skłodowska-Curie actions), while at the same time the societal challenge pillar is expected to address higher TRL research and innovation.

In addition to the changes in programme focus and scope, there have been several general implementation changes from FP7 to SC2 – including: a strategic programming approach to the preparation of work programmes, allowing the identification of “focus areas” or calls, where R&I efforts should be focussed for maximum impact; broader call topics; a more joined up approach with the different DGs (‘Horizon Group’); introduction of new instruments (e.g., the SME instrument, Innovation Actions); introduction of the multi-actor approach for agriculture and forestry projects; shared responsibility between RTD and AGRI for the development of SC2 programme; delegation of implementation management of calls to European Commission Executive Agencies (mainly REA, to a lesser extent INEA and EASME). These elements are discussed in-depth in subsequent sections.

2.3.3. *Intervention logic*

Figure 2 provides a simplified intervention logic for the Societal Challenge 2¹¹. This logic informs and relates to a ‘theory of change’ i.e., the causal mechanisms through which the programme is expected to bring about the desired change(s). It consists of the following building blocks:

- The challenges or opportunities being addressed by SC2;
- The financial and non-financial inputs available under the programme which include EUR 3.85 billion of EU funding over the period 2014-2020 (including EUR 800 million allocated to the BBI JU), co-financing and contributions from other public and private sources (including at least EUR 2.73 billion of private investments expected to be leveraged by the BBI JU) as well as policy inputs provided by the Commission such as the legal basis, work programme etc.;
- The main programme activities, namely R&I activities as well as activities aiming to valorise existing research results;
- The main outputs generated by funded projects – which are both instrument and call topic specific - including generation of new knowledge; research outputs such as publications; development and/or validation of technologies, approaches, tools and methodologies; new products, processes, materials etc.; dissemination tools and awareness raising activities; as well as policy recommendations and policy evidence;
- Expected effects i.e. the results, outcomes and impacts reflecting the main objectives;
- The main external factors (confounding factors) that also influence the direction and scale of effects such as macroeconomic conditions, environmental factors, national R&I policy and capacity etc.

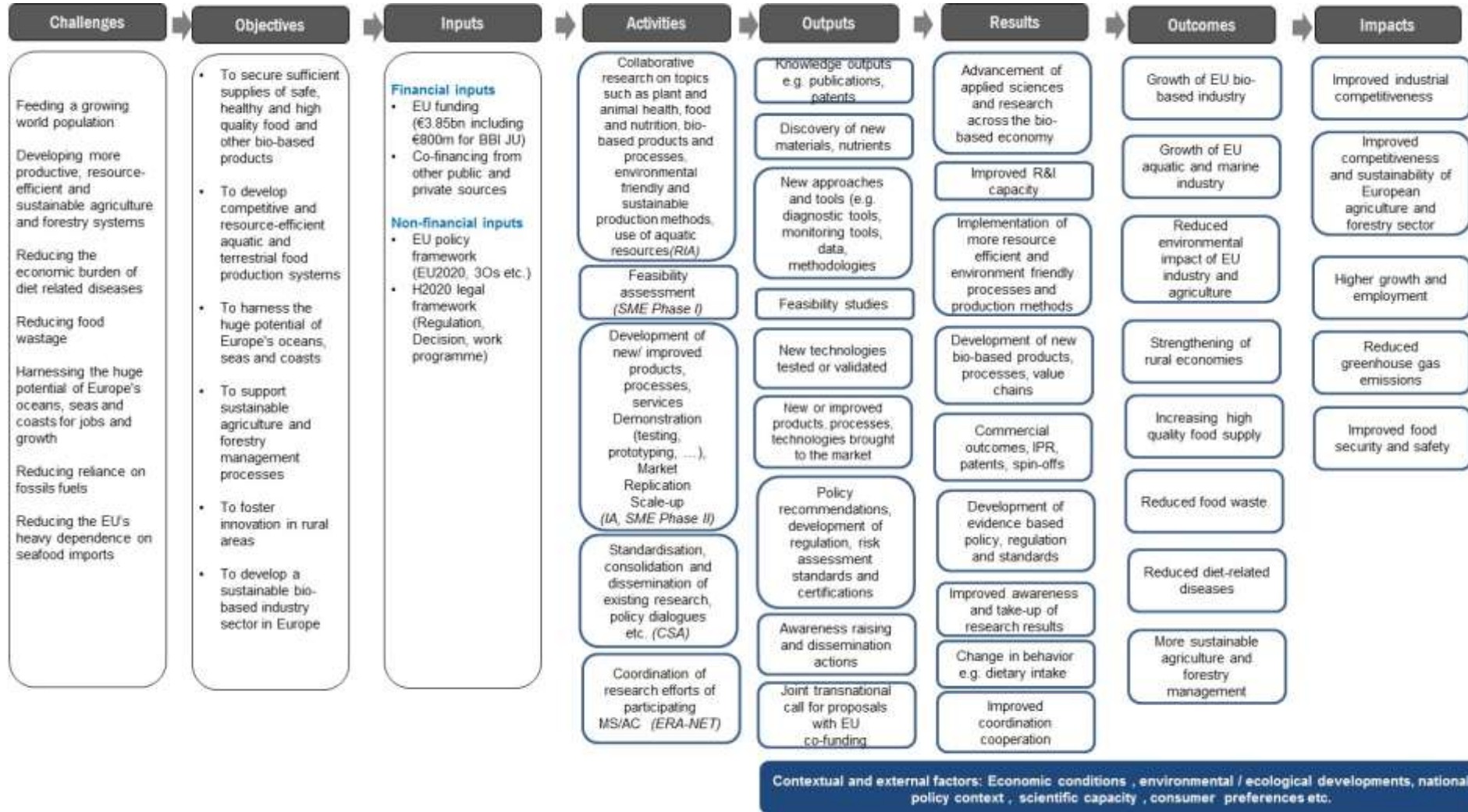
While an intervention logic is useful for setting out how the programme is expected to generate its impacts, these models are by the nature simplistic and linear, and in some ways not suited to the complexity of R&I and its inherent riskiness (the likelihood that outputs will not generate outcomes etc.). Indeed, there are a number of assumptions underpinning the relationship between activities/ outputs and effects in the intervention logic presented e.g.:

- That call topics are relevant;
- That the programme is successful in selecting suitable project ideas;

¹¹ Detailed intervention logics for each of the specific activity areas are provided in the Expert Group report.

- That research results are disseminated and exploited to, *inter alia*, change consumer behaviour, inform policy and to develop new standards, processes, products etc.;
- That innovations are successful and ultimately scaled up.

Figure 2: Simplified intervention logic of Horizon 2020 Societal Challenge 2 (developed by the SC2 expert group)



3. IMPLEMENTATION STATE OF PLAY

3.1. OVERVIEW OF PROGRAMME INPUTS AND ACTIVITIES

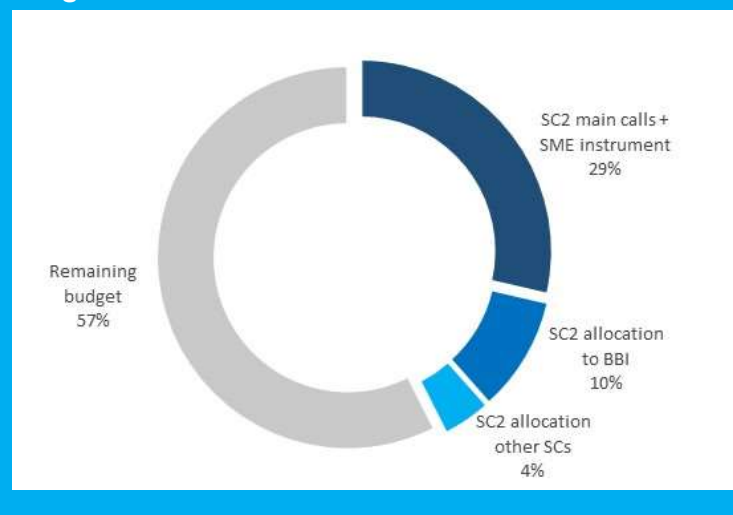
The data analysed by the expert group in this section reflects the situation as of 30 April 2016 concerning the portfolio of projects with which grant agreements were signed. The deadline for the last corresponding call – from which the portfolio was selected – was 5 December 2015. All data has been extracted from CORDA and provided by DG RTD.

Project grants are allocated to individual projects via three mechanisms: (1) SC2 main calls; (2) dedicated Phase 1 and Phase 2 calls of the SME Instrument; and (3) the calls launched by the Bio-Based Joint Undertaking (BBI JU). Subsequent analysis of the state of play presents – apart from data at overall SC2 level – the three implementation mechanisms separately, where feasible.

3.1.1. Budget allocation

The EC contribution allocated to the implementation of the calls included in Work Programme 2014-2015 and which have been closed at the date of 5 December 2015 was EUR 738 million (of which EUR 482 million were allocated to SC2 main calls and SME instrument and EUR 256 million were allocated to BBI calls). EUR 639.6 million came from SC2 budget, EUR 60 million were allocated from other SCs to SC2 work programme and EUR 38.4 million was allocated from LEIT to BBI. During the same period, EUR 46 million from SC2 budget was allocated to other SCs. Total EC contribution to 2016-2017 work programme amounts to EUR

Figure 3: Allocation of the SC2 budget to Work Programmes 2014-2015 and 2016-2017



945 million (of which EUR 752 million have been allocated to SC2 main calls and SME instrument and EUR 188 million were allocated to BBI calls¹²). EUR 838.8 million came from SC2 budget, EUR 78 million were allocated from other SCs to SC2 work programme, EUR 28.2 million was allocated from LEIT to BBI. During the same period, EUR 112 million from SC2 budget was allocated to other SCs. By the end of 2017, approximately 43% of the total SC2 budget would have been allocated (EUR 1.64 billion).¹³

In the Work Programme 2014-2015, the most significant implementation mechanisms in terms of total budget were the *three main SC2 calls*: Sustainable Food Security (H2020-SFS-2014/2015), Blue Growth: Unlocking the potential of Seas and Oceans (H2020-BG-

¹² The figures for BBI JU do not cover the Work Programme for the year 2017.

¹³ Apart from grant funding, the SC2 budget is also used to cover expert costs and to contribute to H2020 horizontal activities, which amounted to a total of EUR 7.14 million under the Work Programme 2014-2015.

2014/2015), and Sustainable and Inclusive Bioeconomy (H2020-ISIB-2014/2015), with a combined budget of EUR 482 million.¹⁴

The SME Instrument (SMEInst) had a dedicated budget of EUR 36 million to fund related calls in the SC2 Work Programme 2014-2015, and the BBI JU was allocated a sum of EUR 256 million to fund their flagship, demonstration, and R&I calls.

Finally, a part of the SC2 budget (EUR 32 million) was allocated through calls implemented in the “SC1 - Health, demographic change and wellbeing” (PHC-07-2014 call topic) and “SC5 - Climate action, resource efficiency and raw materials” Work Programmes (WASTE-2-2014, WASTE-7-2015 and WATER-4b-2015 calls topics), as well as EUR 8.9 million within the framework of H2020-FTIPilot-2015 Fast Track to Innovation. The latter group of FTI Pilot projects is not included in subsequent analyses.

The specific challenges or research topics to be addressed by the proposals, as outlined in the Work Programmes, are grouped into *six* activity lines (referred to as level 5 topics in CORDA). Through the Horizon 2020 Work Programmes 2014-2017, each of these lines of activity was allocated a share of the overall budget of SC2, as indicated in the table below.

Table 3 Activity lines and their allocated share of budget, Work Programmes 2014 – 2017

Activity lines	2014-15 WP	2016-2017 WP*	2014-2017 total
2.1 Sustainable agriculture & forestry	28%	35%	32%
2.2 Sustainable & competitive agri-food sector	8%	14%	12%
2.3 Unlocking the potential of aquatic living resources	7%	6%	7%
2.4 Sustainable & competitive bio-based industries	35%	23%	28%
2.5 Cross-cutting marine and maritime research	12%	12%	12%
2.6 Specific implementation aspects	9%	11%	10%
Total	100%	100%	100%

*Source: data provided by DG RTD; * Does not include BBI WP for 2017*

3.1.2. Response to the calls and main calls

For the entire SC2, a total of 273 grant agreements were signed by 30 April 2016, the chosen cut-off date for the analysis (including five projects under the PHC, WASTE and WATER calls, not managed by SC2), selected from a total of 2,892 eligible proposals, including 248 proposals submitted to the three non-SC2 calls (2,094 proposals when discounting applications that were not admitted to the second stage of two-stage calls – of which 69 were submitted to the WASTE calls). At the time of the interim evaluation, 110 projects from the original portfolio – 109 SMEInst Phase 1 projects and 1 CSA project – are completed and 163 are still ongoing (no project to date has been abandoned).

The **three main calls** of the SC2 2014-2015 Work Programme, i.e. those excluding the SME Instrument and the calls managed by the BBI Joint Undertaking (as well as the WASTE, WATER and PHC calls which were co-financed from SC2 budget but which fall partly outside the remit of SC2), yielded a total of 97 projects with grant agreement signed before the cut-off date. This mainstream part of the programme has so far been implemented mainly through Research and Innovation Actions (RIA) in terms of total EU contribution (78.9% of

¹⁴ The EC contribution committed to projects under the H2020-BG-2014/2015 call came partly – in a total value of EUR 60 million – from the budget of other societal challenges (SC3 – Energy, SC4 – Transport, and SC5 – Climate).

the funding), followed by Coordination and Support Actions (CSA, 12.7%). Innovation Actions (4.0%) and ERA-NET Cofund (4.4%) played only a smaller role. The total EC contribution committed to the 97 projects was EUR 453.8 million up to 30 April 2016. The average amount of EU funding committed to projects was higher for RIA (EUR 6.2 million) and lower for IA and CSA projects (EUR 2.6 million and EUR 2.1 million, respectively).

Table 4 Number of projects, EC funding, share of total budget and average EC contribution per type of action for the three main calls of SC2 (without SME instrument and Joint Undertakings)

Type of action	Number of projects	Total EC funding (€ m)	Share of total budget	Average EC contribution (€ m)
RIA	58	358.0	78.9%	6.2
IA	7	18.2	4.0%	2.6
CSA	28	57.8	12.7%	2.1
ERA-NET Cofund	4	19.8	4.4%	4.9
Total	97	453.8	100.0%	4.7

Source: *CORDA analysis*.

The total EC contribution committed under the three main calls (EUR 453.8 million) formed part of a total combined project budget of EUR 525.7 million (corresponding to a 86.3% average funding rate). Regarding activity lines, the average EC contribution per project was relatively high for the “2.4 Sustainable & competitive bio-based industries” and “2.5 Cross-cutting marine and maritime research” topics (EUR 6.1 and EUR 6.8 million, respectively), and lower for “2.6 Special implementation aspects” (EUR 2.4 million).

Table 7 Overview of results from activity lines included in calls for proposals closed before the end of 2015 (without SME instrument and Joint Undertakings)

Activity line	Number of projects	Total cost (€ m)	Total EC contr. (€ m)	Average project cost (€ m)	Average EC contr. (€ m)
2.1 Sustainable agriculture & forestry	46	261.3	212.1	5.7	4.6
2.2 Sustainable & competitive agri-food sector	13	63.0	48.1	4.8	3.7
2.3 Unlocking the potential of aquatic living resources	10	62.4	58.3	6.2	5.8
2.4 Sustainable & competitive bio-based industries	3	19.0	18.2	6.3	6.1
2.5 Cross-cutting marine and maritime research	13	90.7	88.8	7.0	6.8
2.6 Special implementation aspects	12	29.3	28.3	2.4	2.4
Total	97	525.7	453.8	5.4	4.7

Source: *CORDA analysis*

The three main calls were implemented either through one- or two-stage calls (whereas the SME Instrument and BBI JU calls were all one-stage calls). Two stage calls were launched in the case of 40 call topics out of the total 61 call topics under the main calls¹⁵, in both 2014 and 2015 and under all three calls (SFS, BG and ISIB), linked predominantly to activity line

¹⁵ Topics that have the same content but were launched in different years (i.e. in both 2014 and 2015) were counted separately.

“2.1 Sustainable agriculture & forestry” (55.6% of all first and second-stage proposals) and the RIA instrument (for 93.8% of proposals; the remaining 6.2% being IA).

The two-stage calls of SC2 on aggregate yielded 65 projects. Out of a total of 1,008 eligible proposals submitted, 597 did not meet the quality threshold in stage 1, leaving 411 proposals above threshold. Out of these, 389 proposals were submitted to stage 2, of which 257 were above the quality threshold. The overall success rate for two-stage calls would be 6.4%, but calculating the success rate only for the second stage – acknowledging the filtering effect of the first stage – the success rate increases to 16.7%. The success rate of excellent proposals (which were above the quality threshold in stage 2) was 25.3% for the three main calls. Submitted eligible proposals oversubscribed the funding actually committed by a factor of 14.3 for the two-stage calls, although this figure falls to 6.0 when considering only proposals submitted to the second stage. The oversubscription of funds regarding excellent second-stage proposals only was 4.1.

One-stage calls were launched for 21 call topics. The majority of proposals submitted to one-stage calls were, as for two stage calls, linked to activity line “2.1 Sustainable agriculture & forestry” (54.8% of proposals) and to the RIA instrument (97.5%). The number of related grant agreements signed was 32. The success rate of proposals was with 20.4% somewhat higher than for proposals submitted to two-stage calls (the second-stage part). The success rate of excellent proposals was 35.2%. Correspondingly, the oversubscription of funds was lower than for two-stage calls: 4.1 overall and 2.6 when looking only at excellent proposals.

Table 8 Success rate and oversubscription for the main calls of SC2, one- and two-stage calls (without SME instrument and Joint Undertakings)

	SC2 One-stage calls	SC2 Two-stage calls (first stage)	SC2 Two-stage calls (second stage)
Eligible proposals received	157	1,008	389
Proposals above threshold	91	411	257
Grant agreement signed	32	-	65
Success rate*	20.4%	-	16.7%
Success rate (excellent proposals)**	35.2%	-	25.3%
EC contribution requested by eligible proposals (€ m)	316.9	5,397.0	2,249.6
EC contribution requested by proposals above the threshold (€ m)	199.0	2,331.2	1,543.8
EC contribution granted (€ m)	77.8	-	377.0
Oversubscription	4.1	-	6.0
Oversubscription (excellent proposals)	2.6	-	4.1

Source: *CORDA analysis*. * No. of grant agreements per eligible proposals. ** No. of grant agreements per proposals above threshold

There were marked differences between the success rates of individual activity lines. Proposals under the “2.1 Sustainable agriculture & forestry” and “2.4 Sustainable & competitive bio-based industries” activity lines were overall less likely to succeed, whilst success rates were higher for “2.3 Unlocking the potential of aquatic living resources” and “2.5 Cross-cutting marine and maritime research” proposals.

3.1.3. SME Instrument

The **SME Instrument** funded in total 135 projects, of which 109 were Phase 1 (feasibility study phase) and 26 Phase 2 projects. A subset of Phase 2 projects was first funded by the

programme under Phase 1 and progressed from there; another subset was submitted directly for Phase 2 calls. A total of EUR 44.9 million has been committed. Despite only funding 26 projects, the combined EC contribution committed to Phase 2 projects accounted for 87.9% of the total EC contribution allocated to SME Instrument, considering that the standard funding given to Phase 1 projects was only EUR 50,000. The average EC contribution for the 26 Phase 2 projects was around EUR 1.5 million.

In both years, the SME Instrument covered two topics: “Resource-efficient eco-innovative food production and processing (SFS-08)” and “Supporting SMEs efforts for the development - deployment and market replication of innovative solutions for blue growth (BG-12)”, of which the first was considerably more significant in terms of projects (114 out of 135) and funding (EUR 36.0 million out of EUR 44.9 million). Whilst Stage 1 projects were the same size by design, Blue Growth Stage 2 projects were on average slightly larger than those funded under the Sustainable Food Safety call.

For the SME Instrument, a total of 1,359 eligible proposals were submitted (1,046 to Stage 1 and 313 to Stage 2). A large proportion, 80.3% (1,091) were below the quality threshold and rejected, and 132 proposals, equivalent to 9.7% of all proposals, passed the quality threshold, but were not selected due to lack of funds available.

The proportion of low quality proposals was about the same for both Phase 1 and Phase 2 calls. Although the overall success rate for the SME Instrument is very low at 9.9% (10.4% for Phase 1 and 8.3% for Phase 2), looking only at good-quality proposals that surpassed the quality threshold, the rates rise dramatically, to 50.4%. (55.3% for Stage 1 and 36.6% for Stage 2). Oversubscription rates in the SME Instrument were correspondingly high (12.3), although only 2.4 for above-threshold proposals.

Table 12 Success rate and oversubscription for SC2 (SME Instrument)

	SC2 SME Instr. Phase 1	SC2 SME instr. Phase 2	Total SC2 SME instr.
Eligible proposals received	1,046	313	1,359
Proposals above threshold	197	71	268
Grant agreement signed	109	26	135
Success rate*	10.4%	8.3%	9.9%
Success rate (excellent proposals)**	55.3%	36.6%	50.4%
EC contribution requested by eligible proposals (€ m)	52.3	499.7	552.0
EC contribution requested by proposals above the threshold (€ m)	9.9	100.1	110.0
EC contribution granted (€ m)	5.5	39.4	44.9
Oversubscription	9.5	12.7	12.3
Oversubscription (excellent proposals)	1.8	2.5	2.4

*Source: CORDA analysis. * No. of grant agreements per eligible proposals. ** No. of grant agreements per proposals above threshold*

3.1.4. Bio-Based Industries Joint Undertaking

The Bio-Based Industries JU signed a grant agreement with a total of 36 projects before the cut-off date for this evaluation. 18 of these were RIA projects, 15 IA projects (4 large flagship projects and 11 demonstration projects), and the remaining 3, CSA actions. In terms of funding, the large majority (75.4%) of the EUR 229.7 million committed went to IA actions (39.5% to flagship projects and 35.9% to demonstration projects); and 23.3% to RIA projects.

The total amount of EC contribution committed to BBI JU projects was €229.0 million which corresponds to a per-project average of €6.4 million. Average project cost was €9.2 million (the funding rate was 69.4%).

The BBI JU received 120 eligible proposals in 2014-2015, from which 65 (54.2%) were below the quality threshold, and 19 (15.7%) were above the quality threshold but were not funded due to limited budget available. The success rate for BBI JU was higher than for other parts of SC2 (30.0%), and this rate is even higher (65.5%) among good-quality proposals.

Oversubscription was therefore less extreme than under the mainstream calls and the SME Instrument: available funds were oversubscribed by a factor of 3.5, which is reduced to 1.5 once low-quality proposals are excluded. Both success rates and oversubscription were most attractive for CSA calls, and less-than-average for RIA proposals.

Table 14 Success rate and oversubscription for SC2 (BBI Joint Undertaking)

	BBI- RIA	BBI- Flagship	BBI- Demo	BBI- CSA	BBI Total
Eligible proposals received	63	13	38	6	120
Proposals above threshold	27	4	20	4	55
Grant agreement signed	18	4	11	3	36
Success rate*	28.6%	30.8%	28.9%	50.0%	30.0%
Success rate (excellent proposals)**	66.7%	100.0%	55.0%	75.0%	65.5%
EC contribution requested by eligible proposals (€ m)	215.6	293.5	296.2	5.5	810.7
EC contribution requested by proposals above the threshold (€ m)	85.8	90.7	153.5	4.0	334.1
EC contribution granted (€ m)	53.5	90.7	82.6	3.0	229.7
Oversubscription	4.0	3.2	3.6	1.9	3.5
Oversubscription (excellent proposals)	1.6	1.0	1.9	1.4	1.5

*Source: CORDA analysis. * No. of grant agreements per eligible proposals. ** No. of grant agreements per proposals above threshold*

3.2. PARTICIPATION PATTERNS

The selected proposals under SC2 (excl. the SME instrument and Joint Undertakings) represent a total of 1,990 participations, mobilising 1,228 distinct participants, corresponding to an average of 1.60 participations per participant. A relative majority of the participants (382, i.e. 31.1%) were private for-profit entities; 24.9% were research organisations and 23.3% higher or secondary education establishments. Public bodies accounted for 8.1% of participants and the remaining 12.6% were other types of actors. In terms of total participations (beneficiary slots) the share of private for-profit entities falls to 21.4%, as a number of research organisations and higher or secondary educations establishments participate many times (their share in participations increases to 32.7% and 27.7%, respectively). Success rates by type of actors vary considerably: private for-profit entities will be funded only in 12.4% of all of their applications whilst public bodies in 34.6% of the cases.

