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COVER NOTE

From:	Secretary-General of the European Commission, signed by Ms Martine DEPREZ, Director
date of receipt:	23 February 2021
To:	Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council of the European Union
No. Cion doc.:	SWD(2021) 37 final - Part 9/19
Subject:	COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT Accompanying the document Proposal for a COUNCIL REGULATION establishing the Joint Undertakings under Horizon Europe European Partnership for Smart Networks and Services

Delegations will find attached document SWD(2021) 37 final - Part 9/19.

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Brussels, 23.2.2021
SWD(2021) 37 final

PART 9/19

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

Proposal for a COUNCIL REGULATION establishing the Joint Undertakings under Horizon Europe

European Partnership for Smart Networks and Services

{COM(2021) 87 final} - {SEC(2021) 100 final} - {SWD(2021) 38 final}

ANNEXES

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Annex 1 Procedural information

1. LEAD DG, DECIDE PLANNING REFERENCES

Co-Lead DG: Directorate-General for Research and Innovation Directorate-General for Communications Networks (CNECT), Directorate General Research and Innovation (RTD)

Decide number: PLAN/2019/5390

2. ORGANISATION AND TIMING

Institutionalised partnerships are foreseen in Articles 185 and 187 of the Treaty on the Functioning of the European Union (TFEU). The preliminary agreement on Horizon Europe contained a list of possible areas for institutionalised partnerships based on Article 185 and 187. For each of these areas the Commission considered 12 potential institutionalised partnerships. Their set up involves new EU legislation and the establishment of dedicated implementing structures and therefore an impact assessment for each of these initiatives.

Following political validation in June 2019, the impact assessment process started with the publication of inception impact assessments for each initiative in August 2019.

An inter-service steering group (ISSG) on research and innovation partnerships under Horizon Europe was set up in May 2019 and held 4 meetings before submission of the Staff Working Document to the Regulatory Scrutiny Board (7 May 2019, 19 June 2019, 5 December 2019, 20 January 2020). The ISSG consisted of representatives of the Secretariat-General, Directorate-General for Budget, Directorate-General for Research and Innovation Directorate-General for Communications Networks, Content and Technology, Directorate-General for Mobility and Transport, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Directorate-General for Energy, Directorate-General for Environment, Directorate-General for Climate Action, and the Legal Service.

An online public stakeholder consultation was launched between September and November 2019, gathering 1635 replies for all 12 initiatives.

3. CONSULTATION OF THE RSB

Two upstream meetings with the Regulatory Scrutiny Board of were held on 10 July 2019 and 30 September 2019.

In accordance with the feedback received from the Regulatory Scrutiny Board on 15 May 2020 the Staff Working Document has been revised as presented in Figure 1. The impact assessment was endorsed by the Inter Service Steering Group on 20 January 2020.

4. EVIDENCE, SOURCES AND QUALITY

To ensure a high level of coherence and comparability of analysis for all candidate initiatives, an external study was procured to feed into the impact assessments of the 12 candidate

institutionalised partnerships [1] (Technopolis Group, 2020). It consisted of an horizontal analysis and individual thematic analyses for each of the initiatives under review.

For all initiatives, the evidence used includes desk research partly covering the main impacts and lessons learned from previous partnerships. A range of quantitative and qualitative data sources complement the evidence base, including evaluations; foresight studies; statistical analyses of Framework Programmes application and participation data and Community Innovation Survey data; analyses of science, technology and innovation indicators; reviews of academic literature; sectoral competitiveness studies and expert hearings. The analyses included a portfolio analysis, a stakeholder and social network analysis in order to profile the actors involved as well as their co-operation patterns, and an assessment of the partnerships' outputs (bibliometrics and patent analysis). A cost modelling exercise was performed in order to feed into the efficiency assessments of the partnership options. Public consultations (open and targeted) supported the comparative assessment of the policy options. For each initiative up to 50 relevant stakeholders were interviewed by the external contractor (policymakers, business including SMEs and business associations, research institutes and universities, and civil organisations, among others). In addition the analysis was informed by the results of the Open Public Consultation (Sep – Nov 2019), the consultation of the Member States through the Strategic Programme Committee and the online feedback received on the Inception Impact Assessments of the set of candidate Institutionalised European Partnerships.

A more detailed description of the methodology and evidence base used, completed by thematic specific methodologies, is provided in Annexes 4 and 6.

Figure 1 Modifications to the draft Staff Working Document based on comments received from the Regulatory Scrutiny Board

Comments from the Regulatory Scrutiny Board	**Actions taken for the Staff Working Document**
(1) The report should put greater focus on assessing and justifying the (change of) partnership choice. It should clarify to what extent the problems addressed by this initiative have developed or differ from those that the current 5G-PPP addresses.	The document has been rewritten to highlight the partnership choice pointing out the limitations of the previous one. It also further clarifies the extension of scope, the new technology challenges, the need to address policy objectives beyond industrial competitiveness such as technological sovereignty, critical role of suppliers, green deal objectives, and deployment programmes. Alongside a number of substantial improvements, Box 3, page 26-27, has been redrafted to clarify the needs for change of partnership.
(2) The report should clarify the intervention logic and the mechanisms through which the partnership would deliver on its objectives (including the environmental and social objectives). It should elaborate on what can	Section 4.3 on intervention logic of the initiative has been rewritten (pages 40 and 41) underlining the sovereignty aspects, the necessary extension of the set of stakeholders, the activities related to deployment, public

[1] Technopolis Group, 2020, forthcoming.

realistically be achieved via the partnership and to what extent it will need to be complemented by other policy initiatives (regulatory, financial, public and private investments and investments by Member States). The report should clearly outline the roles of the key public and private actors. The report should explain to what extent the initiative intends to integrate the deployment of networks.	policy objectives, what it will deliver and how. The report has been improved to clarify the roles of the key public and private sectors notably in 4.4.1 and 4.4.2
(3) The report should clarify the scoring system applied when assessing the options and explain the relative importance of the different criteria. It should remove the discrepancies between the text and the tables and correct any inconsistencies in terms of expected impacts. On this basis, the report should better describe the main differences in impact between a co-programmed partnership and a partnership under Article 187 TFEU, and how significant they are. The report should be clearer on the added value of changing from the current co-programmed partnership to an institutionalized partnership.	The scoring system has been clarified and a few inconsistencies corrected (Tables 5, 6 and 10). Section 6 on how the different policy options compare has been extensively rewritten to highlight the main differences of impacts between a co-programmed and an institutionalised partnership, notably on Scientific impacts, social impact, efficiency and coherence. A summary assessment has been added on page 68 underlining the added value of an institutionalised partnership compared to the current model.
(4) The report should explain better how the preferred partnership option would motivate large companies to join, even if this could limit benefiting from size advantages of network industries and opportunities to earn a dominant market position. It should show in more detail how the partnership facilitates a strong prior commitment to public investment.	The report has been revised to better explain how the preferred option will motivate the industry through strategic roadmaps and long-term investment certainty and will also motivate the Member States through formal and close participation as part of the governance structure. These points are now inter alia described on page 68 of the report.
(5) The report should integrate stakeholders' views throughout the assessment. In particular, it should elaborate on stakeholders' positions on the different options and to what extent the preferred partnership form is expected to attract their participation.	In the draft report submitted to the Board, the views of different stakeholders had been reflected in part II, Annex 2 and in part II, Annex 6.4. The main stakeholder views have now been integrated in part I. Details of the results of the Open Public Consultation have been explained beyond the raw statistics, showing the motivation and openness of the stakeholders vis-à-vis the preferred option. These aspects are now presented on page 66 of the IA and in more detail in Annex 2.

Annex 2 Stakeholder Consultation

1. OVERVIEW FOR ALL CANDIDATE INSTITUTIONALISED EUROPEAN PARTNERSHIPS

1.1. Introduction

In line with the Better Regulation Guidelines,[2] the stakeholders were widely consulted as part of the impact assessment process of the 12 candidates for institutionalised partnerships, including national authorities, the EU research community, industry, EU institutions and bodies, and others. These inputs were collected through different channels:

- A feedback phase on the inception impact assessments of the candidate initiatives in August 2019, gathering 350 replies for all 12 initiatives on the "Have your say" web portal during a period of 3 weeks;
- A structured consultation of Member States performed by the EC services over 2019 through the Shadow Strategic Configuration of the Programme Committee of Horizon Europe (in line with the Article 4a of the Specific Programme of Horizon Europe). This resulted in 44 possible candidates for European Partnerships identified as part of the first draft Orientations Document towards the Strategic Plan for Horizon Europe (2021-2024), taking into account the areas for possible institutionalised partnerships defined in the Regulation.
- An online public stakeholder consultation administered by the EC, based on a structured questionnaire, open between September and November 2019, gathering 1635 replies for all 12 initiatives;
- A targeted consultation run by the external study contractors with a total of 608 interviews performed as part of the thematic studies by the different study teams between August 2019 and January 2020.

1.2. Horizontal results of the Open Public Consultation

The consultation was open to everyone via the EU Survey online system.[3] The survey contained two main parts to collect views on general issues related to European partnerships (in Part 1) and specific responses related to one or more of the 12 candidate initiatives (as selected by a participant). The survey was open from 11 September till 12 November 2019. The consultation was available in English, German and French and advertised widely through the European Commission's online channels as well as via various stakeholder organisations.

1.2.1. Profile of respondents

In total, 1635 respondents filled in the questionnaire of the open public consultation. Among them, 272 respondents (16.64%) were identified to have responded to the consultation as part of a campaign (coordinated responses). Based on the Better Regulation Guidelines, the groups of respondents where at least 10 respondents provided coordinated answers were labelled as *'campaigns',* segregated and analysed separately and from other responses. In total 11 campaigns were identified, the largest of them includes 57 respondents[4]. In addition, 162 respondents in the

[2] https://ec.europa.eu/info/files/better-regulation-guidelines-stakeholder-consultation_en
[3] https://ec.europa.eu/eusurvey/runner/ConsultationPartnershipsHorizonEurope
[44] The candidate Institutionalised Partnership Clean Hydrogen has the highest number of campaigns, namely 5. A few initiatives, such as Innovative SMEs, Smart Networks and Systems, were not targeted by campaigns. Some campaign respondents decided to provide opinions about several partnerships.

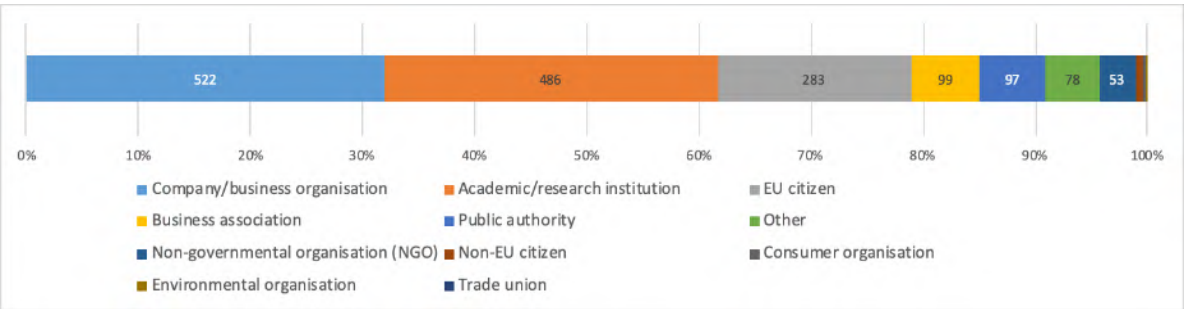
consultation also display similarities in responses but in groups smaller than 10 respondents. Hence, these respondents were not labelled as campaigns and therefore were not excluded from the general analysis.

Table 1: Country of origin of respondents (N=1635)

Country	Number of respondents	Percentage of respondents
Germany	254	15.54%
Italy	221	13.52%
France	175	10.70%
Spain	173	10.58%
Belgium	140	8.56%
The Netherlands	86	5.26%
Austria; United Kingdom	61	3.73%
Finland	49	3.00%
Sweden	48	2.94%
Poland	45	2.75%
Portugal	32	1.96%
Switzerland	28	1.71%
Czechia	24	1.47%
Greece	23	1.41%
Norway; Romania	22	1.35%
Denmark	20	1.22%
Turkey	19	1.16%
Hungary	14	0.86%
Ireland	12	0.73%
United States	11	0.67%
Estonia; Slovakia; Slovenia	10	0.61%
Bulgaria; Latvia	9	0.55%
Bosnia and Herzegovina	7	0.43%
Lithuania	4	0.24%
Canada; Croatia; Israel	3	0.18%
China; Ghana; Iceland; Japan; Luxembourg; Morocco	2	0.12%
Bhutan; Botswana; Cyprus; Iran; Malta; Mexico; Moldova; Mongolia; Palestine; Russia; Serbia; South Africa; Tunisia; Ukraine; Uruguay	1	0.06%

As shown in Figure 2, the three biggest **categories of respondents** are representatives of companies and business organisations (522 respondents or 31.9%), academic and research institutions (486 respondents or 29.7%) and EU citizens (283 respondents or 17.3%). Among the group of respondents that are part of campaigns, most respondents are provided by the same groups of stakeholders, namely company and business organisations (121 respondents or 44.5%), academic and research institutions (54 respondents or 19.8%) and EU citizens (42 respondents or 15.4%).

Figure 2 Type of respondents (N=1635) - For all candidate initiatives



Among all consultation respondents, 1303 (79.69%) have been **involved in the on-going research and innovation framework programme** Horizon 2020 or the preceding Framework Programme 7, while 332 respondents (20.31%) were not. In the group of campaign respondents, the share of those who were involved in these programmes is higher (245 respondents out of 272 or 90.07%) than in the group of non-campaign respondents (1058 out of 1363 or 77.62%). When respondents that participated in the Horizon 2020 or in the preceding Framework Programme 7 were asked to indicate in which capacity they were involved in these programmes, the majority stated they were a beneficiary (1033 respondents) or applicant (852 respondents). The main stakeholder categories, e.g. companies/business organisation, academic/research institutions, etc., show a similar distribution across the capacities in which they 'have been involved in Horizon 2020 or in the Framework Programme 7' as the overall population of consultation respondents.

Among those who have been involved in Horizon 2020 or the preceding Framework Programme 7, 1035 respondents (79.43%) are/were **involved in a partnership**. The share of respondents from campaigns that are/were involved in a partnership is higher than for non-campaign respondents, 89.80% versus 77.03% respectively. The list of partnerships under Horizon 2020 or its predecessor Framework Programme 7 together with the numbers, percentages of participants is presented in Table 4, the table also show the key stakeholder categories for each partnership. Most consultation respondents participated in the following partnerships: Fuel Cells and Hydrogen 2 (FCH2) Joint Undertaking, Clean Sky 2 Joint Undertaking, European Metrology Programme for Innovation and Research (EMPIR) and in Bio-Based Industries Joint Undertaking. The comparison between the non-campaign and campaign groups of respondents shows that the overall distribution is quite similar. However, there are some differences. For the campaign group almost a half of respondents is/was involved in the Fuel Cells and Hydrogen 2 (FCH2) Joint Undertaking, a higher share of campaign respondents is/was participating in Clean Sky 2 Joint Undertaking and in Single European Sky Air Traffic Management Research (SESAR) Joint Undertaking.

When respondents were asked in which **role**(s) **they participate(d) in a partnership**(s), over 40% indicated that they act(ed) as partner/member/beneficiary in a partnership. The second largest group of respondents stated that they applied for funding under a partnership. The roles selected by non-campaign and campaign respondents are similar.

Table 4: Partnerships in which consultation respondents participated (N=1035)

Name of the partnership	Number and % of respondents from both groups (n=1035)	Number and % of respondents from a non-campaign group (n=815)	Academic/research institutions	Business associations	Company/business	Company/business	EU citizens	NGOs	Public authority
Fuel Cells and Hydrogen 2 (FCH2) Joint Undertaking	354 (33.33%)	247 (30.31%)	97	9	37	43	41	8	5
Clean Sky 2 Joint Undertaking	195 (18.84%)	145 (17.79%)	57	2	10	27	37	1	7
European Metrology Programme for Innovation and Research (EMPIR)	150 (14.49%)	124 (15.21%)	64	0	13	9	14	2	19
Bio-Based Industries Joint Undertaking	142 (13.72%)	122 (14.97%)	39	8	20	27	14	1	6
Shift2Rail Joint Undertaking	124 (11.98%)	101 (12.40%)	31	7	5	31	14	3	7
Electronic Components and Systems for European Leadership (ECSEL) Joint Undertaking	111 (10.72%)	88 (10.80%)	42	2	7	20	12	0	5
Single European Sky Air Traffic Management Research (SESAR) Joint Undertaking	66 (6.38%)	46 (5.64%)	10	3	3	20	3	2	3
5G (5G-PPP)	53 (5.12%)	47 (5.77%)	20	1	6	14	5	0	1
Eurostrars-2 (supporting research-performing small and medium-sized enterprises)	44 (4.25%)	40 (4.91%)	17	0	6	1	7	0	6
Innovative Medicines Initiative 2 (IMI2) Joint Undertaking	37 (3.57%)	35 (4.29%)	18	2	3	3	2	4	3
Partnership for Research and Innovation in the Mediterranean Area (PRIMA)	28 (2.71%)	26 (3.19%)	15	0	3	1	2	0	2
European and Developing Countries Clinical Trials Partnership	25 (2.42%)	24 (2.94%)	12	0	1	2	3	3	2
Ambient Assisted Living (AAL 2)	22 (2.13%)	21 (2.58%)	11	2	1	1	3	0	3
European High-	22 (2.13%)	18 (2.21%)	6	0	2	3	5	0	2

Name of the partnership	Number and % of respondents from both groups (n=1035)	Number and % of respondents from a non-campaign group (n=815)	Academic/research institutions	Business associations	Company/business	Company/business	EU citizens	NGOs	Public authority
Performance Computing Joint Undertaking (EuroHPC)									

For the remaining of the consultation respondents could provide their views on each/several of the candidate initiatives. The majority of respondents (31.4%) provided their views on the Clean Hydrogen candidate partnership. More than 45% of respondents from the campaigns selected this partnership. Around 15% provided their views for European Metrology, Clean Aviation and Circular Bio-based Europe. The share of respondents in the campaign group that chose to provide views on the Clean Aviation candidate partnership is of 20%. The smallest number of respondents provided opinions on the candidate initiative 'EU-Africa research partnership on health security to tackle infectious diseases – Global Health'.

Table 5: Candidate Institutionalised Partnerships for which consultation respondents provide responses (N=1613)

Name of the candidate Institutionalised European partnership	Number and % of respondents from both groups (n=1613)	Number and % of respondents from a non-campaign group (n=1341)
Clean Hydrogen	506 (31.37%)	382 (28.49%)
European Metrology	265 (16.43%)	225 (16.78%)
Clean Aviation	246 (15.25%)	191 (14.24%)
Circular bio-based Europe	242 (15%)	215 (16.03%)
Transforming Europe's rail system	184 (11.41%)	151 (11.26%)
Key Digital Technologies	182 (11.28%)	162 (12.08%)
Innovative SMEs	111 (6.88%)	110 (8.20%)
Innovative Health Initiative	110 (6.82%)	108 (8.05%)
Smart Networks and Services	109 (6.76%)	107 (7.98%)
Safe and Automated Road Transport	108 (6.70%)	102 (7.61%)
Integrated Air Traffic Management	93 (5.77%)	66 (4.92%)
EU-Africa research partnership on health security to tackle infectious diseases – Global Health	49 (3.04%)	47 (3.50%)

1.2.2. Characteristics of future candidate European Partnerships

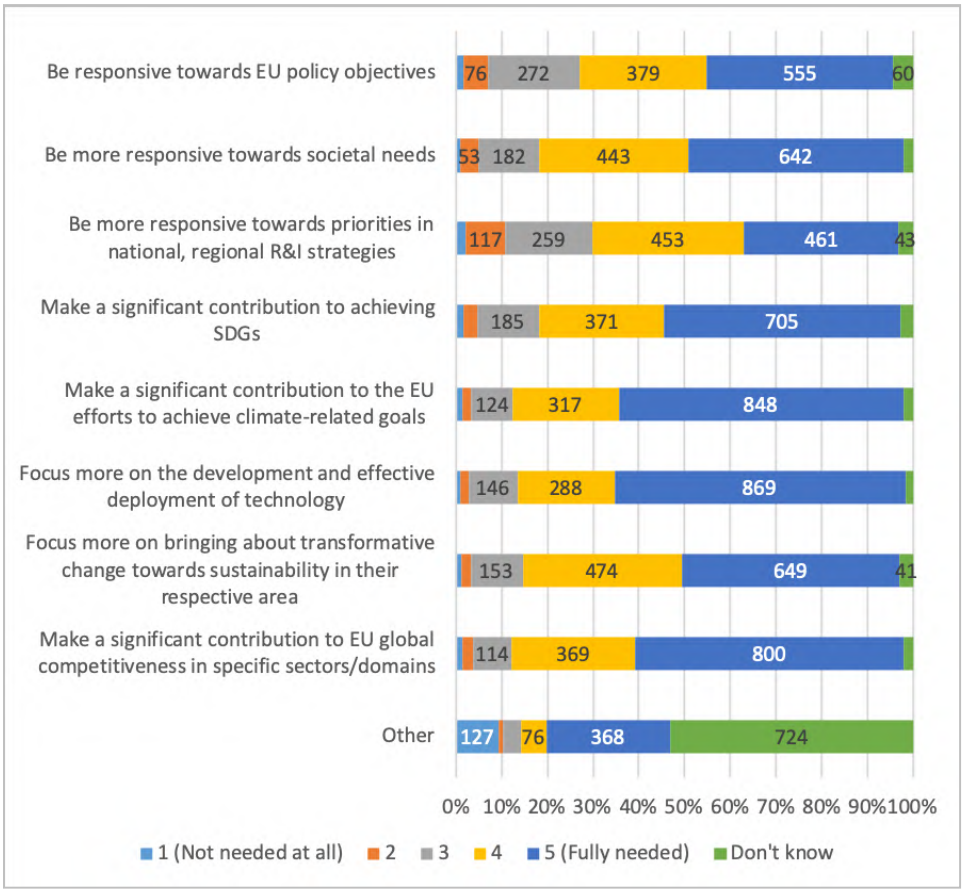
Respondents were asked to assess what areas, objectives, aspects need to be in the **focus of the future European Partnerships** under Horizon Europe and to what extent. According to Figure 6, a great number of respondents consider that a significant contribution by the future European Partnerships is 'fully needed' to achieve climate-related goals, to the development and effective

deployment of technology and to EU global competitiveness in specific sectors/domains. Overall, respondents' views reflect that many aspects require attention of the Partnerships. The least attention should be paid to responding towards priorities of national, regional R&D strategies, including smart specialisation strategies, according to respondents.

Overall, only minor differences can be found between the main stakeholder categories. Academic/research institutions value the responsiveness towards EU policy objectives and focus on development and effective deployment of technology a little less than other respondents. Business associations, however, find that the future European Partnerships under Horizon Europe should focus a little bit more on the development and effective deployment of technology than other respondents. Furthermore, business associations, large companies as well as SMEs value the role of the future European Partnerships for significant contributions to EU global competitiveness in specific sectors domains a little higher than other respondents. Finally, both NGOs and Public authorities put a little more emphasis on the role of the future European Partnerships for significant contributions to achieving the UN SDGs. The views of citizens (249, or 18.3%) do not reflect significant differences with other types of respondents. However, respondents that are/were directly involved in a partnership under Horizon 2020 or its predecessor Framework Programme 7 assign a higher importance of the future European Partnerships to be more responsive towards EU policy objectives and to make a significant contribution to achieving the UN's Sustainable Development Goals.

A qualitative analysis of the "other" answers highlights the importance of collaboration and integration of relevant stakeholders to tackle main societal challenges and to contribute to policy goals against which fragmentation of funding and research efforts across Europe should be avoided. Additionally, several respondents suggested that faster development and testing of technologies, acceleration of industrial innovation projects, science transfer and market uptake are needed. Next to that, many respondents provided answers related to the hydrogen and the energy transition, which corresponds to the high number of respondents that provided answers to the candidate initiative on this topic.

Figure 6: To what extent do you think that the future European Partnerships under Horizon Europe need to (N=1363) (non-campaign replies) For all candidate initiatives



1.2.3. Main advantages and disadvantages of Institutionalised European Partnerships

An open question asked to outline the main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe (1551 respondents). The advantages mentioned focus on the development of technology, overall collaboration between industry and research institutions, and the long-term commitment. Disadvantages mentioned are mainly administrative burdens. An overview is provided below.

Advantages mentioned: Long term commitment, stability, and visibility in financial, legal, and strategic terms; Participation of wide range of relevant stakeholders in an ecosystem (large/small business, academics, researchers, experts, etc.); Complementarity with other (policy) initiatives at all levels EU, national, regional; Efficient and effective coordination and management; High leverage of (public) funds; Some innovative field require high levels of international coordination/standardisation (at EU/global level); Ability to scale up technology (in terms of TRL) through collaboration; Networking between members; Direct communication with EU and national authorities

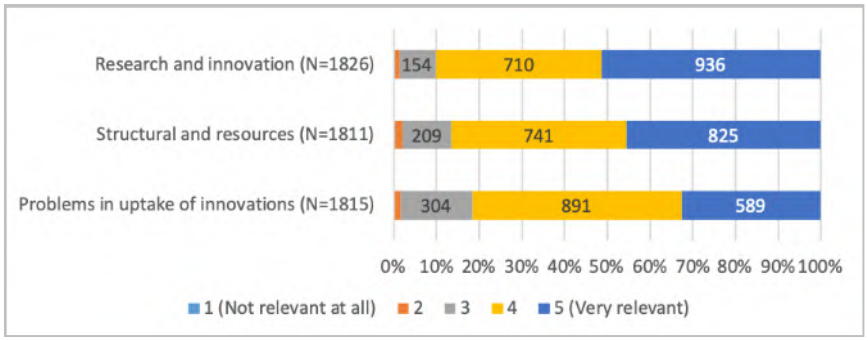
Disadvantages mentioned: Slow processes; System complexity; Continuous openness to new players should be better supported as new participants often bring in new ideas/technologies that are important for innovation; Lower funding percentage compared to regular Horizon Europe projects; Cash contributions; Administrative burdens; Potential for IPR constraints.

1.2.4. Relevance of EU level to address problems in Partnerships' areas

Respondents were asked to rate the **relevance of research and innovation efforts at EU level efforts to address specific problems in the area of partnerships**. Research and innovation related problems were rated as most relevant across all candidate initiatives, followed by

structural and resources problems and problems in the uptake of innovations. Overall, all three areas were deemed (very) relevant across the partnerships, as more than 80% of respondents found these challenges (very) relevant. Only minor differences were found between stakeholder categories. Research and innovation problems were found slightly more relevant by academic/research institutions, yet slight less relevant by large companies and SMEs. Structural and resource problems were indicated as slightly more relevant by NGOs, but slightly less by academic/research institutions. While both NGOs and public authorities find slightly more relevant to address problems in uptake of innovation than other respondents. The views of citizens are not differing significantly. Respondents that are/were directly involved in a current/preceding partnership find, however, the need to address problems related to the uptake of innovations slightly more relevant than other respondents.