Table 15 Share of applicants, participants, coordinators, EC contribution, number of participations and rate of success by type of actor for SC2 (without SME instrument and Joint Undertakings)

Type of actor	Total applicants	Total applications	Total participants	Total participations	Total coordinators	EC contribution (€ m)	Success rate (participation / applications)
Higher or Secondary Education Establishment	913	3,537	286	551	36	167.3	15.6%
Research Organisations	850	3,059	306	650	50	193.0	21.2%
Public bodies	260	537	99	186	3	31.4	34.6%
Private for-profit entities	2,701	3,443	382	426	10	85.4	12.4%
Other	425	664	155	177	3	23.4	26.7%
Total	5,149	11,240	1,228	1,990	102	500.5	17.7%

Source: *CORDA analysis*.

The SME Instrument typically involves single-beneficiary projects, the 135 projects have in total 158 participations by 145 participants (the difference reflects the projects that progress from Phase 1 to Phase 2 with the same participants). Due to the nature of the instrument, all participants are private for-profit entities, although there were other types of actors (public bodies, higher and secondary education establishments, other actors) among the applicants. The success rate for obtaining funding for a private for-profit applicant was 9.8%.

For the BBI JU, 304 individual participants combine a total of 414 participations among themselves. Most of the participants (72.0%) were private for-profit entities, whilst from the remainder, 14.1% were research organisations and 8.9% higher or secondary education establishments. The total participation number of private for-profit entities is somewhat lower, 63.8%, with research organisations and higher or secondary education establishments increasing their share (to 20.0% and 11.1%, respectively), as they are more likely to have multiple occurrences in the programme. The success rates do not vary visibly between different types of actors, with one exception: higher or secondary education establishments are considerably less likely to be funded than other actors (18.2% versus 31-37%).

3.2.1. Attraction of new participants / newcomers

There are 21.6% (414) participations in SC2 from ‘newcomers’, defined here as those who did not participate in FP7 (excluding the SME instrument and Joint Undertakings). The significance of newcomers is much more pronounced among private for-profit entities (56.2% of all participations) and among other actors (49.6%) than among public bodies (10.1%), research organisations (7.5%) and higher or secondary education establishments (4.8%). Success rates of newcomers were somewhat lower (with 12.8%) than those of applicants with FP7 experience (18.8%). The difference was however mild across the different types of actors and a very large one for one type of actor: private for-profit companies (12.5% versus 43.9%).

Table 18 Number of applications and of participations by FP7 experience (without SME instrument and Joint Undertakings)

Type of actor	Total applications	Of which: no FP7	As % of total	Total participations	Of which: no FP7	As % of total
Higher or Secondary Education Establishment	3,537	219	6.2%	524	25	4.8%
Research Organisations	3,059	279	9.1%	614	46	7.5%
Public bodies	537	152	28.3%	188	19	10.1%

Private for-profit entities	3,443	2,204	64.0%	473	266	56.2%
Other	664	382	57.5%	117	58	49.6%
Total	11,240	3,236	28.8%	1,916	414	21.6%

Source: *CORDA analysis*.

In the SME Instrument, 83.6% of all participations were by newcomers. Success rates between companies without or with FP7 experience did not differ very strongly (9.0% versus 15.2%).

As for the BBI JU, the proportion of newcomers among participations was very similar to the mainstream calls, 33.6%. There were considerably more newcomers among public bodies (40.0%), private for-profit entities (48.2%) and other actors (50.0%) however, and none, or barely any, among research organisations (0%) and higher or secondary education establishments (4.4%). The largest difference between newcomers and actors with FP7 experience was again within the group of private for-profit entities (18.2% versus 60.0%).

3.2.2. Geographical participation patterns

A summary of the geographical participation in *SC2* is presented in the tables below. The country with the largest number of participations in the **main SC2 calls** is the United Kingdom, with a total of 205 participations. The UK also gives the second largest number of coordinators (16, behind France's 17). The countries following the UK are Spain (191 participations), Italy (173), Germany (165), France (162), the Netherlands (146) and Belgium (101). Associated Countries account for 7.9% of applications, for 8.4% of participations and 6.5% of the funding. Their success rate, with 18.2% is the highest of all the country groups. From the Associated Countries, Norway, with 55 participations is the most active. With this figure it occupies the 10th place of all countries, after Ireland but before Greece. Switzerland comes second in the list of Associated Countries (29), and Turkey third (24).

Table 20 Participation patterns (number and shares of participations, of project coordinators, EU contribution, and rate of success) by country for SC2, without SME instrument and Joint Undertakings

Country	Total applicants	Total applications	Total participants	Total participations	Total coordinators	EC contribution (€ m)	Success rate (participation / applications)
<i>EU28</i>							
UK	388	979	123	205	16	71.3	20.9%
ES	559	1,245	116	191	10	49.2	15.3%
IT	581	1,334	109	173	6	47.0	13.0%
DE	437	966	104	165	9	50.7	17.1%
FR	356	785	87	162	17	56.5	20.6%
NL	263	690	79	146	13	51.7	21.2%
BE	204	464	66	101	5	24.3	21.8%
DK	99	329	23	61	5	21.6	18.5%
IE	73	207	28	60	6	17.0	29.0%
EL	155	411	33	54	2	13.1	13.1%
PT	150	306	32	48	1	10.0	15.7%
SE	99	239	23	40	2	11.4	16.7%
PL	121	239	21	29	1	4.9	12.1%
AT	92	213	17	27	1	6.2	12.7%
HU	91	178	20	27		4.5	15.2%

Country	Total applicants	Total applications	Total participants	Total participations	Total coordinators	EC contribution (€ m)	Success rate (participation / applications)
FI	73	212	14	25	2	7.1	11.8%
RO	96	139	14	19		2.5	13.7%
CZ	54	109	14	18		2.0	16.5%
EE	25	50	10	13	1	2.3	26.0%
SI	36	84	10	13	1	1.6	15.5%
HR	50	74	12	12		1.5	16.2%
LV	31	57	8	11		1.8	19.3%
LT	29	47	7	10		1.4	21.3%
BG	45	62	7	8		0.8	12.9%
CY	27	58	5	5		1.0	8.6%
SK	21	33	5	5		0.5	15.2%
MT	9	26	2	3		0.6	11.5%
LU	7	11	1	1		0.08	9.1%
<i>Associated Countries</i>							
NO	114	286	26	55	3	18.5	19.2%
CH	70	157	20	29		0.05	18.5%
TR	64	112	18	24		3.2	21.4%
RS	43	86	14	17		2.0	19.8%
IS	20	53	7	15	1	4.2	28.3%
IL	53	105	9	12		3.3	11.4%
Other	71	87	8	9		1.1	10.3%
<i>Third Countries</i>							
CN	144	214	33	38		0	17.8%
CA	36	59	14	20		0.04	33.9%
US	54	71	9	10		0	14.1%
AR	13	18	5	5		0.5	27.8%
TW	3	6	3	5		0.4	83.3%
BR	7	8	3	4		0	50.0%
ZA	14	21	4	4		0.2	19.0%
KE	23	36	3	3		0.6	8.3%
NZ	10	15	3	3		0.09	20.0%
UG	10	13	3	3		0.2	23.1%
VN	11	13	2	3		0.2	23.1%
AU	20	29	2	2		0	6.9%
CL	9	10	2	2		0.2	20.0%
EG	16	20	2	2		0.1	10.0%
GH	9	11	2	2		0.2	18.2%
Other	211	263	17	17		2.4	6.5%
Total	5149	11240	1196	1916	102	500.4	17.0%

Source: *CORDA analysis.*

The EU28, and within that the EU15, accounts for far the most participations and by far the most funding committed in SC2. EU28 participants have a combined 1632 participations (85.2%) and receive EC contribution worth EUR 462.8 million (92.5%). Within this group, EU15 countries combined a total of 1459 participations (76.1%) and EUR 437.3 million

funding (87.4%) – they also give 93.1% of all the coordinators. EU15 countries have a lower number of participations, 173 (9.0%) and an even lower share of funding received (5.1%). Their success rate (15.0%) is lower than the success rate of EU15 applicants (17.4%).

Table 21 Geographical distribution of funding, participants and coordinators, and overall rates of success, EU28, EU13, EU15, Associated countries, Third Countries - without SME instrument and Joint Undertakings

Country	Total applicants	Total applications	Total participants	Total participations	Total coordinators	EC contribution (€ m)	Success rate (participation / applications)
EU28	4125	9547	987	1632	98	462.8	17.1%
EU15	3498	8391	852	1459	95	437.3	17.4%
EU13	627	1156	135	173	3	25.6	15.0%
Associated Countries	435	886	102	161	4	32.4	18.2%
Third Countries	590	807	107	123	-	5.2	15.2%
<i>In percentage</i>							
EU28	80.3%	84.9%	82.6%	85.2%	96.1%	92.5%	-
EU15	68.1%	74.7%	71.3%	76.1%	93.1%	87.4%	-
EU13	12.2%	10.3%	11.3%	9.0%	2.9%	5.1%	-
Associated Countries	8.4%	7.9%	8.5%	8.4%	3.9%	6.5%	-
Third Countries	11.4%	7.2%	8.9%	6.4%		1.0%	-

Source: CORDA analysis.

In the SME Instrument, Spanish companies take the lead with 48 participations for a total of EUR 11.1 million funding. They are followed, with considerable gap, by Italian (27 participations, EUR 4.5 million), French (10, EUR 1.7 million), UK (10, EUR 2.9 million) and Irish participants (8, EUR 3.4 million). From the Associated Countries, Israel has 5 participations (EUR 2.5 million) and Norway 4 (EUR 2.7 million). EU28 countries account for 92.5% of all participations, and 88.0% of the funding disbursed. Companies from the EU15 take 80.5% of participations 83.7% of the funding, whilst the share of EU13 companies is only 10.4% among all participants and 4.3% among the EC contribution committed. They are surpassed by Associated Countries in the latter, which account for 12.0% of all funding under the SME Instrument. The differences in success rates are considerable: EU15 companies have a 11.2% chance of getting funded, EU13 applicants only 5.2%, whilst companies from Associated Countries are in the middle with 8.9%.

As for the **Bio-Based Industries Joint Undertaking**, the country ranking is markedly different from the ranking of the mainstream calls. The country with the highest number of participations (61) and funding received (43.3 million euro) is Germany, followed by the Netherlands (53, €22.6 million), Italy (32, €28.7 million), Sweden (32, €13.8 million), Belgium (31, €11.4 million) and Finland (30, €10.4 million).

Funding via the BBI JU is also concentrated among participants from the EU15 (76.7%), whilst EU13 participants only account for 9.5% of the EC contributions received. This puts them behind the Associated Countries which secured 13.8% of the funding. Again, the success rate of EU13 applicants is far worse with 15.7% than that of actors from the EU15 (33.7%) or from Associated Countries (41.1%).

3.2.3. International cooperation

Third Countries have a 7.2% share of all applications and 6.4% of all participations. Their share in funding is merely 1.0%, as most of them are ineligible to claim any EC contribution.

A total of 596 entities from third countries applied to the programme (814 applications), within 313 project proposals out of 2,981 (10.5%). 15% of these proposals (47) were retained for funding, involving 123 third countries participants.

These third-country participants are coming predominantly from *China* (30.9%), *Canada* (16.3%) and the *United States* (8.1%). More of half (60.2%) of third-country participants are either Higher or Secondary Education Establishments or Research Organisations, and 22% of them are private companies.

The projects they are involved in relate mostly to the *2.1 Sustainable agriculture & forestry* main topic (53.2%); to lesser extent to *2.2 Sustainable & competitive agri-food sector* (19.2%) and to *2.5 Cross-cutting marine and maritime research* (12.8%). 83.7% are RIA projects, 16.0% are funded under CSA.

3.3. CROSS-CUTTING ISSUES

In 2014-2015, 93.1% (EUR 721.3 million) of the budget has been so far allocated to Sustainable development topics (the target for Horizon 2020 is at least 60%)¹⁶, an estimated 39.4% (EUR 305.4 million; but at least EUR 267.7 million) of the budget to Climate related topics (it should exceed 35% of the overall Horizon 2020 budget) and an estimated 26.6% (EUR 206.4 million; at least EUR 151.5 million) of the budget has been so far allocated to biodiversity. An estimated 0.3 % (EUR 2.2 million; at least EUR 0.4 million) of the EC contribution is related to the Commission's Digital Agenda, notably ICT Research and Innovation.¹⁷

Almost a fifth, i.e. 19% of the SC2 projects, is reported to have significant international cooperation aspects. As these are on average larger projects they account for 39.6% of the EC funding disbursed (EUR 307.2 million). An estimated 18.8% of the projects – calculated on projects for which the marker was filled in in the CORDA database – address the cross-cutting issue of gender equality, receiving an estimated 21.2% of the funding (EUR 164 million; at least EUR 70.5 million). Responsible Research and Innovation is a relevant cross-cutting issue for 14 out of 81 (17.3%) projects, which receive an estimated 22.8% of EC funding (EUR 177 million; at least EUR 68.8 million). In terms of promotion of socio-economic sciences and humanities, it can be observed that 21.8% of projects are SSH relevant, receiving an estimated 30.3% of the EC contribution (EUR 234.8 million; at least EUR 104.1 million).

In SC2 projects 44.8% (5,567 out of 12,427) of the PR GD staff are women while 53% (165 out of 313) of coordinators are women.

Within the 273 projects of SC2 contracted before the cut-off date for this evaluation, 2.4% (€18.2 million) of EC contribution is allocated to innovation actions (a total of 7 projects), all of which include demonstration activities.

¹⁶ In line with the OECD's Rio markers methodology, the budget for individual projects was assigned 100% to supporting sustainable development, and within that biodiversity or climate change (mitigation, adaptation) where these issues were the principal objective of the project, 40% where they were significant, but not predominant objectives, and 0% if these issues were not targeted by the project.

¹⁷ The percentages were calculated for projects for which corresponding markers were included in the CORDA database. The minimum value is the EC contribution allocated to projects with relevant markers only, the estimated value is an extrapolation to the full portfolio.

At least 575 participants of a total of 1,651 (34.8% of the total, 42.9% of those 1,339 that could be classified) involved in SC2 projects are SMEs, start-ups or individual entrepreneurs. SMEs hold – at least – a combined 677 participations (participant slots) out of a total of 2,562, which corresponds to a proportion of 26.4%, climbing to 31.7% when put in relation only to those participants that have been formally classified regarding their organisation type. SMEs received at least EUR 182.4 million EC contribution under these projects (23.5% of the total funding; 26.5% when not counting contributions to participants which were not classified).

Table 27 Breakdown of projects by their contribution to cross-cutting issues and calculated total budgets allocated to addressing these issues

Cross-cutting issues	Projects with marker available	Of which cross-cutting issue is:			Calculated EC contr. allocated to issue (€ m)	As % of total EC contr. (if marker available)
		Principal objective (100%)	Significant objective (40%)	Not targeted (0%)		
Sustainable development	273	243	29	1	721.3	93.1%
- Climate change	233	5	214	14	305.4 (Min. 267.7)	39.4%
- Biodiversity	138	10	54	74	206.4 (Min. 151.5)	26.6%
Digital Agenda	42	-	2	40	2.2 (Min. 0.4)	0.3%
Cross-cutting issues	Projects with marker available	Projects relevant to addressing issue	Projects not relevant to addressing issue	EC contr. allocated to relevant projects (€ m)	As % of total EC contr. (if marker available)	
International cooperation	273	52	221	307.2	39.6%	
Gender	85	16	69	164.7 (Min. 70.5)	21.2%	
Responsible Research and Innovation	81	14	67	177.0 (Min. 68.8)	22.8%	
Social Sciences and Humanities	87	19	68	234.8 (Min. 104.1)	30.3%	

Source: CORDA

Table 43 Overview of cross-cutting indicators

Indicator	SC2	H2020 average
Percentage of publications in peer reviewed journals	84%	43%
Share of Signed Grants flagged as SSH-relevant (all projects)	7%	8%
Percentage of RRI projects where citizens, Civil Society Organisations (CSOs) and other societal actors contribute to the co-creation of scientific agendas and scientific contents	5%	7%
Percentage of women coordinators	53%	35%
Percentage of projects taking into account the gender dimension in R&I content	11%	36%
Percentage of budget of topics in the WP mentioning at least one third country or region	41%	23%
Percentage of EU financial contribution that is climate-related	35%	24%
Percentage of EU financial contribution that is sustainability-related	92%	46%
Percentage of EU financial contribution that is biodiversity-related	21%	3%
Share of EC contribution to Innovation Actions (IA) Signed Grants	25%	17%
Within IAs share of EC contribution focused on demonstration and piloting activities	34%	78%
Within IAs share of EC contribution focused on market replication activities	39%	7%
Share of EC contribution to Digital Agenda (all projects)	6%	24%

Based on data provided by DG RTD (dated 01.09.2016)

4. RELEVANCE

4.1. IS SOCIETAL CHALLENGE 2 TACKLING THE RIGHT ISSUES?

4.1.1. *The relevance of SC2 given the challenges to address*

At a high level, SC2 responds to a well-defined set of challenges and opportunities. As articulated in the various Commission documents and policy statements, Societal Challenge 2 specifically addresses the following inter-related challenges and opportunities:

Feeding a growing world population: the UN Food and Agriculture Organisation (FAO) estimates that farmers will have to produce 70% more food by 2050 to meet the needs of the world's estimated 9-billion population¹⁸. World population growth will therefore continue to put pressure on increasing agricultural and other types of food production on land and at sea. However, *the challenge not only to produce more, but also to produce safe and healthy food with fewer resources, less negative environmental impacts and in more difficult conditions.* Environmentally-harmful farming practices are causing soil degradation and water contamination, reduction in pollinators, loss of natural biological control of pests and diseases and of plant and animal genetic diversity. In addition, both agriculture and forestry are increasingly affected by the adverse effects of climate change. Climate change induced changes in temperatures, crop, water requirements and water availability and quality are negatively affecting both crop and livestock production systems in several parts of the world, thus putting pressure on the global agriculture system. The changing climate is also contributing to resource problems beyond food security, such as water scarcity, pollution and soil degradation. Not only would agriculture and forestry have to adapt to climate change, they will also have to contribute to climate change mitigation measures such as reduction in GHG emissions considering the impact that they have on the environment. For instance, agriculture accounts for about 10% of EU greenhouse gas (GHG) emissions including more than half of the non-CO₂ gases¹⁹. Globally, agriculture and forestry are the source of 24% of emissions, including through tropical deforestation²⁰. Going forward, agriculture and forestry, food processing and consumption, environmental protection of natural resources and climate change will need to be considered in an integrated manner. Investment in R&I is essential to overcome these challenges and necessary to work towards an integrated food systems approach.

Improving food security requires not only increasing food production, but also:

- *Reducing food waste:* around 88 million tonnes of food are wasted annually in the EU, with associated costs estimated at EUR 143 billion.²¹ Globally, food losses and waste are estimated at around 30% of all food produced²²;

¹⁸ FAO (n.d.) How to Feed the World in 2050. Available at:

http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf

¹⁹ Global figures: IPCC "Climate change (2014) synthesis report". For the EU: Eurostat, Agriculture - greenhouse gas emission statistics.

²⁰ Fifth Assessment Report of the Intergovernmental Panel on Climate Change, agriculture and forestry contribute to GHG mainly and agricultural emissions from livestock, soil and nutrient management (CH₄ and N₂O emissions) and through deforestation. See: <http://www.ipcc.ch/report/ar5/wg3/>

²¹ Europa website: http://ec.europa.eu/food/safety/food_waste/index_en.htm

²² FAO (2013) Food wastage footprint, impact on natural resources, summary report

- *Producing safe, healthy and high quality food* that is accessible, nutritious, contains minimal or no allergens and chemical contaminants, and free of food-borne pathogens and toxins. This is particularly important when considering the *economic burden of diet-related diseases*, not only on healthcare systems, but also on the workforce and in the face of an ageing population. For instance, cardio-vascular diseases are the cause of 52% of deaths in Europe and are estimated to cost the EU economy €192 billion annually. Projections suggest that in 2020 3.4 million Europeans will develop cancer and over 2.1 million will die as a result of the disease.²³ It is estimated that 35 million adults had diabetes (both Type 1 and Type 2) in Europe in 2011. This is projected to increase by 23%, to 43 million in 2030. Furthermore, EUR 89 billion were spent on treating and managing diabetes and its related complications in 2011. The total cost of diabetes to society would be even higher if indirect costs such as productivity losses were taken into account.²⁴ The World Health Organisation (WHO) estimates that 80% of cardiovascular diseases, 90% of type 2 diabetes and 30% of all cancers could be prevented by a healthy diet.²⁵ However, producing safer and healthier food is one side of the equation. In parallel, behavioural change among consumers is also needed.
- *Reducing demand for animal protein:* protein intake has risen by 43 per cent in the daily diet, from an average of 355 calories a day in 1965 to 507 in 2014.²⁶ According to the FAO, demand for meat, fish and dairy products will peak in 2025. This will put an enormous pressure on natural resources in terms of the amount of feed and land use involved to meet this demand. Moreover, livestock produces 14.5 per cent of all greenhouse gas emissions, according to the UN. There is therefore, an urgent need or developing plant-based alternatives as a way of reducing demand for animals as food.
- *Taking account of the impact of urbanisation:* the worldwide trend towards more urbanisation is expected to continue over the next decades, creating a greater demand for higher quality and processed food. The challenge of providing habitants in cities with sufficient, safe, and nutritious food is both urgent and complex and also depends on the regional, national or global position of the city. R&I on city-region food systems can contribute to overcome this challenge.

Harnessing the huge potential of Europe's oceans, seas and coasts for jobs and growth: oceans cover over 70% of planet Earth. They contain vast resources which can potentially be used for meeting human needs for food and energy, as well as producing a large variety of goods and services contributing to health and well-being. Additionally, the role of healthy seas and oceans in capturing greenhouse gas emissions is essential for all sectors of the global economy. Oceans and seas therefore, offer many great opportunities for growth and jobs in the EU which has the world's largest maritime territory, with the Exclusive Economic Zone of its Member States covering 25 million km². The blue economy represents more than 5 million jobs and an added value of nearly €500 billion per year.²⁷ The growth and job creating potential of European marine resources however, remains largely under-exploited²⁸. Marine

²³ EPHAC (n.d.) Towards a healthier, more sustainable CAP, European Public Health and Agriculture Consortium (EPHAC) position on "The Future of the Common Agricultural Policy"

²⁴ OECD (n.d.) The diabetes epidemic and its impact on Europe

²⁵ World Health Organization (2008) 2008-2013 Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases, World Health Organization, Geneva

²⁶ Financial Times (2016) The appliance of agricultural science: Businesses are pushing futuristic schemes to help feed the world, 30 November 2016

²⁷ European Commission (2012) COM(2012) 494 final

²⁸ Blue Growth opportunities for marine and maritime sustainable growth COM(2012)494

resources are under-exploited and under-explored due to a number of constraints include data access, financial constraints, human resource constraints, difficulties of coordination, legal and regulatory barriers to innovation. Public intervention – and particularly, support for R&I – is necessary to overcome these barriers.

Reducing the EU's heavy dependence on seafood imports: sea and ocean bio-resources provide 15% of the animal protein consumed globally. Approximately 60 % of total European seafood consumption depends on imports; the EU is the world's largest importer of fisheries products.²⁹ Fish stocks are increasingly overexploited, even if the aquaculture production is rising relentlessly. Thus, fisheries and aquaculture need sustained major investments in R&I to develop effective solutions to yield food and feed while coping with climate change and ecosystem sustainability challenges.

The need to shift to a bio based economy not only because of climate change, but also to reduce Europe's dependence on fossil resources and to create jobs and green growth. The transition from a fossil-based economy towards a bio based economy is however, a major challenge. The switch, inter alia, entails the transformation of conventional industrial processes and products into bio-based processes and products, the development of industrial biotechnologies, integrated bio-refineries and the opening of new markets for bio-based products. The growth potential for bio-based products depends on their capacity to substitute fossil-based products at competitive cost, with smaller ecological footprint and lower GHG emissions. Investment in R&I is essential to overcome these challenges and to accelerate Europe's transition to a bio based economy.

Forests as a renewable resource have the potential to play a key role in the emerging bio-based economy. A key challenge however, is *to get more feed, energy, and biological raw materials from forests while ensuring their sustainability*. Addressing these challenges will require new knowledge and technology, and investment in R&I will be essential.

The Expert Group's desk research and stakeholder interviews suggest that these challenges and opportunities continue to remain valid in the present context and that there is a clear scientific rationale for investing in R&I to address these. As such, the objectives of SC2 are highly pertinent to the challenges and opportunities facing Europe. However, the programme objectives as currently articulated in the legal basis are very broad and “all inclusive”. They provide no indication of what success would look like on programme completion. As such, the current definition of objectives does not provide an adequate basis for programme priority setting, monitoring progress or evaluating programme performance.

The Expert Group observes that the translation of high level challenges and objectives into specific call topics might not be clear to external stakeholders. Several interviewees expressed the concern that the development of call topics within the work programmes is not transparent and that the inputs that they provide through various channels “go into a black box”. The process through which the high-level challenges set out in the programming documentation (e.g. legal basis, public consultation documents) are translated into the specific challenges addressed by call topics is not set out in the work programmes and might not be clear to the ‘outside world’. While the participatory nature of the Strategic Programming Process is greatly appreciated by stakeholders interviewed, the link between the scoping papers (which are not made publicly available) and the specific call topics is not always clear cut. There is little publicly documented evidence (a) explaining how the specific challenges (at call topic

²⁹ Council Decision 2013/743/EU of 3 December 2013 establishing the specific programme implementing Horizon 2020

level) are identified and prioritised and (b) demonstrating that SC2 is funding the most critical or promising research topics to address the societal challenges identified

Moreover, in certain areas, call topics are described in very broad terms in the opinion of several interviewed stakeholders (including project participants) – a view which is also shared by the Expert Group. While broadly defined call topics give applicants more room for creativity and developing different approaches/ solutions to a research topic, such an approach has the following potential disadvantages:

- *It makes it difficult for participants to respond to them appropriately* - individual topics sometimes list a broad range of requirements (e.g., SFS-7-2014/2015; ISIB-1-2014) which creates the dilemma if individual proposals should concentrate on only some of those requirements or if each project should address all of the requirements listed. This puts applicants and selection panels in a difficult position, especially where a large number of proposals to these broad call topics are made.
- Another outcome of broadly and imprecisely defined call topics is that in some cases *it has led to the funding of several projects in a related technical area with potentially little impact*. For example, resulting from the 2014-15 work programme, a significant research effort is devoted to the breeding or production of tomatoes: two projects on breeding tomatoes (TomGEN and TRADITOM) and two with a significant tomato component (G2P-SOL and EUCLID). There is no reason to question the merits of these projects, but this number of projects might make tomatoes the most researched crop species in this programme so far. It so happens that tomato is a good model plant for research such as analysing plant-pathogen interactions, genetics and genomics, but this was not a deliberate programming choice (rather, as explained above, an outcome of broadly and imprecisely defined call topics).
- *It might contribute to a high level of demand to some calls, particularly at stage 1 and potentially low quality proposals*. High demand translates into low success rates which also results in higher evaluation costs. The programme is attracting oversubscription and a worryingly high share of low-middle quality proposals (59.2% of the proposals were below the quality threshold for SC2 main calls, 80.3% were below threshold in case of the SME instrument and 54.2% of the proposals attracted by the BBI calls were below the quality threshold). It is possible that this is somewhat related to the broadly defined call topics, at least as far as the main SC2 calls are concerned³⁰.

Whether call topics should be broadly or precisely defined is not an easy issue to resolve and it can be hard to please everybody. For instance, in the past, the Commission was criticised for developing top-down and overly prescriptive calls. In comparison to FP7, topics under Horizon 2020 therefore, have a broader introductory description but very precise impact expectations (reflecting the spirit of Horizon 2020 to fund impact driven research). Stakeholders debate the advantages and disadvantages of ‘broad’ versus ‘narrow’ topics, or ‘prescriptive’ versus ‘non prescriptive’ topics, and the same discussion has been led within the Commission. There may be a false dichotomy in this discussion and the real issue is the optimal degree of precision in topic texts in relation to the purpose of the topic.

4.1.2. *The relevance of SC2 in addressing European objectives*

European Commission’s policy agenda

³⁰ For the SME instrument, it is potentially a consequence of lack of understanding from new participants and for the BBI due to lack of good research ideas to match the opportunity described

As demonstrated by the programme's intervention logic presented in section 1.3.2, SC2 (by design) is highly relevant to the European Commission's policy agenda:

- *A new boost for jobs, growth and investment*: by creating new bio-based value chains, commercialisation of new products, processes and technologies, supporting innovation within SMEs, SC2 is expected to stimulate investment, growth and jobs.
- *A deeper and fairer internal market with a strengthened industrial base*: a key objective of SC2 is to strengthen the European industrial base and particularly, the agri-food sector, bio-based industries and the fisheries, aquaculture and marine and maritime sectors.
- *A resilient EU with a forward looking climate change policy*: the programme seeks to support the transition from a fossil fuels based economy to a bio-based economy, support better management of forests, seas and oceans and reduce the environmental impact of food and feed production and consumption.

Moreover, a detailed mapping of 111 non-SME project proposals (out of 138 projects falling within the scope of the evaluation) shows that project activities are highly aligned with the Juncker Commission's policy agenda). Specifically, 72% of the non-SME projects mapped are expected to contribute to Europe's economic and industrial competitiveness. A mapping of SME projects suggests that Phase I SMEs are expected to generate additional EUR 1.5 billion of turnover and create 1,113 jobs during the next three years from commercialisation of products, processes and technologies being developed with support from the programme.³¹ While the 26 SMEs that received Phase II funding are expected to generate additional EUR 1.03 billion of turnover and create 1,121 jobs during the next five years as a result of bringing their products to market.³²

3Os: Open access, Open innovation and Open to the world

The following paragraphs assess the extent to which SC2 is aligned with the Commission's policy objectives with respect to 3Os. It should however, be noted that 3Os were introduced as a policy objective in 2015 i.e. after the first work programme had been published.

Open access³³ can apply to two broad types of research outputs:

- Peer-reviewed publications (these are published in academic journals);
- Scientific research data (data underlying publications and/or raw data).

The project mapping exercise reveals that open access issues are not systematically covered in project proposals (less than one in three projects share all their research outputs), the exceptions being CSA projects and projects addressing specific implementation aspects and horizontal issues (2.6)³⁴, see Table 30). Open access to data is a very ambitious goal set by the European Commission and the European Cloud Initiative launched in 2016 is expected to provide the infrastructure, rules and standards to push Europe to the forefront of Open

³¹ These figures do not include indirect job creation or destruction which the innovations lead to. Likewise, the effect of innovations on the turnover of other companies, which may either use the innovation or compete with it, are not taken into account in these estimates.

³² The expected turnover and employment figures of Phase I and Phase II should not be added due to avoid double counting (several Phase II SME projects also received funding under Phase I).

³³ Under FP7 projects could opt in for open access, whereas the general rule in Horizon 2020 is that projects are by default 'open access' for publications and need to justify a derogation from that rule if they wish to opt out.

³⁴ This makes sense as many of the horizontal marine issues are about international ocean cooperation and management

Science. The realisation of the European Cloud roadmap is expected to have a bold impact on Open Science that will only be visible at the end of Horizon 2020 and beyond that. With few exceptions, the projects funded so far do not intend to take part in the European Cloud Initiative.

Table 30 Envisaged use of four approaches to open access among SC2 projects (% of projects mapped)

	CSA	ERA-Net Cofund	IA	RIA	BI-IA	BBI-RIA	Overall
<i>% of projects that envisage...</i>							
Freely sharing all outputs (e.g. publications data blueprints prototypes...) - During project implementation	71%	0%	0%	25%	0%	0%	30%
Freely sharing all outputs (e.g. publications data blueprints prototypes...) - After project implementation	33%	0%	0%	18%	0%	0%	18%
Freely sharing the research outputs of the project on the European Open Science forum - During project implementation	10%	0%	0%	5%	0%	0%	5%
Freely sharing the research outputs of the project on the European Open Science forum - After project implementation	10%	0%	0%	3%	0%	0%	4%
Number of projects	27	3	7	61	6	7	111

	Activity level						Overall
	2.1	2.2	2.3	2.4	2.5	2.6	
<i>% of projects that envisage...</i>							
Freely sharing all outputs (e.g. publications data blueprints prototypes...) - During project implementation	30%	11%	30%	0%	46%	67%	30%
Freely sharing all outputs (e.g. publications data blueprints prototypes...) - After project implementation	24%	11%	20%	0%	8%	33%	18%
Freely sharing the research outputs of the project on the European Open Science forum - During project implementation	9%	0%	0%	0%	8%	0%	5%
Freely sharing the research outputs of the project on the European Open Science forum - After project implementation	5%	0%	0%	0%	17%	0%	4%
Number of projects	49	10	10	16	14	12	111

Source: project mapping by the expert group; N=111 projects

Open innovation

Open Innovation is about opening up the innovation process to all active players so “that knowledge can circulate more freely and be transformed into products and services that create new markets, fostering a stronger culture of entrepreneurship”³⁵. The Open Innovation 2.0 concept provides opportunities to realise the ambitious goals of Horizon 2020 in two fundamental ways. First, it emphasises the need to move from a researcher-centric to a user-centric innovation model, where the user is seen as the focal actor in the innovation process. This implies that users should be intensively involved throughout the whole process. The creation of Living Labs, the multi-actor approach (in Agriculture), and the adoption of rapid prototyping are seen as important tools to realise such close collaboration with users. Second, the Open Innovation 2.0 concept stresses that, in order to maximise societal impact, it is vital

³⁵ European Commission (2015) Open Innovation Open Science Open to the World – a vision for Europe at http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=16022

to move from mono-disciplinary collaborative clusters to multi-disciplinary ecosystems, in which a wide variety of different actors come together³⁶.

The expert group observes that:

- Open innovation is not a common approach in the projects funded so far, the exception being IA and multi-actor projects with a user-centric approach and envisaging a multi-disciplinary ecosystem approach.
- Open innovation is practiced more in activity lines 2.1 (sustainable and competitive agri-food sector) and 2.3 (unlocking the potential of aquatic living resources).
- Over half of the projects falling under activity line 2.5 (cross-cutting marine and maritime research) and four out of five projects in activity line 2.3 (unlocking the potential of aquatic living resources) envisage using open source tools and data. This could be explained by the fact that a large number of simulation models, management tools and modelling software are freely available.

Table 31 Share of projects addressing open innovation issues by instrument and activity area

	CSA	ERA-Net Cofund	IA	RIA	BBI- IA	BBI- RIA	Overall
<i>% of projects that envisage...</i>							
...a user-centric innovation model approach	28%	0%	100%	37%	0%	0%	34%
...to follow a multi-disciplinary ecosystem	52%	0%	57%	47%	0%	0%	43%
... to make use of open innovation platforms	12%	0%	0%	13%	0%	14%	11%
... to make use of open source tools, software, data,...	24%	0%	14%	30%	0%	0%	24%
Number of projects	27	3	7	61	6	7	111

	Activity level						Overall
	2.1	2.2	2.3	2.4	2.5	2.6	Overall
<i>% of projects that envisage...</i>							
...a user-centric innovation model approach	20%	90%	90%	0%	31%	42%	34%
...to follow a multi-disciplinary ecosystem	50%	60%	60%	6%	46%	33%	43%
... to make use of open innovation platforms	2%	0%	10%	6%	46%	25%	11%
... to make use of open source tools, software, data,...	11%	10%	80%	0%	54%	33%	24%
Number of projects	49	10	10	16	14	12	111

Source: project mapping by the expert group; N=111 projects

Open to the world

Open to the world means striving to ensure that EU R&I has an impact at a global level, addressing global challenges, supporting international policy making and international collaboration.

³⁶European Commission (2013). Open Innovation 2.0:

ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=2118

European Commission (2015). Open Innovation 2.0 and Horizon2020: Opportunities and Challenges.: <https://ec.europa.eu/digital-single-market/en/news/open-innovation-20-and-horizon2020-opportunities-and-challenges>

SC2 has been carrying out a strategic international co-operation, with major programme – level co-operation activities, such as the Atlantic Ocean Research Alliance, the BLUEMED initiative, the EU-China Task Force and flagship in Food Agriculture and Bioeconomy, the Africa Partnership for food and nutrition. Consequently, a high number of call topics specifically encouraged cooperation with partners from third countries such as Africa, China and North America (Table 32).

This is however not fully reflected nor measurable merely in terms of third countries participation / EC contributions statistics, due to the nature of this type of international co-operation which often goes beyond direct participation in Horizon 2020 projects and rather imply mirroring activities by third countries' own programmes. Thus, third country participation appears quite low within SC2 – Figures 4 and 5 – despite the fact that substantial activities are on-going. In budgetary terms also, funding allocated to third country partners has decreased from 12% under FP7- KBBE to 8% under H2020 calls in the 2014-2015 period. However, these figures do not include: i) third country contribution to projects participants (several cases being third countries who do not have automatic right to EC funds), ii) third countries partners associated to the projects (but not being formal participants), and iii) third country funding leveraged within the framework of major strategic international co-operation activities that have been implemented under SC2 through programme level co-operation with main partners worldwide.

For example, in Horizon 2020 there are 14 projects with 318 partners that support the implementation of the Galway Statement and run under the Atlantic Ocean Research Alliance. Within these projects, there are 10 project partners or participants through other arrangements from the United States, and there are 12 project partners or participants through other arrangements from Canada. Following the Communiqué of the G7 S&T Ministerial in May 2016, DG RTD is also working with its G7 partners on Ocean observations, ocean assessment and data sharing. Also in this case, third countries partners invest through mirroring own research programmes, supporting projects which interact with corresponding SC2-funded projects.

Table 32 Call topics encouraging international cooperation with third countries

	2014-2015 Work Programme			2016-17 Work Programme		
	No. of call topics	No. of call topics -Third country	% of call topics - Third country	No. of call topics	No. of call topics -Third country	% of call topics - Third country
Sustainable Food Security	20	14	70%	48	21	44%
Blue Growth	16	6	38%	14	5	36%
Innovative, Sustainable and Inclusive Bio economy	13	2	15%			
Rural Renaissance				16	0	0%
Bio Based Industries				8	0	0%
Totals	49	22	45%	86	26	30%

Source: based on work programme mapping (Annex 1)

Figure 4: Share of SC2 participations by region

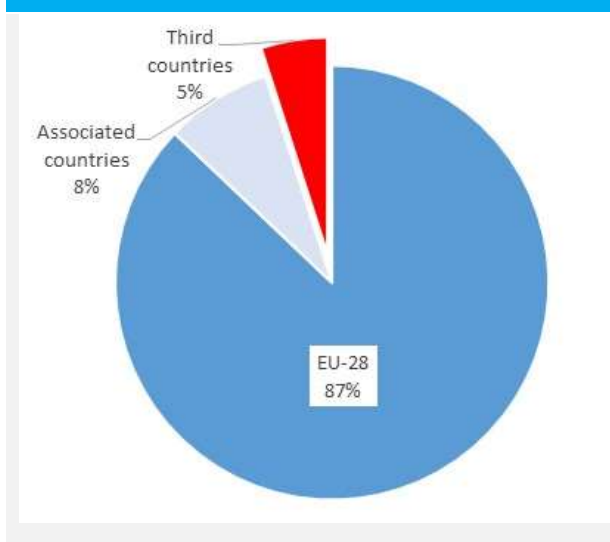
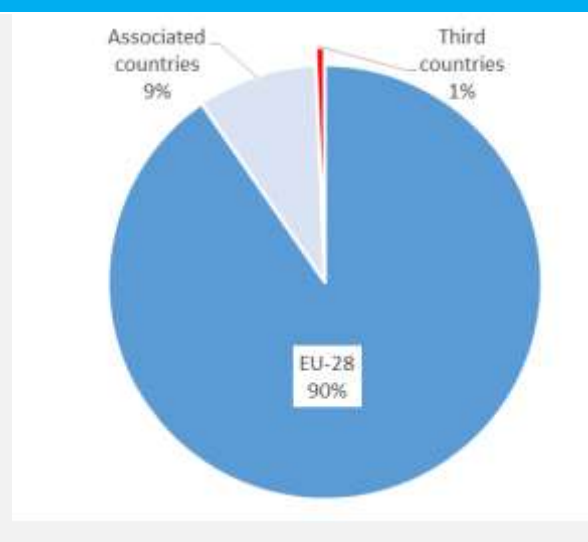


Figure 5: Share of EC contribution by region



Based on CORDA extracted in September 2016 (273 projects, EC contribution = €783M**, Total number of participations = 2,477). Figure 4 does not add to 100% due to rounding off. **There is a discrepancy between the total EC contribution that appears in the project level data and at participant level (of €8M). Third countries are all countries outside the member countries of the EU. Note: Associated third countries are IS, NO, AL, BA, MK, ME, RS, TR, IL, MD, CH, FO, UA, TN, GE

The project mapping exercise further suggests that 42% of the projects mapped envisage dissemination and/ or knowledge sharing activities specifically targeting third country participants (e.g. workshops, conferences etc.). However, only 23% of the projects mapped envisage cooperation or collaboration with third country actors.

Table 35 Share of projects that are open to the world

	CSA	ERA-Net Cofund	IA	RIA	BBI-IA	BBI-RIA	Overall
Any dissemination and/ or knowledge sharing activities specifically targeting third countries	30%	33%	29%	59%	0%	0%	42%
Any cooperation or collaboration with actors from third countries?	19%	0%	0%	34%	0%	0%	23%
Number of projects	27	3	7	61	6	7	111
	Activity level						
	2.1	2.2	2.3	2.4	2.5	2.6	Overall
Any dissemination and/ or knowledge sharing activities specifically targeting third countries	53%	50%	40%	6%	43%	42%	42%
Any cooperation or collaboration with actors from third countries?	22%	40%	30%	6%	29%	25%	23%
Number of projects	49	10	10	16	14	12	111

Source: project mapping by the expert group; N= 111 projects

Overall SC2 performs above Horizon 2020 average as far as international participation is concerned³⁷.

³⁷ European Commission (2016) Performance Analysis of International Participation in Horizon 2020, A support study for the interim evaluation of Horizon 2020

4.2. FLEXIBILITY TO ADAPT TO NEW SCIENTIFIC AND SOCIO-ECONOMIC DEVELOPMENTS

Since the beginning of Horizon 2020, major political developments both in the EU and in the international arena relevant to SC2 included the Juncker's Agenda for Jobs, Growth, Fairness and Democratic Change (2014), the Paris Agreement on Climate (2015), the UN Sustainable Development Goals (2015).

The Expert Group reported that desk research, stakeholder interviews and expert opinions suggest that there have not been any significant technological or scientific advances or wider socio-economic or political developments³⁸ since the initiation of Horizon 2020 that call for a substantive change in direction or shift of focus in the programme. Nevertheless, the programme has evolved to respond to new developments within specific thematic areas. As an example, in the 2014-2015 work programme, there were no topics directly addressing consumer research within SFS. The 2016-2017 work programme has however, included consumer science in its scope and this is reflected in at least three of its call topics. This change reflects new developments in the field that highlight the key role of consumers and citizens in achieving sustainable food and nutrition security. Likewise, the inclusion of the SFS-18 (CSA Food 2030)³⁹ in the 2016-17 work programme, strongly reflects current research policy needs identified in this field.

Generally, stakeholders note that the needs to be addressed by SC2, the programme and its priorities are broadly defined covering implicitly or explicitly the essence of important research areas related to food security, agriculture and forestry, marine, maritime and inland water and the bioeconomy. Given the breadth and the loosely defined coverage, stakeholders generally consider the programme to be sufficiently flexible to adapt to new needs.

4.3. ADDRESSING SPECIFIC STAKEHOLDER NEEDS

A series of initiatives have been implemented to ensure continuous interaction and engagement of stakeholders in the identification of R&I needed to address the challenges and opportunities described earlier. At an operational level, relevance is fostered through a bottom-up consultation of stakeholders to inform the drafting of the Work Programmes (via targeted and open public consultations⁴⁰), expert advice (Advisory Group inputs, foresight exercises), inputs from working groups⁴¹, and Member State inputs (via the SC2 Programme Committee and SCAR) while taking account of top-down considerations (EU policies, legal basis, strategies and road maps). The extensive use of the multi-actor approach (Table 28) and the creation of the BBI JU further supports relevance of the programme to the needs of stakeholder and end users.

These initiatives, independent or European Commission supported work to continuously identify stakeholder needs at all levels- national, regional, European - and deliver foresight

³⁸ The implications of BREXIT are unknown at this stage

³⁹ Support to the development and implementation of FOOD 2030 - a European research and innovation policy framework for food and nutrition security

⁴⁰ For the WP2014-2015 there was no public consultation as it was adopted in December 2013 immediately after the adoption of the regulation. A public consultation has been organised for subsequent work programmes.

⁴¹ For example, DG AGRI Research workshops, including EIP-Agri and DG RTD Thematic Workshops (e.g. on microbiomes): specific working sessions were organised to deepen the gap analysis and formulate research questions with key selected experts.

papers and roadmaps. As an example for the bioeconomy, a EU Bioeconomy Stakeholders Panel has been established and a Bioeconomy Stakeholder's Manifesto was produced⁴².

Table 5 The use of multi-actor approach within SC2 during 2014-2015

	Total number of call topics	Call topics requiring multi-actor approach	No. of Multi-actor projects funded**	EU funds requested for €M*	EU funds allocated to multi-actor projects as % of call budget
Sustainable Food Security	20	8	17	89	36%
Blue Growth	16	-	-	-	-
Innovative, Sustainable and Inclusive Bio economy	13	2	11	24	28%
Totals	49	10	28	113	34%

* *CORDA data provided to evaluators does not include the POnTE project.* ***The above list does not include 3 projects funded under WASTE and WATER calls (EU funds requested = €18.6M)*

Evidence box 1: Strategic Programming 2016 for WP2018-2020

- Open public consultation in 2016
- Stakeholders workshops - Conferences – Foresight : from Expo Milan onwards, at least 20 events have been organised : SCAR Conference and Foresight, Bioeconomy Investment Summit, Future of Agricultural Research, Bioeconomy Stakeholders Conference -Utrecht, Food 2030 High-Level Event, Lodz and Bratislava Bioeconomy for regions; thematic workshops on microbiomes, plant health protection ...)
- Horizon Group: Inter-Service Group involving all the Commission services that have a stake in SC2. This includes all the other Horizon 2020 parts + JRC, DG SANTE, DG ENV, DG CLIMA, DG GROW, DG MARE, DG ENER, DG TRANSPORT, DG EAC, DG DEVCO, DG ECHO
- MS SCAR/PC workshops: 7 participatory workshops between EC, SCAR and PC dedicated to the strategic programming exercise (in addition to formal PCs and SCAR plenaries)

The approaches to user and societal engagement also mentioned above address some of the criticisms voiced in the past Framework Programmes: that the research agenda was driven primarily by the scientific community (and therefore not necessarily effective in meeting the needs of potential users and wider society) with the consequence of having a sometimes poor uptake of research results. The cross-cutting H2020 project CIMULACT⁴³ ('Citizen and Multi-Actor Consultation on Horizon 2020'), a three-year project that started in June 2015, represents one of the efforts to improve the engagement of citizens and to provide concrete input to the European Union's R&I agenda.

Overall, SC2 is highly valued and appreciated by stakeholders – as also evident from the high demand for programming funds. The introduction of the Strategic Programming Process has greatly improved the intelligence base underpinning programming choices and has helped better define the focus of the programme.

⁴² 4th Bioeconomy Stakeholders Conference, Utrecht April 2016

⁴³ <http://www.cimulact.eu/>

Evidence Box 2: Stakeholder engagement within the Blue Growth theme

The European Marine Board (EMB) is a platform of leading European marine research performing and research funding organisations established to promote enhanced cooperation in marine science at a European level. EMB operates in association with the European Science Foundation (ESF) and contributes to the development of a more coordinated and integrated policy framework for marine science and ocean stewardship, addressing societal needs, through the creation of expert working groups, the publication of strategic publications, facilitation of major marine science-policy conferences (e.g. EuroOCEAN conference series).

The Marine Board Expert Working Groups are the primary foresight and priority-setting tools of the Marine Board. Working groups are established on topics of strategic importance for marine sciences in Europe which are yet to be addressed properly or lacking visibility. The mode of operation of EMB ensures wide consultation of stakeholders group and close interaction with policy organisations in Europe and beyond. This systematic interaction led to the Rome Declaration in EuroOcean 2014 that sets a vision for seas and ocean science, identifies four important goals that have been clearly considered in drafting the Horizon 2020 work programmes.