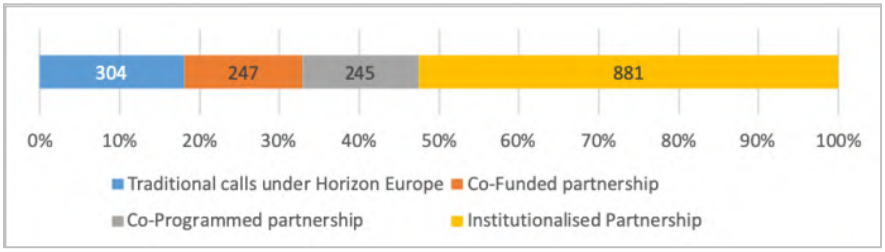
Figure 9: To what extent do you think this is relevant for research and innovation efforts at EU level to address the following problems in relation to the candidate partnership in question? (non-campaign replies) Aggregation of responses of all candidate initiatives



1.2.5. Horizon Europe mode of intervention to address problems

Respondents were asked to indicate how these challenges could be addressed through **Horizon Europe intervention**. Just over 50% of all respondents indicated that institutionalised partnerships were the best fitting intervention, with relatively strong differences between stakeholder categories. The use of Institutionalised Partnership was indicated more by business associations and large companies, but less by academic/research institutions and SMEs. While academic/research institutions valued traditional calls more often, this was not the case for business associations, large companies and public authorities. Public authorities indicated a co-programmed intervention more often than other respondents. Citizens indicated slightly less often that institutionalised partnerships were the best fitting intervention. Respondents that are/were directly involved in a current/preceding partnership, selected the institutionalised partnership intervention in far higher numbers (nearly 70%).

Figure 10: In your view, how should the specific challenges described above be addressed through Horizon Europe intervention? (non-campaign replies) For all candidate initiatives



When asked to reflect on their answers, respondents that pointed to the need for using institutionalised partnership mentioned the long-term commitment of collaboration, a common and ambitious R&I strategy as well as the overall collaboration between industry and research institutions. Others shared positive experiences with other modes of interventions:

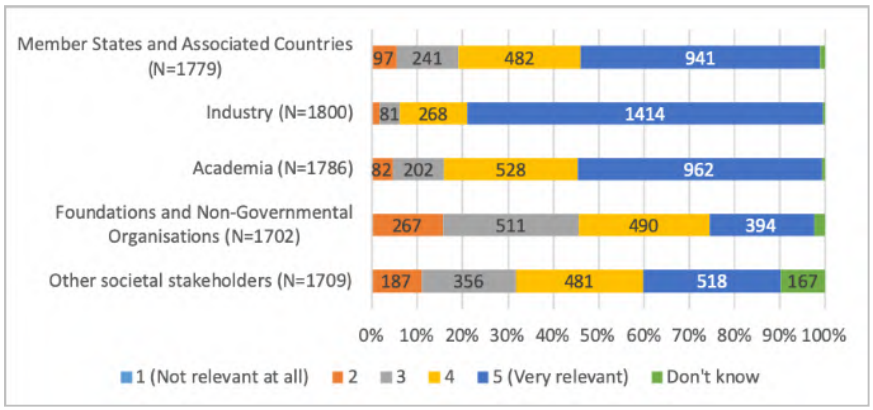
- Traditional calls, because of their flexibility and integration of a wide range of actors, as long as the evaluation panels do not deviate from the policy premier. This was mentioned by 94 participants, including companies (25), academics (26) and EU citizens (25).
- Co-funded partnership, as a mechanism to ensure that all participants take the effort seriously, while allowing business partnerships to develop. This approach was deemed suitable based on previous experiences with ERANETs. This was raised by 84 participants, 36 of them academic respondents, 18 companies and 16 EU citizens.
- Co-programmed partnerships, to tackle the need to promote and engage more intensively with the private sector. This was mentioned by 97 participants, most of them companies (34), followed by academics (22), business associations (15) and EU citizens (11).

1.2.6. Relevance of a set of elements and activities to ensure that the proposed European Partnership would meet its objectives

Setting joint long-term agendas

Respondents were asked how relevant it is for the proposed European Partnerships to meet their objectives to have a strong involvement of specific stakeholder groups in setting joint long-term agenda. All respondents see stakeholders from industry as the most relevant, followed by academia and governments. The involvement of foundations and NGOs as well as other societal stakeholders were, however, still found to be (very) relevant by more than 50% of the respondents. Most respondents indicated the stakeholder group they belong to themselves or that represent them as relevant to involve.

Figure 11: In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives - Setting joint long-term agenda with strong involvement of: (non-campaign replies) For all candidate initiatives

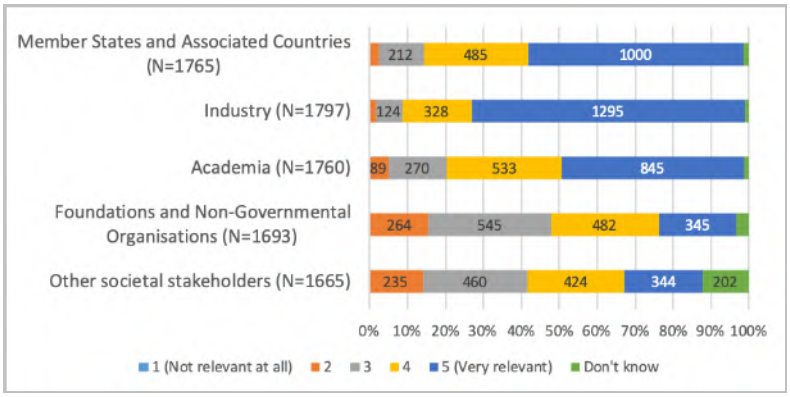


Pooling and leveraging resources through coordination, alignment and integration with stakeholders

Respondents were asked how relevant it is for the proposed European Partnership to meet its objectives to pool and leverage resources (financial, infrastructure, in-kind expertise, etc.)

through coordination, alignment and integration with specific groups of stakeholders. Respondents see stakeholders from industry as the most relevant, followed by academia and governments (Member States and Associated Countries). The involvement of foundations and NGOs as well as other societal stakeholders are also still found to be (very) relevant for more than 50% of the respondents. Similarly as described for the question on setting joint long-term agendas, most stakeholder categories valued their own involvement higher than other respondents – although also here differences between stakeholder categories were minor.

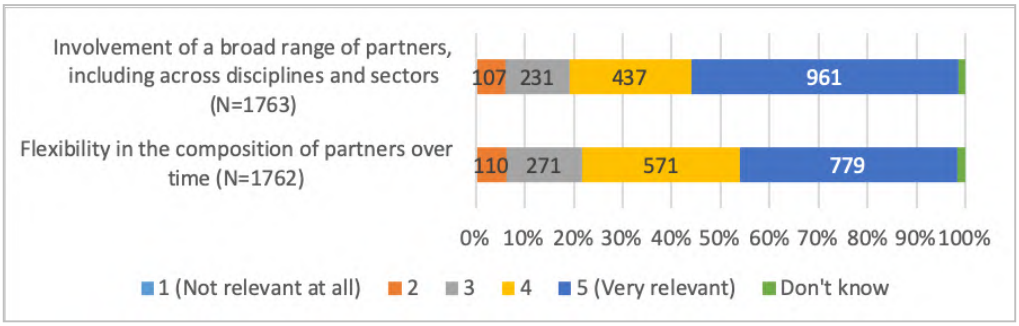
Figure 12: In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives – Pooling and leveraging resources (financial, infrastructure, in-kind expertise, etc.) through coordination, alignment and integration with: (non-campaign replies) For all candidate initiatives



Composition of the partnerships

Regarding the composition of the partnership most respondents indicated that for the proposed European Partnership to meet its objectives the composition of partners needs to be flexible over time and that a broad range of partners, including across disciplines and sectors, should be involved (see Figure 13). When comparing stakeholder groups only minor differences were found. Academic/research institutions and public authorities found the involvement of a broad range of partners and flexibility in the composition of partners over time slightly more relevant than other respondents, while large companies found both less relevant. SMEs mainly found the flexibility in the composition of partners over time less relevant than other respondents, while no significant differences were found regarding the involvement of a broad range of partners. Citizens provided a similar response to non-citizens. Respondents that are/were directly involved in a current/preceding partnership, when compared to respondents not involved in a current/preceding partnership, indicated a slightly lower relevance of the involvement of a broad range of partners and flexibility in the composition of partners over time.

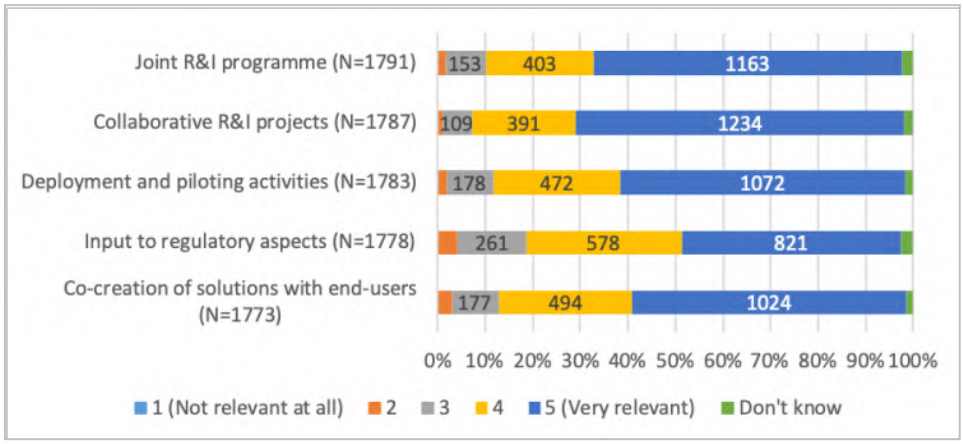
Figure 13: In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives – Partnership composition (non-campaign replies) Aggregation of responses of all candidate initiatives



Implementation of activities

Most respondents indicated that implementing activities like a joint R&I programme, collaborative R&I projects, deployment and piloting activities, providing input to regulatory aspects and the co-creation of solutions with end-users are all (very) relevant for the partnerships to be able to meet its objectives. Minor differences were found between the main stakeholder categories, the differences found were in line with their profile. As such, academic/research institutions found joint R&I programme & collaborative R&I projects slightly more relevant and deployment and piloting activities, input to regulatory aspects and co-creation with end-users slightly less relevant than other respondents. For SMEs an opposite pattern is shown. Large companies, however, also found collaborative R&I projects slightly more relevant than other respondents, as well as input to regulatory aspects. The views of citizens are similar to non-citizens. Respondents that are/were directly involved in a current/preceding partnership, when compared to respondents not involved in a current/preceding partnership, show a slightly higher relevance across all activities.

Figure 14: In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives – Implementing the following activities (non-campaign replies) For all candidate initiatives

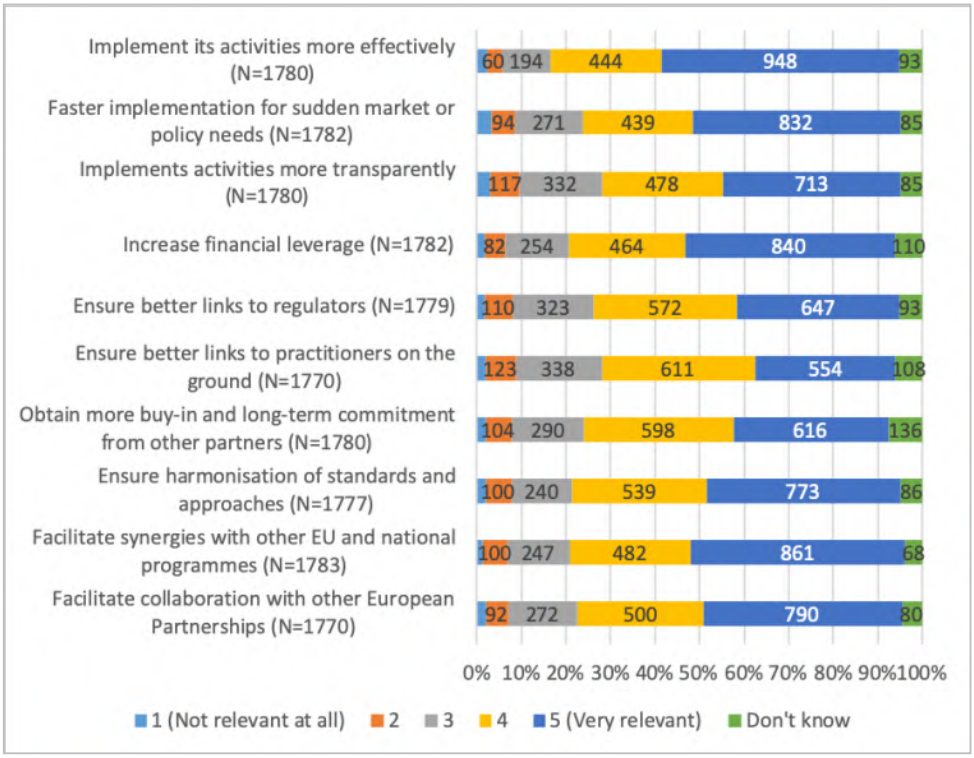


1.2.7. Relevance of setting up a legal structure (funding body) for the candidate European Partnerships to achieve improvements

Respondents were asked to reflect on the relevance of setting up a legal structure (funding body) for achieving a set of improvements, as shown in the Figure below. In general, 70%-80% of respondents find a legal structure (very) relevant for these activities. It was found most relevant

for implementing activities in a more effective way and least relevant for ensuring a better link to practitioners on the ground, however differences are small.

Figure 15: In your view, how relevant is to set up a specific legal structure (funding body) for the candidate European Partnership to achieve the following? (non-campaign replies) Aggregation of responses of all candidate initiatives



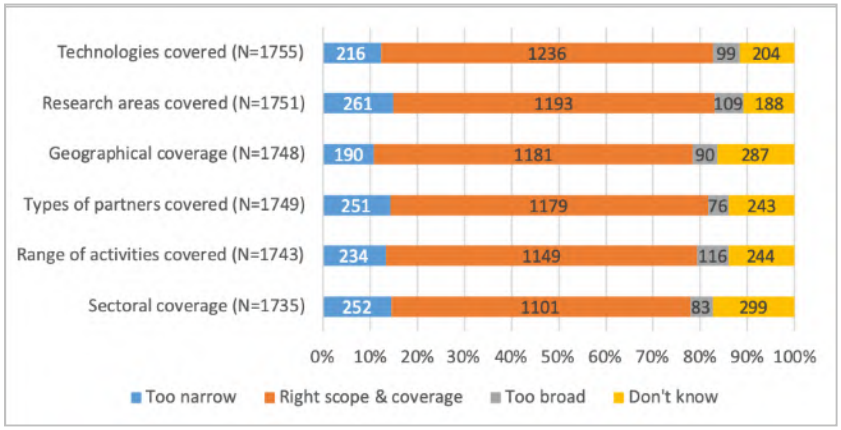
When comparing stakeholder categories there are only minor differences. Academic/research institutions indicated a slightly lower relevance for transparency, better links to regulators as well as obtaining the buy-in and long-term commitment of other partners. SMEs also indicated a lower relevance regarding obtaining the buy-in and long-term commitment of other partners. Large companies showed a slightly higher relevance for implementing activities effectively, ensure better links to regulators, obtaining the buy-in and long-term commitment of other partners, synergies with other EU/MS programmes and collaboration with other EU partnerships. NGOs find it slightly more relevant to implement activities faster for sudden market or policy needs. Public authorities, however, find it slightly less relevant to facilitate collaboration with other European Partnerships than other respondents. The views of citizens show a slightly lower relevance for a legal structure in relation to implementing activities in an effective way. Respondents that are/were directly involved in a current/preceding partnership indicated a higher relevance across all elements presented.

1.2.8. Scope and coverage of the candidate European Partnerships based on their inception impact assessments

Consulted on the scope and coverage for the partnerships, based on their inception impact assessments, the large majority feels like the scope and coverage initially proposed in the inception impact assessments is correct. However, about 11% to 15% of the respondents indicated the scope and coverage to be too narrow. About 11%-17% of respondents answered

"Don't know". Overall, differences between the main stakeholder categories were found to be minor. Academic/research institutions indicated slightly more often that the research area was "too narrow" then other respondents. SMEs on the other hand indicated slightly more often that the research area and the geographical coverage were "too broad". NGOs and public authorities, however, found the geographical coverage slightly more often "too narrow". Large companies found the range of activities slightly more often "too broad" and the sectoral focus slightly more often "too narrow" when compared to other respondents. The views of citizens are the same as for other respondents. Respondents that are/were directly involved in a current/preceding partnership more often indicated that the candidate institutionalised European Partnership have the "right scope & coverage".

Figure 16: What is your view on the scope and coverage proposed for this candidate institutionalised European Partnership, based on its inception impact assessment? (non-campaign replies) Aggregation of responses of all candidate initiatives



1.2.9. Scope for rationalisation and alignment of candidate European Partnerships with other initiatives

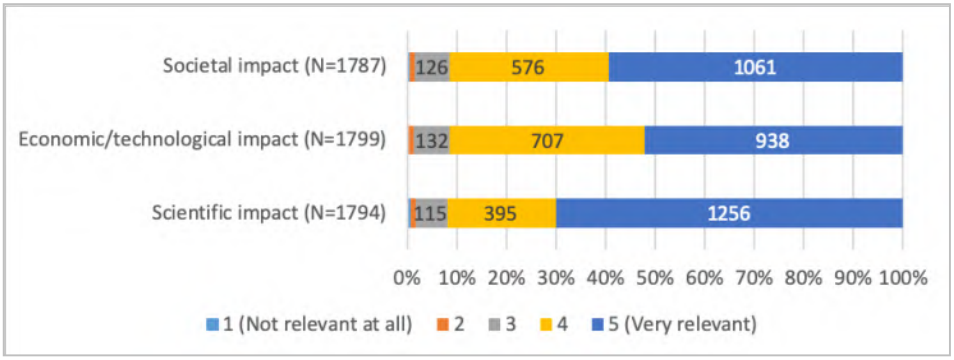
When asked whether it would be possible to rationalise a specific candidate European Institutionalised Partnership and its activities, and/or to better link with other comparable initiatives, nearly two thirds of respondents answered "Yes" (1000, or 62%), while over one third answered "No" (609, or 39%). Nearly no differences were found between stakeholder categories, only large companies and SMEs indicated slightly more often "Yes" in comparison to other respondents. The views of citizens are the same as for other respondents. Respondents that are/were directly involved in a current/preceding partnership, indicated "No" more often, the balance is about 50/50 between "Yes" and "No" for this group.

1.2.10. Relevance of European Partnerships to deliver targeted scientific, economic/technological and societal impacts

Finally, respondents were asked to rate the relevance of partnership specific impacts in three main areas: Societal; Economic/technological; and Scientific impacts. All three areas were deemed (very) relevant across the candidate partnerships. Scientific impact was indicated as the most relevant impact, more than 90% of respondents indicated that this as (very) relevant. Only minor difference between stakeholder groups were found. Academic/research institutions found scientific impacts slightly more relevant, while large companies found economic and

technological impacts slightly more relevant than other respondents. NGOs found societal impact slightly more relevant, while SMEs found this slightly less important. Citizens did not a significantly different view when compared to other respondents. Respondents that are/were directly involved in a current/preceding partnership find all impacts slightly more relevant than other respondents.

Figure 17: In your view, how relevant is it for the candidate European Institutionalised Partnership to deliver on the following impacts? (non-campaign replies) Aggregation of responses of all candidate initiatives



1.3. Stakeholder consultation results for this specific initiative

The consultation strategy aimed to involve potential members of the partnership, currently involved in the 5G Public-Private Partnership (PPP) or in the other domains, together with a broad range of interested stakeholders from the European ICT sector and vertical industries. New actors from complementary technological domains such as artificial intelligence (AI), components and devices, and from vertical sectors, energy, health and transport that were not yet involved were involved as well.

The main stakeholders are the European Technology Platform Networld2020 with more than 1000 members, covering a vast research constituency of academics and industry actors active in the field of telecommunications: network vendors and operators, SMEs, researchers from universities and research centres. A further extension to stakeholders from IoT and cloud has been established to reflect the convergence of these areas of research: the 5G Infrastructure Association (5G-IA) with more than 55 organisations, which comprises the major players of 5G research leading the 5G-PPP R&I, and the Alliance for Internet of Things Innovation (AIOTI), working on the deployment of Internet of Things (IoT) and its applications in Europe and on the development of a future vision for Horizon Europe.

A list of profiles that have been consulted either directly, or through consultation efforts such as an open public consultation, covers the following type of stakeholders:

- The **research community** across the EU, which includes academic/research institutions such as universities, public government-funded organisations, independent organisations or private research centres.
- The **industrial community**, which includes large companies, SMEs and start-ups, network operators and manufacturers.
- **Business oriented stakeholders**.
- **Public authorities**, which includes ministries, utility companies and national bodies for research.
- **Non-governmental organisations** (NGOs), including non-profit advocacy organisations and scientific medical societies.
- **EU citizens** responding on their own behalf.
- **'Other' stakeholders**, which includes multi-utility companies, independent authorities and platforms (interest representatives).

1.3.1. Feedback to the inception impact assessment on candidate initiatives for Institutionalised Partnerships

The inception impact assessment[5] of the initiative was published for feedback from 30 July 2019 to 27 August 2019, with the aim to seek initial feedback. Eight feedback reactions were received, notably from industry associations dealing with 5G and IoT, such as for example the 5G Infrastructure Organisation (5G IA) the Alliance for Internet of Things Innovation (AIOTI). There was also a feedback reaction from the German government and from citizens.

[5] Available at https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2019-4972300_en

In summary, the reactions showed a strong support for the initiative. The AIOTI association promoted larger inclusion of the IoT dimension which is being taken into account the Partnership proposal. The 5G IA considers that a 'Co-programmed partnership' (option 1), including mechanisms to ensure effective communication and coordination with Member States, would be the most suitable instrument to achieve them. Alternatively, the creation of a joint undertaking bringing together the European Commission and private partners without requiring a financial contribution from Member States (option 2a) could also be considered.

1.3.2. Structured consultation of the Member States on European partnerships

The Commission has organised three workshops on the future involvement of Member States in the candidate European Partnerships with industry participation. In parallel, the engagement of Member States was discussed through some bilateral meetings (notably FR, DE) and through the Future Internet Forum. This provided space for Member States to present their ideas and discuss modalities for possible future participation in industry partnerships.

The Future Internet Forum (FIF) consultations - 3 FIF consultation meetings on the proposed SNS partnership took place, followed by a questionnaire on all aspects of the SNS partnership, including R&I. The FIF is a registered group which aims to exchange views on H2020 topics relating to "Future Networks" (5G, cloud, Next-Generation Internet and IoT). The members of this group have been appointed by the respective national authorities of the Member States.

Smart Networks and Services Partnership Members States consultation meeting (Brussels, Belgium) was held on 11 September 2019. Most of the participants considered the two-pillar approach (R&I and deployment) with very ambitious objectives of the proposed partnership to be highly relevant for Europe. They welcomed the idea of developing a body that offers strategic orientation at European level on, among others, support to 5G cross-border corridors. Grouping R&I and deployment in the same partnership was considered very appropriate, as it should facilitate the link between research, testing, validation and deployment. At the same time, several Member States expressed their concerns about the complexity inherent to the implementation of such an approach.

The 'Digital partnerships workshop' with Member States (Brussels, Belgium) took place on 28 November 2019 as part of efforts to ensure early involvement of Member States in the preparation of European Partnerships with the industry. All 'digital-centric' partnerships were considered of high relevance. For SNS, the added value of closer cooperation with the Member States compared to the current Public Private Partnership (PPP) would be the alignment of R&I agendas with for example the following topics: 6G, terabit connectivity, next generation IoT, cloud computing continuum made possible by high-speed connectivity, standardisation for interoperability. In addition, the partnership would enable structured collaboration on key issues related to 5G deployment, such as cross-border corridors for connected and automated mobility, or regulatory issues.

There was broad agreement that joint cooperation must offer clear added value that goes beyond financial leverage and that other motivators must be included. Cooperation was also perceived as important for scaling up technologies, especially in sectoral applications.

1.3.3. Targeted consultation of stakeholders

For the preparation of the research period after 2020, the first actions of the engagement process were taken by the 5G Infrastructure Association and the Networld2020 European Technology

Platform. They jointly organised workshops on 17 and 29 October 2019, with a large audience, including representatives of key stakeholders in the telecommunications and microelectronics sectors (e.g. Ericsson, Nokia, Infineon, LETI, IMEC, Amazon Edge Computing, ADVA and SMEs). The events included discussions related to the preparation of the planned future partnership, particularly with a focus on the various options for links between partnerships, notably Key Digital Technologies (KDT) and SNS. The workshops have also revealed the accrued importance of relatively new drivers including sustainability and security. To complement the previous initiatives the Commission has organised a series of workshops to gather input from a larger number of interested parties through direct interaction.

Workshops dedicated to the SNS partnership with private sector (Industry, Research and Academia)

Several workshops took place, with a focus on key related areas, such as next generation internet of things, next generation cloud, cybersecurity, components and devices, core smart networks technologies and industrial perspectives.

The 6G Wireless Summit (Levi, Finland) took place on 26 March 2019. The Commission presented the current status of preparation of the partnership, the upcoming steps and the possible timetable towards legislative implementation. Among positive feedback, Nokia has confirmed that they are actively investigating the institutionalised partnership scenario, as well as the co-programmed partnership scenario. The Finnish authorities insisted on the necessity to develop a strong European approach for the deployment of future networks that support the digitisation of the society. They also advocated for a coordinated approach among the Member States, especially with regards to investments.

The European Conferences on Networks and Communications took place in June 2018 (Ljubljana, Slovenia) and June 2019 (Valencia, Spain). The theme for the EuCNC'19 was 'Enabling Smart Connectivity'. The event was thus very useful to gather stakeholders' views on the future of connectivity in the research and innovation domain.

The Smart Networks and Services partnership stakeholder workshop (Brussels, Belgium) with a focus on next generation internet of things (IoT), next generation cloud and cybersecurity. The Commission held the workshop on 4 July 2019, during which participants exchanged their views on challenges associated with the development of future Smart Networks and Services.

The 5G World Forum + SNS Partnership Stakeholder Workshop (Dresden, Germany) took place from 30 September to 2 October 2019. The event gathered industry leaders such as the Huawei CTO, the Nokia CEO for Germany, the Vodafone CTO. The developing ideas for SNS were supported by several speakers: the current trend towards digitisation of industry will continue to be an important driver and push the limits of the KPI's identified for 5G and stimulate collaboration across connectivity, cloud and IoT; the security and energy efficiency are key; societal issues such as climate, sustainable development goals, accessibility are also seen as important design drivers; emerging technologies such as AI, blockchain should be included.

The Panel session 'Partnering for Digital Excellence' at the ICT Proposers Day (Helsinki, Finland) took place on 19 September 2019. The event included a session on the challenges and opportunities offered by future European partnerships. Colin Willcock, Chairman of the 5G-IA, emphasized the necessity and the impact of a European partnership on Smart Networks and

Services, and how such a partnership will boost innovation in vertical industries and public sectors.

The Strategic Deployment Agenda and Stakeholders workshop at Digital Transport Day, (Helsinki, Finland) took place on 7-9 October 2019. The European Commission and key stakeholders discussed 5G deployment for connected and automated mobility. In general, there was agreement that the partnership should contribute to the digital transformation of vertical sectors through deployment of connectivity infrastructure, in parallel to developing the next wave of technologies beyond 5G.

SNS Partnership Stakeholder Vision Workshop, with a focus on core smart networks technologies, 26-27 November 2019 aimed at refining the Strategic Research and Innovation Agenda of the future partnership.

1.3.4. Open Public Consultation

An online public consultation[6] took place from 11 September 2019 to 12 November 2019, with the aim to seek the views of EU research and innovation stakeholders and citizens on the 12 proposed institutionalised European partnerships under the future Horizon Europe Research and Innovation programme (2021-2027). The consultation was available in English, German and French. It was advertised widely the European Commission's online channels as well as via various stakeholder organisations.

The consultation focused on the overall need for and the planned focus of these potential European partnerships, and had a part with specific questions on the proposed SNS Partnership.

Participants in the consultation

For the Smart Networks and Services Partnership, 107 respondents provided their views. Among them, 21 respondents (20%) are citizens. The group is dominated by respondents from academic and research institutions (34 respondents or 32%), citizens and company/business organisations (29 respondents or 27%).