Another important tool used for stakeholder interaction is the Joint Programming Initiative Oceans, created to tackle Grand Societal Challenges that cannot be solved solely at the national level. Based on the principle of variable geometry, it allows Member States and Associated Countries to participate in joint initiatives most relevant to their national priorities. JPI Oceans currently includes 20 marine Member Countries, covers all European sea basins, and can provide an interface between European and international activities at global and regional levels, such as the Transatlantic Ocean Research Alliance and the Blue Growth Initiative for the Mediterranean Sea. The JPI Oceans Management Board have delivered the first iteration of the Strategic Research and Innovation Agenda (SRIA), presenting ten Strategic Areas, developed and agreed through an extensive consultation process through 60 stakeholder workshops. Building on the mapping and gap analysis and consultation process JPI Oceans has highlighted new research needs which the European Commission could consider for the Horizon 2020 work programmes. Additionally, the use of existing EC instruments such as public – public partnerships (ERA-NETs, ERA-NET Plus, ERA-NET COFUNDS or Article 185, infrastructures, mobility and training grants will enhance the ability of participants to work together in the implementation of the JPI Oceans Strategic Research and Innovation Agenda.

Horizon2020 work programmes directly reflect the strategic areas identified in foresight papers and SRIAs developed by the different initiatives, supporting at the same time the valorisation of distinct sea basins (BlueMed Initiative) and the interaction required by the lack of

Table 36 presents the amounts of EU funding allocated to each type of participating organisation, for SC2. The largest category of beneficiary so far is the private sector receiving 38% of the EU funding allocated so far, with a particularly high share in BBI-JU (73%) due to the nature of this part of the programme. Compared to its predecessor programmes, Horizon 2020 SC2 represents a significant improvement in involvement and participation of industry (Figure 6). The BBI-JU, SME instrument, and the use of the multi-actor approach in Agriculture have greatly facilitated private sector participation within the programme. Expert opinion suggests that the needs of the farming sector and industry are well represented in most parts of the programme, with the exception being forestry projects (despite there being a huge forestry industry within the EU).

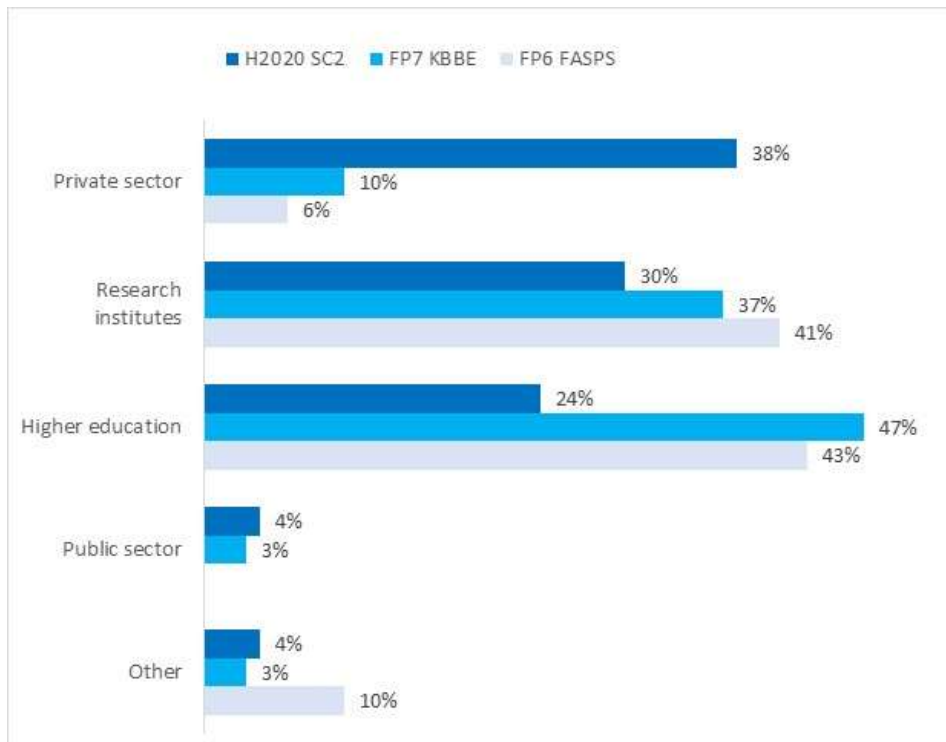
The Higher Education and research sectors are also well represented within SC2 projects. The public sector and other category of participants (e.g. CSOs) however, are less well represented.

Table 36 Share of EC contribution by type of organisation

Type	Share of EC contribution				EC contribution on €M
	BBI projects (RIA, IA flagships, IA demo, CSA)	SME Instrument	SC2 projects under the EC's WPs (RIA, IA, CSA and Co-funds)	SC2 overall	
Higher education	8%		33%	24%	186.4
Other	3%		5%	4%	30.5
Private sector	73%	100%	17%	38%	300.8
Public sector	0%		6%	4%	32.4
Research institutes	16%		39%	30%	233.0
Total	232.8	44.9	505.4	783.1*	783.1*

*Based on CORDA data extracted in September 2016. (273 projects, *EC contribution = €775M). There is a discrepancy between the total EC contribution that appears in the project level data and at participant level (of €8M)*

Figure 6: Share of EC contribution by type of organisation under FP6, FP7 and Horizon 2020



Horizon 2020 SC2 based on CORDA data extracted in September 2016. FP6 (Food quality and safety & Policy support actions) and FP7 KBBE sourced from ex-post evaluation of the rationale, implementation and impacts of EU Seventh Framework Programme (2007-2013) Cooperation Theme 2: food, agriculture and fisheries, and biotechnology

Dissemination and outreach activities – and reach of citizens

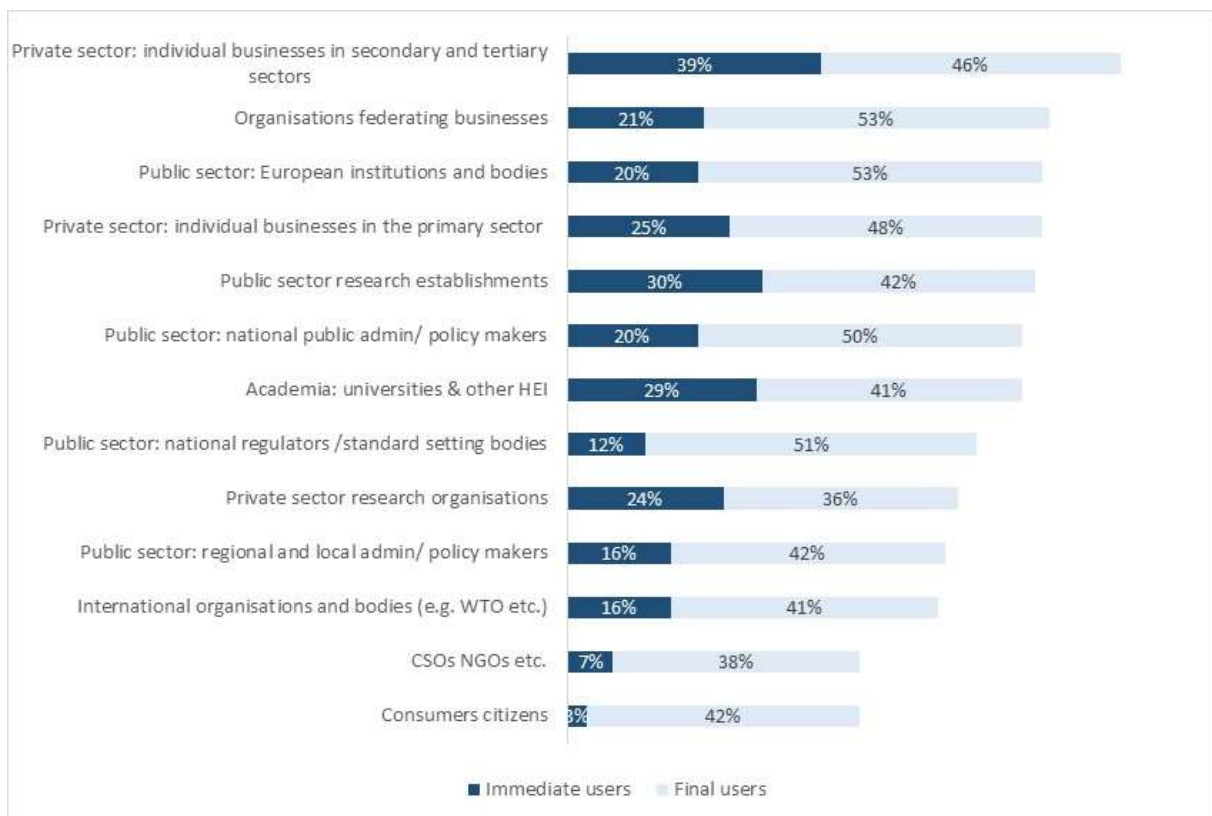
Dissemination and exploitation of research results are strongly encouraged in Horizon 2020. Project beneficiaries have an obligation to promote funded projects and their results, and communication forms part of the activities expected to generate project impact. To guide communication efforts, Horizon 2020 requires that projects develop and implement a communication plan, which goes beyond the project's own community to include "the media and the public"⁴⁴. In addition to these general approaches, a large proportion of SC2 activity is relevant to the European Innovation Partnership for "Agricultural Productivity and Sustainability" which provides a mechanism to deliver research outputs to the farming sector.

The mapping of projects show that SC2 funded projects target a broad range of stakeholders as potential users of their outputs – Figure 7. As a result of the introduction of the multi-actor approach, it could be expected that new beneficiaries (farmers' organisations, advisory services etc.) will take part in SC2.

⁴⁴ See for example, the Guidance for evaluators of Horizon 2020 proposals (2014):

http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/pse/h2020-evaluation-faq_en.pdf

Figure 7 Share of projects targeting the different stakeholder categories as users



Source: project mapping by the expert group, n= 111 projects

A review of the successful project proposals indicate that dissemination and communication efforts are largely targeting stakeholders which are expected to be “immediate users” of project results. Ensuring that potential users are aware of project developments and project outputs is generally the stated rationale for both dissemination and communication efforts. Target audiences are defined accordingly.

Many projects additionally aim at reaching out to citizens or consumers (and the media as an intermediary) as part of their communication efforts. This is in line with the requirement for Horizon 2020 communication which stipulates that “The beneficiaries must promote the action and its results, by providing targeted information to multiple audiences (including the media and the public) in a strategic and effective manner.”

Citizens however, are not an important target group, but rather a secondary or tertiary audience as can be expected. Low priority to citizens is illustrated by short or no objective descriptions for this audience and the communication approach presented by many project Consortia. Projects stating that they intend to target citizens typically mention websites, newsletters, publications social media channels and YouTube videos as means to reach the general public. Such tools require significant promotional efforts to generate public interest (i.e. communication to drive viewers to a website, make citizens follow a Facebook account etc.). However, only few project proposals reviewed, outline any strategy for generating public interest, suggesting that most projects are unlikely to generate any substantial citizen reach. It is only in cases where consumer engagement is a key for project success that proposals contain elements of a dedicated communication strategy targeting the general public. Illustratively, this is the case for the IA project EcoPROLIVE which includes specific communication activities targeting consumers with the aim of stimulating demand for the market uptake of olive end-products.

The fact that projects largely prioritise dissemination and communication efforts for a stakeholder community should be viewed positively. Projects are likely to be of variable public interest – with many projects unlikely to match core criteria for newsworthiness, especially at project start up and during project implementation (science content is more likely to be of interest if it is relevant for everyday life, tells something not known previously, is geographically linked to the audience, provide a political angle or are able to “touch” the audience⁴⁵). The potential modest public interest may also be illustrated by the EC’s own data on press coverage of projects which in a 1.5-month period identified 18 articles – half were identified media targeted professionals in the sector⁴⁶. Furthermore, stakeholders consistently highlight the need to ensure adequate and focused communication to stakeholders and dissemination was mentioned as one of the main programme weakness in the 2011 study on *Impacts of EU Framework Programmes (2000-2010) and Prospects for Research and Innovation in FAFB*. Concentrating communication on actors which are key for ensuring programme impact is also in line with good communication practice⁴⁷. This said, judging by the review of project applications, projects’ attention to communication and dissemination – and the quality of approaches - varies across project types as discussed in section 6.

4.4. OTHER ISSUES RELATED TO RELEVANCE

- Several interviewed stakeholders mentioned that it might be better to fund a larger number of smaller projects; rather than one big project under the call topics. According to them, the tendency to fund larger projects is resulting in larger consortia, but not necessarily better research. This approach is perceived as reducing diversity in R&I solutions proposed (and ultimately funded) in response to the specific challenges being addressed via the call topics.
- According to some stakeholders, the important role of forestry in tackling climate change, producing biomass and creating new jobs in relation to forest management, tourism, producing new products, value chains etc.) is not prominent within SC2. These stakeholders perhaps do not realise that these issues are covered by the BBI JU.
- Programme content analysis carried out by a DG RTD expert group reveals that the identified keywords from the EU and International priorities, the needs of the EU citizens and subsequent technological and scientific advances are to a high degree covered in both the SC2 legal basis as well as the 2014-2015 and the 2016-2017 work programmes⁴⁸.

4.5. LESSONS LEARNT/ AREAS FOR IMPROVEMENT

- SC2 is addressing a well-defined and important set of societal challenges. There is a clear scientific rationale for investing in R&I in the activity areas covered by SC2. The programme is supporting R&I on important and pertinent issues. There is a strong justification (as well as strong stakeholder support) for a challenge based approach to EU funded R&I.

⁴⁵ See “Survey of Researchers and Media Professionals” undertaken by The Evaluation Partnership and Deloitte for DG Research 2007 at https://ec.europa.eu/research/conferences/2007/bcn2007/executive_summary_en.pdf

⁴⁶ e.g. Sheep Farmer; AgriLand.ie; Fleisch Magazin; Over the Counter; www.farmer.pl; Today's Farm and Fresh Produce Journal

⁴⁷ which highlight the need to concentrate efforts on audiences which can generate the desired project or policy impact – as opposed to activities which aim at raising awareness as an end in itself. See for example A.Henningsen et al Measuring the European Commission’s communication: Technical and Methodological Report study undertaken for the European Commission, DG COMM.

⁴⁸ European Commission (2016) Applying relevance-assessing methodologies to Horizon 2020

- The programme is highly valued and appreciated by stakeholders – as evident by the high demand for programming funds
- The policy relevance of SC2 is generally high. All SC2 activity lines are underpinned by an EU policy framework. It is well aligned with Juncker Commission's policy agenda. As far as 3O's is concerned:
 - Open access: is the norm for SC2 research publications. 90% of SC2 open access articles are expected to be published in peer-reviewed journals. However, only 30% of the mapped projects plan to share all their research outputs (presumably due to IPR issues especially among projects involving industry participation).
 - Open innovation: is not a common approach among funded projects. Nevertheless, 34% of mapped projects envisage a user-centric approach to innovation, 43% envisage following a multi-disciplinary eco-system, 11% envisage making use of open innovation platforms while 34% envisage using open source tools, software and data.
 - Open to the world: major strategic international cooperation established; 30-45% of call topics encourage cooperation with third countries. Overall SC2 performs better than Horizon 2020 on international cooperation.
- Significant improvements have been made to SC2 programme design and implementation arrangements (as compared to FP7-KBBE) to improve its relevance:
 - Development of Blue Growth as a distinct cross-cutting focus area;
 - Focus on Sustainable Food Security (40% of resources over 2014-17);
 - Creation of a BBI-JU, developing new integrated value-chains; and
- Introduction of the Strategic Programming Process has improved the intelligence base underpinning programming choices and helped better define the focus of the programme. However, the translation of high level challenges and objectives into specific call topics is not clear to external stakeholders.
- A stronger involvement of policy DGs, including co-management with DG AGRI and greater coordination with relevant policy DGs (e.g. DG MARE) has also been an important development.
- There are however some practical challenges in reconciling the perspectives of policy DGs with research perspectives. Specifically, the short to mid-term and specific legislative and policy making tasks of policy DGs can sometimes clash with the need for a long term and systemic view on research.
- Anecdotal evidence suggests that the tendency to fund larger projects in resulting in larger consortia (not necessarily better research) and excluding certain stakeholders (who lack the capacity to implement large projects) and excellent smaller-scale research. In certain areas, call topics are regarded as too broad making it difficult for participants to respond to them appropriately, resulting in funding of several projects in a technical area with potentially little impact, contributing to a high level of demand to some calls and potentially contributing to low quality proposals. The evaluation could not explore this issue in further detail due to time and data constraints.

5. EFFECTIVENESS

5.1. SHORT-TERM OUTPUTS FROM THE PROGRAMME

As indicated in section 3, 110 projects (109 SME Phase I projects and 1 CSA) have completed to date whereas 163 projects are ongoing. There is therefore, very limited evidence

available on the effectiveness of the programme at this stage. Moreover, given the early stage of the programme, funded projects have reported a limited set of outputs so far.

Table 37 Outputs reported by SC2 projects funded under the main calls (actuals)

Output Indicator	Value	Reported by:
Number of peer reviewed publications	95	11 projects
Number of patents/ trademarks/ registered designs applied for	9	7 projects
Number of patents/ trademarks/ registered designs awarded, of which	5	4 projects
<i>Patent</i>	<i>1</i>	
<i>Trademark</i>	<i>3</i>	
<i>Registered design</i>	<i>1</i>	

Data provided by DG RTD in August 2016

Looking at the share of peer-reviewed publications provided in open access, SC2 records a 90% versus the 81% average of Horizon 2020.

Table 29: Open access to publications under SC2

Nr of Signed Grants	Number of Publications in Peer-Reviewed Journals (expected)	Number of Open access articles published in peer-reviewed journals (expected)	% of Open access articles published in peer-reviewed journals
348	159	143	89.9%

Source: DG RTD. Based on CORDA data extracted 1 October 2016. Horizon 2020 average = 80.9%

The table below provides the preliminary results of the KPIs for the first ten BBI projects (2014 call projects).

Table 38 Estimated contribution of 10 projects (Call 2014) to BBI JU specific KPIs

KPI description	Estimates based on Grant Agreement data from 2014 Call projects	Target by 2020
KPI1 New cross-sector interconnections in bio-based economy clusters	> 8	36
KPI 2: New bio-based value chains	10	10
KPI 3: Cooperation projects	10	200
KPI 4: New building blocks based on biomass of European origin validated at demonstration scale	6-7	5
KPI 5: New bio-based materials	5-6	50
KPI 6: New demonstrated 'consumer' products based on bio-based chemicals and materials	4	30
KPI 7: Flagships resulting from BBI JU funded projects	1-2	5

Source: BBI Annual Activity Report - 2015

Aside from the outputs and KPIs reported above, the mapping exercise carried out by the expert group suggests that funded projects are expected to deliver a much wider range of outputs.

Table 39: Range of outputs envisaged by mapped (non-SME) projects

Output category	Number of projects	Share of projects
Non-academic publications (e.g.articles, workshop/conference proceedings, thesis, ...)	92	83%
Models, methodologies and tools	85	77%
Knowledge transfer (transfer of existing or new knowledge)	80	72%
Dissemination of results to national/local gov./policy makers	73	66%
Dissemination of results to wider society	68	61%
Advanced or new knowledge	65	59%
Technological outputs	65	59%
Tested concepts, tested models, or tested products	65	59%
Dissemination of results to international organisations	65	59%
Training events and materials for non-project participants: students, researchers ...	61	55%
Academic publications (peer reviewed)	60	54%
Training events and materials for project participants	54	49%
Evidence-based policy/ policy recommendations linked to (R&D) regional/national level	53	48%
Demonstrations	48	43%
New processes	47	42%
Protocols, technical manuals	46	41%
Prototypes	44	40%
New products	44	40%
Proofs of concept	42	38%
Best practices	42	38%
Research data	36	32%
Guidelines/standards	36	32%
Patents	36	32%
New non-research related partnerships (networks)	32	29%
Evidence-based policy/ policy recommendations linked to (R&D) international level	28	25%
New research partnerships (networks)	26	23%
Forward looking elements (scenario building, Delphi survey, forecast, roadmapping ...)	24	22%
Evidence for new legislation	22	20%
Research capacity	18	16%
Organisational change	13	12%
Flagships	6	5%

A mapping of SME projects suggests that at this stage of the programme implementation, crowding in effects on private funding seem low, as gleaned from SMEs' declared intended funding sources for the next stages of innovation development. It is important to better understand the reasons for the low declared intentions to use private capital. One possible explanation could be the nature of the innovation projects, for which private capital is difficult to attract, for example due to a high degree of risk. However, little evidence exists indicating that financed projects involve a high level of technological and/or commercial risk. A second possible explanation could be that projects do not apply for private funding because they are not considered profitable enough by private investors. Expected profitability could not be identified as determining the intention to use private funding for developing innovation ideas. Another possible explanation is that SMEs intending to apply for Phase 2 funding – which is the case for the majority of Phase 1 projects – may have an incentive to under-report access to private funding. If that is the case, one important question is whether Phase 2 financing crowds out private funding de facto, or whether SMEs merely under report committed private

funds before applying to Phase 2 grants. However, Phase 2 project proposals alone cannot reveal crowding in/out effects. Final reports and/or additional surveys addressing funding sources for the R&D projects are needed in order to complement the current analysis and examine whether supported projects attract or replace private funds.

5.2. EXPECTED LONGER-TERM RESULTS FROM THE PROGRAMME

While it is too early to report on the longer term impacts of SC2, the programme is eventually expected to contribute to:

- The development of low-carbon, resource-efficient and competitive European agro-food and bio-based industries;
- Improved competitiveness and sustainability of European agriculture and forestry sector;
- Reduced greenhouse gas emissions;
- Improved food security and safety;
- Oceans observation and mapping; sustainable and smart use of marine resources;
- Higher growth and employment.

Notable examples of projects which are expected to contribute to the above impacts include:

- *Development of eco-friendly insecticides that target damaging insects while sparing beneficial ones* (nEUROSTRESSPEP). Considering that about 20% of global agricultural output is lost to insect attack, this project has the potential to significantly improve agricultural productivity and forest health.
- *Development of three novel food processing technologies* (i³-food): Pulsed Electric Field preservation which extends the shelf life of fruit and vegetable juices (e.g. from 7 to 21 days for orange juice); High pressure thermal sterilization HPTS which has the potential to deliver a comparable or even improved quality compared to the current heat pasteurisation technologies for e.g. chilled meals, which can be stored at ambient temperature without cooling; and Low shear extrusion of cold food products (ice cream) which has the potential to deliver significant energy savings (15-20%) and improve the quality of the ice cream in terms of creaminess and melting behaviour. These technologies will benefit both the European food and drink industry and the manufacturing industry.
- *Development of video technology to make underwater observation more accurate and less costly than is currently possible* (UTOFIA). Underwater video cameras are important tools for monitoring the marine environment, fish stocks and pollution. Other applications, including for the inspection of subsea installations, harbour surveillance and seabed mapping. Current commercially available cameras that provide the kind of resolution and clarity needed in turbid waters are often expensive – a barrier to their more widespread use. UTOFIA will thus fill a gap in the market and be commercialisation ready by 2018.
- *Exchange and transfer of innovative knowledge between European wine-growing regions on two important diseases in vineyard* (grapevine trunk diseases and Flavesence dorée) to increase the productivity and sustainability of the sector (WINETWORK).
- *Development of tools and adaptive strategies allowing fisheries and aquaculture sectors and their governance to anticipate and prepare for adverse effects or future benefits of climate change* (CERES)
- *Development of novel marine derived biomolecules to be used in prosthetic devices to treat biofilm infections* (NoMorFilm). The novel biomolecules will not only improve

clinical effectiveness of prosthesis and quality of life for patients, but also reduce health system costs and surgical interventions.

- *Development of innovative, cost-effective and resource-efficient food crops that are high in protein (PROTEIN2FOOD)*. Expected impacts include a 25% increase in protein production and shift in consumption of animal-based protein to plant-based protein in Europe.
- *Development of ICT-based platforms and tools to support new and existing solutions to reduce food waste as well as evidence based policy recommendations (at EU/national level) to help policy makers tackle food waste (REFRESH)*.
- *Development of evidence-based dietary and physical activity strategies to prevent malnutrition and support active and healthy ageing* as well as new food concepts, new food products and electronic support systems that fit within these newly developed dietary strategies (PROMISS). Expected economic benefits include lower healthcare costs and a strong EU market position in innovative and sustainable food products for older adults.

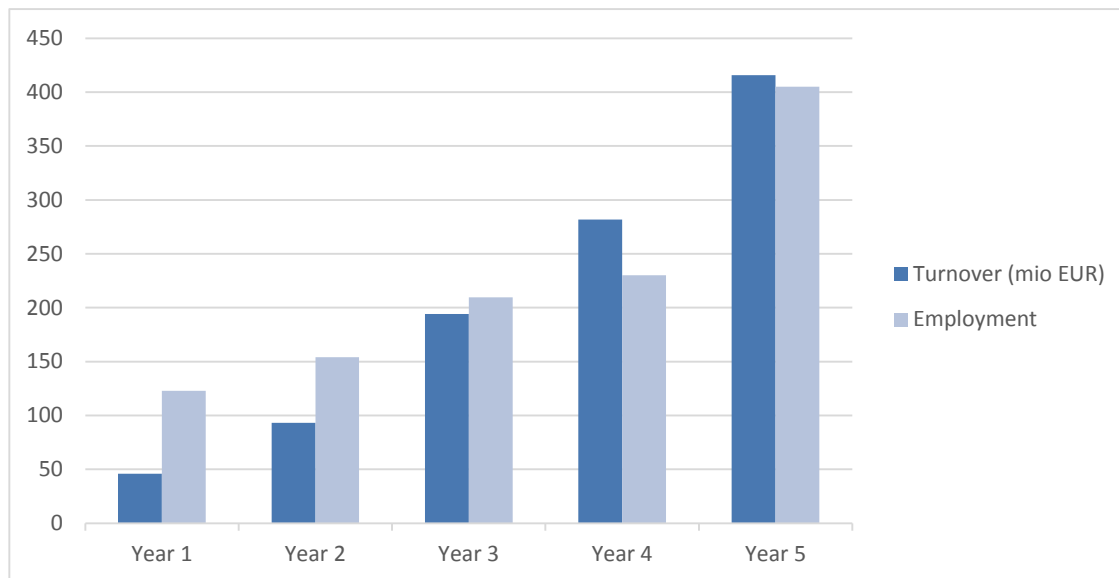
Some indications of the expected direct impact of SC2 on growth and jobs is available from completed SME Phase I projects and from Phase II proposal. The 55 projects for which this information was available are expected to generate an additional turnover of EUR 1.5 billion over the next three years. The innovations developed with support of SME Instrument Phase 2 funding (based on an analysis of 26 project proposals) are expected to produce a combined turnover of EUR 46 million in the first year of commercialisation, or an average of EUR 2.19 million per SME. The figures double for the second year to EUR 93 million and an average of EUR 4.44 million. The trend continues to year three, when the total expected turnover reaches EUR 194 million and an average of EUR 8.44 million, followed by EUR 282 million in total and EUR 12.81 million on average in the fourth year. Finally, by year five, SMEs expect to increase their turnover by EUR 19.8 million on average, for a total of EUR 416 million.

Regarding employment, the growth is more linear and less abrupt in the first four years, followed by a steep increase in year five. The average SME which benefited from Phase I funding expects to employ 10 extra personnel in the first year following commercialisation of the innovation, the number rising to 14 in year two, 19 by the third year, 25 and 46 in years four and five respectively. The 55 projects for which this information was available are expected to generate over 1,500 jobs over the next three years by bringing their innovations to market.⁴⁹The total expected employment increase per year connected to Phase 2-funded projects starts at 123 employees in year one and rises constantly up to 230 in year four, peaking at 405 persons in the fifth year after commercialization (see Figure 8).⁵⁰ However, total figures need to be considered with caution, as less than half of the analysed Phase 2 projects provided yearly projections for employment growth.

⁴⁹ Note: these figures are based on projected economic impact of the innovations, as indicated in project proposals and feasibility study reports by the beneficiary SMEs.

⁵⁰ This may suggest that beneficiaries of Phase II are selected among the projects with the highest expected impact on job creation.

Figure 8 Expected total increase in employment and turnover attributed to projects funded in Phase 2



Moreover, the principal expected outcome of BBI projects is the production of new bio-based materials (e.g. such as specialty fibres, plastics, composites and packaging solutions) which would eventually:

- Replace current materials such as high-cost petroleum-based carbon fibre with lignin-based carbon fibre (GREENLIGHT, SMARTLI, LIBRE), textile fibres with fibres derived from techno-economically feasible alkaline processes from reactive highcellulose pulps in connection to pulp mills (NEOCEL);
- Improve sustainability for example by valorizing residues and by-products from the agriculture and food processing industry to extract valuable biocompounds used to produce active ingredients, packaging and agricultural materials (AgriMax), or valorising agro-residues from mushroom industrial cultivation into bio-based functional additives and biopolymers (FUNGUSCHAIN), or residues of lignocellulosic biomass to extract molecules from hemicellulose and bio-polyesters (HYPERBIOCOAT);
- Improve products for example by developing new plant-based protein ingredients in pasta, biscuit, cake and/or beverage production processes (PROMINENT), by optimizing moulded pulp for renewable packaging solutions (PULPACKTION) and so on.

BBI projects are also planning to develop bio-based chemicals for example with wood-based chemicals to replace fossil chemicals (VALCHEM, ZELCOR) and to create new value chains (from raw material to product) such as lignocellulosic value chains (BIOFOREVER), vegetable processing industry remnants value chain for functional proteins and other food ingredients (GREENPROTEIN), levulinic acid value chain for solvent and resin production from lignocellulosic biomass (GREENSOLRES), biorefinery technologies value chain for conversion of organic side-streams into multiple marketable products (INDIRECT) or for refining sugar beet pulp (SBP) in order to produce microcellulose fibers, arabinose and galacturonic acid (PULP2VALUE), nutrient recovery bioprocesses value chain from waste streams and residues for manufacturing a new generation of bio-based fertilisers (NEWFERT).

Examples of new bio-based applications to consumer products being demonstrated are: final products packaging (AGRIMAX, PULPACKTION); food supplements, cleaning products, commercial masterbatches, commercial plasticizers and industrial films (FUNGUSCHAIN); detergents, personal care, (PULP2VALUE; VALCHEM), cosmetics (FIRST2RUN); biolubricants and bioplastics (FIRST2RUN).

The flagship projects will also create direct and indirect employment in some of the lagging regions of Europe. For example, the FIRST2RUN project (flagship demonstration of an integrated biorefinery) is expected to revitalise local economies across Europe by reconvertng old industrial sites and the creation of skilled jobs: an estimated 60 new skilled jobs will be created for every kton of bioplastics produced, taking into account the whole value chain, from agriculture to the end life of the final products (i.e municipalities, composting plants).

As only SME-1 projects are completed at this stage there is very limited evidence available on the effectiveness of the programme. When considering the expected effects however, the following observations may be made.

Overall, projects associate added value especially with the programme scope and focus (coverage of transnational challenges addressing societal needs). When prompted on different attributes of potential added value compared to national or regional project funding “ability to address the needs of EU citizens and other final users”, “tackling global challenges”, “transfer of technology and knowledge”, and “delivery of outputs targeting policy making” stand out (together with reputation and image) as the areas where the EU funding makes the biggest difference. Overall, more than 4 in 10 SC2 project coordinators surveyed report that Horizon 2020 (compared to national funding) significantly increased their projects’ ability to address the needs of final users and to tackle global challenges and an additional third indicated that Horizon 2020 contributed hereto “slightly”. Also, half of the projects note that they expect a significant, positive impact on the delivery of specific outputs targeting policy making.

These results are consistent with interview results, where interviewees highlight the transnational coverage/coverage of common priorities and challenges, a systemic approach to call topics (as opposed to a topical one); coverage of areas which may not be covered as part of national programmes and knowledge transfer as the main avenues in which the programme add, or has the potential to add, value.

Beyond this strategic level, project coordinators also report more R&I activities and output than what could have been achieved by national funding and improved commercial capacity. Areas where Horizon 2020 appears to have the potential to add significant value compared to national funding are undertakings of large scale demonstration projects and other testing/prototype activities and policy making. Horizon 2020 funding is also reported to generate more outputs, activities and other benefits (e.g. more publication in journals, non-academic publications; qualification of researchers; development of methods and technologies as well as commercial products and services; standards, business models, patents etc.). However, for most of these aspects the contribution of Horizon 2020 is reported to be small – with less than one in five reporting a significant impact. Furthermore, with the data available it is not clear if the (potential) added value in these areas is generated from the quality of the project – or if it rather results from project/funding additionality.

Finally, more than two thirds of the commercially oriented projects consider Horizon 2020 to improve/has the potential to improve partners’ competitive advance. The expected improvement mainly relates to access to new markets and the competitive position of partners internationally. In other areas, (competitive position nationally, market share in existing

markets and revenue), most commercially oriented projects have either expectations of modest improvements, or no improvements.

5.3. PROGRESS TOWARDS ATTAINING THE SPECIFIC OBJECTIVES

As stated in section 2.31, the specific objective of SC2 is “to secure sufficient supplies of safe, healthy and high quality food and other bio-based products by developing productive, sustainable and resource-efficient primary production systems, fostering related ecosystem services and the recovery of biological diversity, alongside competitive and low-carbon supply, processing and marketing chains. This will accelerate the transition to a sustainable European bio economy, bridging the gap between new technologies and their implementation”. The highly ambitious and general nature of the stated objectives of the programme and the absence of pre-defined ‘success indicators’ makes it difficult to monitor and evaluate the programme’s progress towards attaining its objectives. In general, the introduction of more KPIs for reporting, including specific ones for this part of the programme could help the monitoring and evaluation processes. However, some qualitative statements and evidence of expected impacts are provided in the preceding section.

Three quarters of the funded (non-SME) projects are expected to contribute to sustainable and resilient production and consumption systems and rural empowerment, 50% to food security and safety, 29% to empowering rural areas.

Table 40: Intended (non-SME) project objectives by SC2 activity line - percentage of projects for which stated objectives were assessed as important, very important or extremely important objective

Objective	2.1	2.2	2.3	2.4	2.5	2.6	SC2 overall
Sustainable and resilient production and consumption systems	90%	70%	100%	56%	50%	50%	75%
Food security and safety (incl. improved diets)	69%	70%	40%	13%	36%	25%	50%
Empowering rural areas	53%	10%	0%	25%	0%	8%	29%
Number of projects	49	10	10	16	14	12	111

Source: project mapping by the expert group; N=111 projects

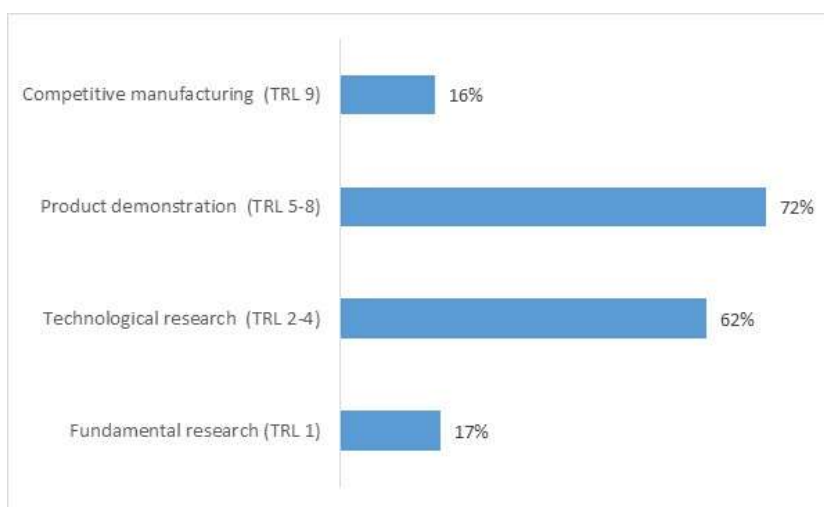
Additionally, the majority of SME phase I project proposals and reports mention several societal benefits the innovation is expected to bring, in addition to economic benefits for the applicant SME. Improved welfare for consumers or producers (which generally involve cost reductions and lower prices or higher product quality), improved food quality and food security, greater resource efficiency were the most frequently mentioned benefits. Examples of such benefits include improved fruit tree yields by 20%, reduced fertilizer and water use in agriculture, elimination of biological contamination in stored grains, 75% reduction of grain losses, improved health through consumption of iodine-rich seaweed, reduction of fruit waste, cultivation of vegetables in dense urban areas, reduction of costly food quarantines and recalls, reduction in pesticide usage. The expert group also analysed the impact on society that the innovations undertaken in Phase 2 projects are expected to have if they are successfully commercialised. Most innovations are expected to improve food quality (15 out of 26 projects) and food safety (14), followed by reduction in air and soil pollution (12). Eleven projects envisage their innovations to help increase EU competitiveness in different areas, the same number expect to help increase society-wide water use efficiency. Improved energy efficiency is expected from 8 innovation projects, the same number tackling food waste along the value chain, while 4 expect to reduce food waste at the source. Food security is expected to improve as a result of 7 innovations receiving Phase 2 support. Five projects stated their

expected positive effect on preserving wild aquatic (4) and land (1) fauna, the same number expecting to create added value from waste and by-products (3 from waste at source, 2 along the value chain), improve consumer welfare, and reduce water pollution. Animal welfare will be improved through the implementation of 4 innovation projects, while 3 expect to help improve work productivity. The results concerning expected societal benefits from SME projects should however, be treated with caution as in many cases, such predictions are probably difficult to undertake by the SMEs. Moreover, SMEs also have incentives to overstate such benefits in order to obtain public funding for developing their projects.

Additionally, the main achievements of SC2 can be summarised as follows:

- The BBI has been successfully established and secured industry buy-in.
- The programme has been successful in fostering huge technological advance (reflecting the spirit of Horizon 2020). Mapping data suggests that 88% of the projects are developing technologies which have been assessed at TRL 5 and above. Figure 9 shows the TRLs of mapped projects as assessed by the Expert Group.

Figure 9 Share of non-SME projects by Technology Readiness Level (TRL)



Source: project mapping by the expert group, n= 90 projects. For remaining projects, TRLs could not be established

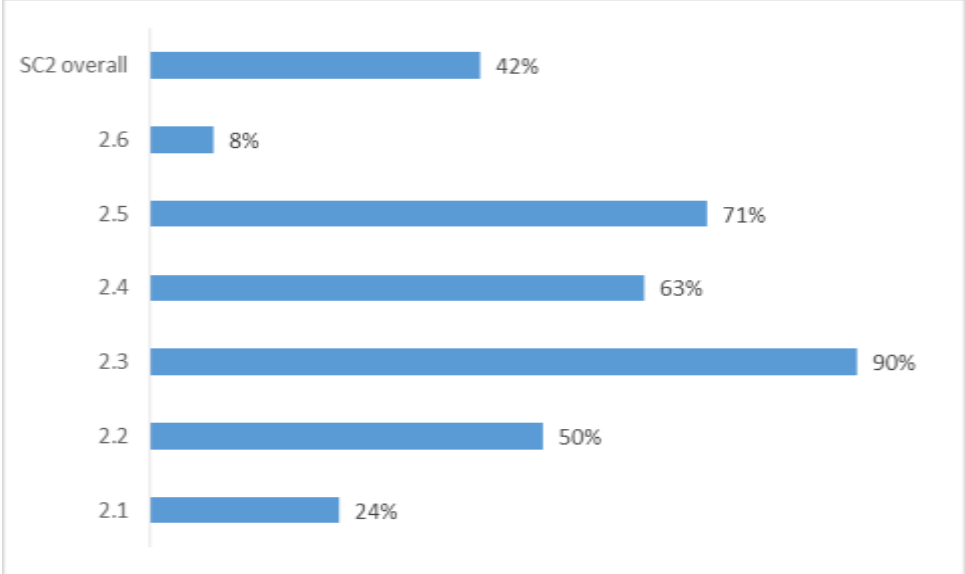
- The programme has successfully set up strategic international cooperations. Several challenges that SC2 deals with are global by nature e.g. global warming and ocean acidification. In order to efficiently deal with global problems, international coordination and collaboration is necessary. Within Blue Growth focus area several such initiatives can be found such as the Atlantic Ocean Research Alliance, Joint Programming Initiative on Oceans, Arctic observation systems, Atlantic Ocean Research Alliance, the BLUEMED Initiative on marine and maritime R&I activities in the Mediterranean area, the Joint Baltic Sea research and development programme-BONUS.

5.4. PROGRESS TOWARDS THE OVERALL HORIZON 2020 OBJECTIVES

5.4.1. Fostering excellent science in scientific and technological research

Section 5.2 provided examples of SC2 projects fostering scientific excellence. Additionally, results of the project mapping exercise suggest that 42% of the funded projects are expected to contribute to research excellence i.e. breakthrough research.

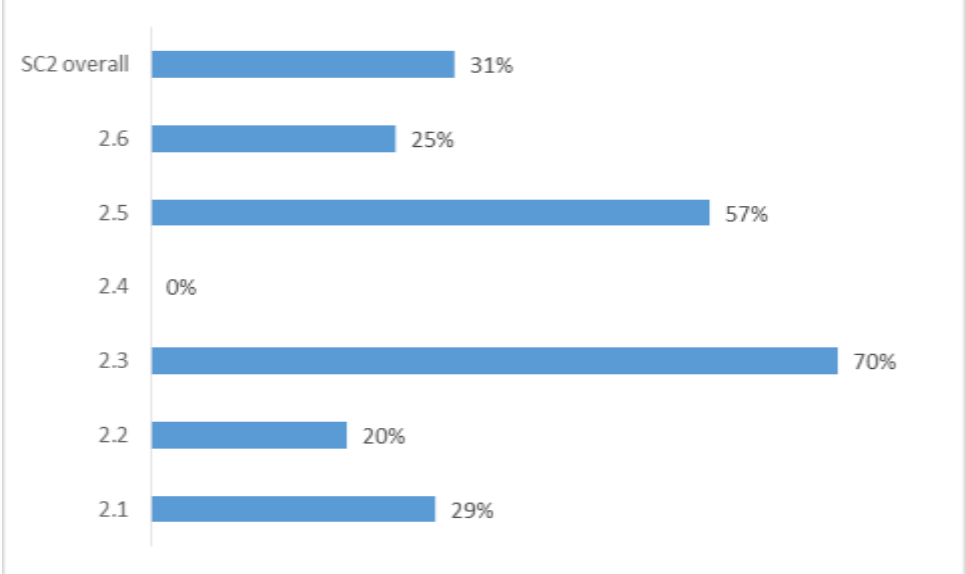
Figure 10 Intended project objectives by SC2 activity line - percentage of projects for which “research excellence” was assessed as important, very important or extremely important objective



Source: project mapping by the expert group; N=111 projects

Results of the project mapping exercise suggest that almost a third of the funded projects are expected to contribute to strengthening Europe’s research skills base.

Figure 11 Intended project objectives by SC2 activity line - percentage of projects for which “strengthening Europe's research skills base” was assessed as important, very important or extremely important objective



Source: project mapping by the expert group; N=111 projects

5.4.2. Boosting innovation, industrial leadership, growth, competitiveness and job creation

Section 5.2 also describes how specific projects are boosting innovation and contributing to industrial leadership, jobs and growth.

5.4.3. Addressing the major societal challenges

Aside from addressing the societal challenges directly addressed by the programme (e.g. food security and safety, sustainable and resilient production and consumption systems and rural empowerment), more than half the funded (non-SME) projects are also expected to contribute to other societal challenges.

Table 40: Intended (non-SME) project objectives by SC2 activity line - percentage of projects for which stated objectives were assessed as important, very important or extremely important objective

Objective	2.1	2.2	2.3	2.4	2.5	2.6	SC2 overall
Societal challenges outside SC2 (e.g. environment, health, transport, energy ...)	45%	70%	100%	13%	93%	50%	54%
Number of projects	49	10	10	16	14	12	111

Source: project mapping by the expert group; N=111 projects

Basic knowledge findings and product innovations resulting from marine research have the potential to contribute to societal challenges across the Horizon 2020 programme. They are expected to provide innovative solutions contributing to energy efficiency and sustainability (SC3), smart integrated transport (SC4), climate actions resource efficiency (SC5). Research infrastructure created with the purpose of supporting BG research may have spill-over effects on R&I in other sectors.

5.4.4. Spreading excellence and widening participation

The important steps taken by the programme to widen participation (through the use of multi-actor approach for example) and develop international cooperation have already previously been described.

5.5. EARLY SUCCESS STORIES

HIPSTER: An ongoing Horizon 2020 Innovation Action project, HIPSTER, is focused on scaled-up development and full implementation of High Hydrostatic Pressure in combination with Temperature (HPT) technology to be used by the food industry in order to extend the shelf life of processed foods and improve their microbial safety while preserving the sensory qualities. To date, the work resulted in design and prototyping of the equipment (patented), initial establishment of the process parameters for treatment of foods, and determination of detailed inactivation kinetics of selected strains of both background (spoilage) microbiota and foodborne pathogen *Clostridium botulinum* in food model systems when exposed to HPT-treatment. In the next stage, the full-scale, industrial equipment will be produced and validated in the industrial setting. The project results will enable food producers to produce higher quality and safety foods with economic savings, reduce the carbon footprint through reduced food transport and wastes, improve own competitiveness, and better satisfy consumer's needs regarding nutritious and safe food.

COMPARE: COMPARE is a large EU project with the intention to speed up the detection of and response to disease outbreaks among humans and animals worldwide through the use of new genome technology (Next Generation Sequencing, Whole Genome Sequencing, Whole Community Sequencing). The COMPARE Consortium is receiving approximately 20.8 million €, and the project will run from 01 December 2014 through 30 November 2019. The partners (29) in this project form a multidisciplinary research network that is set up with the common vision to become: (a) the enabling analytical framework and globally linked data and

information sharing platform system; (b) for the rapid identification, containment and mitigation of emerging infectious diseases and foodborne outbreaks. The system sets out to integrate state-of-the-art strategies, tools, technologies and methods for collecting, processing and analysing sequence-based pathogen data in combination with associated (clinical, epidemiological and other) data, for the generation of actionable information to relevant authorities and other users in the human health, animal health and food safety domains. Although there are rather high number of partners involved the project is well organised, and managed. This reflects in rather high number (49) of published peer review articles. In parallel to that, the project partners tends to established comprehensive database of protocols, information about reference genomes etc.

ATLAS project: ATLAS is a research project designed to provide the first coherent, integrated basin-scale assessment of Atlantic deep-water ecosystems and their potential to contribute to Blue Growth. ATLAS will unify research from physical oceanography through ecosystem function, biodiversity and connectivity as the foundation for unlocking the deep sea potential and making it a familiar ground for exploitation in Blue Growth activities. ATLAS aggregates a number of important international contributions through a network of Associate Partners and philanthropic funding to cover the substantial range of deep-water ecosystems in the North Atlantic and to take advantage of international ocean observation and prediction modelling initiatives, data collections and science for a. Furthermore, ATLAS will draw from a comprehensive knowledge and expertise base established by its partners in previous seabed mapping, spatial management, earth observation, climate change and human impact FP6 and FP7 projects, and its enhanced and synchronous ocean observations link to AtlantOS, another Horizon 2020 project with aligned mission to support Blue Growth and strengthen trans-Atlantic co-operation through strong international partnership. Finally, to achieve the trans-Atlantic scale and incorporate the diversity of sensitive Atlantic deep-water ecosystems, ATLAS has assembled 12 Case Studies that follow the major Atlantic current patterns and are at proximity to Blue Growth activities (Biotechnology; Fisheries; Mining; Oil & Gas; Tourism). Integrating the wealth of expected outputs to policy-making across the Atlantic to support Blue Growth is the ultimate ambition of ATLAS.

5.6. LESSONS LEARNT/ AREAS FOR IMPROVEMENT

- There is little evidence of outputs and effects at this early stage of programme implementation. Of the 273 projects falling within the scope of the evaluation 163 projects are still ongoing and although 110 projects have closed, 109 of these are SME phase I projects and 1 is a CSA. Only 10 out of the 163 ongoing projects had submitted periodic reports at the time of writing this report.
- Outputs reported so far include: 95 peer reviewed publications, 5 patents, 3 trademarks and 1 registered design.
- The evaluation however, found several examples of promising projects which can reasonably be expected to contribute to the following longer term impacts:
 - The development of low-carbon, resource-efficient and competitive European agro-food and bio-based industries;
 - Improved competitiveness and sustainability of European agriculture and forestry sector;
 - Higher growth and employment;
 - Reduced greenhouse gas emissions;
 - Improved food security and safety;

- Oceans observation and mapping, sustainable and smart use of marine resources.
- Expected impacts of 55 closed SME Phase I projects that were mapped include:
 - EUR 1.5 billion of additional turnover over next three years
 - over 1,500 jobs over next three years
- Expected impacts of 26 SME Phase II projects include:
 - EUR 1.03 billion of additional turnover over next five years
 - 1,121 jobs over next five years
- Major achievements of the programme to date include:
 - Setting up of the BBI JU
 - development of strategic cooperations e.g. Trans-Atlantic Research Cooperation
 - Significant technological advance - 88% of the mapped SC2 projects are developing technologies which have been assessed at TRL 5 and above (reflecting the spirit of Horizon 2020)
- The programme could benefit from the use of more KPIs for evaluating and monitoring the programme's effectiveness towards attaining its specific objectives.