The majority of respondents (84 or 78%), have been involved in the on-going research and innovation framework programme, while 62 respondents (74%) were directly involved in a partnership under Horizon 2020 or its predecessor Framework Programme 7.

Results on general questions

In order to assess the stakeholders' views on the relevancy of several listed impacts or problems and thus obtain an overall percentage, the 5 ("very relevant") and 4-ratings were combined.

[6] Available at https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2019-4972300/public-consultation_en

Relevance of efforts of the candidate European Partnership to address problems

At the beginning of the consultation, all 107 of the respondents for this partnership indicated their views of the needs of the future European Partnerships under Horizon Europe. Overall, respondents indicated that many of the options presented were fully needed (score 5) or gave them a score of 4. The needs where most respondents indicated that it was fully needed was related to its contribution to EU global competitiveness in specific sectors and/or domains (68%). Aside from 'other', the needs where the least respondents indicated that improvements were fully needed, was being more responsive towards priorities in national and/or regional R&I strategies (35%) and focusing more on bringing about transformative change towards sustainability in their respective area (36%). However, these options have a large number of respondents who have given the option a 4 out of 5 on the scale. The respondents also had the option to indicate other needs. The results show that respondents have indicated needs around citizen representation and significant healthcare contribution.

Main advantages and disadvantages of participation in the Institutionalised European Partnership

A key-word analysis showed that the respondents viewed collaboration as the main advantage, while also mentioning European leadership and long-term vision.

Results on candidate European Partnership Specific Closed Questions

Relevance of research and innovation efforts at the EU level to address problems in relation to smart networks and services

In the consultation, respondents were asked to provide their view on the relevancy (5-point scale) of research and innovation efforts at EU level to address the following problems:

- *Problems in uptake of SNS innovations*

With regard to the problems in uptake of SNS innovations, the majority of respondents have picked either a 4 or a 5 on the 5-point relevancy scale. Respondents indicated that insufficient digitalisation (data access and analysis, interoperability) especially for what concerns vertical user sectors is a very relevant problem, with 49 respondents giving this answer (48%). The option that has received the least 5 (very relevant) answers, out of all the problems presented, is regulation in the field of radio spectrum allocation including identification of new innovative spectrum management and sharing technologies (33 respondents or 31%). This lower relevancy could also be related to the higher number of respondents who have indicated that they 'don't know'. 14 respondents have selected this answer (13%), the highest number for any of the options.

Further uptake problems that the initiative would have to address are the 'market fragmentation due to lack of industrial policy favouring harmonised national take up and implementation strategies for new generation of smart connectivity systems', as has been confirmed by 76% of respondents and 'barriers to exploitation due to potential lack of global standards', as confirmed by 76% of respondents. Moreover, efforts are needed to solve 'concerns with use of smart

networks and services platforms for ethical, privacy, security, or EMF reasons", for 74% of respondents.

- *Structural and resource problems*

The gathered input has also shown that a future initiative on Smart Networks and Services would have to address the 'limited collaboration and pooling of resources between public actors, private actors i.e. network and internet service providers, connectivity vendors, computing and device actors, vertical industries and users, leading research centres and public authorities', as has been indicated by a large majority of respondents (88 respondents or 84% indicated this a relevant or very relevant problem to address).

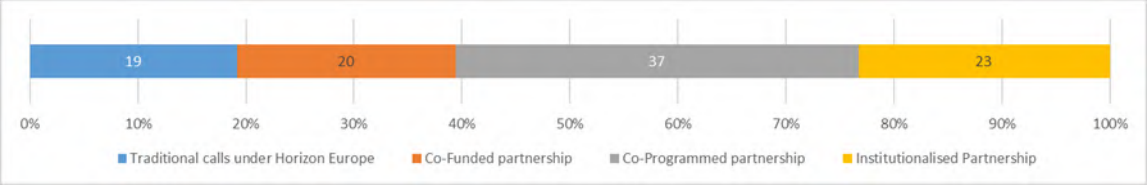
- *Research and innovations problems*

Respondents have indicated that research and innovation problems are considered the most relevant, as both of the problems presented in this category have received more 5 (very relevant) answers than any of the other problems. The innovation gap in the EU in translating the results of connectivity, cloud and Internet of Things devices research into the development of innovative networks and service platforms is considered the most relevant with 72 respondents (69%) indicating it is a very relevant problem.

Type of partnership to be pursued

Respondents were also asked to indicate how the specific SNS challenges could be addressed through Horizon Europe intervention. As shown in the figure below, just over 20% of the respondents indicated that an institutionalised partnership would be the best fitting intervention.

Figure 1 - Assessment of Horizon Europe intervention



The respondents were asked to briefly explain their answers to the question above. A key-word analysis of respondents that selected an institutionalised partnership as the best fitting intervention revealed 'public private European partnership', 'significant results and specific challenges' as common co-occurring keywords.

Stakeholders favoured the known model of co-programmed partnership due to the successful implementation of the 5G-PPP, which was found to present significant added value compared to traditional calls.

However, the stakeholders are fully open and understand the advantages of the institutionalised model. Even if different stakeholder groups cannot always be properly disaggregated, we found that academics tend slightly to prefer the co-programmed model. The 20% supporting co-funding appears to be a misunderstanding of the instrument since industry is core in the initiative. For the 37% preferring a co-programmed model, it is to be noted that at least 6 organisations in the 5G PPP, representing a large majority of the Industry and the 5G Industry Association, chose "co-programmed" as preferred option with a common line of comments saying "*In our view this Partnership could be implemented equally as an Institutionalised Partnership. The choice between Co-Programmed or Institutionalized Partnership is difficult to make today as the details of how such Programs will be implemented have not been published. In our view the area of SNS*

has the breadth, multiple stakeholders and ambitious goals to justify an Institutionalised Partnership however we also believe that this could be achieved by an extended form of a current cPPP". Another 5 stakeholders had a very similar text and this relativises the significantly the raw statistics and shows good support for an institutionalised approach, provided that its complexity and model for financial contributions are reasonable, which is the condition for them to sign up.

Involvement of actors in setting a joint long-term agenda

Respondents were asked how relevant the involvement of actors is in setting a joint long-term agenda to ensure that the proposed European Partnership would meet its objectives. A high number of respondents (86 respondents or 84%) indicated that a strong involvement of industry is very relevant for setting a joint long-term agenda. In contrast, a low number of respondents (21 respondents or 22%) stated that a strong involvement of foundations and NGOs is very relevant for this purpose.

A slight statistical difference was found between the views of citizens and other respondents. Citizens found a strong involvement of other stakeholders (like Connectivity vendors, Telecom operators, regulators, user groups) in setting a joint long-term agenda slightly more relevant.

Coordination in pooling and leveraging resources

Most respondents also considered that coordination with the industry, academia and Member States and associated countries is very relevant in pooling and leveraging resources. Industry is considered as the most relevant actor for this purpose, based on views of 91 out of 101 respondents (90%). The relevance of academia and Member States, Associated Countries and other stakeholders is also perceived relatively high for pooling and leveraging resources to reach objectives of the Smart Networks and Services Partnership (respectively 72% and 78% indicated their role as relevant or very relevant). Here again, less support could be found for foundations and non-governmental organisations (54%), but also for other societal stakeholders (57%).

Partnership composition

Respondents were asked about the relevance of certain elements of the Partnership composition, such as flexibility in the composition of partners over time and involvement of a broad range of partners, to reach Partnership objectives. A high share of respondents (67%) consider the involvement of a broad range of partners very relevant for meeting objectives of the SNS Partnership. Respondents also highlighted the importance of flexibility in the composition of partners over time (46% of the respondents indicated this as very relevant).

Implementation of activities

Respondents were asked to provide opinions on the relevance of implementation of several activities for meeting objectives of the Partnership. The following activities were listed – joint R&I programme, collaborative R&I projects, deployment and piloting activities, input to regulatory aspects and co-creation of solutions with end-users.

A high number of respondents view that that joint R&I programme (72 respondents or 70%), collaborative R&I projects (80 respondents or 77%), as well as, co-creation of solutions with end-users (104 respondents or 65%) is very relevant for meeting the objectives. In comparison, only 38 respondents out of 103 (37%) consider that the input to regulatory aspects is very relevant for this purpose, and 54 respondents (52%) view that deployment and piloting activities are very relevant for meeting objectives of this partnership.

Activities where a specific legal structure is relevant

Respondents were asked to assess the relevance of a specific legal structure (funding body) for the candidate European Partnership to achieve several objectives. A greater number of respondents indicated that the legal structure would be helpful/relevant to implement activities more effectively (83 respondents gave a score of 4 and 5, or 81%), to ensure harmonization of standards and approaches (82 respondents or 83%). The least number of respondents suggest that the legal structure would assist in ensuring better links to regulators, as only 34 respondents (34%) indicated that it would be very relevant (a score of 5) for this purpose.

Scope and coverage of the partnership

Respondents were asked to assess the scope and coverage of the proposed Partnership, based on its inception impact assessment. The majority of them consider that the Partnership has a right scope and coverage in all aspects. However, among listed areas, a slightly smaller share of respondents (64 respondents or 65%) indicated that the sectoral coverage is right and has an appropriate scope, and (13 respondents or 13%) suggested that the sectoral coverage is too narrow.

Societal impact

With regard to the possible societal impacts, the ‘digital transformation of industries such as health, education, media and transport’ was widely considered to be the most important field of action on which the future partnership should deliver, as has been confirmed by 89% of respondents (93 out 105 respondents indicated this as relevant or very relevant). Furthermore, a large majority of participants considered that the partnership should ‘drastically reduce energy consumption of future smart network and service platform’ (80 respondents or 76%) and deliver on ‘providing consumers faster and smarter mobile communications for consumers’ (77 respondents or 75%).

Economic/ technological impact

Respondents have widely emphasised the importance of ‘developing the digital economy of networks, Internet of Things and cloud computing’ (91 respondents or 88% indicated this as relevant or very relevant), ‘creating new industrial value chains across different sectors such as network equipment and service providers, big data, cloud, software-defined infrastructures and Internet of things technologies and services’ (89 respondents or 86%) and ‘faster, energy efficient and affordable advanced communication systems’ (89%).

Scientific impact

Respondents have widely emphasized the importance of 'creating synergies between networks, cloud and internet of Things to achieve intelligent connectivity as a basis for the next generation Internet services and applications' (92 respondents or 89% indicated this as relevant or very relevant), 'maintaining and reinforcing European world-class research and innovation capabilities in networks and related domains' (90 respondents or 87%) and 'developing the scientific knowledge preparing for the 6th Generation of mobile communication networks' (88 respondents or 85%).

Results on candidate European Partnership Specific Open questions

This part of the questionnaire allowed respondents to personalize their answers.

A future European partnership was generally perceived as a good option to preserve European independence, especially in light of the success of the 5G-PPP. Many have also underlined that they have difficulties choosing between the institutionalised and the co-programmed model, as they find both appropriate.

For some respondents, traditional calls were the preferred option, as they are easy to work with, function well, take into account quick evolving technologies, and ensure better coordination. For others, an institutionalised partnership was the preferred option, as it could reduce complexity, ensure direct involvement of both member states and industrial actors, and thus strategic alignment between European and national authorities as well. Furthermore, it would allow for pulling and deployment of resources in a more coherent way and improve competitiveness. Finally, its inherent stability could justify its adoption, also considering the broad spectrum and wide range of stakeholders of the current initiative. Respondents who viewed the co-programmed partnership as the most suitable model argued that its advantages are its flexibility and speed (quick to set up). Many respondents also wish to extend the current form of CPPP, given the good experience they had with it and create implementation synergies with other domains.

Many respondents agreed with the technical scope and highlighted the need to focus on mobile communications networks but also to include IoT, cloud, edge computing, and devices, AI and smart algorithms in order to enable novel applications. Several stakeholders also stressed the necessity to involve key vertical industries and recommended to take a comprehensive value chain approach. Other (isolated) propositions were to focus on SME's, or to focus less on connected/automated mobility and smart cities, but rather on fresh food or dangerous goods. With regard to prospective activities, some drew attention to climate change and protection of water resources.

INTERVIEWS REPORT FROM THE IA STUDY

30 stakeholders have been interviewed to support the impact assessment study work, with a large part of the interviewees having experience in EU research program. The objectives of the interviews were to better understand the different perspectives of the stakeholders on the problems to be addressed by the initiative, and to identify the desired objectives and features of a future initiative

The distribution of interviews showed a good balance between academia (23%), the telecom industry (34%), SMEs (17%), industry associations, including verticals, (16%) and representatives from Member States (10%).

Figure 2 - Number of interviews per stakeholder category

Stakeholder category	Number	Share (%)
Academics	7	23%
Telecommunication Equipment / Hardware / Software Providers	8	27%
Telecom Operators	2	7%
Networks, Telecommunications and Digital Services SMEs	5	17%
Other Telecom Representatives (Industry Association, Regulators, Think tanks, etc.)	1	3%
Representatives from Vertical Industries (companies and industrial associations)	4	13%
Representatives from Member States	3	10%
TOTAL	30	100%

The interview outcomes confirm the trends from the other consultation activities, including the strong need for a partnership.

With regard to the preferred form of partnership, the co-programmed partnership was clearly the preferred option. This appears to be linked to the existence of the 5G-PPP, which was successful in a form equivalent to a co-programmed partnership.

- *Option 0: Traditional calls*

Only two interviewees out of the 30 were in favour of traditional calls because of its greater flexibility. For other interviewees – e.g. representatives of vertical industries and representatives of Member States, this **option should be ruled out** because the proposed partnership is required to have an impact on the increasing global competition in the field of SNS. Also, according to the majority of interviewees, this option lacks coordination and engagement capabilities between all stakeholders and thus is not adapted to reach the required objectives.

- *Option 1: Co-programmed partnership*

A co-programmed partnership is **clearly the preferred option among the majority of the interviewees**. This option is especially backed by those already having experience in the 5G-PPP, and comes mainly from the following categories of stakeholders: telecom operators and telecom infrastructure providers. These stakeholders were satisfied with the good achievements of the currently existing 5G-PPP. Although these stakeholders agree on improving the partnership form, they put forward that there is "*no reason to change*" the structure at the "*risk of losing momentum*". Other categories of stakeholders – e.g. academia and SMEs, are also in favour of a co-programmed partnership but they are **also open to an institutionalized partnership**.

- *Option 2: Institutionalised partnership*

The **second preferred option by interviewees** is an institutionalised partnership. The advantages outlined by stakeholders during the interviews include: the ability to have all relevant players involved including Member States, Commission and the industrial partners, thus maximising cooperation and synergies. It is also seen as a reasonable option if Member States are needed", for the ability to engage in a long-term contract that is legally binding which would be a strong commitment for the implementation to reach scale and for the ability to reach higher ambition to face the global competition.

For other interviewees, the drawbacks for this option are related to its **organisation structure,** and can be summarized by the following points: doubts on the rules of governance; fear of being an organisation that is too cumbersome; too much overhead and heavy procedures; lack of agility; presence of the Member States that introduces political issues and delays. However, some interviewees would be in favour of an institutionalised partnership option without the Member States.

1.3.5. Conclusion

In summary, the consultation followed the original strategy leading to results that clearly indicates very good support for the SNS Partnership. Stakeholders have recognized the importance of a partnership approach in contributing to Europe's future connectivity infrastructure ecosystem across all value chains.

Overall, the evidence shows that, with a few exceptions, respondents agree on the (research and innovation, structure and resources, uptake of innovations) problems that a future partnership would need to address. Problems that were widely considered as relevant were:

- the innovation gap in the EU in translating the results of connectivity, cloud and Internet of Things devices research
- the limited collaboration and pooling of resources between public/private actors
- the understanding of or knowledge about next generation converged Digital Infrastructures.

The same conclusion can be drawn about the (societal, economic/technological and scientific) impacts where the prospective partnership should deliver on. Furthermore, the present analysis has also shown that respondents are generally satisfied with the proposed scope of the partnership – especially with regard to the range of activities and technologies covered.

On average, respondents were also in agreement about the partnership composition (=broad range of partners, flexibility over time), the joint long-term agenda and the pooling/ leveraging of resources (i.e. to involve industry, academia, Member states and associated countries).

The analysis did however reveal more differences with regard to the preferred type of partnership by stakeholders**.** The gathered results indicated a preference for either a co-programmed or an institutionalised partnership but many respondents also stressed that they lack clear knowledge of the administrative and legal implications to make a choice between the two partnership models.

Annex 3 Who is affected and how?

PRACTICAL IMPLICATIONS OF THE INITIATIVE

This annex describes the practical implications of the preferred option identified in the Impact Assessment – the establishment of an institutionalised partnership to implement R&I on Smart Networks and Services and to implement the CEF2 initiative related to deployment of 5G networks in Europe, as two complementary activities.

I. Overview of benefits (total for all provisions) – Preferred Option

Member States

The EU Member States will have at disposal an effective mechanism providing them with opportunities to leverage their national investments into SNS at European level, which will also help them to get return from this initiative. They will have an upstream capability to plan ahead the needed national measures to facilitate EU level deployment of technologies.

The initiative will enable Member States to create better synergies together with the Commission for their national investments in necessary SNS research and deployment at the national and European levels. The initiative will allow Member States to plan for pooling expertise as well as resources for tools and infrastructures which would otherwise be more costly or not affordable for individual Member States. Such approach would allow economies of scale and rationalisation. This planning capability is a major benefit of the preferred option, which could not be achieved through traditional Horizon Europe calls (baseline option).

The return from such investments would be also proportionally higher as the Member States would benefit from the access to upgraded capacities and facilities that may not be achieved through national efforts only.

The increased coherence and synergies between different funding mechanisms (Horizon Europe, CEF2) would also reduce the administrative burden of managing different funding programmes, with a positive impact on the efficiency of the EU budget to which Member State contribute.

The preferred option will also have a positive impact on the Member States' capability to deal with the wide range of issues related to downstream regulatory and deployment related issues. The functionalities of the initiative linked to the EU wide comprehensive R&I on SNS, will complement the efforts of the Member States initiatives by providing appropriate input to regulatory and policy makers. At the same time, the access for researchers to cutting-edge projects will help contain the "brain drain" phenomenon and increase the chances of retaining the best talents in the EU and attracting foreign highly skilled professionals.

Businesses

European firms from the networking, the cloud computing and the IoT sectors, alongside the companies active in vertical sectors (e.g. automotive, healthcare, media and energy), will profit the most from the partnership. This comprehensive supplier-user approach will stimulate cross industry synergies and innovative digital use cases, helping them to ensure that supplied technology actually cover the requirements of the user side. This should also help them cut

research and development costs and speed up the development process, which would further reinforce their competitiveness.

The chosen mechanism will ensure coordination between research and industry and therefore direct the research efforts towards concrete industrial needs. The provision of cutting-edge expertise and tools in SNS will indirectly support economic operators in complying with the future Internet regulatory environment.

In addition one of the key functionalities of the initiative is to support the deployment of European 5G leading-edge products and solutions across the market (transport paths).

SMEs

The European SMEs and micro-enterprises operating in the SNS field will experience direct and indirect economic benefits from the initiative as highlighted above. While the set-up of the SNS partnership does not impose regulatory obligations upon them, it will open up opportunities in terms of costs reduction for the design of new products and it will help them gaining easier access to the investors' community and attract the necessary funding to deploy marketable solutions at EU scale. In the case of SMEs and micro-enterprises the access to publically funded testing and experimentation facilities is even more important as they are lacking resources to either purchase or to travel outside their market (and often outside the EU) to find necessary infrastructure. It is also hoped that this initiative would open up new markets for European SMEs and micro-enterprises active in the field of SNS.

Research Community

Research and development organisations throughout the EU, both on the supply and usage side, will enjoy the benefits deriving from better coordination, resource pooling and increased availability of advanced methodologies and tools (such as testing and experimentation facilities). They will be able to achieve the critical mass to carry out projects of common interest with a longer-time, strategic perspective. In addition, the chosen mechanism will ensure coordination between research and industry and therefore direct the research efforts towards concrete industrial needs helping the process of turning the outcomes of the research into applicable and marketable solutions that could be then used by different industries and public authorities. The European dimension will help them to plan in advance for important exploitation such as standardisation spin off of R&I.

The hosting of several programmes under a common "umbrella", possible under traditional Horizon Europe calls, would also allow the research community to experience cross-fertilisation among the different stakeholder groups related to SNS and increase the visibility of the EU excellence in research on the global scene.

Citizens

Stronger European know-how in SNS should result in an overall higher level of societal impact directly beneficial to citizens in the Digital Single Market, e.g. in Internet of Things domains such as smart energy, medical devices, or connected automated vehicles. The initiative should result in an improved provision of products and services which reflect European values and are directly in line with European policies and regulations. Key citizen impacts like energy efficiency and reduction of carbon footprint of networked infrastructures, reduction in EMF radiations, better support of medical or automotive applications will positively impact citizens.

EU institutions, agencies and bodies

The EU institutions, agencies and bodies will benefit both from the outcome of the research and development and the procurement activities of the initiative, and from the access to state-of -the art methodologies and tools to perform their operations as effectively as possible. Cross links of the initiatives with other domains opens capabilities of synergies with multiple other bodies of EU relevance such as the European Space Agency, the KDT partnership, the cybersecurity partnership. It is also relevant as "one stop EU shop" for policy and regulatory settings such as the RSPG, BEREC, COCOM and the EU for a dealing with digitisation of industry at large.

II. Overview of direct and indirect costs – Preferred option[7]							
		Citizens/Consumers		Businesses		Administrations	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Management/ Administrative costs	Direct costs				€ 800.000 /year		€ 800.000 /year
	Indirect costs						
Personnel costs	Direct costs				€ 1.2 million /year 50% of 19 FTE		€ 1.2 million /year 50% of 19 FTE
	Indirect costs						
Coordination costs (or transaction costs)							
Budget expenditure/ investment costs							

[7] Estimation based on the average expenditures of the H2020 Joint Undertaking ECSELand on the estimation from the SNS industry taskforce ("Smart Networks and Services Partnership Proposal" document).

Annex 4 Analytical Methods

The methodology for each impact assessment is based on the Commission Better Regulation Guidelines[8] to evaluate and compare options with regards to their **efficiency, effectiveness and coherence**. This is complemented by integrating the **conditions and selection criteria for European Partnerships**, as well as requirements for setting up Institutionalised Partnerships.[9]

1. OVERVIEW OF THE METHODOLOGIES EMPLOYED

In terms of **methods and evidence used**, the set of impact assessments for all candidate Institutionalised European Partnerships draw on an external study covering all initiatives in parallel to ensure a high level of coherence and comparability of analysis [10] (Technopolis Group, 2020).

All impact assessment mobilised a mix of qualitative and quantitative data collection and analysis methods. These methods range from desk research and interviews to the analysis of the responses to the Open Consultation, stakeholder analysis and composition/portfolio analysis, bibliometrics/patent analysis and social network analysis, and a cost-effectiveness analysis.

The first step in the impact assessment studies consisted in the definition of the context and the problems that the candidate partnerships are expected to solve in the medium term or long run. The main data source in this respect was desk research. This includes grey and academic literature to identify the main challenges in the scientific and technologic fields and in the economic sectors relevant for the candidate partnerships, as well as the review of official documentations on the policy context for each initiative.

In the assessment of the problems to address, the lessons to be learned from past and ongoing partnerships were taken into account, especially from relevant midterm or ex-post evaluations.

The description of the context of the candidate institutionalised European Partnerships required a good understanding of the corresponding research and innovation systems and their outputs already measured. Data on past and ongoing Horizon 2020 projects, including the ones implemented through Partnerships, served as basis for descriptive statistic of the numbers of projects and their respective levels of funding, the type of organisations participating (e.g. universities, RTOs, large enterprises, SMEs, public administrations, NGOs, etc.) and how the funding was distributed across them. Special attention was given to analysing the participating countries (and groups of countries, such as EU, Associated Countries, EU13 or EU15) and industrial sectors, where relevant. The sectoral analysis required enriching the eCORDA data received from the European Commission services with sector information extracted from ORBIS, using the NACE codification up to level 2. These data enabled the identification of the main and, where possible, emerging actors in the relevant systems, i.e. the organisations, countries and sectors that would need to be involved (further) in a new initiative.

[8] European Commission (2017), Better Regulation Guidelines (SWD (2017) 350)

[9] A pivotal element of the present analysis is the so-called two-step 'necessity test' for European Partnerships, used to establish: step 1) the need for a partnership approach in the first place, followed by step 2) a justification for the form of Institutionalised Partnership. The necessity test is described in Annex 6. This impact assessment focuses on the second step of the test.

[10] Technopolis Group (2020), Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe

A Social Network Analysis was performed by the contractors using the same data. It consisted in mapping the collaboration between the participants in the projects funded under the ongoing R&I partnerships. This analysis revealed which actors – broken down per type of stakeholders or per industrial sector – collaborate the most often together, and those that are therefore the most central to the relevant research and innovation systems.

The data provided finally served a bibliometric analysis run by the contractor aimed at measuring the outputs (patents and scientific publications) of the currently EU-funded research and innovation projects. A complementary analysis of the Scopus data enabled to determine the position and excellence of the European Union on the international scene, and identify who its main competitors are, and whether the European research and innovation is leading, following or lagging behind.

A cost modelling exercise was performed in order to feed into the efficiency assessments of the partnership options.

The conclusions drawn from the data analysis were confronted to the views of experts and stakeholders collected via three means:

- The comments to the inception impact assessments of the individual candidate institutionalised European Partnerships;
- The open public consultation organised by the European Commission from September to November 2019;
- The interviews (up to 50) conducted by each impact assessment study team conducted between August 2019 and January 2020 (policymakers, business including SMEs and business associations, research institutes and universities, and civil organisations, among others).

The views of stakeholders (and experts) were particularly important for determining the basic functionalities (see further below) that the future partnerships need to demonstrate to achieve their objectives as well as their most anticipated scientific, economic and technological, and societal impacts. The interviews allowed more flexibility to ask the respondents to reflect about the different types of European Partnerships. Furthermore, as a method for targeted consultation, it was used to get insights from the actors that both the Study Teams and the European Commission were deemed the most relevant. For the comparative assessment of impacts, the external contractors confronted the outcomes of the different stakeholder consultation exercises to each other with a view of increasing the validity of their conclusions, in line with the principles of triangulation.

Annex 2 includes also the main outcomes of the stakeholder consultation exercises.

2. METHOD FOR ASSESSING THE EFFECTIVENESS, EFFICIENCY AND COHERENCE OF EACH OPTION - THE USE OF FUNCTIONALITIES

Given the focus of the impact assessment on comparing different forms of implementation, the Better Regulation framework has been adapted to introduce "**key functionalities needed**" – so as to link the intended objectives of the candidate European Partnerships and what would be crucial

to achieve them *in terms of implementation*. The identification of "key functionalities needed" for each initiative as an additional step in the impact assessment is based on the distinguishing factors between the different options (see Section 2.2.1 in the main body of the impact assessment). In practical terms, each option is assessed on the basis of the degree to which it would allow for the key needed functionalities to be covered, as regards e.g. the type and composition of actors that can be involved ('openness'), the range of activities that can be performed (including additionality and level of integration), the level of directionality and integration of R&I strategies; the possibilities offered for coherence and synergies with other components of Horizon Europe, including other Partnerships (internal coherence), and the coherence with the wider policy environments, including with the relevant regulatory and standardisation framework (external coherence). This approach guides the identification of discarded options. It also allows for a structured comparison of the options as regards their effectiveness, efficiency and coherence, and also against a set of other key selection criteria for European Partnerships (openness, transparency, directionality)[11].