6. EFFICIENCY

6.1. BUDGETARY RESOURCES

The thematic allocation of funding is very close to what was envisaged in the work programme for 2014-15. Likewise the take up of budgetary instruments is as envisaged. This is not surprising considering that work programmes specify the budget and nature of instrument for each call topic.

Table 41 Thematic allocation and absorption of programme resources (BBI not included)

	Work Programme budget		EC funds requested by approved projects	
	Amount €M	As % of total	Amount €M	As % of total
SFS	251.5	52%	265.3	53%
BG	144.0	30%	141.6	28%
ISIB	86.5	18%	91.7	18%
	482.0	100%	498.7	100%

Source: CORDA data. Based on 232 SME and non-SME projects. The above table does not include 5 projects selected under PHC, WASTE and WATER calls

Table 42 Allocation and absorption of programme resources by theme and instrument (BBI not included)

	Work programme					EC contribution requested by approved projects				
	SFS	BG	ISIB	Total	As % total	SFS	BG	ISIB	Total	As % total
RIA	211	112	35	358	74%	215.6	105.9	36.5	358.0	74%
IA	12	6		18	4%	12.2	6.0	-	18.2	4%
CSA	1.5	17	31.5	50	10%	1.5	20.8	35.5	57.8	12%
ERA-NET	0	0	20	20	4%	-	-	19.8	19.8	4%
SME	27	9		36	7%	36.0	8.9	-	44.9	9%
	251.5	144	86.5	482	100%	251.5	144.0	86.5	482.0	100%

Source: CORDA data. Based on 232 SME and non-SME projects. The above table does not include 5 projects selected under PHC, WASTE and WATER calls

6.2. PROGRAMME'S ATTRACTIVENESS

6.2.1. Mobilisation of stakeholders

Ensuring participation of newcomers, dissemination towards stakeholders and other potential users and uptake of project results, are areas which has been given enhanced attention with H2020 – and especially within SC2. A range of activities are implemented to inform potential applicants, investors and stakeholders about the Work Programme, its policy lines and funding opportunities under SC2.

The programme has been quite successful in attracting newcomers. As previously reported:

- There are 21.6% (414) participations in SC2 from 'newcomers', defined here as those who did not participate in FP7 (excluding the SME instrument and Joint Undertakings).
- In the SME Instrument, 83.6% of all participations were by newcomers.
- 33.6% of the participations in the BBI JU represent newcomers.

The ECs SC2 info days/info week, organised jointly by REA, DG RTD and DG AGRI, is the main “flagship” activity to promote new funding opportunities. The info week provides information about the policy background of SC2 calls, the call implementation practicalities and guidance on the objectives of the WP topics. It also serves to showcase successful projects. The content of the events is in continuous development reflecting participants demands⁵¹.

The 2016 info week attracted just above 400 participants (409), almost the double of 2015 (210) but identical to 2014. In addition, quite a number of people web stream the event or part of the event live⁵². The number of registrations usually reaches the maximum possible number. However, the share of “no show” appears significant. 2016 as much as 38% of those registered did not show. Most participants are Brussels based or from the six large and older Member States. About one fourth of showing participants (24%) are located in Belgium (representation offices largely). An additional 39% stem from six Member States (ES, FR, UK, DE, NL and IT). Participants from EU-12, Croatia and Greece represent only 8% of all participants. There is no data on the nature of the organisations represented.

Beyond the info week the EC implement a number of other communication and supporting activities to promote and generate H2020 participation organised around three main stages:

- *Launch of the WP:* Publication of the road map and release of communication material; press release/article on funding opportunities when the WP is published, info week and presentations of the WP at national Info-days;
- *During the opening of a call:* Promotion of the call and information sources at third party events, facilitation of partner search (through the EIP) and support to the RES;
- *After call evaluation closure:* Show and Tell events to show-case the projects portfolio as well a collection of data to communicate on the results of the calls (call statistics) and lessons learned.

Beyond the EC level, (Bio)NCPs play a key role in promoting SC2 funding opportunities. They undertake to this end various activities incl. national info days. BioNCPs receive

⁵¹ The the latest 2016 info week (June 2016) included a brokerage event to support networking; an NCP meeting; infoday incl. Q/A session; a dissemination event to showcase case results of FP7 and Horizon 2020 projects and a coordinators day for new project coordinators

⁵² Ranging depending on session between some 150 to 880 viewers live viewing in the range of 20 to 40 minutes per day

support for their activities through a CSA project *Bio Horizon* which organises several communication and dissemination events in collaboration with the EC. There is no data available on the reach of these activities.

Some participants mentioned executive agencies are not accessible to address questions relating to calls (under FP7, applicants could informally contact the Commission to obtain clarifications). This is due to the new standard approach whereby Commission services cannot be contacted directly by prospective applicants (in order to ensure a fair treatment of all potential applicants). A network of trained National Contract Points (NCPs) has been set up to help project participants, but it is understood that the quality of service varies across the network.

With respect to the SME instrument, at this stage of the programme implementation, no evidence of tangible benefits of coaching services could be established.

Dissemination of SC2 project results is a joint responsibility of DG RTD, DG AGRI, the Executive Agencies and H2020 projects. DG RTD, DG AGRI and the EAs activities takes place within the framework of the EC's *Strategy for effective dissemination and exploitation of research results in Horizon 2020*, which set as objectives to improve the use of research project results contributing to commercial and social innovation as well as to ensure improve use in EU policy making when tackling the societal challenges. To this end the strategy foresees three lines of action: a) facilitating the dissemination of and access to the outputs and more targeted dissemination b) describing and facilitating a process for the feedback of results into policy making and c) supporting exploitation of research results. In SC2, DG AGRI and DG RTD operationalise the line of actions through exhibitions, publications and dissemination of success stories to external audiences, in addition to the dissemination activities which are organised horizontally for H2020⁵³. Events include the bioeconomy village at the Bioeconomy Investment Summit and the Food village where successful projects display their results.

Dissemination of research results however, is far from limited to activities directly undertaken by the EC. Research projects themselves are expected to play a key role in the dissemination of results and are required to provide a plan for the exploitation and dissemination of results (as well as a communication plan as part of the project proposals). Effectiveness of the proposed measures to disseminate and otherwise promote uptake of the project results forms part of the assessment criteria. Furthermore, dissemination of research results is, in the framework of SC2, supported through:

- CSAs projects which explicitly aim at compiling, clustering and disseminating research EU funded research results from projects under FP7 and H2020/SC2: Columbus; CommBeBiz; Biolinks and ProBio)
- The thematic networks (CSAs) which are designed to identify and disseminate research on a specific agricultural area/theme (cover the identification and dissemination of research results and innovation practices of any relevant nature)
- EIP AGRI which among other provide formation about R&I projects

⁵³ e.g. dissemination CORDIS, the EU Open Data Portal, OpenAIRE, and other public and commercial repositories – as well as activities which are intended to support EC dissemination internally for the purpose of policy uptake

There are at this stage little evidence on the extent to which dissemination activities approaches have proven effective to support the dissemination of research results. However, the following observations may be made.

- The fact that funding is allocated specifically to dissemination projects and initiatives should be assessed positively given the dissemination challenges under the KBBE⁵⁴, and the reported difficulties of research projects and researchers to be able to communicate results effectively in laymen terms.
- The first outputs of the CSAs projects which are to disseminate FP7 results are delivering promising first results (see Box 3)
- The multi-actor approach has a potential to address a traditional weakness in project dissemination because it requires the involvement of end-users' in all stages of the project design and implementation. As such it increases the likeliness that the projects dissemination efforts are better adapted and targeted to potential users of the research.
- Judging from the project proposals there is great heterogeneity in the approach, detail and quality of the dissemination and communication plans across projects. As it could be expected dissemination focused CSAs have better quality dissemination plans. The quality of the RIA proposals varies. Many SME -1 projects do not contain any plans to disseminate the results of the projects. This suggests that scientific excellence and other criteria are likely to prevail over dissemination in the selection process. Consequently, the plans to improve dissemination via additional guidance and a dissemination toolbox and the plans to raise appraisers focus on dissemination appear still relevant (as outlined in the Strategy for effective dissemination and exploitation of research results in Horizon 2020)
- Judging from the feedback from thematic network projects (CSAs) collaboration is well established with the EIP-AGRI providing the basis for subsequent dissemination.
- While REA has put in place mechanisms to ensure feedback on policy relevant research outputs there is concern regarding the potential effectiveness of such mechanisms. In view of the importance of the policy feedback close monitoring and assessment of these mechanisms will be necessary once projects start delivering results.

Evidence box 3: Dissemination via CSAs

COLUMBUS is CSA project tasked with ensuring that applicable knowledge generated through EC-funded science and technology research can be transferred effectively to advance the governance of the marine and maritime sectors while improving competitiveness of European companies and unlocking the potential of the oceans.

As the project passes its 18-month interim point (Sept 2016), results of the project already point to significant achievements including:

- The implementation of a replicable, efficient and systematic process to knowledge transfer covering four phases - collection, analysis, transfer and impact measurement: Nine partners from a variety of organisation types across Europe are applying this methodology to different sub-sectors including key blue growth areas;
- The piloting of aspects of the process by the EC and Member States: The EC have adapted the collection templates to gather 466 exploitable results from FP7 Oceans of Tomorrow projects and uploaded them to the EC 'Information Sharing Platform

for marine and Maritime Research’ and, the Irish Environmental Protection Agency will pilot the full process on nationally funded projects in 2017;

- The identification of 1,199 Knowledge Outputs from 111 FP7 marine projects submitted to a publicly accessible repository and
- Evidence based case studies of successful transfer of knowledge and measurable uptake, using the aforementioned methodology, by end-users in policy and industry

6.2.2. Geographical dimension

Some progress has been made in increasing participation from ‘new’ member states in SC2 as compared to FP7-KBBE. Under FP7, the EU13 accounted for 8% of participations while less than 1% of funding for coordinators went to partners based in the EU13. Under SC2, the EU13 accounts for 9% of the participations and 6% of the budget (including BBI JU). There is also a slightly larger share of project coordinators coming from EU13 under SC2 as compared to FP7-KBBE.

Third countries account for 5% of SC2 participations, a slightly higher share than what is being achieved within H2020 as a whole (1.6%). Likewise, a slightly higher share of the programme budget goes to third country participants (1%) under SC2 as compared to Horizon 2020 overall (0.4%). As mentioned in section 4, the third-country participants are coming predominantly from *China* (30.9%), *Canada* (16.3%) and the *United States* (8.1%). More of half (60.2%) of third-country participants are either Higher or Secondary Education Establishments or Research Organisations, and 22% of them are private companies. Under FP7-KBBE, 71 third countries were involved and they accounted for 8% of all participations. China, Russia, the United States, South Africa, India, Brazil, Canada, Morocco, Australia, Tunisia, Argentina and Egypt were most common third country participants with more than 20 participations each in the FP7 KBBE projects. However, as previously mentioned SC2 has adopted a more targeted and strategic approach to the involvement of third countries.

6.2.3. Cross-cutting issues

On several cross-cutting indicators, SC2 performs better than Horizon 2020 overall. There are two areas where SC2 lags particularly behind: the percentage of projects where societal actors contribute to the co-creation of scientific agendas and content; and the percentage of projects taking into account the gender dimension in R&I content.

6.3. COST-BENEFIT ANALYSIS

A cost-benefit analysis cannot be performed at such an early stage of programme implementation, where very limited evidence is available on the effects. This section therefore, summarises the factors (both enabling as well as constraining) affecting efficiency.

According to the analysis from the Expert Group, the delegation of parts of SC2 implementation to REA took place smoothly at the end of the first year of the programme (2014). According to the Expert Group, efficient mechanisms have been put in place since then to ensure close interactions between the executive agency and the DGs, while issues such as feed-back loop to policy making and dissemination would still deserve further attention.

With respect to delegation of programme management to the executive agencies, there were some concerns expressed by Commission officials and stakeholders alike that this is creating distance between policy and projects and consequently, weakening the feedback loop. To address this issue several communication channels have been established between the RTD and REA / EAs:

- Each topic and project is assigned to a project officer (REA) and a policy officer (European Commission).
- There is a continuous communication between project and policy officers (e.g. selection and briefing of evaluators; participation to kick-off meetings and project review meetings).
- There are regular SC2 coordination meetings, both at middle (Head of Unit) and senior management (directors) level.
- SC2 encounters (internal meetings) are regularly organised with a focus on information exchange regarding policy framework and project implementation.

In addition to above, dedicated policy feedback mechanisms are planned to be established in 2017 (e.g. dedicated policy review meetings involving projects acting under one coherent research area). This was not done before because projects from the 2014 calls are just reaching now a stage where significant outputs are delivered.

A key assumption is that management has become simpler. However, the decentralisation of the programme requires much more coordination not only across the Commission services but also externally with the three executive agencies involved. For example, the cross-cutting nature of the Blue Growth focus areas implies that DG RTD needs to coordinate contributions (topics and budget) from other parts (such as Climate, Transport, Energy etc). In practice, this is a complex exercise, as it requires strong interactions with many other services, both during the programming phase as well as the implementation phase: this involved three executive agencies and various services. Despite the fact that SC2 succeeded in the first years, it is indeed a complex issue, and also quite a continuous challenge to receive contributions from other parts of the programme in order to reach a budget which meets the high and increasing political ambition of BG.

As regards the simplifications introduced within the programme, these have generally been positively received by project participants. Project participants specifically cited the following simplifications as examples of efficiency driving improvements: the removal of negotiation stage, simplified reporting; the participant portal, the electronic signatures for grants agreements, the single reimbursement rate, single flat rate for indirect costs.

Interviews with stakeholders and project partners suggests that the key added value of SC2 (in H2020 more broadly) lies in the pan-European coverage of research and research related activities. Undertaking activities beyond the boundaries of national priorities, focusing on common issues and/or areas which may be neglected at national level, involving a network of multi-national partners provides, given this wider scope, the basis for the identification of common solutions and a wider “European” application of research results – including via policy uptake at EU level. Given this wider scope for application of project outputs and results, projects are expected to provide better value for money.

Beyond this main line of expected added value, interviews and survey results furthermore suggest that the programme contributes to ensuring added value by:

- Supporting the development and deepening of collaboration between partners which would not have been possible without EU funding. More than the creation of new academic partnerships, funding allows for in depth collaboration between “best in category” around a specific theme of EU level priority. Furthermore, Horizon 2020 encourages new public and private partnerships and industry/business involvement.
- Developing research capacity. Judging by the added value survey results, SC2 funding contributes positively to understanding and knowledge of existing as well as new areas, scientific capabilities, technological capabilities and access to infrastructure and equipment. Compared to other public sources, SC2 funding improves the three types

research capabilities mentioned at project level. Impact is most widespread as regards development and understanding of new knowledge – with 74% of the SC2 projects indicating that their understanding and knowledge in new areas would have been smaller without Horizon 2020 funding. About half of the SC2 projects also indicate that Horizon 2020 funding, compared to national funding, impacted positively on planning and coordination of research and technological development (52%), scientific capabilities (49%) and understanding and knowledge in existing areas (46%). As it could be expected, the contribution is small, with most projects indicating that the difference in capability development is small between EU and nationally funded projects. However, half of the projects indicate that H2020 has had at least one significant impact on capabilities. Projects reporting a significant impact on capabilities are mostly RIA, CSA and ERA-nets. More than two thirds of the SME-1 and SME-2 projects (70%) did not consider that H2020 had any significant impact on research capacity.

- Supporting HR capacity. There is across SC2 projects a general agreement over the efficacy of H2020 funding in improving the staff capacity via projects. Participation in Horizon 2020, in a clear majority of the cases, had a positive impact on institutions' ability to attract researchers and other staff – as well as on development of relationships and networks (+70%). About half of the projects surveyed also note a positive impact on training capacity, researcher mobility and career development. The largest effect is identified in relation to relationship and network development (more than half of the respondents stating that EU funding has made a significant difference).
- Quicker delivery of project results. Judging by the added value survey results, participation in Horizon 2020 has also impacted positively on project delivery with 4 in 10 of the project coordinators of SC2 projects (41%) indicating that project delivery would have been slower had it been funded by national or regional public funds.
- Leverage of resources for follow up activities and/or spill over effects. According to the added value survey results, a clear majority of project coordinators of SC2 s expect that participation in Horizon 2020 will impact positively on access to other public funding opportunities for similar activities, EU as well as national (Public national/regional schemes; other EU programmes and private/industrial sources). Importantly also, project funding appears to leverage additional “in house” R&D funding in the case of many non-SME projects. In contrast, judging by the final reports from SME Phase 1 projects, the crowding in /leverage effect of own sources is seemingly low (as previously reported). Some non-SME projects also mention other project spill-over effects, where partner interaction results in further partner and non-partner exchange and mutual learning.

6.4. LESSONS LEARNT/ AREAS FOR IMPROVEMENT

The programme has a complex management arrangement involving coordination with multiple DGs; co-management with DG AGRI and delegation of parts of the programme across three executive agencies (REA, INEA, EASME). This has made coordination challenging and resource intensive. Further development of Standard operating procedures and clear division of tasks between different DGs and the executive agencies would help improve coordination.

At the same time several simplifications introduced under Horizon 2020 have contributed to improving efficiency: the removal of negotiation stage, simplified financial reporting; the participant portal, the electronic signatures for grants agreements, the single reimbursement rate, single flat rate for indirect costs.

7. COHERENCE

7.1. INTERNAL COHERENCE

7.1.1. *Internal coherence of the actions*

SC2 Work programmes 2014-2015 and 2016-2017 are designed as responses to the multi-faceted societal challenges facing Europe, EU and international policy issues and are aligned with the legal basis. The work programmes have put in place a wide array of instruments to address:

- Research and commercialisation of research outcomes: RIA, IA (including BBI-DEMO and BBI-FLAG) and SME instrument;
- Coordination, public-public partnerships and knowledge sharing : ERA-NET, CSA.

The above instruments represent a coherent response to the R&I needs that the programme seeks to meet and its stated objectives. Stakeholders have generally positively assessed the integration of instruments to support innovation alongside within the programme, and the coverage of the full spectrum of activities from fundamental research to technology roll out and innovation. Several stakeholders interviewed however, have argued that SC2 is focussed too much on innovation at the cost of more basic or fundamental research (that is a prerequisite for innovation). This represents a lack of understanding among stakeholders as regards the new structure of Horizon 2020, wherein frontier research is supported under pillar 1 (Excellent science). The balance between R&I therefore, needs to be monitored across Horizon 2020 as a whole for specific themes (e.g. SFS, BG etc.). These data are not readily nor systematically available. RTD.F is however monitoring the implementation of BG through a co-ordination mechanism involving all services addressing marine and maritime research; these carry out joint portfolio analyses and monitoring of relevant activities throughout the programme.

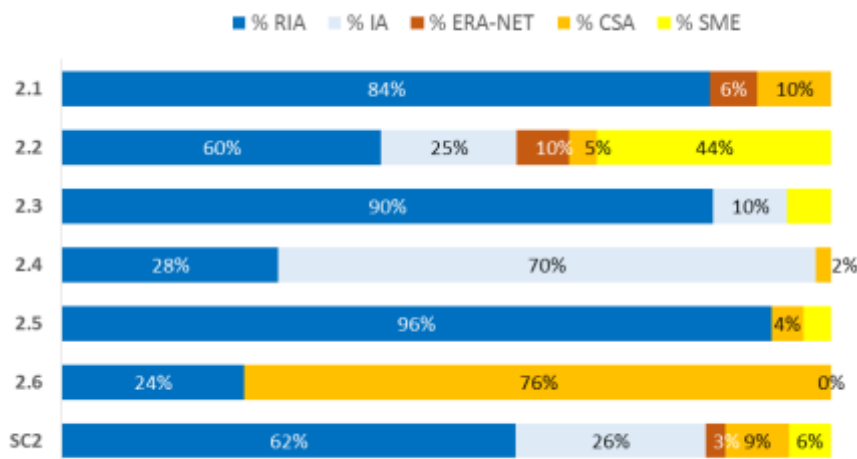
Data are however, available for SC2 which shows that 62% of the funding allocated is dedicated to RIAs; 26% to IAs; 9% to CSAs; 6% to the SME instrument and 3% to ERA-NET – Figure 12. The use of instruments varies between activity lines (agriculture, aquaculture etc.). RIA is by far the most widely used instrument and is particularly strongly used in activity lines 2.1, 2.3 and 2.5 (Agriculture and Blue Growth). In contrast, the ‘Food’ thematic area makes high use of the Innovation Action and SME instrument. The SME instrument has also been used under Blue Growth.

The structure of each work programme indicates a design that serves internal coherence; individual calls make use of different types of actions to deliver in a complementary manner. Illustrative examples include:

- In WP2014-2015, one sub-area within “Sustainable Food Security” is “*Safe Food and Healthy Diets*” that is tackled through four RIAs, one CSA and one IA to address food safety, sustainable and competitive food production.
- The focus area Blue Growth “*Boosting innovation for emerging Blue Growth activities*” in WP2016-2017 comprises three IAs, one CSA and one ERA-NET Cofund to address technologies required for multi-use of the ocean space.

This structural coherence is reinforced by the explicit requirement of the work programme for collaboration between certain projects that are funded to tackle relevant/ complementary issues.

Figure 12: Distribution of EC contribution to SC2 projects by type, by activity line



Based on CORDA data extracted in September 2016 (273 projects, EC contribution = €775M). There is a discrepancy between the total EC contribution that appears in the project level data and at participant level (of €8M).

At project level synergy can especially be observed from CSAs and RIAs – whereas there the synergy effect generated from SME projects is less evident. CSAs in support of the JPIs (JPI HDHL 2.0 and FACCE-Evolve) ensure further implementation and durability of joint programming and actions, which were initiated under FP7. The CSA thematic networks, through the collection and dissemination of scientific knowledge and best practices from across Europe can be expected to contribute to leverage action at a European level. Likewise, across RIAs there are several examples of how projects are working in synergy – and building on - research activities funded by other sources.

7.1.1. Internal coherence with other Horizon 2020 intervention areas

Internal coherence with other areas of H2020 is ensured in a top-down manner (different scopes of intervention) as well as with a bottom-up approach via the coordination of funding and calls. This is also traceable and evident in both SC2 work programmes where justified links to other H2020 intervention areas are provided.

According to the analysis from the Expert Group, SC2 work programme actions are fundamental to a wider range of other Societal Challenges, especially SC1 “Health demographic change and wellbeing”, SC3 “Secure, clean and efficient energy” and SC5 “Climate action, environment, resource efficiency and raw materials”. EC officials have actively engaged with other services in order to link up and ensure complementarity between SC2 and other societal challenges – and associated calls. The complementarity is notably evidenced by 14% of the SC2 budget for 2014-2017 going to SC1 and SC5 Work Programmes. Likewise, 11% of the budget allocated to first two SC2 work programmes (WP2014-2015 and WP2016-2017) came from other SCs (see table 1 in section 2).

Considering the importance of the diet and food quality in human health, wellbeing and aging, SC2 will contribute to SC1 by supporting the development of food value chains that contribute to combating the challenging disorders and diseases of the aging European population. The SFS calls that cover issues in all areas of primary production, terrestrial and aquatic, are rich in projects that contribute to SC1 and in the BG calls, this endeavour extends to “Linking healthy oceans and seas with healthy people” by exploring how the interaction between humans and the oceans contributes to wellbeing and how to improve the availability, safety and dietary properties of seafood.

More evidently, SC2 is closely linked with SC5 with many complementary objectives and activities, i.e. achieving a resource – and water - efficient and climate change resilient economy and society; providing viable solutions of natural ecosystems; a sustainable supply and use of raw materials, in order to meet the needs of a growing global population within the sustainable limits of the planet's natural resources and eco-systems; Earth Observations - information on climate, energy, natural hazards and other societal challenge; systemic Eco-Innovation - Generating and sharing economic and environmental benefits.