Figure 3 Overview of key functionalities of each form of implementation of European Partnerships

Baseline: Horizon Europe calls	**Option 1: Co-programmed**	**Option 2: Co-funded**	**Option 3.1: Institutionalised Article 185**	**Option 3.2: Institutionalised Article 187**
Type and composition of actors (including openness and roles)				
Partners: N.A., no common set of actors that engage in planning and implementation Priority setting: open to all, part of Horizon Europe Strategic planning Participation in R&I activities: fully open in line with standard Horizon Europe rules	Partners: Suitable for all types: private and/or public partners, foundations Priority setting: Driven by partners, open stakeholder consultation, MS in comitology Participation in R&I activities: fully open in line with standard Horizon Europe rules	Partners: core of national funding bodies or govern-mental research organisations Priority setting: Driven by partners, open stakeholder consultation Participation in R&I activities: limited, according to national rules of partner countries	Partners: National funding bodies or governmental research organisation Priority setting: Driven by partners, open stakeholder consultation Participation in R&I activities: fully open in line with standard Horizon Europe rules, but possible derogations	Partners: Suitable for all types: private and/or public partners, foundations Priority setting: Driven by partners, open stakeholder consultation Participation in R&I activities: fully open in line with standard Horizon Europe rules, but possible derogations
Type and range of activities (including additionality and level of integration)				
Activities: Horizon Europe standards that allow broad range of	Activities: Horizon Europe standard actions that allow broad range of	Activities: Broad, according to rules/programmes of	Activities: Horizon Europe standards that allow broad range of individual	Activities: Horizon Europe standards that allow broad range of

[11] The criterion on the ex-ante demonstration of partners' long term commitment depends on a series of factors that are unknown at this stage, and thus fall outside the scope of the analysis.

Baseline: Horizon Europe calls	Option 1: Co-programmed	Option 2: Co-funded	Option 3.1: Institutionalised Article 185	Option 3.2: Institutionalised Article 187
individual actions Additionality: no additional activities and investments outside the funded projects Limitations: No systemic approach beyond individual actions	individual actions, support to market, regulatory or policy/ societal uptake Additionality: Activities/investments of partners, National funding Limitations: Limited systemic approach beyond individual actions.	participating States, State-aid rules, support to regulatory or policy/ societal uptake Additionality: National funding Limitations: Scale and scope depend on the participating programmes, often smaller in scale	actions, support to regulatory or policy/societal uptake, possibility to systemic approach Additionality: National funding	individual actions, support to regulatory or policy/societal uptake, possibility to systemic approach (portfolios of projects, scaling up of results, synergies with other funds. Additionality: Activities/investments of partners/ national funding
Directionality				
Priority setting: Strategic Plan and annual work programmes, covering max. 4 years. Limitations: Fully taking into account existing or to be developed SRIA/ roadmap	Priority setting: Strategic R&I agenda/ roadmap agreed between partners and COM, covering usually 7 years, including allocation of Union contribution Input to FP annual work programme drafted by partners, finalised by COM (comitology) Objectives and commitments are set in the contractual arrangement.	Priority setting: Strategic R&I agenda/ roadmap agreed between partners and COM, covering usually 7 years, including allocation of Union contribution Annual work programme drafted by partners, approved by COM Objectives and commitments are set in the Grant Agreement.	Priority setting: Strategic R&I agenda/ roadmap agreed between partners and COM, covering usually 7 years, including allocation of Union contribution Annual work programme drafted by partners, approved by COM Objectives and commitments are set in the legal base.	Priority setting: Strategic R&I agenda/ roadmap agreed between partners and COM, covering usually 7 years, including allocation of Union contribution Annual work programme drafted by partners, approved by COM (veto-right in governance) Objectives and commitments are set in the legal base.
Coherence: internal (Horizon Europe) and external (other Union programmes, national programmes, industrial strategies)				
Internal: Between	Internal: Coherence among	Internal: Coherence	Internal: Coherence among	Internal: Coherence

Baseline: Horizon Europe calls	Option 1: Co-programmed	Option 2: Co-funded	Option 3.1: Institutionalised Article 185	Option 3.2: Institutionalised Article 187
different parts of the Annual Work programme can be ensured by COM External: Limited for other Union programmes, no synergies with national/regional programmes and activities	partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and COM External: Limited synergies with other Union programmes and industrial strategies If MS participate, with national/ regional programmes and activities	among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and COM External: Synergies with national/ regional programmes and activities	partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and COM External: Synergies with national/ regional programmes and activities	among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and COM External: Synergies with other Union programmes and industrial strategies If MS participate, with national/ regional programmes and activities

In line with the Better Regulation Framework, the assessment of the effectiveness, efficiency and coherence of each option is made in comparison to the baseline. Therefore, for each of the above criteria, the performance of using traditional calls under Horizon Europe is first estimated and scored 0 to serve as a reference point. When relevant, this estimation also includes the costs/benefits of discontinuing existing implementation structures. The policy options are then scored compared to the baseline with a + and – system along a two-point scale, to indicate limited (+ or -) or high (++ or --) additional/lower performance compared to the baseline. When a policy option is scored 0, this means that its impact is expected to be roughly equal to the baseline option.

On the basis of the evidence collected, the intervention logic of each initiative and the key functionalities needed, the impact assessments first evaluate the **effectiveness** of the various policy options to deliver on their objectives. To be in line with the Horizon Europe impact framework, the fulfilment of the specific objectives of the initiative is translated into 'expected impacts' - how success would look like -, differentiating between scientific, economic/ technological, and societal (including environmental) impacts. Each impact assessment considers to which extent the different policy options provides the 'key functionalities needed' to achieve the intended objectives. The effectiveness assessment does not use a compound score but shows

how the options would deliver on the different types of expected impacts. This is done to increase transparency and accuracy in the assessment of options[12].

A similar approach is followed to evaluate the coherence of options with the overarching objectives of the EU's R&I policy, and distinguishes between **internal** and **external coherence**. Specifically, internal coherence covers the consistency of the activities that could be implemented with the rest of Horizon Europe, including European Partnerships (any type). External coherence refers to the potential for synergies and/or complementarities (including risks of overlaps/gaps) of the initiative with its external environment, including with other programmes under the MFF 2021-27, but also the framework conditions at European, national or regional level (incl. regulatory aspects, standardisation).

To compare the expected costs and benefits of each option (**efficiency**), the thematic impact assessments broadly follow a cost-effectiveness approach[13] to establish to which extent the intended objectives can be achieved for a given cost. A preliminary step in this process is to obtain a measure of the expected costs of the policy options, to be used in the thematic assessments. As the options correspond to different implementation modes, relevant cost categories generally include the costs of setting-up and running an initiative. For instance, set-up costs includes items such as the preparation of a European Partnership proposal and the preparation of an implementation structure. The running costs include the annual work programme preparation costs. Where a Partnership already exists, discontinuation costs and cost-savings are also taken into account[14]. The table below provides an overview of the cost categories used in the impact assessment and a qualitative scoring of their intensity when compared to the baseline option (traditional calls). Providing a monetised value for these average static costs would have been misleading, because of the different features and needs of each candidate initiative.[15] The table shows the overall administrative, operational and coordination costs of the various options. These costs are then put into context in the impact assessments to reflect the expected co-financing rates and the total budget available for each of the policy options, assuming a common Union contribution (cost-efficiency):

- The costs related to the baseline scenario (traditional calls under Horizon Europe) are predominantly the costs of implementing the respective Union contribution via calls and project, managed by the executive agencies (around 4%, efficiency of 96% for the overall investment).
- For a Co-Programmed partnership the costs of preparation and implementation increase only marginally compared to the baseline (<1%),[16] but lead to an additional R&I

[12] In the thematic impact assessments, scores are justified in a detailed manner to avoid arbitrariness and spurious accuracy. A qualitative or even quantitative explanation is provided of why certain scores were given to specific impacts, and why one option scores better or worse than others.

[13] For further details, see Better Regulation Toolbox # 57.

[14] Discontinuation costs will bear winding down and social discontinuation costs and vary depending on e.g. the number of full-time-equivalent (FTEs) staff concerned, the type of contract (staff category and duration) and applicable rules on termination (e.g. contracts under Belgian law or other). If buildings are being rented, the cost of rental termination also apply. As rental contracts are normally tied to the expected duration of the current initiatives, these termination costs are likely to be very limited. In parallel, there would also be financial cost-savings related to the closing of the structure, related to operations, staff and coordination costs in particular. This is developed further in the individual efficiency assessments.

[15] A complete presentation of the methodology developed to assess costs as well as the sources used is described in the external study supporting this impact assessment (Technopolis Group, 2020).

[16] Specifically, some additional set-up costs linked for example to the creation of a strategic research and innovation agenda (SRIA) and additional running costs linked with the partners role in the creation of the annual work programmes and the Commission's additional supervisory responsibilities. A CPP will have lower overall costs than each of the other types of European Partnership, as it will function with a smaller governance and implementation

investment of at least the same amount than the Union contribution[17] (efficiency of 98% for the overall investment).

- For a Co-Funded partnership the additional R&I investment by Member States accounts for 2,3 times the Union contribution[18]. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the national programmes, can be estimated at 6% of the Union contribution (efficiency of 98% related to the overall investment).[19]
- For an Article 185 initiative the additional R&I investment by Member States is equal to the Union contribution[20]. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the dedicated implementation structure, can be estimated at 7% of the Union contribution (efficiency of 96% related to the overall investment).
- For an Article 187 initiative the additional R&I investment by partners is equal to the Union contribution[21]. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the dedicated implementation structure, can be estimated at 9% of the Union contribution (efficiency of 94% related to the overall investment).

Figure 4 - Intensity of additional costs compared with Horizon Europe Calls (for Partners, stakeholders, public and EU)

Cost items	Baseline: traditional calls	Option 1: Co-programmed	Option 2 Co-funded	Option 3a - Art. 185	Option 3b -Art. 187
Preparation and set-up costs					
Preparation of a partnership proposal (partners and EC)	0	↑↑			
Set-up of a dedicated implementation structure	0			Existing: ↑ New: ↑↑	Existing: ↑↑ New: ↑↑↑
Preparation of the SRIA / roadmap	0	↑↑			
Ex-ante Impact Assessment for partnership	0			↑↑↑	
Preparation of EC proposal and negotiation	0			↑↑↑	
Running costs (Annual cycle of implementation)					
Annual Work Programme preparation	0	↑			
Call and project implementation	0	0 In case of MS contributions: ↑	↑	↑	↑
Cost to applicants	Comparable, unless there are strong arguments of major differences in oversubscription				
Partners costs not covered by the above	0	↑	0	↑	↑
Additional EC costs (e.g. supervision)	0	↑	↑	↑	↑↑
Winding down costs					
EC	0				↑↑↑

structure than will be required for a Co-Funded Partnership or an Institutionalised Partnership and – related to this – its calls will be operated through the existing HEU agencies and RDI infrastructure and systems.

[17] Minimum contributions from partners equal to the Union contribution.
[18] Based on the default funding rate for programme co-fund actions of 30%, partners contribute with 70% of the total investment.
[19] These costs reflect set-up costs and additional running costs for partners, and the Commission, of the distributed, multi-agency implementation model.

[20] Based on the minimum requirement in the legal basis that partners contribute at least 50% of the budget.
[21] Based on the minimum requirement in the legal basis that partners contribute at least 50% of the budget.

Cost items	Baseline: traditional calls	Option 1: Co-programmed	Option 2 Co-funded	Option 3a - Art. 185	Option 3b -Art. 187
Partners	0	↑	0	↑	↑

Notes: 0: no additional costs, as compared with the baseline; ↑: minor additional costs, as compared with the baseline; ↑↑: medium additional costs, as compared with the baseline; ↑↑↑: higher costs, as compared with the baseline.

The cost categories estimated for the common model are then used to develop a scorecard analysis and further refine the assessment of options for each of the 12 candidate Institutionalised Partnerships. Specifically, the scores related to the set-up and implementation costs are used in the thematic impact assessments to consider the scale of the expected benefits and thereby allow a simple "value for money" analysis (**cost-effectiveness**). In carrying out the scoring of options, the results of fieldwork, desk research and stakeholder consultation undertaken and taken into account.

3. METHOD FOR IDENTIFYING THE PREFERRED OPTION – THE SCORECARD ANALYSIS

For the **identification of the preferred option,** a scorecard analysis is used to build a hierarchy of the options by individual criterion and overall in order to identify a single preferred policy option or in case of an inconclusive comparison of options, a number of 'retained' options or hybrid. This exercise supports the systematic appraisal of alternative options across multiple types of monetary, non-monetary and qualitative dimensions. It also allows for easy visualisation of the pros and cons of each option. Each option is attributed a score of the adjudged performance against each criterion with the three broad appraisal dimensions of effectiveness, efficiency and coherence.

This scorecard approach also relies on a standard cost model developed for the external study supporting the impact assessment, as illustrated in Figure 5. . Specifically, the scores related to the set-up and implementation costs are used in the thematic impact assessments to consider the scale of the expected benefits and thereby allow a simple "value for money" analysis (**cost-effectiveness**). In carrying out the scoring of options, the results of fieldwork, desk research and stakeholder consultation undertaken and taken into account.

These costs essentially refer to the administrative, operational and coordination costs of the various options. The figure shows how the scoring of costs range from a value of 0, in case an option does not entail any additional costs compared to the baseline (traditional calls), to a score of (-) for options introducing limited additional costs relative to the baseline and a score of (- -) when substantial additional costs are expected in comparison with the baseline. Should the costs of a policy option be lower than those of the baseline, (+) and (+ +) are used.

It is considered that while there is a clear gradation in the overall costs of the policy options, the cost differentials are less marked when one takes into account the expected co-financing rates and the total budget available for each of the policy options, assuming a common Union contribution. From this perspective, there are only one or two percentage points that split the most cost-efficient policy options – the baseline (traditional calls) and the Co-Programmed policy options – and the least cost-efficient – the Institutionalised Partnership option. A score of + is therefore assigned for **cost-efficiency** to the Co-Programmed and Co-Funded options, a score of 0 to the

Article 185 option and a score of (-) for the Article 187 Institutionalised Partnership policy option[22].

Figure 5: Matrix on 'overall costs' and 'adjusted cost scoring'

	Baseline: Horizon Europe calls	Option 1: Co-programmed	Option 2: Co-funded	Option 3a: Institutionalised 185	Option 3b: Institutionalised 187
Administrative, operational and coordination costs	0	(0)	(-)	(- -)	(- -)
Administrative, operational and coordination costs adjusted per expected co-funding (i.e. *cost-efficiency*)	0	(+)	(+)	(0)	(-)

Notes: Score 0 = same costs as for the baseline; score (-) = limited additional costs compared to baseline; score (- -) = substantial additional costs compared to baseline. ; score (+) = lower costs compared to baseline

Figure 5: Matrix on 'overall costs' and 'adjusted cost scoring'

	Baseline: Horizon Europe calls	Option 1: Co-programmed	Option 2: Co-funded	Option 3: Institutionalised
Administrative, operational and coordination costs	0	(-)	(- -)	(- -)
Administrative, operational and coordination costs adjusted per expected co-funding (i.e. *cost-efficiency*)	0	0	(-)	(-)

Notes: Score 0 = same costs as for the baseline; score (-) = limited additional costs compared to baseline; score (- -) = substantial additional costs compared to baseline.

The **baseline (regular calls)** has the lowest administrative, operational and coordination costs. This is based on two facts: firstly, that Horizon Europe traditional calls will not entail any additional one-off costs to be set up or discontinued at the end, where each of the other policy options will require at least some additional set-up and phasing out costs; and secondly, that Horizon Europe will not require any additional running costs, where each of the other policy options will involve additional efforts by the Commission and partners in the carrying out of necessary additional tasks (e.g. preparing annual work programmes).

A **co-programmed partnership** (Option 1 - CPP) will entail slightly higher overall costs as compared with the baseline. There will be some additional set-up costs linked for example with the creation of a strategic research and innovation agenda (SRIA) and additional running costs linked with the partners role in the creation of the annual work programmes and the Commission's additional supervisory responsibilities. A CPP will have lower overall costs than each of the other types of European Partnership, as it will function with a smaller governance and implementation structure than will be required for a Co-Funded Partnership or an Institutionalised Partnership and – related to this – its calls will be operated through the existing HEU agencies and RDI infrastructure and systems.

[22] The baseline (traditional calls) is scored 0, as explained above.

The **Co-Funded Partnership (**Option 2 – CFP) has been **scored (- -)** on overall cost. This reflects the additional set-up costs of this policy option and the substantial additional running costs for partners, and the Commission, of the distributed, multi-agency implementation model.

The **Institutionalised Partnership** (Option 3 - IP) has been **scored (- -)** on overall cost. This reflects the substantial additional set-up costs of this policy option – and in particular the high costs associated with preparing the Commission proposal and negotiating that through to a legal document – and the substantial additional running costs for the Commission associated with the supervision of this dedicated implementation model.

It is considered that while there is a clear gradation in the overall costs of the policy options, the cost differentials are less marked when one takes into account the expected co-financing rates and the total budget available for each of the policy options, assuming a common Union contribution. From this perspective, there are only one or two percentage points that split the most cost-efficient policy options – the baseline (traditional calls) and the Co-Programmed policy options – and the least cost-efficient – the Institutionalised Partnership option. A score of 0 is therefore assigned for **cost-efficiency** to the Co-Programmed option and a score of (-) for the Co-Funded and the Institutionalised Partnership policy options[23].

[23] The baseline (traditional calls) is scored 0, as explained above.

Annex 5 Subsidiarity Grid

1. Can the Union act? What is the legal basis and competence of the Unions' intended action?
1.1 Which article(s) of the Treaty are used to support the legislative proposal or policy initiative?
This proposal is based on (1) Article 185 TFEU which stipulates that in implementing the multiannual framework programme, the Union may make provision, in agreement with the Member States concerned, for participation in research and development programmes undertaken by several Member States, including participation in the structures created for the execution of those programmes; and (2) Article 187 TFEU according to which the Union may set up joint undertakings or any other structure necessary for the efficient execution of Union research, technological development and demonstration programmes (both Articles are under Title XIX of the TFEU - Research and Technological Development and Space). The proposal aims to implement Article 8 of the Commission proposal for Horizon Europe - the future EU research and innovation (R&I) programme for 2021-2027, according to which, "*European Partnerships shall be established for addressing European or global challenges only in cases where they will more effectively achieve objectives of Horizon Europe than the Union alone and when compared to other forms of support of the Framework programme*". The Horizon Europe proposal has received the political agreement of the Council and the European Parliament.
1.2 Is the Union competence represented by this Treaty article exclusive, shared or supporting in nature?
Research is a shared competence between the EU and its Member States according to the TFEU. Article 4 (3) specifies that in the areas of research, technological development and space, the European Union can carry out specific activities, including defining and implementing programmes, without prejudice to the Member States' freedom to act in the same areas.
Subsidiarity does not apply for policy areas where the Union has ***exclusive*** *competence as defined in Article 3 TFEU[24]. It is the specific legal basis which determines whether the proposal falls under the subsidiarity control mechanism. Article 4 TFEU[25] sets out the areas where competence is shared between the Union and the Member States. Article 6 TFEU[26] sets out the areas for which the Unions has competence only to support the actions of the Member States.*

[24] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:12008E003&from=EN
[25] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:12008E004&from=EN
[26] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:12008E006:EN:HTML

2. Subsidiarity Principle: Why should the EU act?

2.1 Does the proposal fulfil the procedural requirements of Protocol No. 2[27]:

- Has there been a wide consultation before proposing the act?
- Is there a detailed statement with qualitative and, where possible, quantitative indicators allowing an appraisal of whether the action can best be achieved at Union level?

This proposal and the accompanying impact assessment were supported by a wide consultation of stakeholders, both during the preparation of the Horizon Europe proposal and - later on, all the candidates for European Partnerships. Member States were consulted via the Shadow Strategic configuration of the Horizon Europe Programme Committee. On candidates for institutionalised Partnerships based on Article 185/187 of the TFEU, an Open Public Consultation (OPC) was held between 11 September and 6 November 2019. Over 1 600 replies were received. In addition, targeted consultation activities were undertaken to prepare the present impact assessment. In particular, for each of the candidate partnerships, an external consultant interviewed a representative sample of stakeholders. The need for EU action as well as its added value were covered in those interviews.

The explanatory memorandum and the impact assessment (horizontal part, Section 3) contain a dedicated section on the principle of subsidiarity, as explained in question 2.2 below.

2.2 Does the explanatory memorandum (and any impact assessment) accompanying the Commission's proposal contain an adequate justification regarding the conformity with the principle of subsidiarity?

The impact assessment accompanying the proposal features a horizontal part on relevant common elements to all the candidate partnerships, including the conformity of the proposed initiative with the principle of subsidiarity (Section 3). Moreover, the individual assessments of each candidate partnership include additional details on subsidiarity, touching in particular on the specificities of a candidate partnership that could not be adequately reflected in the horizontal part of the impact assessment. This will also be reflected in the explanatory memorandum.

2.3 Based on the answers to the questions below, can the objectives of the proposed action be achieved sufficiently by the Member States acting alone (necessity for EU action)?

National action alone cannot achieve the scale, speed and scope of support to R&I needed for the EU to meet its long-term Treaty objectives, to deliver on the EU's strategic policy priorities (including the climate and energy goals set out in the Paris Agreement, and the European Green Deal), and to contribute to tackling global challenges and meeting the

[27] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:12016E/PRO/02&from=EN

Sustainable Development Goals (SDGs).
(a) Are there significant/appreciable transnational/cross-border aspects to the problems being tackled? Have these been quantified?
The thematic areas covered by the candidate partnerships feature a series of challenges in terms of cross-border/transnational aspects, need to pool resources, need for a critical mass to meet intended policy objectives, need to coordinate different types of actors (e.g. academia, industry, national and regional authorities) across different sectors of the economy and society, which cannot be tackled to the same degree by Member States alone. This is particularly true for the research and innovation (R&I) dimension of the proposed initiative: the importance of a multi-centre and interdisciplinary approach, cross-country data collection and research, and the need to develop and share new knowledge in a timely and coordinated manner to avoid duplication of efforts are key to achieve high quality results and impact. The Interim Evaluation of Horizon 2020 and the impact assessment of Horizon Europe provide extensive qualitative and quantitative evidence on the above points. In addition, Sections 1 and 2 of the individual impact assessments on the candidate partnerships include more detail on the necessity to act at EU-level in specific thematic areas. Finally, it is worth noting that not all Member States have the same capacity or R&I intensity to act on these challenges. As the desired policy objectives can be fully achieved only if the intended benefits are widespread across the Member States, this requires action at the EU-level.
(b) Would national action or the absence of the EU level action conflict with core objectives of the Treaty[28] or significantly damage the interests of other Member States?
As per Article 4(3) TFEU, national action does not conflict with core objectives of the Treaty in the area of R&I. The absence of EU level action in this area would however prevent the achievement of core objectives of the Treaty. Indeed, national action alone cannot achieve the scale, speed and scope of support to R&I needed for the EU to meet its long-term Treaty objectives on e.g. competitiveness, to deliver on the EU's strategic policy priorities, and to contribute to tackling global challenges and meet the Sustainable Development Goals (SDGs).
(c) To what extent do Member States have the ability or possibility to enact appropriate measures?
As foreseen by Article 4(3) TFEU, this proposal does not hamper Member States' ability to enact appropriate measures in the field of R&I. However, the scale and complexity of the policy objectives pursued by the present initiative cannot be fully addressed by acting at national level alone.
(d) How does the problem and its causes (e.g. negative externalities, spill-over effects)

[28] https://europa.eu/european-union/about-eu/eu-in-brief_en

vary across the national, regional and local levels of the EU?
As described in the horizontal part of the impact assessment accompanying the present proposal, several problems (e.g. on competitiveness, global challenges, demographic change) and their underlying causes affect the EU as a whole rather than individual Member States. Where important differences between Member States are present, these are described in Sections 1 and 2 of the individual impact assessments.
(e) Is the problem widespread across the EU or limited to a few Member States?
The problem of coordinating R&I efforts in the thematic areas covered by the candidate partnerships affects all Member States, albeit to different degrees. However, from a general EU perspective, available evidence shows that the EU as a whole needs to step up efforts and investments in thematic areas that are crucial to tackle present and future policy challenges on several fronts, e.g. ageing population, global technological trends, and climate change to name a few. The way these problems affect the EU and its Member States is described in the horizontal part of the impact assessment and in Sections 1 and 2 of the individual impact assessments.
(f) Are Member States overstretched in achieving the objectives of the planned measure?
As indicated in the horizontal part of the impact assessment and in Sections 1 and 2 of the individual assessments, the sheer scale, speed and scope of the needed support to R&I would overstretch national resources, without guaranteeing the achievement of the intended objectives. Acting at EU-level would achieve greater impact in a more effective and efficient manner.
(g) How do the views/preferred courses of action of national, regional and local authorities differ across the EU?
No specific differences between the views of national, regional and local authorities emerged from the stakeholder consultation.
2.4 Based on the answer to the questions below, can the objectives of the proposed action be better achieved at Union level by reason of scale or effects of that action (EU added value)?
EU funded R&I activities, including those covered by the present proposal, produce demonstrable benefits compared to the corresponding national and regional initiatives, due to the scale, speed and scope achievable by acting at the EU level. In addition, the proposed initiatives should be seen as complementary and reinforcing national and sub-national initiatives in the same area.

(a) Are there clear benefits from EU level action?
Quantitative and qualitative evidence of the benefits of EU level action are available in the interim evaluation of Horizon 2020 and in the impact assessment of Horizon Europe, among others. An analysis of the emerging challenges in each thematic areas, of the EU's competitive positioning, as well as feedback gathered from different types of stakeholders for the present impact assessment indicate that EU level action remains appropriate also for the present proposal. In addition, the benefits of acting at EU-level have been illustrated by the success and the impact achieved by the predecessors to the proposed initiative.
(b) Are there economies of scale? Can the objectives be met more efficiently at EU level (larger benefits per unit cost)? Will the functioning of the internal market be improved?
EU funded R&I activities, including those covered by the present proposal, produce demonstrable benefits compared to the corresponding national and regional initiatives, due to the scale, speed and scope achievable by acting at the EU level. This is the case both in terms of effectiveness in achieving intended policy objectives, but also in terms of efficiency. Positive impact is also visible in terms of competitiveness: recent data on EU funded R&I activities indicate that EU-funded teams grow 11.8% faster and are around 40% more likely to be granted patents or produce patents applications than non-EU funded teams. Efficiency gains are also visible in terms of dissemination of results to users beyond national borders, including SMEs and citizens. EU funded R&I is more effective in leveraging private investment. Finally, there are clear additionality benefits (i.e. EU R&I funding does not displace or replace national funding), as the EU focuses on projects that are unlikely to be funded at national or regional level. Overall, this is beneficial to the functioning of the internal market in several respects, including human capital reinforcement through mobility and training, the removal of barriers to cross-border activity for economic players including SMEs, easier access to finance and to relevant knowledge and research, and increased competition in the area of R&I.
(c) What are the benefits in replacing different national policies and rules with a more homogenous policy approach?
A homogeneous policy approach in the various thematic areas covered by the present proposal would reduce fragmentation and increase efficiency and effectiveness in meeting the intended policy objectives. Indeed fragmentation, persisting barriers in the internal market and differences in the resources available to Member States are some of the key problems that stand in the way of fully achieving the intended policy objectives and reaching the required critical mass to obtain tangible results. Specific detail on how these issues differ in each thematic area are illustrated in Sections 1 and 2 of the individual impact assessments, so as to reflect the specificities of each case.
(d) Do the benefits of EU-level action outweigh the loss of competence of the Member States and the local and regional authorities (beyond the costs and benefits of acting at

national, regional and local levels)?

The proposed initiative does not lead to a loss of competence of the Member States. In fact, the proposed initiative should be seen as complementary and reinforcing national and sub-national initiatives in the same area. Previous quantitative and qualitative assessments of Horizon Europe and Horizon 2020 have shown that the proposed EU-level action do not displace national ones and tend to concentrate on initiatives that would not have been funded by the Member States themselves, or would not have reached the same scale and ambition without EU-level intervention, due to their complexity and trans-national nature.