From the analysis of the Expert Group, there are no direct explicit linkages between SC2 and other parts of Horizon 2020 (except for BBI which receives a contribution from Horizon 2020 LEIT). However, due to the multidisciplinary nature of marine and maritime research, close coordination and joint activities with other parts of Horizon 2020 is foreseen as part of the H2020 legal basis. Particular BG calls relevant to exploitation of marine biodiversity and blue biotechnology touch upon the goals served by the ESFRI project European Marine Biological Resource Centre (EMBRC), a distributed research infrastructure that supports both fundamental and applied research based on marine bioresources and marine ecosystems, aiming to drive forward the development of blue biotechnologies. Furthermore, the recent acceptance of the Svalbard Integrated Arctic Earth Observing System in the ESFRI roadmap brings ESFRI infrastructures closer to the objectives of BG theme. In addition, certain BG calls require explicitly the interaction with Copernicus and European Space Agency (ESA) programmes and infrastructure of the European Commission as well as the European Marine Observation and Data Network (EMODnet) and are driven by the aspiration to make EU the leader of the Global Observation Systems. To these higher goals BG projects make their own contribution implementing the commitment undertaken by the Commission. Also, under WP 2016-2017, the focus area Internet of Things (IoT) set up strong links between SC2 and DG CNECT activities.

No systematic action has been taken so far to connect ERC activities with the objectives of SC2, although interaction is sought through informal meetings between Commission officers of the relevant entities to avoid duplication of effort and to enhance cooperation. Being 'investigator-driven', or 'bottom-up', in nature, the ERC approach allows researchers to identify new opportunities and directions in any field of research, rather than being led by priorities set by the Commission as a funder. The ERC complements other funding activities in Europe such as those of the national research funding agencies, and is a flagship component of Horizon 2020. ERC projects are highly productive and many of those operate at the fore-front of scientific excellence. In the Domain of Life Sciences and Panel LS9 “Applied Life Sciences and non-medical Biotechnology” there is – according to the analysis from the Expert Group - a remarkable aggregation of projects with a big potential to contribute to the themes of SC2 such as genetic resources in primary production, bio-based industries and biotechnological applications to bring added-value to primary terrestrial and aquatic production systems.

Some sporadic links could be observed between SC2 and the European Institute of Innovation and Technology (EIT) which was set up in 2008 to enhance Europe’s innovation capacity (information sessions to PC and NCP). EIT seeks to achieve its mission through a distributed network of thematically focussed Knowledge and Innovation Communities (KICs), which bring together higher education institutions, research organisations, industry and other stakeholders to create critical mass needed to stimulate innovation. The KICs are thematically aligned with the Horizon 2020 societal challenges. The following KICs appear to be particularly relevant to SC2:

- Climate-KIC: addressing climate change mitigation and adaptation
- EIT Health: addressing healthy living and active ageing; and

- EIT Raw Materials: addressing sustainable exploration, extraction, processing, recycling and substitution
- EIT Food in the field of sustainable supply chain i.e. from resources to consumers (2016).

While there are currently no plans for a knowledge and innovation community devoted specifically to the blue economy, it is understood that the Commission will examine whether its creation after 2020 could be of value.

SC2 has nevertheless taken actions to promote the bridging of activities related to this societal challenge throughout Horizon 2020, by calling a dedicated topics on *Bridging research and innovation efforts for a sustainable bioeconomy*⁵⁵ (three funded CSAs) and one on *Monitoring, dissemination and uptake of marine and maritime research*⁵⁶ (one funded CSA).

7.1.2. *Ensuring that every euro spent counts twice*

In particular cross-cutting projects such as those funded through Blue Growth calls have the potential to yield (i) interdisciplinary solutions which cut across multiple specific objectives of Horizon 2020 and (ii) to provide support to innovation in programming which is comprehensive and holistic so that it can at the same time tackle societal challenges and give rise to new competitive businesses and industries.

7.1.3. *Results of the Likert scale*

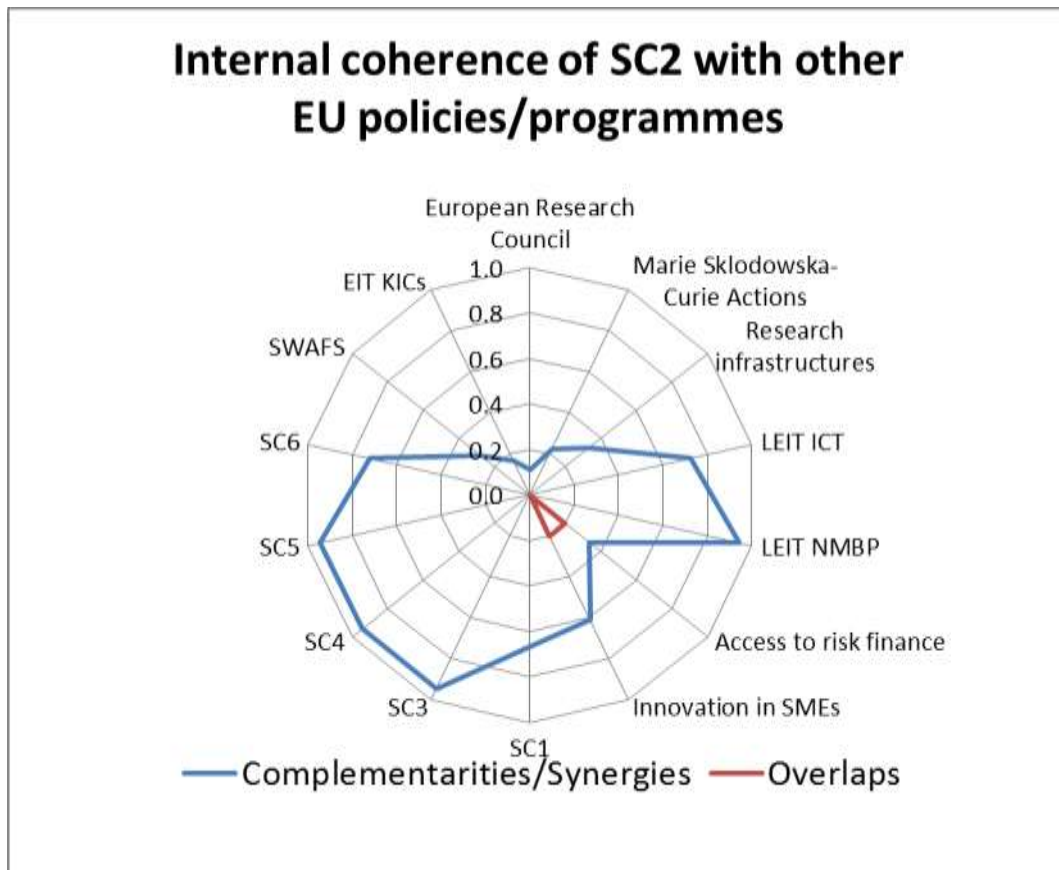
The figure below illustrates the level of coherence between H2020 Societal Challenge 2 and other EU interventions/policies, based on DG RTD's own assessment. As mentioned earlier, there are high levels of coherence between SC2 and certain other parts of Horizon 2020 namely, SC3, SC4, SC5 and LEIT NMBP.

⁵⁵ ISIB-8-2014: Towards an innovative and responsible bioeconomy - B. Bridging research and innovation efforts for a sustainable bioeconomy

Proposals should create links among various bioeconomy-related research and innovation activities carried out under different parts of Horizon 2020 and of the Seventh Framework Programme. This should foster knowledge transfer of best practice in sustainable process and technologies and facilitate the flow from discovery to further research and innovation (e.g. through twinning, networking, exchanges) and help discoveries to reach the market faster.

⁵⁶ Topic BG-11-2014

Figure 13 Degree of internal coherence within Horizon 2020 according to the Likert scale assessment



Based on DG RTD's own assessment

7.2. EXTERNAL COHERENCE

7.2.1. Coherence with other EU funding programmes

Based on the analysis from the Expert Group, in broad policy terms, the 'Agriculture' activity line is coherent with other relevant EU interventions and especially the CAP (incl. the Rural Development Policy). Agriculture related research (Activity 2.1) is now managed jointly by DG Research and Innovation and DG AGRI. This provides a good basis for supporting policy development and delivery. There are also very close links to the European Innovation Partnership 'Agricultural Productivity and Sustainability. In addition to the general support from all farm-related research, the EIP is supported specifically by the Thematic Network CSAs in the agricultural sector which are intended to provide a clear pathway for impact on farm practice. In addition, the facilitation/mediation with Operational Groups funded under Rural Development Programmes also reinforces the coherence and strong link between Research and Rural Development Policy.

Similar high levels of coherence and policy added value is reported by experts with the Common Fisheries Policy and the Integrated Maritime Policy – albeit the management structure is different (DG RTD managed, in close interactions with DG MARE).

The Agricultural Thematic Area (2.1); the fishery and aquaculture area (2.3) bio-based industries (2.4) and Cross-cutting marine and maritime research (2.5) are all relevant to climate action, environment, resource efficiency and raw materials. Each activity line within SC2 is underpinned by an EU policy framework, namely Common Agricultural Policy, Common Fisheries Policy, the Bioeconomy Strategy, Food Safety Policy, the Blue Growth

Agenda, the EU Integrated Marine Policy, the Blue Energy Communication, the Blue Tourism Communication and the Blue Innovation Communication.

Certain SC2 issues are also subjects of funding by the "European Structural and Investment Funds" (ESIF), a common designation for five European funds: the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Cohesion Fund (CF), the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF). ESIF are set to respond to the needs of the real economy by supporting job creation and by getting the European economy growing again in a sustainable way. Although managed by different administration and no official procedures of interaction between SC2 work programmes and ESIF work programmes could be traced (apart from a workshop organised in 2014 to explore links between ESIF and bio-based industries⁵⁷), evidence of complementarities is apparent in work programmes of ESIF funds. Also, the 2016 work programme of EMFF allocates funding to promote *inter alia* the Blue Economy in the Mediterranean Sea basin; Blue technology – innovative solutions for transfer to sea basin economies; Blue Labs: innovative solutions for maritime challenges; Maritime Spatial Planning. This alignment of scope provides ground for productive interaction between SC2 and ESIF that should not be overlooked.

Many actions were initiated to build and strengthen links with the EU Member States and regions and to enhance synergies and complementarities of Horizon 2020 programme / SC2 issues with the ESIF. A series of actions are presented below, *inter alia*:

1. Various events to support closer links with the EU regions and the ESIF, e.g.:

- "The role of regions in the European Bioeconomy" high-level conference on 17/10/2016 in Bratislava,
- The "European Bioeconomy Congress EBCL 2016" .
- Six Workshops under the umbrella of the "Knowledge Exchange Platform (KEP)" in cooperation with the EU Committee of the Regions (CoR). 3rd High-level Black Sea Stakeholder Conference in Odessa (14 June 2016) The meeting of the Integrated Maritime Policy contact points in the Black Sea on 27/10.2016 in Brussels.
- BLUEMED sessions during the Ecomondo exposition, Rimini, November 2016

2. A study "Mapping of EU Member States'/regions' Research and Innovation plans & Strategies for Smart Specialisation (RIS3) on Bioeconomy for 2014-2020" (expected to be completed in Feb 2017, will map the EU MS/regions' intentions and declared priorities, with regard to R&I and close-to-market plans (pilot, demos, commercial stages) on Bioeconomy in their Smart Specialisation Strategies (RIS3) and programmes supported by ESIF. The study will also identify and analyse the regions' commonalities and specificities and will focus on 22 regional case studies (focusing on EU-13), including *inter alia* successful regional R&I initiatives and good practices with a potential to be extrapolated to other regions, as well as bottlenecks and gaps on the deployment of the Bioeconomy;

3. A thematic smart specialisation platform on Agri-food has been launched on 1 June 2016 during the Smart Regions conference organised by DG REGIO, with the aim to facilitate the creation of an investment pipeline of bankable projects in new growth areas in the domain on agro-food based on bottom-up interregional cooperation in the value chain.

4. Various H2020 funded projects are related to EU regions and EU-13, *inter alia*:

⁵⁷ Workshop's report: Synergies between European Structural and Investment Funds (ESIF) and Horizon 2020 for research and innovation on bio-based industries. Brussels 18 March 2014. Available at:

http://www.errin.eu/sites/default/files/publication/media/BBI-ESIF%20Workshop%20Report_18MARCH2014%20%285%29.pdf

- CSA in H2020 / SC2 Work Programme 2016 (1m€): A new CSA project BioREG⁵⁸ will create a Stakeholder platform of regional and local organisations (regional authorities or mandated agencies or clusters) interested to develop ambitious strategies in support of bio-based products/industries. Building on the "model demonstrator regions", successful case studies shall be shared and transposed to other interested European regions, among which also EU-13 with the aim to widen the participation of countries developing regional bio-based strategies.
 - BERST project created a "Bioeconomy Regional Strategy Toolkit" that assists the regions, also the EU-13 to identify their Bioeconomy potential and develop their regional bioeconomies. <http://www.berst.eu/>
 - The S2Biom project provides a tool to support sustainable delivery of non-food biomass feedstock at local, regional and pan European level through developing strategies, and roadmaps <http://www.s2biom.eu/en/>
5. Awareness raising / Guides – brochures "Synergies H2020– ESIF": The Bio-based Industries Consortium (BIC) who participates in the BBI JU, has published as a practical guide for decision-makers at regional level on how to effectively combine European structural funds with Horizon 2020 (and the BBI JU). The EC has also published general guidelines on how to exploit synergies between these different sources of funding, and practical examples of synergies as well and a brochure with examples for synergies, including examples related to SC2⁵⁹.

A recent, but relevant development has been EFSI, the European Fund for Strategic Investments, jointly launched by the European Commission and the European Investment Bank (EIB) in 2015. It also brings into focus the financial needs faced by SC2 R&D projects that have successfully finished at a high TRL level (at and above 7-8). In this context, a study to be published end of 2016, conducted by the EIB within the INNOVFAN advisory services and which focuses on bio-based and blue industries, has identified that these (new) industries are facing particular risks related to the regulatory environment but also to technological as well as market risks. While existing financial instruments such as INNOVFAN and EFSI are relevant to a number of projects, the large majority of projects is not served by existing instruments and there is also a lack of knowledge of these sectors among financial institutions, according to the Expert Group. The potential of specific financial instruments and platforms to boost investment to this sector will be further investigated in 2017 in order to tackle these problems. A study is also underway to investigate the financial needs of the agri-food sector with results expected for the end of 2017.

7.2.2. Coherence with other public support initiatives at regional, national and international level

Coherence with national research initiatives, ensuring EU additionality, is promoted via consultation with Member State authorities in the SC2 Programme Committee, as well as forums such as the Standing Committee for Agriculture Research (SCAR) and its dedicated Strategic Working Groups.

In addition, Public-Public Partnerships are implemented via i) Art185 initiatives such as BONUS, the Joint Baltic Sea research and development programme⁶⁰, ii) Joint Programming

⁵⁸ Horizon 2020/SC2 CSA BioREG from topic BB-6-2016: Bio-based industries regional dimension

⁵⁹ "EU Funds working together for jobs and growth: Synergies between the R&I Framework Programmes and ESIF": <https://ec.europa.eu/research/pdf/publications/ki-01-16-339-en-n.pdf>

⁶⁰ http://www.bonusportal.org/about_us

Initiatives, such as Agriculture, Food Security and Climate Change (FACCE), Healthy Food and Healthy Diet (HDHL) and OCEAN, and iii) the ERA-Net cofund instrument, providing ground for the coordination of joint activities including common calls for research projects constituting clear mechanisms for integrating EU-funded and national research programmes. Furthermore, CSAs in support of the JPIs further support joint planning seeking to bring coherence and common purpose to national programmes across Europe.

Primary and secondary data collected in the framework of this study evidence that the programme raises standards across EU Member States, creates synergies and complements research efforts at different levels.

At a policy level SC2 provides structure and reference for the development of national research programmes, creating synergy and ensuring complementarity in the research funding. This effect is illustrated by research approaches of key Member States such as France and Germany. In the case of France, the national research agenda *l'Agenda stratégique pour la recherche, le transfert et l'innovation "France Europe 2020"*⁶¹ has explicitly been designed with the aim to ensure synergy and complementarity of research efforts. The research Agenda mirror the challenge based approach, with SC2 corresponding to "Défi 5 – Sécurité Alimentaire et Défi Démographique Ressources biologiques, exploitation durable des écosystèmes et Bioéconomie"⁶².

At policy level also, SC2 funding supports directly transnational coordination with the ERA-Net cofunds designed to ensure alignment of national research programmes, generating a structuring effect and leverage action between EU and national research funding programmes. ERA-Net cofund actions are seen by stakeholders as well as the Expert Group to be potentially highly effective strategic investments in the European Research Area, generating a structuring effect and ensuring coherence between EU and national research funding programmes. The potential effect is likely to be particular strong in 'Agriculture' which is characterized by a wide range of regional, national, and European activities, in both the public and private sectors. Coordinators of past ERA-Net cofund actions furthermore highlight the role that these play to raise programming standards across all participating Member States. In view of these benefits, some stakeholders however also highlight the continued need for inclusiveness and cross European Member State representation in the ERA-Nets, which judging by the case of ERA-GAS appear not systematically ensured.

The BG theme calls relevant to marine environment observation systems and implementation of policies and alliances within Europe and internationally make explicit reference and align with the objectives of the following initiatives that EC is member of the board:

- Sustaining Arctic Observation Networks (SAON);
- Group of Earth Observations (GEO) and Global Earth Observation System of Systems (GEOSS) and Cold Region Initiative of the Group on Earth Observation in particular;
- WMO Programme Year of Polar Prediction.

Horizon 2020 work programmes have taken into consideration the Commission's commitment and shared vision to support the activities of the above initiatives in the spirit of synergy with the other actors of the initiatives.

⁶¹ <http://www.enseignementsup-recherche.gouv.fr/cid71873/france-europe-2020-l-agenda-strategique-pour-la-recherche-le-transfert-et-l-innovation.html>

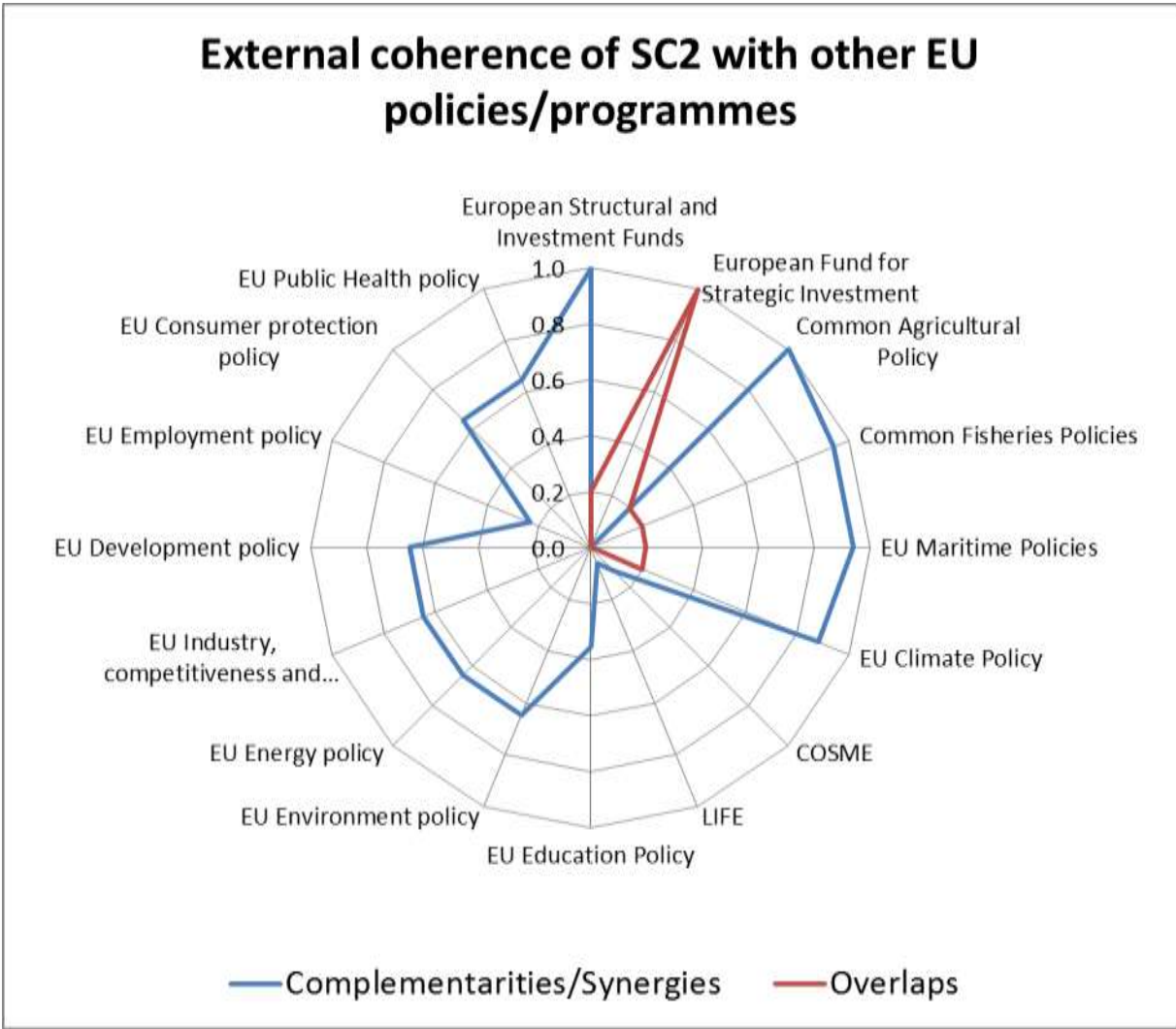
⁶² See for example Agence Nationale de Recherche, Plan d'action 2017 at <http://www.agence-nationale-recherche.fr/fileadmin/aap/2017/ANR-plan-action-2017.pdf>

Overall, when considering capacity improvements, one fifth of the SC2 projects surveyed within the “added value Horizon 2020 project survey” (22%) noted that the capacity to plan and coordinate research to avoid duplication would have been much lower had project funding been provided by national or regional funds – and an additional 30% of SC2 projects indicated that the capacity to coordinate would have slightly decreased. If one considers only RIA, CSAs ERA-Nets, this effect is even more positive. 19 of the 20 RIA, CSAs ERA-Nets projects surveyed note a positive impact. Of these projects half of indicate that their capacity to plan and coordination of R&D to avoid duplication would have significantly decreased had project been funded by national sources.

7.2.3. Results of the Likert scale on external coherence

The figure below illustrates the level of coherence (as well as overlaps) between H2020 Societal Challenge 2 and other EU interventions/policies. As explained in detail in 7.1.1, the assessment by DG RTD found a high degree of coherence, complementarity and synergies in particular with the CAP, the CFP, maritime and climate policies, but also with environment, energy, industry and competitiveness, public health and consumer protection. There is a strong potential for complementarities in SC2 WPs of ESIF funds, e.g. actions targeting the development of new bio-based industries.

Figure 14 Degree of external coherence within Horizon 2020 according to the Likert scale assessment



Based on DG RTD’s own assessment

7.3. LESSONS LEARNT/AREAS FOR IMPROVEMENT

The choice of funding instruments is coherent and complementary– although one of the issues raised by several stakeholders is that the programme is gravitating too much towards innovation at the expense of basic science. It appears that the stakeholders are not fully in tune with the new philosophy and structure of Horizon 2020, although the balance between R&I within each thematic area needs to be systematically monitored.

Thematic allocation of funding looks appropriate given the objectives of the programme.

There are clear links between SC2 and other SCs and LEIT, but no evidence of formal links with ERC or EIT (although interactions happen through meetings of the relevant entities to avoid duplication of effort and enhance cooperation).

Several actions have intensively supported the links with the EU Member States' / regions' plans and smart specialisation strategies using ESIF, for instance those targeting development of new bio-based industries. Although managed by different administrations and no official procedures supporting interaction between SC2 WPs and ESIF WPs are set in place, there is strong potential for complementarities in SC2 WPs of ESIF funds which can be exploited.

ERA-Net cofund actions are potentially highly effective strategic investments in the European Research Area, generating a structuring effect and ensuring coherence between EU and national research funding programmes.

8. EU ADDED VALUE

Overall, the qualitative and quantitative data available provide strong evidence of added value of the SC2 programme. Project additionality is also strong. Furthermore, compared to national and regional funding the programme performs favourably increasing research capacities, commercial advantages and scientific and innovation outputs. However, these effects can mainly be observed for RIA, IA, CSAs and ERA-Net Cofunds, There is less evidence of the added value of the SME projects. This section considers the EU added value in terms of effectiveness, efficiency and synergy – as well as project added value.