(e) Will there be improved legal clarity for those having to implement the legislation?

Yes. The proposed initiatives will be implemented in line with the Horizon Europe single set of rules for participation; this will ensure increased clarity and legal certainty for end beneficiaries, other stakeholders and programme administrators. It will also reduce the administrative burden for beneficiaries, and for the Commission services. In addition, the accessibility and attractiveness of the broader Horizon Europe programme, in particular for applicants with limited resources, would be sustained.

3. Proportionality: How the EU should act

3.1 Does the explanatory memorandum (and any impact assessment) accompanying the Commission's proposal contain an adequate justification regarding the proportionality of the proposal and a statement allowing appraisal of the compliance of the proposal with the principle of proportionality?

The principle of proportionality underpins the entire analysis of the candidate partnerships. Specifically, the analysis included in the accompanying impact assessment is structured along the following logic: 1. Justification of the use of a partnership approach in a given area (including considerations on additionality, directionality, link with strategic priorities) instead of other forms of intervention available under Horizon Europe; 2. If the partnership approach is deemed appropriate, proportionality considerations guide the assessment of which type of partnership intervention (collaborative calls, co-programmed, co-funded or institutionalised partnership) is most effective in achieving the objectives. This will also be reflected in the explanatory memorandum.

3.2 Based on the answers to the questions below and information available from any impact assessment, the explanatory memorandum or other sources, is the proposed action an appropriate way to achieve the intended objectives?

The proposed initiative only focuses on areas where there is a demonstrable advantage in acting at the EU-level due to the scale, speed and scope of the efforts needed for the EU to meet its long-term Treaty objectives and deliver on its strategic policy priorities and commitments. In addition, the present proposal leaves full freedom to the Member States to

pursue their own actions in the policy areas concerned. This will also be reflected in the explanatory memorandum.
(a) Is the initiative limited to those aspects that Member States cannot achieve satisfactorily on their own, and where the Union can do better?
The proposed initiative only focuses on areas where there is a demonstrable advantage in acting at the EU-level due to the scale, speed and scope of the efforts needed for the EU to meet its long-term Treaty objectives and deliver on its strategic policy priorities and commitments.
(b) Is the form of Union action (choice of instrument) justified, as simple as possible, and coherent with the satisfactory achievement of, and ensuring compliance with the objectives pursued (e.g. choice between regulation, (framework) directive, recommendation, or alternative regulatory methods such as co-legislation, etc.)?
For each of the candidate partnerships, the analysis carried out in the accompanying impact assessment has explored several options for implementation. A comparative assessment of the merits of each option also included an analysis of the simplicity of the intervention, its proportionality and effectiveness in achieving the intended objectives. This is reflected in the fact that a tailored approach has been suggested for each candidate partnership, ranging from looser forms of cooperation to more institutionalised ones, depending on the intended policy objectives, specific challenges, and desired outcome identified in each case.
(c) Does the Union action leave as much scope for national decision as possible while achieving satisfactorily the objectives set? (e.g. is it possible to limit the European action to minimum standards or use a less stringent policy instrument or approach?)
The proposed approach leaves full freedom to the Member States to pursue their own actions in the policy areas covered by the present proposal.
(d) Does the initiative create financial or administrative cost for the Union, national governments, regional or local authorities, economic operators or citizens? Are these costs commensurate with the objective to be achieved?
The proposed initiatives do create financial and administrative costs for the Union, national governments and, depending on the chosen mode of implementation, for regional and local authorities. In addition, economic operators and other stakeholders potentially involved in the candidate partnerships will also incur some costs linked to implementation. The financial cost of the proposed initiative is covered under the Horizon Europe programme. Its exact amount is still subject to political decision. As regards the candidate partnerships and the different modes of implementation (co-programmed, co-funded, institutionalised), the relevant costs and benefits are assessed in the individual impact assessments covering each candidate partnership. The additional administrative costs of implementation via partnerships are

limited, when compared to the administrative costs of implementation through traditional calls. As indicated by comparable experience with previous initiatives and in feedback provided by a variety of stakeholders, these costs are expected to be fully justified by the benefits expected from the proposed initiative. Where available, additional details on costs are provided in Annex 3 of the impact assessment.
(e) While respecting the Union law, have special circumstances applying in individual Member States been taken into account?
Where relevant, differences between Member States in capacity and stage of advancement of R&I in specific thematic areas have been taken into account in the individual impact assessments.

Annex 6 Additional background information

1. BACKGROUND INFORMATION FOR ALL INITIATIVES

1.1. Selection criteria of European Partnerships

Partnerships based on Article 185 and 187 TFEU *shall be implemented only where other parts of the Horizon Europe programme, including other forms of European Partnerships would not achieve the objectives or would not generate the necessary expected impacts, and if justified by a long-term perspective and high degree of integration.* At the core of this impact assessment is therefore the need to demonstrate that the impacts generated through a Partnership approach go beyond what could be achieved with traditional calls under the Framework Programme – the Baseline Option. Secondly, it needs to assess if using the Institutionalised form of a Partnership is justified for addressing the priority.

The necessity test for a European Partnership (as set out in the Horizon Europe regulation) has two levels:

1. **The justification for implementing a priority with a European Partnership** to address Horizon Europe and EU priorities. This is linked to demonstrating that a European Partnership can produce added value beyond what can be achieved through other Framework Programme modalities, notably traditional calls in the work programmes (Option 0 – Baseline).

2. **The justification for the use of the form of Institutionalised Partnership**: Once it has been demonstrated that a partnerships approach is justified, co-programmed and/or co-funded forms are considered for addressing the priorities as they are administratively lighter, more agile and easier to set-up (Options 1 and/or 2). As Institutionalised Partnerships require setting up a legal framework and the creation of a dedicated implementation structure, they have to justify higher set-up efforts by demonstrating that it will deliver the expected impacts in a more effective and efficient way, and that a long-term perspective and high degree of integration is required (Option 3).

The outcomes of the 'necessity test' is presented together with the preferred option.

Figure 6 Horizon Europe selection criteria for the European Partnerships

Common selection criteria & principles	Specifications
1. More effective (Union added value) clear impacts for the EU and its citizens	Delivering on global challenges and research and innovation objectives
	Securing EU competitiveness
	Securing sustainability
	Contributing to the strengthening of the European Research and Innovation Area
	Where relevant, contributing to international commitments
2. Coherence and	Within the EU research and innovation landscape

Common selection criteria & principles	Specifications
synergies	Coordination and complementarity with Union, local, regional, national and, where relevant, international initiatives or other partnerships and missions
3. Transparency and openness	Identification of priorities and objectives in terms of expected results and impacts
	Involvement of partners and stakeholders from across the entire value chain, from different sectors, backgrounds and disciplines, including international ones when relevant and not interfering with European competitiveness
	Clear modalities for promoting participation of smes and for disseminating and exploiting results, notably by smes, including through intermediary organisations
4. Additionality and directionality	Common strategic vision of the purpose of the European Partnership
	Approaches to ensure flexibility of implementation and to adjust to changing policy, societal and/or market needs, or scientific advances, to increase policy coherence between regional, national and EU level
	Demonstration of expected qualitative and significant quantitative leverage effects, including a method for the measurement of key performance indicators
	Exit-strategy and measures for phasing-out from the Programme
5. Long-term commitment of all the involved parties	A minimum share of public and/or private investments
	In the case of institutionalised European Partnerships, established in accordance with article 185 or 187 TFEU, the financial and/or in-kind, contributions from partners other than the Union, will at least be equal to 50% and may reach up to 75% of the aggregated European Partnership budgetary commitments

1.2. Overview of potential functions for a common back office among Joint Undertakings

Functions	Current situation	Option of joint back-office	Comments
Organising calls for grant and proposal evaluations	Each JU organises this independently.	A central organisation of evaluation, logistics, contracting evaluators, managing the data of the evaluation results Central database of potential evaluators with domain expertise in thematic areas of partnerships	The evaluations would still need to be supervised by the Scientific staff of the individual Joint Undertakings (consensus meetings of expert evaluators etc)
Human Resources related matters	Each JU has own HR policy and resources Quite some resources spent on recruitment in some JUs Some HR facilities are procured	More generic resources and expertise for HR matters More consistency in HR policy Shared HR investment	Ensuring consistency with EC HR policies is already in place

	from external contractors Some JUs have a Service Level Agreement with COM for HR	for specialised expertise (IP and legal)	
Financial management	Each JU conducts own financial contract management; differences between JUs Each JU is audited separately. Auditing at project level more frequent than in other Horizon 2020 parts and outsourced by JUs thus differences ECA: too many audits on JUs	Financial management by one core team of financial staff Would reduce the number of interfaces for audits and simplifies the auditing of the all JUs Harmonisation of project auditing	Simplifies the harmonisation of financial management across JUs in line with Horizon Europe
Communication (internal and external)	Each JU has a separate communication strategies, teams and resources	A common back-office can support activities such as event organisation, dissemination of results, setting up website communication Can help create a more visible Partnership brand	A considerable share of communication activity is partnership specific (addressing particular target groups, synthesising project results) however there are generic communication activities that can be shared Needs to avoid duplication of efforts
Data management on calls, project portfolios, information on project results	Most JUs but not all use e-Corda for project data Overall IT integration of JUs still difficult	Harmonised data management Reduction of IT systems and support that is procured	This will need to happen regardless of the common back office but will likely be more smooth if managed centrally

2. ADDITIONAL INFORMATION ON THE STANDARD COST MODEL

Appendix A *Standard cost model for the options assessment related to efficiency*

Category \ Policy option (in thousands euros)	Horizon Europe	Co-programmed	Co-funded	Article 185	Article 187
BUDGET					
Total contribution from the Union	1000000	1000000	1000000	1000000	1000000
EU funding rate	100%	50%	30%	50%	50%
TOTAL Investment from partners incl. Union (within the partnership)		1000000	2300000	1000000	1000000
TOTAL BUDGET	1000000	2000000	3333333	2000000	2000000
SET-UP COSTS					
Preparation of a partnership proposal (partners and COM)		500	500	500	900
Preparation of the SRIA/roadmap		1500	1500	1500	1500
Impact Assessment				300	300
Preparation of COM proposal, negotiation				13000	13500
Preparation of dedicated implementation structure					1100
TOTAL SET-UP COSTS		2000	2000	15300	17300
RUNNING COSTS					
AWP preparation and comitology	2100	2100	2100	2100	2100
Call and project implementation	40000	80000	160000	100000	136400
Partners' costs not covered by the above		400			400
Additional COM costs	600	600	600		2500
TOTAL RUNNING COSTS	42700	83100	162700	102100	141400
DISCONTINUATION COSTS					
Costs for COM, MS and partners		500	500	800	1900
TOTAL DISCONTINUATION COSTS		500	500	800	1900
TOTAL COSTS AND INVESTMENTS	1042700	2085600	3498533	2118200	2160600
R&I INVESTMENT	1000000	1959600	3213333	1940600	1901300
EFFICIENCY	96%	94%	92%	92%	88%

Appendix B *Notes and sources per cost*

Category	Notes	Sources
EU funding rate	The EU funding rates used are the co-financing rates for Horizon 2020 regular calls (research and innovation actions) and the minimum co-financing rates required for each of the European Partnership types.	
TOTAL Investment from partners incl. Union (within the partnership)	The partners' contributions are calculated using the 'theoretical' Union contribution and the standard co-financing rate applicable to the specific policy option.	
Total Budget	The total budget is the total investment available and is the sum of the Union's contribution and the partners' contributions.	
Set-up Costs	The set-up costs are the one-off costs involved in the preparation and setting up of each of the four types of European Partnerships. It has been assumed there are no set-up costs associated with the HEU regular calls, as all of the management and supervisory structures exist already.	
Preparation of a partnership proposal (partners and COM)	We assume 7 staff members are needed to prepare a fully costed proposal for a partnership, covering the costs of all partners. CP require 5 staff from private partners and 2 from the COM, CF and A185s require 5 staff from MS and 2 from the COM, and A187s require 5 COM staff and 2 from private partners.	Cost per capita: €128 k for COM staff (SOURCE: JU benchmark data 2018); € 44.5k for MS staff and private partners (SOURCE: Average EU28 personnel costs (per employee) in 2016 (latest available) for NACE Professional, scientific and technical activities, EUROSTAT).
Preparation of the SRIA/roadmap		In 2019, Horizon 2020 approved a community support action to develop a SRIA for Waterborne Transport, with time horizons to 2025, 203 and 2050. The total Union contribution (100% of eligible costs) is €1.5m.
Impact Assessment	This is the cost involved in preparing the ex ante impact assessments for the candidate partnerships: 25 COM staff for 9 months (at yearly rate of €128 k) plus €1.8 M for a contractor to carry out the 13 IA studies. The total number is then divided by 13 to produce an estimate for the IA cost per partnership. It is assumed these costs only apply to the Institutionalised Partnerships as there is no requirement to carry out an IA for the other policy options. In practice, the cost per partnership will be higher, as not all 13 will be approved and the total effort will need to be amortised across a smaller number than 13.	Advice / data provided by DG RTD A4 'partnerships' team (15/11/19).
Preparation of COM proposal, negotiation	This is the cost involved in developing a full-costed proposal for the candidate Institutionalised Partnerships and the resulting costs of refining and	Cost per capita: €128 k for COM staff (SOURCE: JU benchmark data 2018);

Category	Notes	Sources
	negotiating the proposal through Council and into legislation. We assume that this highly involved procedure only applies to the IPs, and we have been advised by DG RTD that this process might typically require 1 year in elapsed time and 25 staff FTEs from the Commission, 15 FTEs from the Council and 5 FTEs from the EP.	We assume the same cost for the Council and Parliament; €44.5 k for MS staff and private partners (SOURCE: Average EU28 personnel costs (per employee) in 2016 (latest available) for NACE Professional, scientific and technical activities, EUROSTAT). Number of required staff members: Advice / data provided by DG RTD A4 'partnerships' team (15/11/19).
Preparation of dedicated implementation structure	This is the cost involved in setting up the governance and implementation structure. We assume that 1 member of staff is needed per each €268M of total budget to set up the new infrastructure in A187s. We assume that in A185s an existing structure in one or several MS is able to be used.	We based this assumption on the estimate made by the shift2rail IA (2013), where for a total budget of €938M, 3.5 members of staff are required for implementing the structure with a cost of €128k per head. This means that setting up the partnership requires about 1 staff member per each €268M. Once we determine the number of staff needed we multiply that by the corresponding staff cost per capita.
Running Costs		
AWP preparation and comitology	We assume 200 staff are needed working 3 days for €500 per day for the whole 7-year programming period (to be re-assessed).	This is an estimate based on a priori knowledge of the costs associated with the development and negotiation of annual work plans. We have not been able to identify any real cost data from past partnerships.
Call and project implementation	This refers to Title 1 and Title 2 expenditures, which represent a given proportion of the budget implemented in calls.	The costs of implementing HEU and CPP calls is estimated to be 4% of the budget, we use a dual figure for CFPcalls (with is 10% applied to 80% of the budget, to reflect typical MS calls, while the remaining 20% is assumed to be expended through regular HEU calls, where a 4% cost rate is used), 6% for A185s and 6.8% for A187s (SOURCE: Advice / data provided by DG RTD A4 'partnerships' team, 15/11/19); We also add an additional cost of €400k in A187s reflecting extra costs of integrating and making systems interoperable for monitoring; the legal obligations to perform interim and ex-post evaluations (Advice provided by DG RTD A2 team, 25/11/19).
Partners' costs not covered by the above	This refers to the intramural costs borne by private partners as a result of their participation in the governance structure and working groups of the partnership (private partners are not involved in the supervision of HEU calls, CFPs or A185s). We used historical data to estimate that these private coordination costs amount to 1 FTE per €242M of total budget.	The estimation is based on the assumption by the shift2rail IA that a half a person-day per project per week is needed for coordination, thus 1 staff per year for 10 projects running. This resulted (in the shift2rail IA) in 3 additional staff members required to coordinate a total budget of €725M, and thereby 1 staff per €242M. Once defined the number of staff needed under each option, we multiply that by the corresponding cost per capita.
Additional COM costs	The additional COM costs refers to the cost of supervising the partnerships. We use auditing expenditures as proxies for supervision costs. HEU regular calls, CPPs and CFPs have low supervision costs, A185s' costs are included in MS's project implementation costs and A187s require higher levels of COM supervision and therefore have higher costs.	We use the max (35) and min (8) number of audits in past JU as reference for high and low level of supervision effort. Then multiply that by €10k —the average cost per audit (SOURCE: JU benchmark data 2018). The inclusion of this cost category was suggested by DG RTD A4 'partnerships' team (15/11/19).
Discontinuation Costs	Discontinuation costs refer to staff expenditures related to winding-down activities, including the disposal of any assets and the cost of closing the implementation structure when there is one.	

Category	Notes	Sources
Costs for COM, MS and partners	We assume that at least the same number of staff is needed to discontinue the partnership as it was for the preparation of the partnership proposal. Plus, for A187s, we assume that dismantling the dedicated structure has the same cost as its implementation. As for A185s, we assume the same value as for A187s, but adjusted to the staff costs of A185s.	
Total Costs and Investments	This category is the sum of "Total Budget", "Set-up costs", "Running costs" and "Discontinuation costs".	
R&I Investment	We assume that funding for R&I activities equals the total Budget under the HE policy option. For the remaining options, this category is composed of the "Total Budget" after subtracting "Marginal Running costs" –Running costs for each policy option discounted by the Running costs under HE.	
Efficiency	This ratio is the proportion of "Total costs and investments" that is available to be spent on "R&I investment".	

3. ADDITIONAL INFORMATION ON THE POLICY CONTEXT

Support in the field in the previous work programme

Scope and objectives of the 5G-PPP

Through 5G-PPP, the goal of Europe is to put in place the right framework to tackle 5G challenges and bring the appropriate solutions, architectures, technologies and standards to the next generation of communication networks.

The main target objectives of the 5G-PPP are the technological development of 5G and the contribution to growth and jobs. Considered as EU flagship initiative, the **5G-PPP** comprises public and private partners. The latter also agreed on KPIs to leverage the 700 million EUR public investment by a factor of 5 bringing **total funding into 5G-PPP to 4.2 billion EUR**.

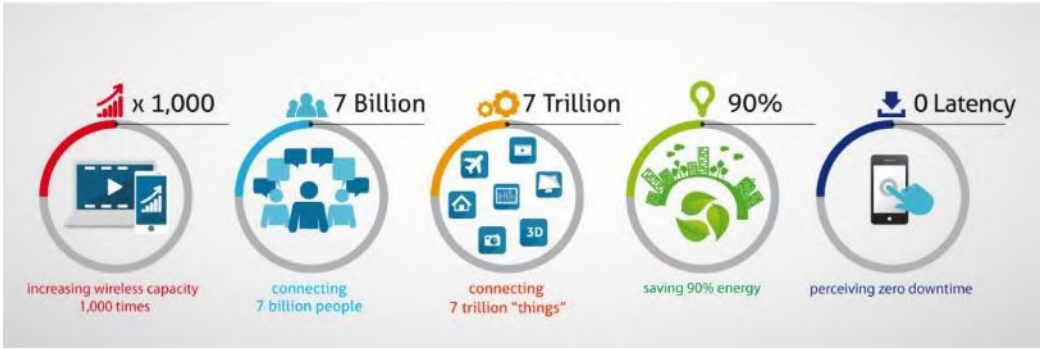
5G-PPP is organized in 3 phases, each comprising several call for projects with a variable duration of 24-36 months:

- Phase 1 with 19 projects (2014-2016) focusing on 5G infrastructure, automotive projects and 5G validation trials across multiple vertical industries;
- Phase 2 (2017-2019) with 21 new projects targeting a move towards demonstrations and experimentations in order to establish closer links between 5G community and verticals industries. Many new stakeholders (more than 60% of phase 2 participants) joined the PPP;
- 3rd and last phase ending in 2020 consolidating the results of the previous phases to support implementation and applicability of 5G and will be dedicated to a number of projects in vertical industries use cases.

The global objectives of the 5G programme is to build the next generation of wireless communication network technologies. This new generation is expected to improve the existing (4G) wireless network capabilities (in term of bandwidth, capacity, coverage, and reliability). But beyond this incremental progress, the 5G technologies also aim to provide new capabilities (ultra-low latencies, ability to connect very large numbers of devices, high dependability and quality of service, etc.) that would enable the wireless network to be used in scenarios that are essential for vertical industries.

Indeed, the vision behind 5G is that this new generation of communication network could serve as a critical infrastructure for numerous industries (automotive, transport, manufacturing, etc.)

5G-PPP objectives



Source: 5G-PPP.

Stakeholder analysis of the 5G-PPP

Stakeholders involved so far in the 5G-PPP (note that the analysis is only based on projects funded from the 5G-PPP during Phase I and Phase II, i.e. projects funded before 2018[29]) are mainly from the telecom

[29] Only a part of Phase 3 projects have really started

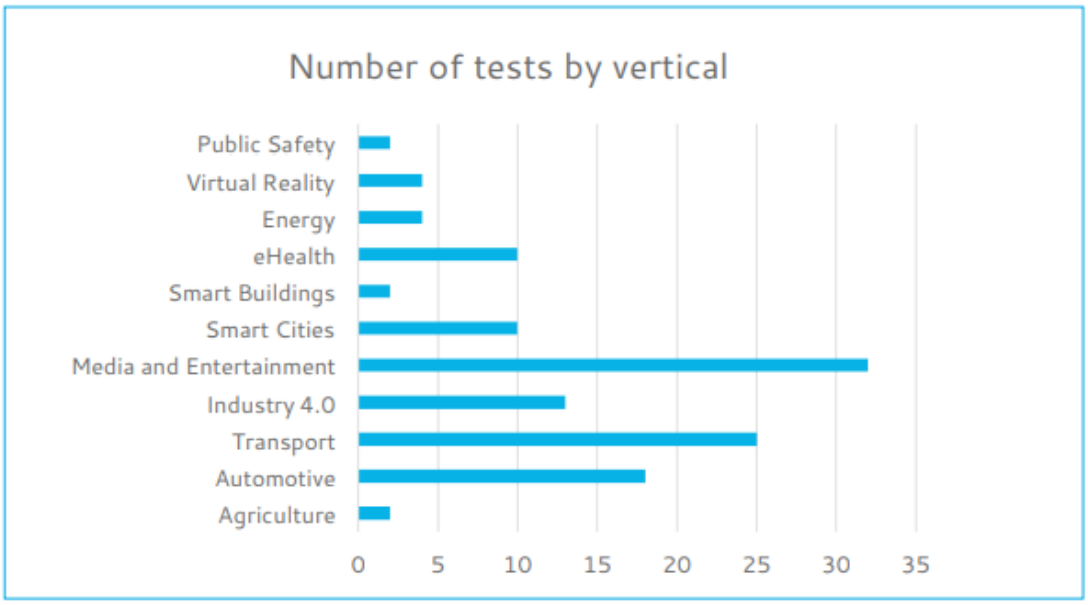
industry or from the public research centres and universities with a strong background in telecommunications. **The majority of funding was directed towards private research** (56% of funding), and within that the vast majority for the telecom (operators, OEMs (Original Equipment Manufacturers) and IT industries. The involvement of verticals is still modest but growing. This is globally consistent with the analysis done for just Phase 1 project [30] (65% of private research)

Funding has been essentially allocated to EU 15[31] Member States (92% of funding, of which 70% for top 5 countries in Phase 1), **reflecting also the domination of telcos from bigger EU countries (and their associated partners),** which are generally controlling telecom operators from smaller EU countries.

Three main groups of players are mainly involved in the 5G-PPP, as designed by the European Commission and the 5G IA (5G Industry Association):

(1) **Current connectivity providers** (MNOs, MVNOs) are taking the opportunity of these new technologies to try to **diversify their offer and address new market segments** (in specific verticals, including manufacturing) as a way to compensate declining consumer revenues. They have engaged into many projects within the 5G-PPP and trials[32] targeting key vertical markets like automotive, healthcare, industry 4.0, energy and media, and additional vertical markets targeted in a second step like public safety and smart city[33]. In Europe, Orange, Telefonica, Telecom Italia and BT (plus to a lesser extent Altice, Deutsche Telekom and OTE) have been leading the efforts on 5G.

Trials in Europe testing vertical markets



Source : Euro-5G Annual Journal[34]

(2) Providers of enabling technologies include software and hardware vendors. **Hardware equipment manufacturers** can also see 5G as an opportunity to **diversify their business modelling,** by bundling equipment with connectivity service provisioning in, for example, the small cell area. The need for an

[30] Mid-term review of the contractual Public Private Partnerships under Horizon 2020 (2007), Report if the Independent Expert Group https://publications.europa.eu/en/publication-detail/-/publication/6de81abe-a71c-11e7-837e-01aa75ed71a1

[31] EU 15 being: Germany, Belgium, France, Italy, Luxembourg, Netherlands, Denmark, Ireland, UK, Greece, Spain, Portugal, Austria, Finland and Sweden.

[32] Vertical trials may not involve a vertical stakeholder

[33] 5G IA (2019) available at https://5g-ppp.eu/verticals/

[34] https://5g-ppp.eu/annual-journal/

upgraded infrastructure, supported by virtualization and allowing for edge computing, is also an opportunity, partly challenged nonetheless by the development of pure software players. Traditional OEMs (especially Nokia and Ericsson, but also Huawei and NEC) and their counterpart software and/or electronics companies (Atos, Samsung, Intel) are well represented within the 5G-PPP projects.

(a) Fundamental building blocks may also be developed by academic and public research institutes/centres also well represented in the 5G-PPP. Close to 40% of participants in 5G-PPP (and 36% of funding)[35] was allocated to either high education and research centres (with a slight bigger proportion for education).

(3) Some content providers (including OTT players) and **industrial solution providers, and potentially manufacturers (a.k.a. vertical stakeholders)**, will also play a role in the new communication value chains, not only as content and service providers, but also as **connectivity providers**, and infrastructure providers. This is reinforced by the integration of **direct, proximity communications** (such as public safety services or V2V (Vehicle to Vehicle communication), V2I (Vehicle to Infrastructure)) in the 5G standards, thereby **removing partially or even entirely in some cases the need for a mobile operator in the value chain.** Their engagement as participants in projects is still modest (5% overall for Phases 1 and 2) but increasing. Indeed, the NACE code analysis shows the following evolution. Most vertical stakeholders have participated to only 1 project.

Analysis of participants based on NACE codes[36]

	2014[37]	2016	2017
% of participants from "vertical" NACE codes [38]	2%	6.3%	16.4%
% of funding from "vertical" NACE codes	2%	5.4%	16.6%

Source : IDATE Digiworld

Vertical industries were not very active around 5G developments before 2018-2019. **Among the active vertical industries, a few already really stand out:** the automotive industry (thanks to the creation of the 5G AA (5G Automotive association)) and to a lesser extent manufacturing industries (5G ACIA - 5G Alliance for Connected Industries and Automation) and utilities. These vertical stakeholders are often not involved around business use cases but rather focus on specific technologies development. The question of the business sustainability of the proposed scenario thus often remain open.

The main vertical stakeholders in projects of phases 1 and 2 and in other 5G initiatives involving vertical stakeholders.

Vertical industries	Vertical stakeholders
Utilities/Energy	ENGIE, ASM Terni, PowerOps, RomGaz, eMOTION, VerticalM2M, EFAFEC, Power Solutions Group, Siemens, World Sensing
Automotive	Volvo, PSA, Bosch, Fiat, ExpertSystems *5GAA (created late 2016) including also AUDI AG, BWM Group, Daimler AG, Ford, Denso, Continental, Honda, Hyundai, Nissan, Mitsubishi, Volkswagen*
Public Safety	Thales, ENGIE, WIND-3, RomGaz, ASM Temi *Public Safety Communication Europe (PSCE), the European public safety Association, and 5G IA, signed a Cooperation agreement in May 2018 to foster collaboration on 5G development.*

[35] NACE code analysis

[36] NACE code analysis based on participant portal data made available by the European Commission.

[37] No calls for the 5G PPP in 2015

[38] Vertical NACE codes excludes all NACE codes related to ICT industry, support actions like marketing or administration and wholesale trade

Vertical industries	Vertical stakeholders
Healthcare	Servicio de Asistencia Municipal de Urgencia y Rescate (SAMUR), Irish National Ambulance Services facilitated by CIT; LifeSemantics, Camanio Care AB
Media	RAI, RTVE, BBC, EBU, IRT, Nurogames
Transport	Fiat, COMSA, FGC, Hamburg Port Authority, riaGnoSys GmbH (Zodiac Inflight Innovations), Ferrovial (through Seamless Air Alliance, Delta and Airbus) Ports of Thessaloniki, Patras and Pireus (in SMI initiative) Ahlers in 5G Manifesto[39]
Industry	Weidmüller, Airbus, Siemens, Royal Philips in 5G Manifesto *5G-ACIA created early 2018*
Smart Cities	City of Lucca, City of Bristol, City of Barcelona, Alba Iulia City Flash Lighting Services

Source : IDATE Digiworld[40]

This limited participation of actors from the vertical industries to the 5G-PPP can be explained mainly by the natural phasing of the 5G-PPP, with earlier phases dedicated to technology development and later phases to validation, testbeds and trials, especially around platforms. The increase overtime of the vertical stakeholders' presence in project and access to funding shows positive signs of uptake.

This is in addition confirmed by analysis of the Phase 3 projects started or about to start, reaching even at least 22% of vertical participants (some projects like 5G-TOURS and 5G-DRONES are even with more than a third of vertical participants), when excluding platforms. Verticals industries with the most contributors are by far automotive (with a specific call), transport and industry 4.0, with a mix of very large companies and smaller ones.

Analysis of participants based on listing

	15 Phase 3 projects from calls in 2018	Same scope but excluding the CSA and the 3 platforms
% of participants from "vertical industries" (private only)	18.0%	22.4%

Source : IDATE Digiworld (from 5G-PPP description of projects) [41]

Non-exhaustive list of vertical participants in Phase 3 projects

Vertical	
Energy	Enel, EDF, Iren, Mirantis, Admie
Automotive	BMW, PSA, Renault, Bosch, Volvo, Volkswagen, Fiat, Swarco, Daimler, Ford, Dalian, Valeo,

[39] 5G Manifesto is an open letter from 17 telcos, equipment vendors and satellite operators that was sent to European Commissioner for Digital Economy and Society Günther Oettinger in July 2016. The 5G Manifesto covers a wide range of verticals. Five non-telecoms companies expressed their interest and willingness to participate in the next phase: Ahlers (logistics and maritime service provider), Airbus Defence & Space (defence and aerospace), Royal Philips (electronics, healthcare, and lighting), Siemens AG (engineering) and Thales Alenia Space (satellites, payloads).

[40] ESA, Techno-Economic impacts of 5G for the European Satellite Industry, (2019), https://artes.esa.int/projects/techno-economic-impact-5g-standards-european-canadian-satellite-industry-ecosystem

[41] https://5g-ppp.eu/5g-ppp-phase-3-projects/

	Alsa
Industry 4,0 *(including robotics and drones)*	ABB, Bombardier, Marposs, Bosch, Orbis, Cafa, Involi, Unmanned systems, Droneradar, Comau
Transport	Athens Airport, Deutsche Bahn, Vediafi, Sanef, Autostrada del Brennero, Aenl, Siemens Mobility, Trenitalia
Other	Procter&Gamble, City of Torino, City of Egaleo, Polar, Sealab, Epitomical, Nurogames, RAI, LiveU, Philips, CHU Rennes, AMA

Source : IDATE Digiworld

Outcomes and (expected) impacts

It is quite early to measure the outcomes of the 5G-PPP based on previous assessments or evaluations, as the 5G-PPP is still ongoing. Only Phase 1 projects are closed and Phase 2 projects ran until mid 2019 for most of them, while most Phase 3 projects have just started or will start in 2020.

The only evaluation conducted so far relates to the 19 Phase 1 projects[42] (but is not specific to 5G). The 5G-PPP showed some very good performances in shorter average time to grant than FP7 or Horizon 2020 and higher quality and success rates. This illustrates that the overall structuration has been well thought and organized in advance. Funding was mainly allocated to a limited number of beneficiaries (top 50 getting 65% against only 22% in other Horizon 2020 projects). In Phase 1, 5G-PPP was seen as performing well in general, with some improvements needed around inclusion of SMEs and of EU13 (only 2% of funding for Phase 1) and also in terms of links with other cPPPs (contractual Public Private Partnership).

The contractual arrangement defines 12-13 (depending on documents) specific KPIs (Key Performance Indicators) for the 5G-PPP in addition the common set of KPIs defined by the EC for all cPPPs. These KPIs have been assessed in Euro-5G and To-Euro-5G[43].

Scientific and technological results

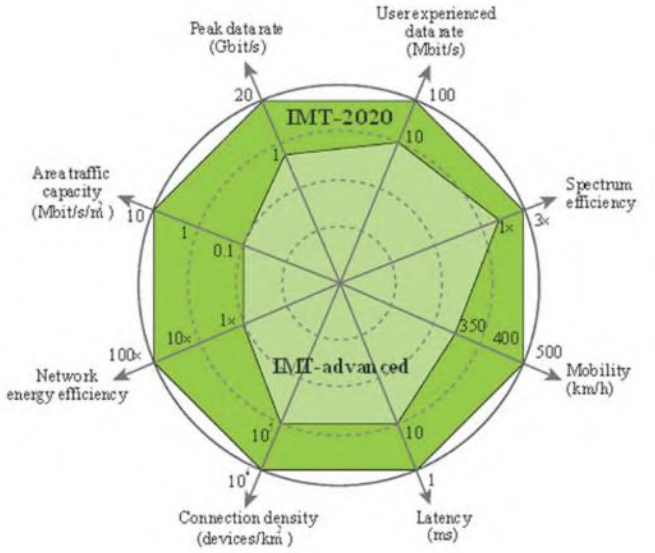
ITU requirements

The targets set for IMT-2020, corresponding to the fifth generation of mobile systems, by ITU are described below. IMT-Advanced corresponds to 3GPP LTE.

[42] Mid-term review of the contractual Public Private Partnerships under Horizon 2020 (2007), Report if the Independent Expert Group https://publications.europa.eu/en/publication-detail/-/publication/6de81abe-a71c-11e7-837e-01aa75ed71a1

[43] D4.4 Final report on 5G PPP KPI progression of June 2019, To-Euro 5G

Enhancement of key capabilities from IMT-Advanced to IMT-2020



Source: ITU[44]

5G-PPP KPIs

The following Key Performance Indicators were set by the Public Private Partnership on 5G[45]:

(4) Providing 1000 times higher wireless area capacity and more varied service capabilities compared to 2010.
(5) Saving up to 90% of energy per service provided.
(6) Reducing the average service creation time cycle from 90 hours to 90 minutes.
(7) Creating a secure, reliable and dependable Internet with a "zero perceived" downtime for services provision.
(8) Facilitating very dense deployments of wireless communication links to connect over 7 trillion wireless devices serving over 7 billion people.

The 5G Initiative Technology Board produced a document on the definition, assessment and there cannot and will not be one single overall system analysis per Performance KPI across all 5G Infrastructure PPP projects. The running study leads to a summary of clustered projects contributions to the Performance KPIs in a structured programmatic approach. The PPP Performance KPIs definition, at Programme level, are based on the work of a Phase 1 project (Flex5GWare), the approach has been extended to the overall set of PPP Phase 2 Projects.

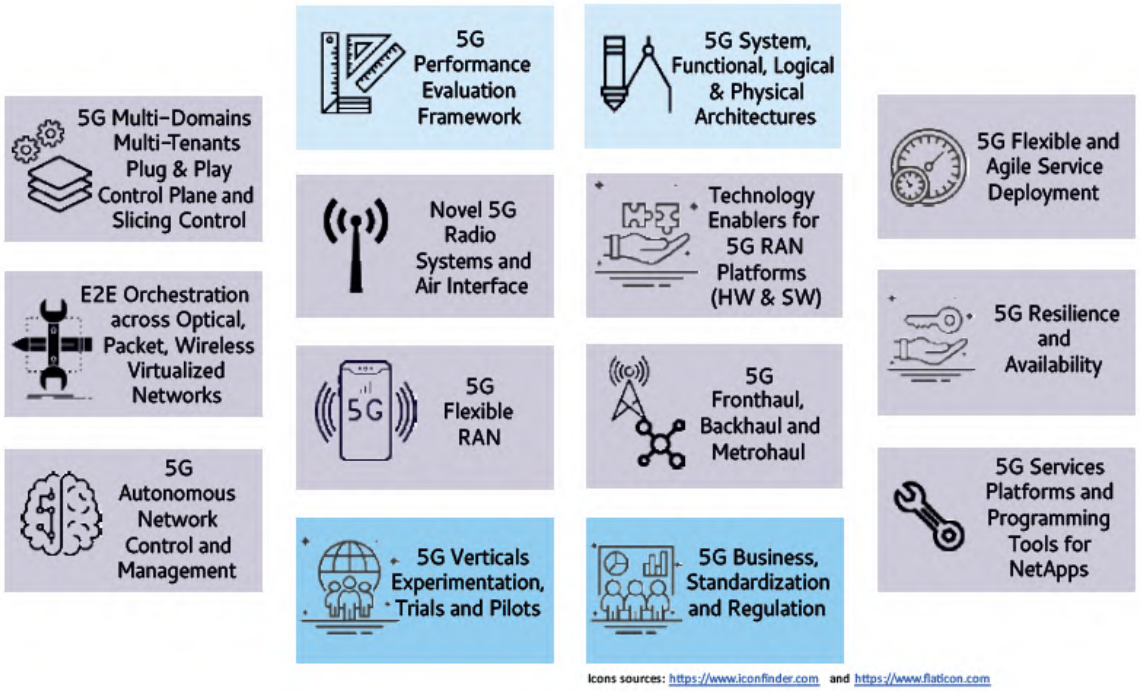
The PMR (Progress Monitoring Report) Annex consolidates the available KPIs from the different sources of the 5G Infrastructure PPP Programme Working Group activities and projects. It consolidates an agreed definition for each KPI and provides an agreed method of measurement. The PPP Performance KPIs work has also then been further developed on specific Performance KPIs, starting first with Latency and Service Creation Time. This information is included in the PMR Annex. It contains the up-to-date status on these KPIs / Projects contributions. **The work is in progress and the final reports will be released during the second half of 2019.** Potentially, additional White Papers could be developed on Peak Data Rate KPI, Summary of individual Projects Performance KPI and PPP KPIs Cartography development of '5G-PPP Phase II Projects Performance KPIs'.

[44] ITU, *Setting the Scene for 5G : Opportunities and Challenges, 2018. Available at:* https://www.itu.int/en/ITU-D/Documents/ITU_5G_REPORT-2018.pdf

[45] 5G PPP, *5G PPP progress monitoring report, 2017, available at:* https://5g-ppp.eu/wp-content/uploads/2018/10/5G-PPP-Progress-Monitoring-Report-2017.pdf

The 5G-PPP Technical Board advanced the approach defined in Phase 1 with the definition of the Programme Golden Nuggets (GNs), elaborated on the basis of the key projects achievements. The PPP GNs Version 2.0 was released in February 2019, allowing all PPP projects to fully understand and match their individual contributions inside the overall programme achievements. **Key achievements from Phase 2 5G-PPP projects include 60 highlighted results categorised under 14 program level achievements as shown in the figure below.**

PPP Key Achievement Phase 2 Projects (Golden Nuggets Version 2.0)



Source: 5G-PPP[46]

Additional Programme-Level KPIs

(9) Patents

At the end of March 2019, Europe had filed for ~22% of standard essential patents (SEP) for 5G communication systems.

(10) Standardisation activities

5G-PPP has had significant influence in building pre-standardization consensus across key actors. Major impact on the 5G architecture ideas has also been achieved through 610 activities leading to standardization (Phase 1: 315; Phase 2: 295). The table below shows a breakdown of the inputs for the development of 5G standardization tracked between June 2018 and June 2019:

Input to 5G standardisation

	Number of contributions per category tracked
Overall architecture: Mostly to 3GPP, with many inputs on the implementation of 5G V2X systems and multimedia broadcast or streaming services.	70
Core and transport architecture: Mostly to 3GPP, with most of the inputs related to terminals.	58
Management and orchestration architecture: Mostly to three ETSI groups, namely, the ZSM ISG, NFV ISG and OSM.	50

[46] EURO 5G – The European 5G Annual Journal, 2019 https://bscw.5g-ppp.eu/pub/bscw.cgi/d302069/Euro%205G%20PPP%20Annual%20Journal%202019-web.pdf

Radio and edge architecture: Mostly to 3GPP, with many inputs on 5G NR enhancements for V2X and multimedia broadcast.	41
Other 3GPP WGs: RAN 3 (new radio); SA1 (service requirements); SA5 (network management, including energy efficiency and architecture); SA4 (codec); SA6 (northbound APIs); SA4-5-6 (media and broadcasting).	21
ETSI Multi-Access Edge Computing (e.g. Instantiating a Network Slice integrating MEC applications, using 3GPP elements).	6
Industry groups (e.g. DVB for media and broadcasting); other standards organisations (e.g. IETF for network virtualisation, fog computing and northbound interfaces); not specified	49
Total	295

Business outcomes and impacts

Three business KPIs were set and have been mostly achieved:

(11) Leverage effect of EU research and innovation funding in terms of private investment in R&D for 5G systems in the order of 5 to 10 times (B1). The expected KPI has been surpassed, with private investments from large industry and SMEs reaching 10,12 in 2018 (7.24 when taking into account all beneficiaries like education).

(12) Target SME participation under this initiative commensurate with an allocation of 20% of the total public funding (B2). This KPI has been almost reached over Phase 1 and Phase 2 (19%) and is expected to be reached thanks to the last phase (trials).

(13) Reach a global market share for 5G equipment & services delivered by European headquartered ICT companies at, or above, the reported 2011 level of 43% global market share in communication infrastructure (B3). With roll-out in progress, it is too early to assess this KPI, but there are some early signs showing the KPI can be reached (such as the good positioning of actors such as Ericsson and Nokia in the standardization and patent activity).

As part of the common set of KPIs, additional outcomes have been calculated or identified

(14) around 2,000 new jobs are expected from 5G-PPP participants over the period 2014-2018 (i.e. an increase of 5 jobs per participant, of which 2.3 for SMEs)

(15) an increase of turnover by 10% for SMEs in 2018

(16) the development of a brochure “European SME expertise in 5G and beyond” (June 2019)

Societal outcomes and impacts

Five business KPIs were set, for which outcomes are not still limited for now (except KPI S3) but are still on track to be achieved for most of them in Phase 3:

(17) Enabling advanced user-controlled privacy (S1). Progress has been made around security (especially with MEC and slicing) more than privacy, expected to be tackled around with new projects, in Phase 3 and more likely in the candidate PPP.

(18) Reduction of energy consumption per service up to 90% (as compared to 2010) (S2). No results yet beyond some initial findings in METIS-II project. Data is indicated to be collected from projects to get better information.

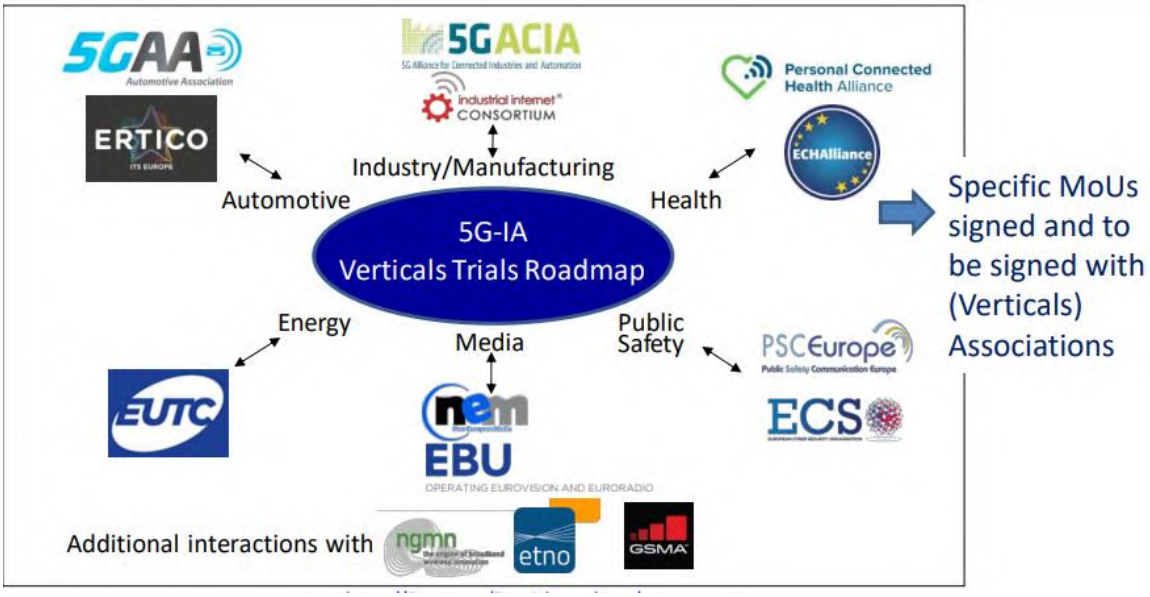
(19) European availability of a competitive industrial offer for 5G systems and technologies (S3). In addition to B3, progress has been made by progressive integration of verticals during Phase 2 and then Phase3. Current forecasts for the share of patent by European HQ vendors is of 45.6% for 5G RAN, 29.45% for 5G patents at a global level and a 25.32% for 5G declared standard essential patents in the automotive industry[47].

(20) Stimulation of new economically-viable services of high societal value like U-HDTV and M2M applications (S4). Initial results are encouraging with the progressive integration of verticals and the definition of candidate pilots for media usage by NEM-Networld 2020 and of various pilots and use cases in other projects (with some live experience for a few of them). MoUs are signed or under negotiation with several stakeholder groups (see image below).

[47] To Euro 5G Project - Final Report on 5G PPP KPI progression, July 2019.

(21) Establishment and availability of 5G skills development curricula (in partnership with the EIT) (S5). Around 500 new curricula and educational qualifications among 5G-PPP participants (around 1.25 per participant) were created over the period 2014-2018. 5G IA and EIT are also in discussions.

Highlights from 5G vertical strategy of 5G-PPP



Source : 5G-PPP[48], Roadmap Version 3.0

[48] Didier Bourse – 5G IA, 5G Pan-European Trials Roadmap, 7th Global 5G Event in Valencia (June 2019),

4. ADDITIONAL INFORMATION ON THE PROBLEM DRIVERS

Additional evidence on the key problem drivers are further detailed below.

4.1. Insufficient presence of EU actors in the global digital value chain

As presented above in section 1.2.1, the European current digital ecosystem is not in a very strong or favourable position. This threatens the future European technological sovereignty in not only future smart networks and services as the current players, will be under threats of rising , competition but also those industry segments and society at large - "the verticals" that will need to use the Smart Networks Services, will be subject to increasing competition by their correspondents in other regions.

As presented above in section 1.2.1, the European current digital ecosystem is not a very strong or favourable position. This threatens the future European technological sovereignty in future smart networks and services as current players will be under threats of rising competition.

This problem is further reinforced by two factors:

The smart networks and services field is a sector with a strong R&D intensity, illustrating a high-risk research and innovation process. This puts European players at further risk as sustaining a leading position requires important investment in research and innovation.

The smart networks and services field is a sector that relies heavily on standardization, and ensuring a strong presence in Standardization requires a coordinated approach at the European level to ensure a critical mass of European contributions.

4.2. A fragile position of European actors in the global digital ecosystem

Europe cannot be considered as the leader for the 5G R&D (no specific advantage in terms of 5G technology), but is still a contender and stands out regarding some specific initiatives around verticals:

Europe has major and very active 5G infrastructure manufacturers (Ericsson & Nokia), but the rest of the EU ecosystem developing the R&D is more limited: no smartphone manufacturer, some test equipment manufacturers (Rohde & Schwarz), software players and minor activities for chipsets (Sequans).

Collaboration has started with various industries (Automotive, ports…) in Europe through R&D projects and represent a significant potential for 5G B2B services provision. The relatively strong position of European industry (as presented in section 1.2.1.2) present an opportunity for future European digital ecosystem.

New form factors for devices (such as IoT) might provide an opportunity for Europe to regain a presence in the device industry.

Although satellite is likely to have a limited impact on 5G and beyond 5G research as well as business wise, it should also be noted that Europe has two of the world major satellite manufacturers.

Companies outside Europe participating to European R&D programs are mainly equipment vendors that have R&D laboratories in Europe. Countries present in past R&D programs mainly come from the USA (Intel, Interdigital, IBM…), China (Huawei), Japan (NEC, Mitsubishi) and South Korea (Samsung).

Stakeholder opinion

A key statement coming up from interviews commonly to all categories deals with the position of Europe lagging behind Asia and US. Indeed almost all interviewees mention the need to keep or regain European leadership in the value chain. Indeed, on network infrastructure, interviewees recognize the leadership of Europe with the presence of two mastodons – Nokia and Ericsson. On the rest of the value chain, Europe has lost its position on devices but for most of interviews there could be an opportunity to gain a leadership position on other fields like IoT devices and other emerging technologies like edge computing considered as critical topic. Europe should have the capacity to both support areas where Europe is good at in the value chain and create European alternatives in the whole supply chain.

Also, interviewees from academia categories draw the attention on the necessity to invest more in research in Europe in order to develop its potential, to remain competitive and to avoid shortage of skills and lack of ventures and start-ups.

4.3. High risk R&D reinforces the risks for European actors

Telecommunication equipment is among the sectors that have the highest research intensity, with an average value around 15% and going up to 30% for some actors. This level of R&D intensity is comparable to other R&D intensive sectors such as Pharmaceuticals and Semiconductors and is the sign of a R&D process that involve significant risks and require huge investments.

The table below both illustrate this high research intensity and show the limited presence of European actors in the field.

Appendix C ***R&D Intensity of Telecommunication Equipment providers.***

Company	Country	R&D Expense (in USD billions)	Total Revenue (in USD billions)	R&D Intensity (%)
Huawei	China	12,53	85,54	14,6%
Cisco Systems, Inc.	United States	6,06	48,01	12,6%
Nokia Corporation	Finland	5,90	27,79	21,2%
Telefonaktiebolaget LM Ericsson	Sweden	4,63	24,59	18,8%
ZTE Corporation	China	1,99	16,72	11,9%
ARRIS International plc	United States	0,54	6,61	8,2%
Motorola Solutions, Inc.	United States	0,57	6,38	8,9%
Juniper Networks, Inc.	United States	0,98	5,03	19,5%
Fiberhome Telecommunication Technologies Co., Ltd.	China	0,30	3,24	9,3%
Ciena Corporation	United States	0,48	2,80	17,0%
F5 Networks, Inc.	United States	0,35	2,09	16,8%
Palo Alto Networks, Inc.	United States	0,35	1,76	19,7%
Arista Networks, Inc.	United States	0,35	1,65	21,2%
Viasat, Inc.	United States	0,20	1,56	12,9%
Finisar Corporation	United States	0,24	1,45	16,5%
Fujian Star-net Communication Co., Ltd.	China	0,14	1,18	11,9%
NetScout Systems, Inc.	United States	0,22	1,16	18,5%
Lumentum Holdings Inc.	United States	0,15	0,90	16,4%
Viavi Solutions Inc.	United States	0,14	0,81	16,8%
Infinera Corporation	United States	0,22	0,74	30,3%
Datang Telecom Technology Co., Ltd.	China	0,16	0,67	23,9%
ADTRAN, Inc.	United States	0,13	0,67	19,6%
ADVA Optical Networking SE	Germany	0,12	0,62	19,1%
Calix, Inc.	United States	0,13	0,51	25,0%
Ribbon Communications Inc.	United States	0,12	0,33	36,3%

Source: Strategy& PwC, The 2018 Global Innovation 1000 study, analysis of the 1000 largest corporate R&D spenders.

The consultations of the stakeholders' further support this view of a risk prone R&D in the sector, and more importantly that R&D efforts need to be sustained overtime at all stage of the innovation process:

from long-term R&D with low Technology Readiness Levels (TRL) (which prepare future generations of communication equipment and investigate very long term technological vision),
to mid-term R&D (necessary to investigate how identified technology opportunities can transform into potential products),
to short-term R&D (which investigate deployment issues and the future services enabled by the new infrastructure).

Without long term commitment and sustained R&D efforts at all stages of the innovation process, European industry players would take a significant risk of being, in short or long term relegated to secondary players or even disappear.

A need for critical mass in standardization

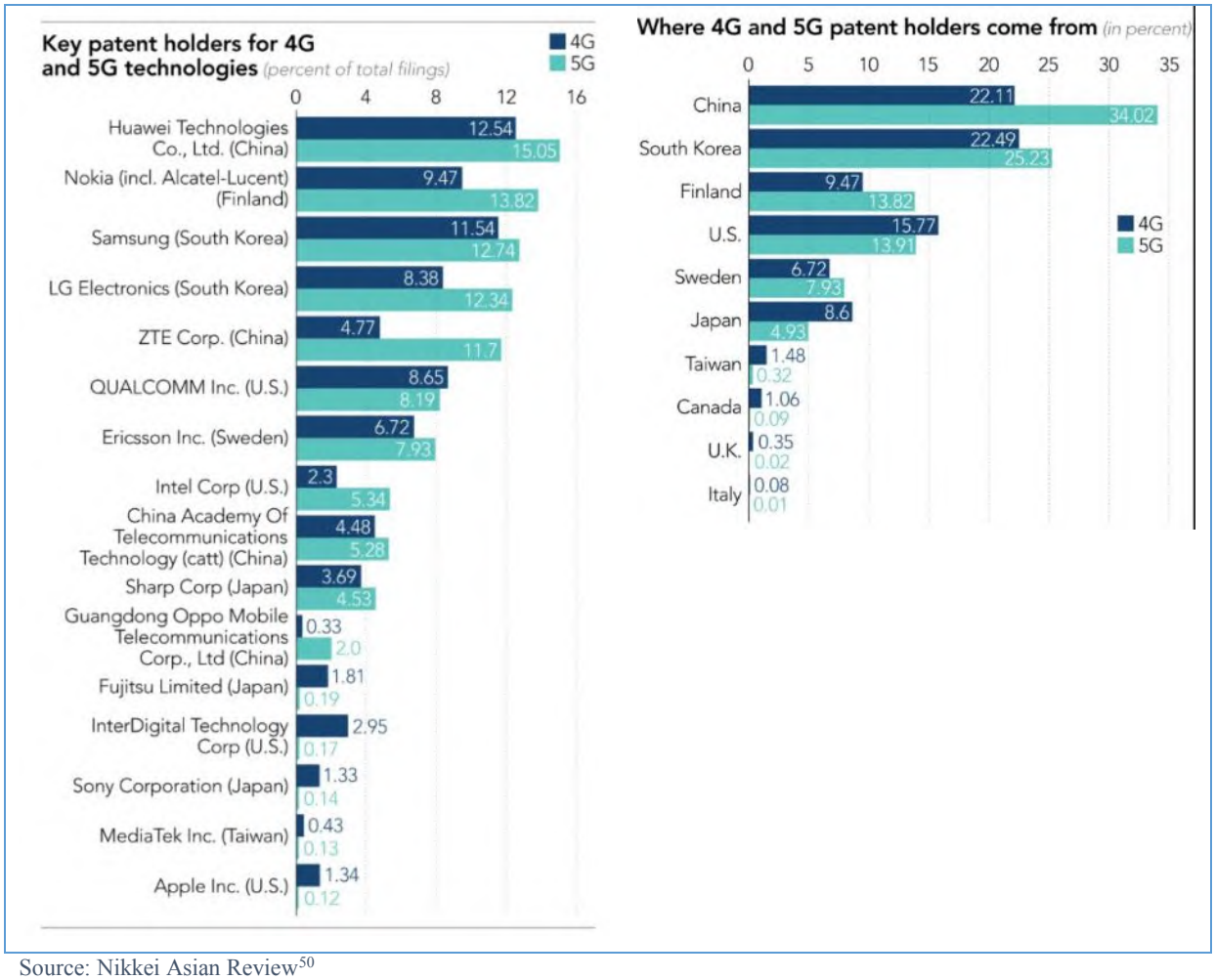
Being in the forefront of standardisation means that those driving standardisation will have a competitive advantage with respect to know how in development but also possibility to file systems and standards blocking (essential) patents and by this being able to position the products and services complying to standards and by this control the market. Generally, those that control the standards arena will have a competitive advantage.