SC2 has clear additionality, supporting projects which otherwise would not have been implemented or which would have been substantially modified and smaller in scale and aims. Judging by the results of the project participant survey conducted by *PPMI* within the framework of the assessment of the Union added value and the economic impact of the EU research framework programmes⁶³, 4 out of 10 (42%) of SC2 projects would not have gone ahead without EU funding. An additional 32% would have gone ahead in some form – but with significant modifications.

The share of SC2 projects which would not have been undertaken without H2020 is high and suggests that a discontinuation of funding would have serious negative impacts on the scale of research being undertaken in the areas covered by SC2. However, the share of SC2 projects which would not be undertaken is lower than the average for all the projects funded under H2020 (53%) and is lower than the equivalent numbers for other societal challenges (which vary between 43% and 64%). In total, one of four SC2 projects (26%) is estimated to be a “project deadweight” – i.e. projects which would have gone ahead with small or no

⁶³ The report by PPMI is not published at this point of time.

modifications without H2020 funding. This number is significantly higher than average results for H2020 (14%) and for all of the other SCs (between 7 and 18%).

SC2 project additionality is highest for RIA and CSA projects with close to all surveyed projects stating that they would not have gone ahead without EU funding. In contrast it is low for SME projects. SC2 projects which would have gone ahead anyhow are nearly all SME-1 projects. Overall, every second SME 1 project (50%) would, according to the survey results have gone ahead with none or minor modifications without H2020 funding. Nearly all of the remaining SME 1 projects would also have gone ahead, but with significant modification - as would all of the SME-2 projects. Only 1 of the 23 surveyed SME projects would not have gone ahead at all. The share of SC2 SME “deadweight” projects is much higher than SME deadweight in H2020 in general (only 27% would have gone ahead anyhow, vs. 50% for SC2).

Project additionality of SC2 – understood as not being able to implement the project without SC2 or only with substantial modifications - is explained principally by three main factors: inability to address pan-European issues via other funding mechanisms, non-availability of funding at the scale needed for the project and lack of alternative funding sources for the type of activities undertaken by the project, with stakeholders and project partners generally highlighting the uniqueness of the research and/or research related activities at an EU level.

For projects which would have been subject to significant modifications – such modifications would principally have related to: the scope of the project (fewer areas, subjects or the ambition of its objectives) and the time frame (longer time frame).

8.1. HORIZON 2020 PROJECTS DEMONSTRATING EU ADDED VALUE

The following three projects have clearly demonstrated a potential for providing significant EU Added Value:

ERA-HDHL is a ERA-NET Cofund in the field of nutrition and health supporting the JPI Healthy Diet for a Healthy Life (HDHL). The members of the JPI are working together to develop means to (1) motivate people to adopt healthier lifestyles (2) develop and produce healthy, high-quality, safe and sustainable foods and (3) prevent diet-related diseases. The project ensures EU added value by:

- **Synergy:** ERA-HDHL being dedicated to JPI HDHL, it will improve coordination and reduce the overlap between national and EU funding in relevant fields of research. Furthermore, coordination with the FACCE-JPI is planned and further activities to coordinate and seek synergies with other European initiatives are expected as part of the complementary project CSA project CSA JPI HDHL 2.0.
- **Efficiency:** The 19 public funding organisations participating in ERA-HDHL consortium have committed a total of 12,51 M€ for the cofunded call. This commitment has doubled from 2014 when the first co-funded call on Biomarkers in Nutrition and health was launched.
- **Effectiveness:** ERA-HDHL aims to provide a robust platform for implementing Joint Funding Actions addressing the research challenges identified and described and agreed by the members of the JPI. As such ERA-HDHL will help ensuring critical mass and better use of limited resources.

CERES is a RIA project dedicated to advancing the understanding of how climate change influences important fish and shellfish resources in Europe and the economic activities depending on them. The project EU added value relate to:

- **Effectiveness:** CERES will provide industry tools and develop adaptive management strategies allowing fisheries and aquaculture sectors and their governance to anticipate and prepare for adverse changes or future benefits of climate change. A key innovative aspect is to assess where the adverse impacts of climate change can produce opportunities for new aquaculture production systems and profitable changes to fisheries.
- **Efficiency:** CERES focus on 32 commercially important species groups which collectively span the whole of the European territorial seas from the Mediterranean to the high Arctic and inland waters from Turkey/Romania to the north of Scotland and Norway.
- **Synergy:** CERES plan close collaboration with industry and policy stakeholders to provide regionally and industry relevant, future projections of key environmental variables for European marine and freshwater ecosystems; to assist in the adaptation of aquatic food production industries, to apply innovative risk-assessment methodologies and to formulate policy guidelines and recommendations.

REFRESH is a RIA project focusing on the reduction of food waste and improved valorisation of food re-sources. The project ensures EU added value by:

- **Effectiveness:** building on research into the drivers of food waste the project takes an innovative, systemic approach to curbing food waste through practice oriented collaborative platforms and pilot projects. Knowledge from research are turned into actions – via reports, advising, and tools to encourage better decision-making.
- **Synergy:** the project will develop strategic agreements to reduce food waste with governments, business and local stakeholders in four pilot countries (ES, DE, HU and NL). Building on this experience the project will develop guidance and recommendations to EU and national legislators and policy makers to help support effective governance to tackle food waste and national implementation of food waste policy frameworks
- **Efficiency:** the project engages a multi-faceted consortium (universities, research institutes, businesses, governments, civil society etc.) allowing direct application of theory in practice.

8.2. LESSONS LEARNT/AREAS FOR IMPROVEMENT

Overall, there is strong qualitative and quantitative evidence of added value of the SC2 programme. Project additionality is strong.

The main elements of EU added value of SC2 are as follows:

- Supporting the development and deepening of collaboration between partners which would not have been possible without EU funding.
- Developing research capacity. SC2 project funding contributes positively to understanding and knowledge in existing as well as new areas, scientific capabilities, technological capabilities and access to infrastructure and equipment.
- Supporting HR capacity. Participation in Horizon 2020 SC2 seems to have a positive impact on institutions' ability to attract researchers and other staff – as well as on development of relationships and networks, training capacity, researcher mobility and career development.

- Quicker delivery of project results. 4 out of 10 SC2 project coordinators surveyed (41%) indicated that project delivery would have been slower had it been funded by national or regional public funds.
- Leverage of resources for follow up activities and/or spill over effects. A clear majority of SC2 project coordinators report that participation in Horizon 2020 will impact positively on access to other public funding opportunities for similar activities, EU as well as national (Public national/regional schemes; other EU programmes and private/industrial sources). Importantly also, project funding appears to leverage additional “in house” R&D funding from many Non SME projects.
- Overall, projects associate added value especially with the programme scope and focus (coverage of transnational challenges addressing societal needs). When prompted on different attributes of potential added value compared to national or regional project funding “ability to address the needs of EU citizens and other final users”, “tackling global challenges”, “transfer of technology and knowledge”, and “delivery outputs targeting policy making” stand out (together with reputation and image) as the areas where the EU funding makes the biggest difference.
- More than two thirds of the commercially oriented SC2 projects consider Horizon 2020 to improve/has the potential to improve the partners' competitive advantage. The expected improvement mainly relates to access to new markets and the competitive position of partners internationally.
- At a policy level, SC2 provides structure and reference for the development of national research programmes, creating synergy and ensuring complementary in the research funding.

However, these effects can mainly be observed for RIA, IA, CSAs and ERA-Net Cofunds, There is less evidence of the added value of the SME projects.

9. SUCCESS STORIES FROM PREVIOUS FRAMEWORK PROGRAMMES

The selected (collaborative) projects were chosen based on the mapping experience, and/or based on the analysis of their outcomes. For example, MultiHemp project was selected as it exhibits extremely versatile project teams with experiences from agriculture, pharmaceutical, construction ... and they perform great in terms of the outcomes (Publication, web pages, dissemination). Similar criteria were used at other successful projects as well.

LipiDiDiet: Therapeutic and preventive impact of nutritional lipids on neuronal and cognitive performance in aging, Alzheimer's disease and vascular dementia (Budget: €5,899,843.00; Project period: 08/2008 - 03/2015)

The FP7 funded project LipiDiDiet has researched and developed a nutrition-based approach to reducing the risks of dementia including Alzheimer's, slowing down the progression of the disease and stabilising cognitive performance in aging. This is a very relevant public health issue: around 47 million people live with dementia worldwide, which is projected to increase to over 131 million by 2050. The economic cost of dementia is estimated to increase from US\$818 billion worldwide today to become a trillion dollar disease by 2018 (World Alzheimer Report 2016). Based on extensive multi- and inter-disciplinary research, the LIPIDIET project has led to comprehensive dietary guidance which addresses specific issues including dietary recommendations, novel foods, and modified foods, all contributing

in a novel way to effective dementia management. The guidance includes specially targeted nutrition to help patients in nursing homes, clinics, and at home, as well as recommendations for healthy ageing and the well-being of the elderly in general. The impact is wide and varied. The project provides sound scientific data for the food industry and regulators for the assessment of health and nutrition claims, improving food quality/safety, and reducing socio-economic costs, and increasing Europe's competitiveness. In respect to commercialization of the results, a dietary product for human consumption has been made by an industrial partner (Danone) under the name „Souvenaid“, which is effective in fighting pre-dementia Alzheimer's disease. The product has been used internationally, including outside of Europe, and it is expected that the use will further expand toward finding application for more disease stage or more disease over time.

LIFECYCLE: Building a biological knowledge-base on fish lifecycles for competitive, sustainable European aquaculture (Budget: €5,995,801.00; Project period: 02/2009 - 07/2013)

LIFECYCLE researched the early development, growth and environmental adaptation of sea bass, sea bream, Atlantic salmon and rainbow trout. This addresses production problems linked to abnormal larval development, skeletal deformities, poor growth and energy utilization, high mortality related to life stage transitions, poor environmental performance, and unwanted sexual maturation. The research resulted in a very large scientific impact with 106 academic papers, including many in high-impact general science journals that reach a wider academic audience. The project also provided a great example how aquaculture research can offer models in other areas of biological and medical sciences. LIFECYCLE supported the development of **Xelect Ltd** for the commercialisation of over 30 years of basic research made possible by continuous support from the UK Research Councils and the European Commission, the later through SEAFOODplus (FP6) and LIFECYCLE (FP7). Xelect has licensed genetic markers for superior meat yield in Atlantic salmon to SalmoBreed A/s and Landcatch Natural selection and several other license opportunities for this and other traits are currently under negotiation. An analytical method termed “**Smoltprobe**” has been established as a predictive tool in the assessment of smolt quality. The work has involved two of the major international salmon producing companies (Lerøy Seafood A/S and Marine Harvest A/S) and the Smoltprobe has been tested and evaluated in two commercial smolt producing operations. The Smoltprobe helps prediction of the correct timing of transfer to seawater, and to detect problems arising from poor freshwater quality and desmoltification (loss of smolt status).

MaCuMBA: Marine Microorganisms: Cultivation Methods for Improving their Biotechnological Applications (Budget: €8,999,948.00; Project period: 08/2008 - 07/2016)

MaCuMBA has discovered marine microbes that can help in mitigating climate change, control disease and generate alternative energy sources. The project also solved problems in isolating and growing them. Besides the excellent scientific publication record, MaCuMBA: produced four major collections of key isolated strains; developed a Knowledge Management and Transfer Methodology (KMTM) based on a tried and tested Knowledge Management methodology developed by **MaCuMBA** partner AquaTT, which focuses on Knowledge Outputs (KOs), units of knowledge that have been generated out of a scientific project, all made publicly available through means of the EurOcean Marine Knowledge Gate, available at www.kg.eurocean.org; produced “*The Marine Microbiome: An Untapped Source of Biodiversity and Biotechnological Potential*” published by Springer; and organised the *Marine Microbiome Discovery & Innovation* event organized in Berlin in 27-30 June 2016 represented the culmination of the MaCuMBA project. MaCuMBA actively explores synergies with the other EU projects, Micro B3 and PharmaSea.

MultiHemp: Multipurpose hemp for industrial bioproducts and biomass (Budget: €5,999,999.00; Project period: 09/2012 - 02/2017)

MultiHemp is a good example of the multidisciplinary project teams that EU-funded research is so good at developing, comprising experts in biology, biotechnology, plant production, pharmaceutical industry, civil engineering, textile industry. Traditionally cultivated for the fibres, seeds and psychoactive substances, hemp is well suited to producing innovative biomaterials. Its production has a relatively low impact on the environment. Cutting-edge genomic approaches were used to support genetic improvement in line with end-users requirements. Knowledge in relevant areas of plant biology and metabolic pathways and utilisation of state of the art molecular tools was extended. A modular biorefinery was developed with long blast fibres extracted for high value textiles while short bast fibres extracted for injection moulded bio-composites and insulation products. The woody shives are used for low-carbon construction materials. Oil is used for health and personal care applications, protein for food and feed, and high added value chemicals such as phytosterols, waxes and essential oils. In parallel, innovative applications was developed for the by-products and side-products from processing routes including: dust from fibre processing, retting liquor from fibre degumming, flour from oil extraction, and residues from seed harvesting.

Open-Bio: Opening Bio-based Markets Via Standards, Labelling and Procurement (Budget: €5,996,597.00; Project period: 11/2013 - 10/2016)

Open-Bio focused on standardization and labelling as a way to stimulate the uptake of bio-based products. The aim is to support informed procurement decisions especially in public procurement. The project ended in October 2016. Open-Bio developed methods to assess bio-based products and prepared them for standardisation. These included the determination of the total bio-based content of a product, its likely biodegradation in sea water, compostability and the extent to which it can be recycled. Several of the developed methods have been submitted to the European Committee for Standardization (CEN) and the International Standardization Organisation (ISO). Two have already been adopted, and several more are being finalised in cooperation with these bodies. Eventually the standardized methods help manufacturers to substantiate their claims about bio-based products and their related properties. The project also looked at consumers' understanding of the term 'bio-based'. To some, it means eco-friendly, bio-degradable or compostable, whereas others assume that there was biotechnology involved. The consortium explored how the EU's Ecolabel system might convey information about the bio-based content and related aspects and developed a proposal for a manageable, user-friendly approach to implement this issue. A database to support public procurement decisions was also designed and piloted internally in the project. The database will be developed in another project launched in March 2015.

10. LESSONS LEARNT / CONCLUSIONS

Based on the Expert Group's observations, the main conclusions are the following:

10.1. RELEVANCE

- There is a clear scientific rationale for investing in R&I in the activity areas covered by SC2 and a strong justification and stakeholder support for a challenge based approach.
- A high policy relevance of SC2 in line with the EU's Bioeconomy strategy, the European Commission's policy agenda and major policies such as the CAP and the CFP could be achieved.

- SC2 has so far performed above average with regard to Commissioner Moedas 3-Os-Strategy.
- A high degree of relevance has been achieved due to the new, extensive and increasingly participatory Strategic Programming process.
- Main challenges that have been identified are:
 - The translation of high level challenges and objectives into specific call topics is not always clear;
 - Finding the right balance on project size, coverage of topics and between R&I;
 - Reconciling the perspectives of short to mid- term legislative and specific policy making tasks of policy DGs with a long term and systemic view on R&I.
- Further significant developments and novelties that have been identified are:
 - The development of Blue Growth as a distinct focus area;
 - The focus on Sustainable Food Security (40% of resources);
 - The creation of the BBI-JU, developing new integrated value-chains;
 - The new multi-actor approach, increasing users' involvement and uptake.

10.2. EFFECTIVENESS

- It is too early for significant evidence of outputs and effects (so far all RIA and IA projects are still on-going). However, there are several examples of promising projects with potential impacts on:
 - The development of low-carbon, resource-efficient and competitive European agri-food and bio-based industries;
 - Improved competitiveness, resilience and sustainability of European agriculture and forestry sector;
 - Reduced greenhouse gas emissions;
 - Improved food security and safety;
 - Oceans observation and mapping, sustainable and smart use of marine resources;
 - Higher growth and employment.
- The SME Instrument projects funded have shown the following prospective impacts:
 - 55 SME Phase I projects are expected to generate EUR 1.5 billion of additional turnover and over 1500 jobs over the next three years;
 - 26 SME Phase II projects are likely to deliver EUR 1 billion of additional turnover over next five years and over 1000 jobs over the next three years;
 - Positive, indirect impacts (supply chain and multiplier effects) may increase the economic impact further.
- Some of the most significant achievements of SC2 are the following:
 - Setting up of the BBI JU
 - Strategic international cooperation, e.g. Atlantic Ocean Research Alliance;
 - Very significant technological advances – Mainly higher Technology Readiness Levels (TRL) 5 and above
 - 42% of the funded projects are expected to contribute to research excellence i.e. breakthrough research
 - 1/3 of the projects are expected to contribute to strengthening Europe's research skill base.

10.3. EFFICIENCY

- The thematic allocation of funding very close to what was envisaged.
- The programme has been efficient in attracting newcomers (22% in SC2 calls, 84% in SME topics, 34% in BBI). Although there is still room for further improvement in widening participation from new Member States.
- Programme management has shown to be efficient, albeit coordination arrangements with multiple DGs, co-management with DG AGRI and programme implementation across three executive agencies (REA, INEA, EASME) has been resource intensive.
- The delegation of programme management activities to REA has been smooth and included specific mechanisms for close interactions with the parent-DGs.
- The provision of feedback to policy making and dissemination might still deserve further attention.
- Horizon 2020 simplifications additionally improved efficiency and two-stage evaluation schemes helped to improve the overall success rate.

10.4. COHERENCE

- Strong internal coherence of SC2 has been achieved through:
 - a coherent and complementary choice of funding instruments;
 - an appropriate thematic allocation of funding and links between SC2 and other parts of the programme (particularly other SCs and LEIT).
- External coherence of SC2 is marked by a high degree of coherence, complementarity and synergies with other EU policies, particularly the CAP, the CFP, maritime and climate policies.
- The ERA-Net co-fund actions generate a structuring effect and ensure coherence between EU and national research funding programmes.

10.5. EU ADDED VALUE

- Overall, there has been strong qualitative and quantitative evidence of the added value of the SC2 programme. That includes:
 - High project additionality (42% of SC2 projects would not have gone ahead without EU funding while 32% would have gone ahead with significant modifications.);
 - The development of research capacities and the deepening of collaboration between partners which would not have been possible without EU funding.
 - The provision, at policy level, of structure and reference for the development of national research programmes, creating synergy and ensuring complementary in the research funding.

11. RECOMMENDATIONS ON THE SC2 PROGRAMME

The Expert Group suggests that the overall programme's relevance could be improved by:

- Better evidencing and articulating the grand challenges and specific challenges being addressed by the programme at the level of the Work Programmes
- Developing SMART objectives
- Further strengthening the intelligence base on which programming choices (as reflected in work programme design) are based (e.g. size of projects – more, smaller

projects or fewer, larger projects; broad versus deep coverage of topics, balance between R&I)

A better development and implementation of Standard Operating Procedures and a clear division of tasks between different DGs and the executive agencies would help improve coordination and thus the efficiency of programme management. To ensure coherence, the balance between research and innovation within each thematic area across Horizon 2020 as a whole (not just SC2) should be systematically monitored.

Linkages with ERC and EIT should be systematically explored and where appropriate, developed. Member States should be encouraged to develop synergies between SC2 and ESIF funds under their management.

Given the low strategic contribution of the SME instrument with its bottom-up approach, it would be worthwhile considering how the SME funding earmarked under SC2 could best support the stated objectives of the Societal Challenge, while ensuring a higher level of additionality.

While simplification including financial reporting is generally positively received, the depth of reporting in terms of outcomes, outputs, results and impacts could be improved and it could benefit from the use of more KPIs for evaluating and monitoring the programme's effectiveness towards attaining its objectives. While the programme has put in place a strong programming phase, it would further benefit from a stronger framework to steer the dissemination and exploitation of projects results.

Relevance

The evaluation Expert Group identified the following areas for improvement:

- The high level challenges (e.g. food security, waste etc.) being addressed by SC2 as well as the specific challenges being addressed by SC2 call topics should be better evidenced and articulated.
- It would be helpful if future work programmes could provide background information on the process through which specific challenges and call topics are identified and prioritised.
- SC2 objectives should be better specified, as far as possible in SMART terms i.e. Specific Measurable Aligned (with policy objectives) Realistic and Time-bound. Although the legal basis cannot be changed at this stage, a supplementary document could be produced setting out these SMARTer objectives to guide programme activity and to enable better measurement of programme success.
- DG RTD and DG AGRI should consider the trade-offs involved in funding a larger number of smaller projects compared to the current approach of funding a single large project under a given call topic.
- In drafting of work programmes, attention should be paid to ensuring optimal degree of precision in topic texts in relation to the purpose of the topic.
- Further strengthening the intelligence base on which programming choices (as reflected in work programme design) are based (e.g. size of projects – more, smaller projects or fewer, larger projects; broad versus deep coverage of topics, balance between R&I)
- A stronger framework to steer the dissemination and exploitation of projects results.

Effectiveness

None identified at this stage.

Efficiency

To streamline coordination of activity across SC2, there should be clear division of tasks between the Commission and the executive agencies. Standard Operating Procedures should be further developed to ensure consistency across executive agencies and beyond. Dissemination and feed-back loop to policy making are key issues which deserve further attention.

Coherence

As mentioned earlier, there is potentially scope to strengthen links between SC2 and other parts of Horizon 2020, namely ERC funded research at one end of the spectrum and the EIT at the other end of the spectrum (downstream aspects such as innovation).

The strategic programming effort has clearly engaged a wide range of stakeholders with in-depth discussions about the nature of the societal challenges and how they might be addressed. This has so far contributed to a general direction of R&I activities and helped identify challenging and innovative work programme topics that drive the selection of research projects. However, the Expert Group believes that it is less clear how this process has framed the direction of R&I activities at a programme level, i.e., above the level of projects. Thus for example, and like in FP7, the programme is making a significant investment in gaining better access to a wider range of genetic resources and in tools that can only deliver impact through innovation in plant and animal breeding. However, the Expert Group believes that there is no clear programme-level strategic framework to steer these research projects and to systematically link, disseminate and exploit their outputs to the plant and animal breeding sectors. Coordination between projects and the transfer of results to these users generally depends on project/consortium specific activities. Similar conclusions can be drawn in other innovation areas such as in soil management, innovation in cropping systems, crop protection. It should however be noted that the Commission has developed a Dissemination and Exploitation Strategy and that SC2 supports at least four projects to facilitate the dissemination and uptake of projects results (COLUMBUS for the marine area and ProBio and CommBeBiz under topic ISIB-8-2014).

The most recent strategic programming activities provide a foundation for intensifying programming and delivering research strategy that guides research activities, particularly in agriculture. Looking forward, the EC has taken steps to establishing a more strategic approach to designing its portfolio. The final report of the EC meeting “Designing the path” (26-28 January, 2016) makes a number of very important programming points. For example it states that *“Incorporating research and innovation activities into a long-term strategy will make it easier to identify strategic areas of short-, medium- and long-term interest, and thereby improve their overall consistency, sequencing and impact. By laying down strategic priorities for agricultural and forestry research in the EU it will be possible to reinforce synergies with Member States and non-EU research programmes.”* This provides excellent support to the development of research strategy and the designing of research programmes in a coherent way that results in a portfolio that is more than a list of projects. Furthermore it stated that: *A long-term view on research questions and investment is particularly important given the time lag between the initiation of research, the delivery of results and their uptake by users and ultimate translation into mainstream practice.* The key phrase here ‘research questions’. The report provides a strong mandate to extending strategic programming to the identification of broad research questions to be addressed with greater coordination of the research portfolio to meet specific innovation objectives.

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This report is the Thematic Annex of Societal Challenge 2 (SC2): Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research, and the Bioeconomy, to the Interim Evaluation of Horizon 2020 and it is based on the final report of the Expert Group for SC2 Interim Evaluation. It critically examines the rationale, design and current state of implementation of the programme and presents the SC2 Expert Group's assessment of the relevance, effectiveness, efficiency, EU added-value and coherence of the programme. Although all of these evaluation criteria are covered by the evaluation, given the early stages of programme implementation and considering that limited evidence on actual outputs and results is available, this report focuses on design and implementation issues, relevance and coherence. Moreover, it should be noted that this Report focuses on the projects funded through the main SC2 calls. This evaluation does not examine the SME instrument and the BBI-JU in detail as these topics are the subject of two, parallel, ongoing evaluations.

Studies and reports