Regarding standardization of 5G: European vendors are at the forefront of contributions to mobile standards. This can be attributed to the dedicated efforts toward standardizations in the 5G-PPP programme. These joint collaborations facilitates submitting standards inputs in a concerted fashion with several partners undersigning and by this creating a European momentum. However, this place remains fragile, and Asia has a strong lead on 5G patents. A lack of future coordinated efforts of European actors in standardization, would lead to lack of the critical mass necessary to sustain the position of Europe.

At the end of March 2019, China had filed for 34% of standard essential patents (SEP) for 5G communication systems, an increase of more than 50% compared with its share of 4G patents, according to IPlytics[49]. South Korea had 25% of key 5G patents, while the share of filings by Japanese and U.S. entities was similar to the one for 4G. As mentioned in Appendix E (analysing KPIs of the 5G-PPP), Europe has around 25% of 5G patents (but more than 50% on RAN), therefore behind China and South Korea.

[49] IPLytics, *Who is leading the 5G patent race?*, July 2019 available at: https://www.iplytics.com/wp-content/uploads/2019/01/Who-Leads-the-5G-Patent-Race_2019.pdf

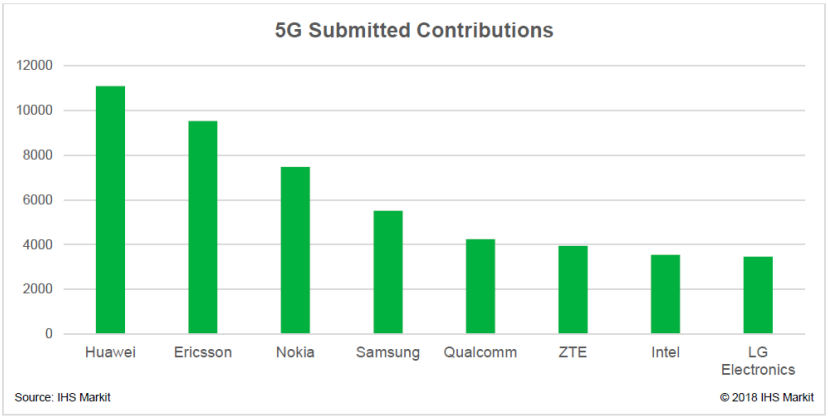
Appendix D *Patent holders for 4G and 5G technologies*



Source: Nikkei Asian Review[50]

However, the analysis of essential patents is complicated and an analysis taking into account the number of 3GPP contributions shows that **Nokia and Ericsson rank second and third behind Huawei**. These contributions correspond to work item (WI) or study item (SI) level in the 3GPP standardisation work.

Appendix E ***Figure 21: Number of submitted 5G contributions (3GPP) – 2015 to 2018 H1***

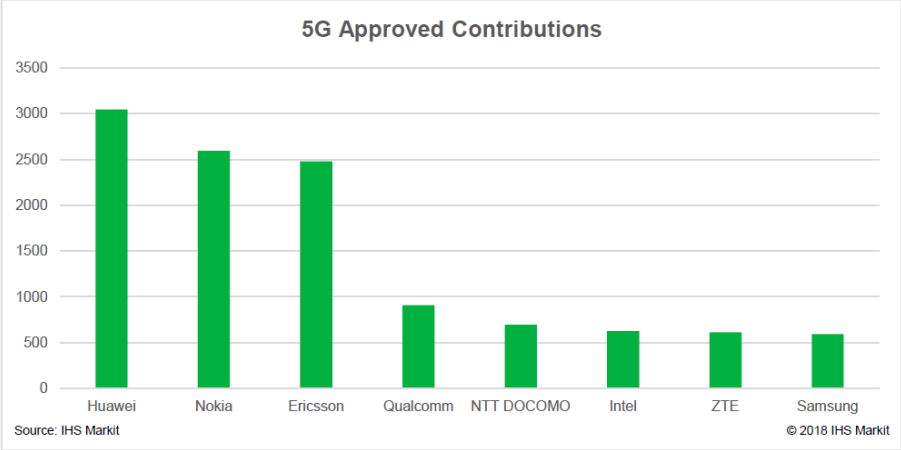


[50] Akito Tanaka, Nikkei Asian Review, *China in pole position for 5G era with a third of key patents,* May 2019, available at: https://asia.nikkei.com/Spotlight/5G-networks/China-in-pole-position-for-5G-era-with-a-third-of-key-patents

Source: IHS Markit

In the 3GPP standardisation process between 2015 and the first half of 2018, Nokia and Ericsson had a little bit more than 5000 contributions approved which is more than Chinese vendors Huawei and ZTE.

Appendix F ***Figure 22: Number of approved 5G contributions (3GPP) – 2015 to 2018 H1***



Source: IHS Markit

Stakeholder opinion

According to the Open Public Consultation, the potential lack of global standards has been seen as very relevant as a barrier to exploitation according to the majority of stakeholders in the categories of business association, large organization, EU citizen, NGO and public authority.

4.4. Insufficient structural capacity of the EU value chains in responding to requirements set by technological developments for smart networks and services

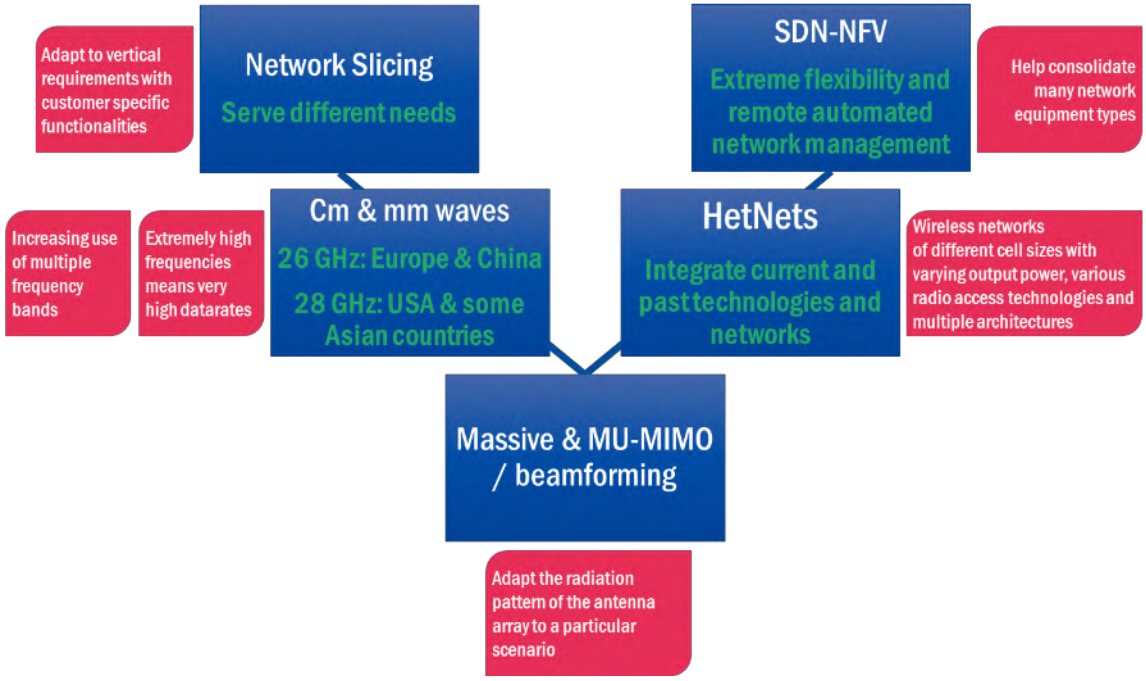
The future smart networks will be an infrastructure relying heavily on advanced digital solutions, that to be developed require the involvement of actors beyond the traditional telecommunication value chain. Furthermore, the services that would be built on top of this infrastructure will have to address the needs of multiple vertical industries (ranging from automotive and manufacturing to transportation, energy, and health). For these industries the future infrastructure and the associated digital services will become critical, which requires their involvement in both defining the requirements and validating its implementation.

4.4.1. A future infrastructure relying heavily on advanced digital solutions

The development of future smart networks and services will require important interactions between the research on future telecommunication networks technologies and other digital technologies. A lack in synergies between these research activities would significantly reduce the potential impact of the initiative.

With 5G, software technologies have taken a critical role in the development of the future generations of telecommunication networks. The development of network slicing and SDN (Software Defined Networks) and NFV (Network Function Virtualization) are key components of the 5G technological stack.

Appendix G ***Figure 23: Examples of 5G Technology Enabler***



Source: IDATE DigiWorld, 5G IoT – Market Opportunities in the Vertical Industries, 2018.

This rising importance of software is impacting the research ecosystem of the telecommunication industry. It requires dedicated investment in software technologies, potentially reaching out of the traditional telecom value chain. A primary example of this need to reach beyond traditional research ecosystem is around the question of cybersecurity. A more important role of software in the network architecture increases the importance of research collaborations between cybersecurity players and telecommunication actors.

Furthermore, the development of an infrastructure able to fit the needs of the future "Smart Services" also requires integration and cooperation with other fields of research that reach beyond pure telecom infrastructure research.

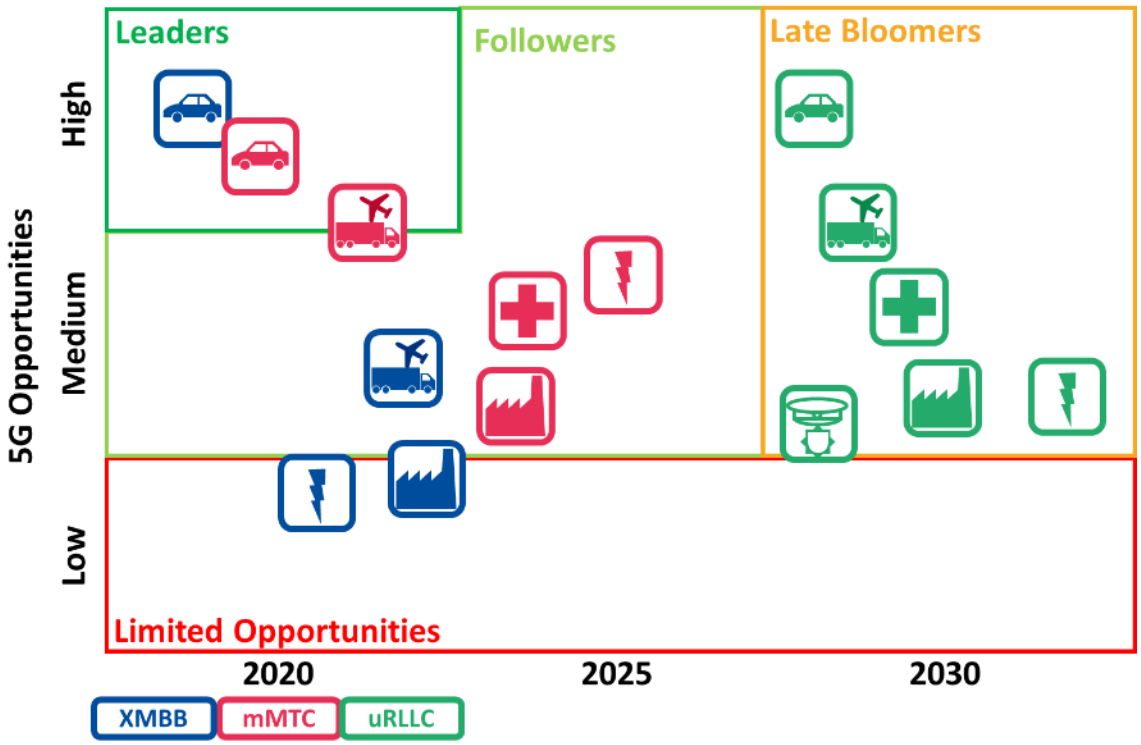
Stakeholder opinion

As such it appears necessary to many stakeholders' interviewed to ensure that future Smart Networks and Services research is sufficiently connected to research in IoT, but also edge computing, artificial intelligence (especially at the edge of the network), cybersecurity and cloud. These technologies will indeed by essential for the development of the future smart services and will also be directly applied to the network infrastructure themselves.

4.4.2. An infrastructure critical for the adoption of digital solutions in many industries

The future network infrastructure is set to become a critical infrastructure for numerous industries that are transforming themselves by progressively adopting digital technologies. The initial research on 5G (as presented above in section 1) has started to mobilise actors beyond the telecommunication industry and dedicated professional associations (such as the 5G AA and 5G ACIA) have been set-up to facilitate the collaboration between the fields.

Appendix H ***Prospects of adoption of 5G in vertical use cases, by sector (Automotive, Transport, Energy, Health, Manufacturing, Public Services) and technologies (eXtended Mobile Broadband, massive Machine Type Communication, ultra-Reliable Low Latency Communications).***



Source: IDATE DigiWorld, 5G IoT – Market Opportunities in the Vertical Industries, 2018.

Future research on 5G, beyond 5G and 6G capabilities will thus have to take into account the requirements from the vertical players. The integration of the players from the vertical industries into Smart Networks and Services research will have to be strengthened. This investment of vertical players is necessary in order to develop both the research on future smart services needed by the various industries to transform themselves and an infrastructure able to meet their requirements.

Stakeholder opinion

The stakeholders interviewed support this vision and insist on the need to have a movement from both the telecommunication industry and the vertical industries to build future smart networks and services and on the necessity of a future programme to encourage such movement. Indeed, vertical industries role is key from the definition of the topics of the research (meeting their requirements) to the evaluation of the technology (applicability) but also in measuring the business approach (value creation) brought by the network technologies.

For the majority of interviewees with no clear distinction of specific category of stakeholders, the involvement of industries is key so that the expansion of the value chain beyond the traditional telecom one is required with notably the integration of vertical players. As a consequence, interviewees insist on the necessity to involve a wide variety of players in the structure of the research program, which is key to understand and to take into account the diversity of verticals' requirements like security, network coverage, energy consumption, ultra-low latency round trip.

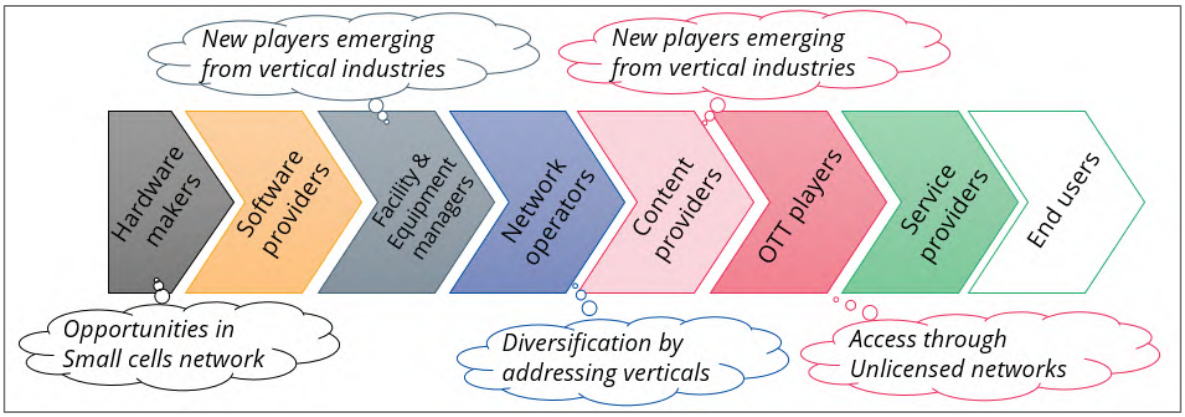
4.4.3. An infrastructure that will require structural changes in various value chains

The telecommunication industry has been characterized by rapid changes triggered by the deregulation of markets, the increased competition and advancing technologies. At the industry level, mobile network operators have traditionally controlled and managed most of the value chain (with the support of OEMs

developing the technologies), but the mobile ecosystem has evolved from a linear relationship into a network of specific companies involved at different stages in the value chain.

The emergence of new modes of communication like 5G is impacting the existing connectivity ecosystem. Indeed, 5G will not only enable new applications and services but also enable more new players to provide connectivity, services and even infrastructure. The virtualisation principle of 5G, for instance, will provide from the end-user perspective a unified network relying on several connectivity providers exploiting various technologies and infrastructures. It can be thus expected that more players will participate in the connectivity value chain.

Appendix I ***Opportunities of evolution of the value chain***



Source: IDATE DigiWorld, *5G IoT*, November 2018

Current connectivity providers (MNOs, MVNOs) will take the opportunity of these new technologies to try to diversify their offer and address new market segments (in specific verticals, including manufacturing) as a way to compensate declining consumer revenues.

Hardware equipment manufacturers can also see these new technologies as an opportunity to diversify their business modelling bundling equipment with connectivity service provisioning for example in the small cell area.

Some industrial solution providers, and potentially manufacturers, will also play a role in the new communication value chains, not only as content and service providers, but also as connectivity provider, infrastructure providers. The opening of vertical markets will also open up space for existing actors of the wireless industry to target specific roles for vertical industries. The emergence of new possible roles will offer opportunities for both new and existing players within the vertical value chains.

Appendix J ***Figure 26: New connectivity business models enabled by 5G***

Source: IDATE DigiWorld, *5G IoT*, November 2018

This is reinforced by the integration of direct, proximity communications (such as public safety services or V2V, V2I) in the 5G standards, removing partially or even entirely in some case the need for a mobile operator in the value chain.

These evolutions of the value chain have a potential to disrupt existing businesses, and could threaten established European actors. They could also be seen as opportunities for Europe to reposition its industry and take a larger part in the digital value chain by relying on its strong existing industries. This will require dedicated actions to support the evolution of the European industrial ecosystems and support synergies between industries.

Stakeholder opinion

According to interviewees with no clear distinction of specific category of stakeholders, the value chain needs to evolve with players emerging from vertical industries. It will give the opportunity to provide new business models such as "Anything as a Service" model allowed by new technologies that provide flexible and open infrastructure.

4.5. Too slow and uneven a development of 5G infrastructure

It is important to note that, although deployment issues are clearly beyond the scope of research programme, the investment need for the deployment of future network can strongly impact future research on smart networks and services.

Indeed, an insufficient investment in the deployment of 5G network in Europe would result both in delays in future research on networks by European players (no need to research solutions beyond 5G if 5G is not deploying), and in research on the associated smart services (which require a deployed infrastructure).

Addressing deployment issues, and ensuring synergies between deployment and research activities is thus important to support R&I activities in the field, it is also of critical importance to ensure the development the European digital market.

The current deployment of 5G in Europe suffers from several factors that delay it in comparison to other regions of the world:

A lack of investment in the deployment of the new infrastructure
Insufficient synergies between national and European initiatives supporting 5G
A lack of coordination of spectrum policies

4.5.1. A lack of investment in the deployment of the new infrastructure

The early development of 5G technology shows an increasing competition at the global level on network technologies and deployments of future infrastructure. The current state of play can be seen as a menace for European telecommunication equipment providers.

According to GSMA, a first stage of 5G investments corresponds to early deployments between 2018 and 2020 with $ 140 billion spent in the USA, South Korea, Japan, and China. It corresponds to two thirds of the global 5G CAPEX. The five largest European countries will contribute for $30 billion and GCC players will spend roughly $5 billion.

During the 2021-2023 period, Europe should double its 5G Capex reaching $ 100 billion as more EU Member States get 5G commercial services. In Asia and in the USA, 5G geographical deployment continue to expand.

After 2024, lagging countries in Latin America, Commonwealth of Independent States Middle East North Africa and other African countries will start to implement 5G infrastructures.

Some mobile operators have already announced their investments in 5G networks for the coming years:

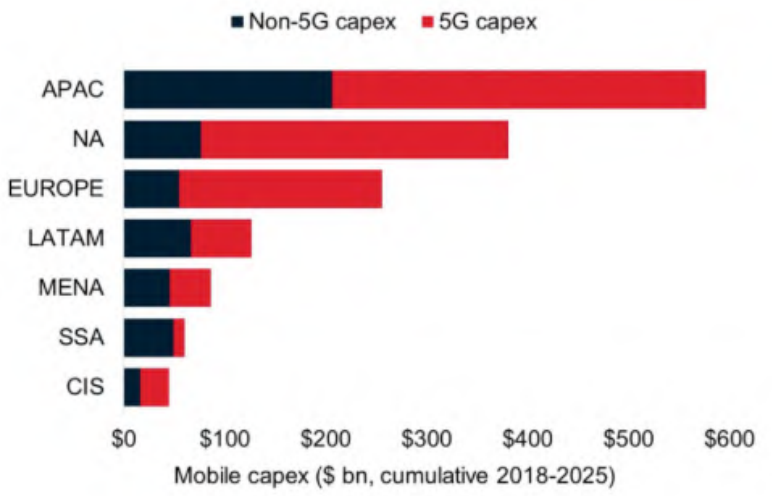
Deutsche Telekom will invest 20 billion EUR in its 5G network for the 2018-2021 period and targets 99% population coverage in 2025.
U.K. operator Three has indicated that it will invest $2.57 billion in getting ready for 5G.

In South Korea, SKT invested 5 billion USD between 2017 and 2019 to build the first part of its 5G network and KT announced a 5G investment of 20.5 billion USD between 2018 and 2023.
Japanese incumbent, NTT Docomo will spend 8.8 billion USD between 2018 and 2023 on its 5G network.
The US mobile operators have awarded multi-year contracts for 5G deployment to Samsung, Ericsson and Nokia. T-Mobile signed two contracts of $ 3.5 billion each to Nokia and Ericsson.
It is expected that the Radio Access Network (RAN) will represent 80% of the total CAPEX whereas the core network will amount for 20% of the total.

In China, the share of network equipment awarded to foreign vendors is controlled by the government. Huawei and ZTE are expected to get the lion's share of network equipment for 5G networks in China. Consequently, Nokia and Ericsson are likely to get a lower share of the 5G infrastructure market in China compared to 4G.

China is expected to deploy hundreds of thousands of 5G base stations in the coming years whereas South Korea had already installed more than 90,000 5G base stations in October 2019. Ramp-up is going to be much slower in Europe with only hundreds of 5G base stations installed at the same date. This discrepancy in investment timetables might favour Chinese vendors against European ones.

Appendix K ***Mobile capex by region***



Source: GSMA Intelligence

Stakeholder opinion

According to the Open Public Consultation, a very large majority of respondents from the categories of academia, business association, SMEs, large organizations and EU citizen agree on the high relevance to address the innovation gap in the Europe in translating the results of connectivity, cloud and Internet of Things devices research.

This vision is also supported by almost all interviewees in the need from Europe to invest in the development of such technologies but above all to help bringing them to commercialization with trials and development of adapted use cases.

4.5.2. A lack of synergies between national and European initiatives supporting 5G

Past activities around 5G have seen the multiplication of initiatives supporting 5G research as well as 5G deployments in Europe at the European, Member States or Local level. These initiatives often miss opportunities for synergies and coordination.

The European 5G Infrastructure Public Private Partnership (5G-PPP) represents a 3.5 Billion investment in 5G with € 700 million of public investment. Public funding for Phase 1 (2014-2016) was €128 million

and it should be noted that overall EU investments from 2007 to 2013 amount to more than €600m in research on future networks, half of which was allocated to wireless technologies contributing to development of 4G and beyond 4G. Phase 2 of the 5G-PPP represented 149 M€ and Phase 3 the remaining budget (423 M€). Work has already started on beyond 5G as 18M€ have been granted by the European Commission for 6 projects.

Many European countries have launched national R&D programmes which are generally restricted to national participants. As an illustration, the table below shows national 5G research & development programs in Finland, Germany, Spain and in the United Kingdom. Even though the share dedicated to 5G cannot be identified exactly, this amount is quite high already in the UK and in Germany.

Appendix L ***: National 5G R&D programmes***

Country	National 5G R&D programmes
Finland	Business Finland is a publicly funded expert organisation for financing research, development and innovation in Finland with 467 MEUR of funding in 2016 (including 6 MEUR from EU structural funds) for 3,760 projects. Business Finland pushed the 5thGear program with 200 MEUR funding for 2015-2019.
France	Many R&D projects on 5G financed by the national research agency ANR
Germany	100 MEUR from the "Gigabit Germany Initiative for the Future" 80 MEUR from the "5G Initiative for Germany"
Spain	In March 2019, the Spanish Administration announced it will give €20 million in public funds to two 5G pilot schemes to be carried out by Telefonica and Vodafone
UK	740 MGBP (834 MEUR) to 5G trials and full fibre deployment across the UK by 2020/2021

Source: IDATE DigiWorld

It should be noted that 5G projects financed by national authorities often overlap the research and development thematic covered by European programs.

Even though players involved in national R&D programs and H2020 projects are mainly the same (vendors, universities, operators…), there is a risk of duplication of the financing effort at national and European level. More coordination is needed at European level in order to optimise resources dedicated to 5G research and development.

Stakeholder opinion

According to the Open Public Consultation, the market fragmentation due to lack of industrial policy and implementation strategies is seen as very relevant for R&I efforts at Europe level especially clearly expressed by the majority of SMEs. For the other categories including academics, business association, large organization and EU citizen, the topic remains relevant but at a lesser level.

This vision is in accordance with interviews where they outline the need to make a link between research and deployment, especially requiring a focus on services and supporting use cases very early in the research program. A pragmatic approach is required in order to have the ability to translate innovation in commercialization. Also, many interviewees from different categories of players mentioned how Europe is good at technologies research but should work on business models and value generation. Lastly, interviewees also mention the lack of coordination to target a single market, lack of incentives to take research to commercialization stage and lack of global vision.

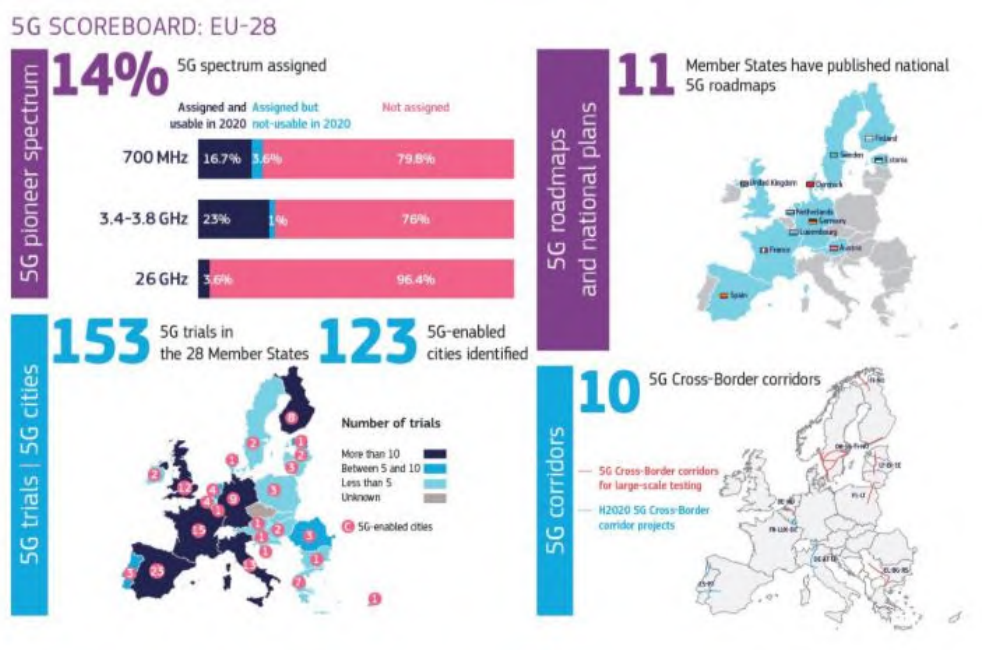
4.5.3. A lack of coordination of spectrum policies

5G pioneer bands identified at EU level are the 700 MHz, the 3.6 GHz (3.4-3.8 GHz) and the 26 GHz (24.25-27.5 GHz) frequencies. Whereas the 700 MHz band has been harmonised through an EC Implementing Decision (EU) 2016(687) of 28 April 2016, a '5G-ready' amendment of the 3.6 GHz

implementing decision has been adopted in January 2019. The European Commission adopted an Implementing Decision to harmonise spectrum in the 26 GHz frequencies in May 2019.

Member States have adopted a common deadline for the effective usability of pioneer spectrum in the European Electronic Communications Code, namely the 3.6 GHz band and at least 1 GHz within the 26 GHz band have to be assigned in all Member States by end of 2020.

Appendix M ***5G scoreboard – June 2019***



Source: European Commission[51]

However, there is no coordination between EU Member States regarding spectrum allocation conditions and at the end of June 2019**,** only 14.2% of the Pioneer Bands had been assigned in the EU (China is in a similar position). Bands are different in other regions of the world and can therefore not be totally compared. USA has already allocated all its spectrum for low bands, Japan and South Korea have almost allocated all their spectrum for mid and high bands (while Europe is lagging behind).

Lack of coordination of spectrum policies in EU creates uncertainties for the operators. This is already the case for bands as mentioned above. The use of frequency bands above 100 GHz will mean more R&D and more certainty regarding availability timetable for experimentations and future commercial use. A common approach to spectrum allocations is needed in order to limit the risk for the industry, as there is a risk that Member States will use the sales of spectrum as an alternative to general taxation, as has been done in the past.

With combination of verticals, combination of multiple regulatory environments become a challenge, whilst public actors may be called upon to play an increased role considering that many of the targeted verticals (healthcare, automotive/transport..) have a clear public policy dimension, different from broadband which is primarily driven by commercial forces (so regulation is mainly about fair competition, accessibility and consumer protection).

Stakeholder opinion

According to the Open Public Consultation, business associations, SMEs and large organizations find very relevant the regulation in the field of radio spectrum allocation.

[51] European 5G Observatory, *5G Scoreboard*, June 2019 http://5gobservatory.eu/observatory-overview/5g-scoreboards/

For several interviewees from different categories, a strong coordination in Europe is required for spectrum harmonization involving the implication of Member States very early in the program. Indeed the spectrum fragmentation in cost and allocation is seen as a key issue (very irregular depending on the countries).

4.6. Insufficient capacity of 5G to respond to advanced communication requirements

Future digital use cases such as super-immersive multimedia and super-high definition video, massive scale communications (IoT) for anything and anywhere, use cases requiring super-precision 3D positioning, and XR experience (AR+VR+MR) will have very demanding telecommunication requirements that exceed the foreseen capabilities of 5G, even in its most advanced roadmaps.

These future use cases include:

Super-immersive multimedia and super-high definition video: going from 8K to 64 K video, with the integration of sensing, imaging and highly accurate positioning capabilities with mobility to enable the provision of new applications. The development of Five-dimension (5D) services, integrating all human sense information (sight, hearing, touch, smell and taste) is in early development and should be available in about 10 years from now. It will provide a truly immersive experience and new services such as telepresence.

Holographic telepresence: Within a 10 year's timeframe, new forms of interaction will become possible leading to a true immersion into a distant environment. Holographic communications, using multiple-view cameras, will require data rates in the order of Tbps, which are not supported by 5G.

XR Experience (AR+VR+MR): XR reality encompasses virtual reality (VR), augmented reality (AR) and mixed reality (MR). Future devices will include haptic interfaces, earphones, glasses and wearable displays that will replace smartphones and provide a totally new user experience.

Massive-scale communications (IoT) for anything and anywhere: 6G networks will support extreme massive connectivity, with more than 500 billion connected things are expected worldwide by 2030. 6G will target capacity expansion to offer high throughput and continuous connectivity. Wider coverage is also planned, including bringing connectivity at sea and in the air.

Smart City: The objectives are improvements of life quality, environmental monitoring, traffic control and city management automation. 6G smart city applications will include support for user-centric M2M communication and use low-cost and low-energy consuming sensors that will interact with each other. Autonomous vehicles will combine wireless networks, sensing and distributed AI.

Use cases requiring super-precision 3D positioning: Many use cases will require super-precision 3D positioning such as commercial UAVs, ground-robotics navigation, lane-level navigation, industrial navigation and tracking, and heavy-machine navigation. 6G will foster the Industry 4.0 revolution and will see new semiconductor and integrated circuit innovations.

Based on this long-term perspective, the early requirement of future communication networks are starting to appear. Some of them can be considered as extensions of 5G requirements, but other are clearly disruptive, requiring major evolutions beyond the state of the art.

Appendix N ***5G and 6G technology requirements***

KPI	5G	6G
Traffic capacity	10 Mbps/m²	~1-10 Gbps/m^3
Peak data rate DL	20 Gbps	1 Tbps
Peak data rate UL	10 Gbps	1 Tbps
Uniform user experience	50 Mbps 2D everywhere	10 Gbps 3D everywhere
Latency (radio interface)	1 msec	0.1 msec
Jitter	Not specified	1 micro second
Reliability (frame error rate)	10^{-5}	10^{-9}
Energy/bit	Not specified	1 pJ/bit
Localisation precision	10 cm on 2D	1 cm on 3D

Legend: evolution, disruptive

Source: IDATE DigiWorld based on *6G - The Next Frontier*, 2019, Emilio Calvanese Strinati,et al., *6G: So, what happens in 2030?*, November 2019

Reaching these future requirements, will require new technological paradigms through the use of spectrum in the THz range (frequencies from 300 GHz to 10THz), innovations in semiconductors, optics and new materials, through a new architecture combining computation and communication resources, and relying heavily on artificial intelligence and machine learning. Energy-efficient communication strategies are also expected to become increasingly important, especially in view of a pervasive deployment of the Internet of Things, with myriads of tiny sensors. Energy harvesting mechanisms and advanced wireless-charging technologies will be developed with a focus on laser-charging techniques (potential of delivery of 2W of power up to a distance of about 10 metres).

Stakeholder opinion

According to respondents from both the Open Public Consultation and interviews, and for a high proportion of SMEs, there is an agreement on the necessity to enlarge the technological scope of the research program beyond 5G. Typically, in order to address critical applications, security should be addressed as well as a wide array of technologies including network intelligence, network automation, network softwarisation, network slicing, edge computing, cybersecurity, machine learning, Artificial Intelligence, IoT, robotics, high performance computing…

4.7. Increasing challenges of digital services toward ethics privacy and cybersecurity

The development of digital services in recent years has seen the rise of several challenges for EU citizen regarding their privacy, data protection, cyber security or more generally ethical concerns.

Several fundamental human principles can be challenged by the development of future smart networks and services, such as:

Identity and Reputation: Several innovative smart services challenges the notions of Identity (relation that one bears to oneself) and of Reputation (relation that others bears to oneself). The limitation of digital technologies to define rationally such notions that are, by human nature, multiple, complex and changing raises several challenges. From the right to be forgotten to the right to have complex and evolving identities that cannot rely on a single online or offline identity. As future smart services are likely to more and more store but also increasingly generate automatically (through profiling and

presentation) identities and reputation, serious challenges can be envisioned on the definition of human identity and reputation. The rise in profiling approach and the rising use of digital profile as a basis for real life services and interactions, and technologies such as Artificial Intelligence can be seen as threatening these human fundamental notions.

Relationships: Digital services based relationships also face the same danger as identity: to try to define rationally, in a Boolean approach the complexity and evolving nature of human relationships. The rise of digitally mediated relationships questions the future of human relationships as physical interactions and non-verbal language, key to human interactions, are for now mostly left out of digital relationships. Concerns can be raised both for those who are left out of the online conversation and for those for which the online conversation replace to a large extent real relationships. Questions of how to consider and handle relationships with purely digital avatars will also have to be handled as such relationships, once considered as farfetched science fiction become closer and closer to our reality.

Culture: The disappearance of traditional boundaries of time and space enabled by smart networks and services is fuelling the definition of ever multiplying alternative cultures as group cutting across traditional boundaries come to define their own set of symbols and values that are coherent and meaningful in their understanding. At the same time the rapid ubiquitous communication mechanisms offered by new digital services enable the rapid spread of cultural elements. The application of evolutionary principles to cultural elements shows that faced to this increased creativity and competition traditional cultural elements could be put to risk. The human impact of putting cultures at risks, with the risk of violent reaction and protective isolative move is a serious challenge.

Motivation and Attention: The collective data and knowledge production, publication, archiving and research capacity has since long far exceeded the human brain ability to process it. This raises serious challenges to both human attention (capacity to freely focus) and human motivation (capacity to freely choose on which information to process).

Responsibility: The rising complexity of digital systems, often based on networks and sometimes decentralized, combined with the multiple roles of stakeholders result in near to impossible attribution of responsibilities in case of failure, error, or denegation of complex digital services. This will have stronger and stronger consequences as such systems get more complex and more intertwined with Physical devices in the vertical industries. Difficulty to attribute responsibility raises the double risk of either putting too much constraint on smart services providers, and therefore impeding innovation capacity, or to the contrary that the risk entirely reposes on end users.

Fairness: The existing risk of "Digital divide" can in a near future be significantly increased both in scale and impact. The differences in access to future network infrastructure and digital services, is being reinforced in a knowledge divide, which create the risk of a 2 speed society with a strong divide between those who master and understand digital technologies and their impact on society and life and those who don't. Additionally, questions of fairness, linked with responsibility, of automated decisions and algorithms will have to be raised. The intentions, and views of the world of the designer are embedded in every creation, therefore the fairness of the decisions can always be questioned even for supposedly neutral and machine automated choices.

Safety and Privacy: Safety concerns are on the rise as digital technologies are having a stronger and stronger impact on everyday lives not only in online world but also increasingly offline. The rise of privacy concerns is also a well-documented risk as personal data collection; archiving, processing, transfer becomes the norm in many digital scenarios. Although these two notions are for now well covered by regulations, past example shows that these regulations were often put into place after the technology development, and that future development could challenge the status quo.

Stakeholder opinion

The relevance of this topic has been asked among stakeholders through the Open Public Consultation especially regarding the concerns with using Smart Networks and Services platforms for ethical, privacy, security, or EMF reasons. For a majority of respondents in several categories including academia, SMEs, large organizations, EU citizen the topic is evaluated as very relevant. For business association and public authority, the topic is seen as relevant but at a lower degree (which can be taken as a hint that this issue is unlikely to resolve only through market dynamics).

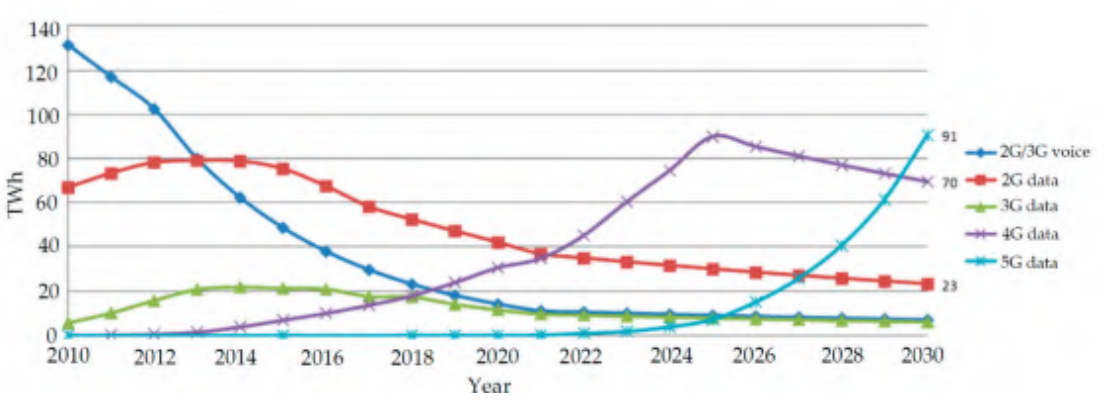
4.8. Lack of energy efficient technological solutions for future network infrastructures

The development and deployment of any infrastructure at a European scale will require significant energy consumption, resulting in increased emissions of greenhouse gases. Beyond this simple fact, the current lack of energy efficient technological solutions for future smart networks and services raise a significant threat in term of future energy consumption throughout the lifespan of the infrastructure.

Current feedbacks on the deployment of early 5G networks points toward an increase in energy consumption of the network. Furthermore, the development of new solutions, such as Edge Computing, that are likely to complement rather than replace cloud-based solutions will result in the deployment of additional computing resources, with increased energy consumption.

Current perspective on the electricity consumption of mobile network generation point to several years of steep growth of the energy consumption of new networks while legacy solution decreases slowly as they are rolled back.

Appendix O ***Expected electricity usage of wireless networks***



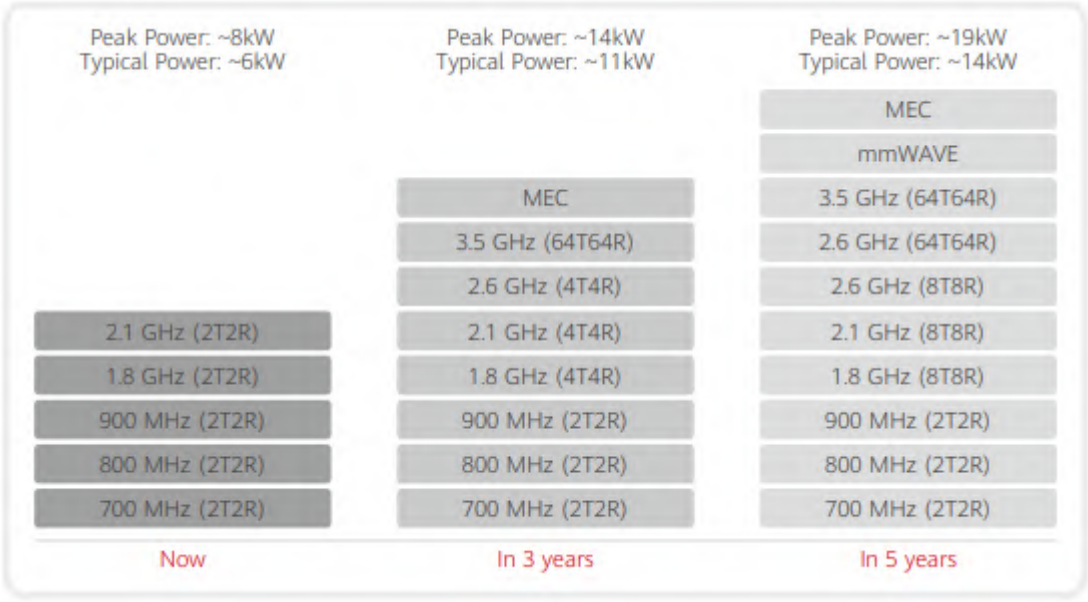
Source: Symetry/MDPI[52]

About 80% of the energy consumption in a network is due to base stations. In a recent whitepaper[53], Huawei indicates that "According to the measured data of multiple operators, the power consumption of one band 5G equipment (64T64R, 3.5 GHz Massive MIMO, including one BBU and three AAU/RRUs) is 300% to 350% of 4G with the same configuration. A 5G BBU is about 300 W while an AAU is about 900 W at 30% load rate (peak is about 1200 W to 1400 W)."

[52] https://www.mdpi.com/2073-8994/11/3/408/pdf

[53] https://carrier.huawei.com/~/media/CNBGV2/download/products/network-energy/5G-Telecom-Energy-Target-Network-White-Paper.pdf

Appendix P ***Power consumption of frequency evolution***



Source: Huawei.

Furthermore, beyond energy issues, the development and deployment of a new infrastructure, as well as the development of new services requiring new devices (including new forms of devices, such as advanced AR/VR solutions or IoT devices) will require the extraction and transformation of primary resources that is very likely to have negative impacts on local environments.

As such and without a specific attention to mitigate these effects, the development of a future smart networks and services is likely to have major environmental impacts, which may not be compatible with other engagements and policies of the European Union and its Member States.

Stakeholder opinion

Based on interviews, this topic is especially seen as primordial for the category of verticals who mention the importance of energy evoking the need to reduce energy consumption as well as the ability to use renewable energies (with the suggestion of new regulation).

This is a cross-referenced vision with the Open Public Consultation in which drastically reducing energy consumption of future smart network and service platforms is seen as very relevant for a couple of categories including academia, SMEs, large organizations, EU citizen and public authority; only the category of business association finds the issue at a lesser level of relevance.

5. ADDITIONAL INFORMATION ON POLICY OPTIONS

Degree of coverage of the different functionalities by policy option

Type and composition of actors (including openness and roles)

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
What is possible? *Any legal entity* in a consortia can apply to Horizon Europe calls in ad hoc combinations Calls are open to participation from across Europe and the world (not all entities from third countries are eligible for funding) ***What is limited?*** Systematic/ structured engagement with public authorities, MS, regulators, standard making bodies, foundations and NGOs. ***What is not possible?*** To have a joint programme of R&I activities between the EU and committed partners that is implemented based on a common vision.	*What is possible?* Partners can include *any national funding body or governmental research organisation*, Possible to include also *other type of actors*, including foundations. *What is limited?* Requires substantial national R&I programmes (competitive or institutional) in the field. Usually only legal entities from countries that are part of the consortia can apply to calls launched by the partnership, under national rules. *What is not possible?* To have industry/ private sector as partners.	*What is possible?* Partners can include *MS and Associated Countries*. *What is limited?* Non-associated third countries can only be included as partners if foreseen in the basic act and subjected to conclusion of dedicated international agreements. Needs good geographical coverage – participation of at least 40% of Member States is required Requires substantial national R&I programmes (competitive or institutional) in the field. While by default the FP rules apply for eligibility for funding/participation, in practice (subject to derogation) often only legal entities from countries that are Participating States can apply to calls launched by the partnership, under national rules. *What is not possible?* To have industry/ private sector as partners.	*What is possible?* Suitable for *all types of partners*: private and/or public partners, including MS, regions, foundations. By default open to AC/ 3rd countries, but subject to policy considerations. Can cover a *large and changing community.* HE rules apply by default to calls included in the FP Work Programme, so any legal entity can apply to these. *What is limited?* If MS launch calls under their responsibility, usually only legal entities from countries that are part of the consortia can apply to these, under national rules *What is not possible?*	*What is possible?* Suitable for *all types of partners*: private and/or public partners, including MS, foundations. By default open to legal entities from AC/ 3rd countries, but subject to policy considerations. In case of countries participating: non-associated third countries can only be included as partners if foreseen in the basic act and subjected to conclusion of dedicated international agreements HE rules apply by default, so any legal entity can apply to partnership calls. *What is limited?* Requires a *rather stable set of partners* (e.g. if a sector has small number of key companies). Basic act can foresee exceptions for participation in calls / eligibility for funding. *What is not possible?*

Type and range of activities (including flexibility and level of integration)

Option 0: Horizon Europe calls	**Option 2: Co-funded**	**Option 3: Institutionalised Art 185**	**Option 1: Co-programmed**	**Option 3: Institutionalised Art 187**
What is possible? Horizon Europe standard actions that allow *broad range of individual activities* from R&I to TRL 7 or sometimes higher. Calls for proposals published in the Work Programmes of Horizon Europe (adopted via comitology). ***What is limited?*** ***What is not possible?*** To design and implement in a systemic approach a portfolio of actions. To leverage additional activities and investments beyond the direct scope of the funded actions	*What is possible?* Activities may range from R&I, pilot, deployment actions to training and mobility, dissemination and exploitation, but according to national programmes and rules. Decision and implementation by "beneficiaries" (partners in the co-fund grant agreement) e.g. through institutional funding programmes, or by "third parties" receiving financial support, following calls for proposals launched by the consortium. *What is limited?* Scale and scope of the programme the resulting funded R&I actions and depend on the participating programmes, typically smaller in scale than FP projects	*What is possible?* Horizon Europe standard actions that allow a broad range of coordinated activities from R&I to uptake. In case of implementation based on national rules (subject to derogation) Activities according to national programmes and rules. Allows integrating national funding and Union funding into the joint funding of projects	*What is possible?* *Horizon Europe standard actions* that allow a broad range of coordinated activities from R&I to uptake. The association representing private partners allows to continuously build further on the results of previous projects, including activities related to regulations and standardisation and developing synergies with other funds Union contribution is implemented via calls for proposals published in the Work Programmes of Horizon Europe based on the input from partners (adopted via comitology). Open and flexible form that is simple and easy to manage. *What is limited?* Limited control over precise call definition, resulting projects and outcomes, as they are implemented by EC agencies.	*What is possible?* *HE standard actions* that allow to build a portfolio with broad range of activities from research to market uptake. The back-office allows dedicated staff to implement integrated portfolio of projects, allowing to build a "system" (e.g. *hydrogen*) via pipeline of support to accelerate and scale up the take-up of results of the partnership, including those related to regulations and standardisation and developing synergies with other funds. E.g. setting up biorefinery plants and promoting their replication by additional investments from MS/ private sector. Procuring/purchasing jointly used equipment (e.g. HPC) Allows integrating national funding and Union funding into the joint funding of projects *What is limited?* Limited flexibility because objectives, range of activities and partners are defined in the Regulation, and negotiated in the Council (EP).

Directionality

Option 0: Horizon Europe calls	**Option 2: Co-funded**	**Option 3: Institutionalised Art 185**	**Option 1: Co-programmed**	**Option 3: Institutionalised Art 187**
What is possible? Strategic Plan (as implementing act), annual work programmes (via comitology). Possible also to base call topics on existing or to be developed SRIA/roadmap ***What is limited?*** No continuity in support of priorities beyond the coverage of the strategic plan (4 years) and budget (2 years Annual work programme). ***What is not possible?*** Coordinated implementation and funding linked to the concrete objectives/ roadmap, since part of overall project portfolio managed by agency	*What is possible?* Strategic R&I agenda/roadmap agreed between partners and EC Annual work programme drafted by partners, approved by EC Objectives and commitments are set in the Grant Agreement.	*What is possible?* Strategic R&I agenda/roadmap agreed between partners and EC Objectives and commitments are set in the legal base. Annual work programme drafted by partners, approved by EC Commitments include obligation for financial contributions (e.g. to administrative costs, from national R&I programmes).	*What is possible?* Strategic R&I agenda/roadmap agreed between partners and EC Objectives and commitments are set in the contractual arrangement. Input to FP annual work programme drafted by partners, finalised by EC (comitology) Commitments are political/best effort, but usually fulfilled	*What is possible?* Strategic R&I agenda/roadmap agreed between partners and EC Objectives and commitments are set in the legal base. Annual work programme drafted by partners, approved by EC(veto-right in governance) Commitments include obligation for financial contributions (e.g. to administrative costs, from national R&I programmes).

Coherence (internal and external)

Option 0: Horizon Europe calls	**Option 2: Co-funded**	**Option 3: Institutionalised Art 185**	**Option 1: Co-programmed**	**Option 3: Institutionalised Art 187**
What is possible? Coherence between different parts of the Annual Work programme of the FP ensured by EC ***What is limited?*** Synergies with other programmes or industrial strategies ***What is not possible?*** Synergies with national/regional programmes and activities	*What is possible?* Coherence among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and EC Synergies with national/regional programmes and activities *What is limited?* Synergies with other programmes or industrial strategies *What is not possible?*	*What is possible?* Coherence among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and EC Synergies with national/regional programmes and activities Synergies with other programmes *What is limited?* Synergies with industrial strategies *What is not possible?*	*What is possible?* Coherence among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and EC If MS participate: Synergies with national/regional programmes and activities Synergies with industrial strategies *What is limited?* Synergies with other programmes *What is not possible?*	*What is possible?* Coherence among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and EC Synergies with other programmes or industrial strategies If MS participate: Synergies with national/regional programmes and activities *What is limited?* *What is not possible?*

6. ADDITIONAL INFORMATION ON GREEN DEAL ISSUES

This annex provides additional information on the Smart Networks and Services (SNS) initiative in relation to the carbon neutral objectives of Europe, as set out in the Green Deal initiative of the Commission. It suggests the need for an extended stakeholder base to reach these ambitious objectives, in view of the fast growing demand of users and industries for connected ICT services

SNS are expected to directly contribute to two key Sustainable Development Goals directly related to energy efficiency and reduction of carbon footprint: SDG 11 on sustainable cities and communities, and SDG 13 on Climate Actions. The targeted impact of SNS is twofold: i) SNS supports energy efficiency improvements of "vertical industries" using SNS to implement their digital business process; ii) drastic reduction and decarbonisation of the energy used for the operations of SNS platforms;

a) Energy savings enabled by SNS platforms

SNS has the potential to optimise the business processes of multiple industrial sectors through tight integration into their digital processes. It can hence enable energy savings and lowering of carbon footprint in other sectors. Already today, the GSMA and the Carbon Trust calculated that the use of mobile technology enabled a global reduction in emissions of around 2,135 million of tons CO2e in 2018[54] (global emission level in the order of 55000 millions of tons). These emissions savings were almost ten times greater than the global carbon footprint of the mobile industry itself.

Figure 1 below shows the ICT and connectivity gains that could apply to a number of sectors as analysed by GeSI[55]. It shows a potential gain of 12,100 millions of tons of CO^2 in 2030, which is the extra emission expected over the period. In that context, SNS would contribute to keep the carbon footprint of these sectors constant, rather than significantly increasing over the period.

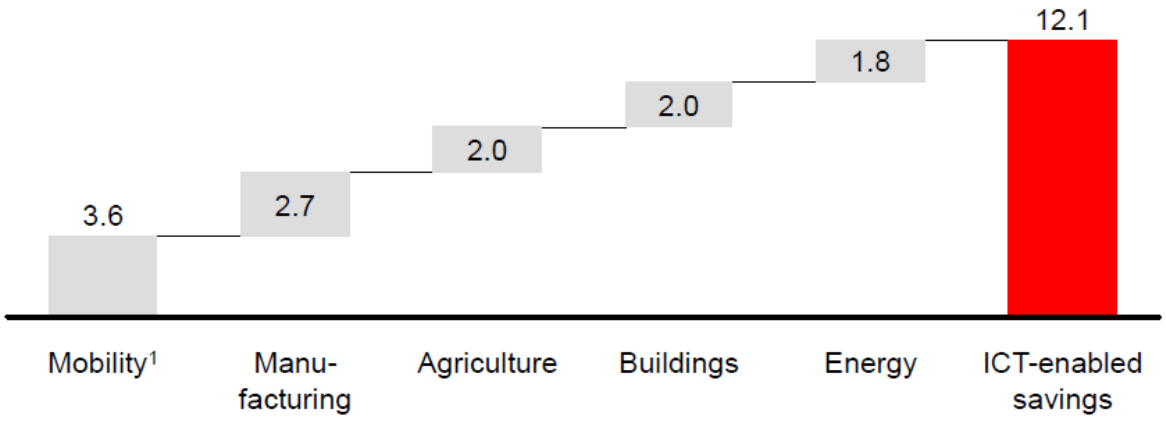
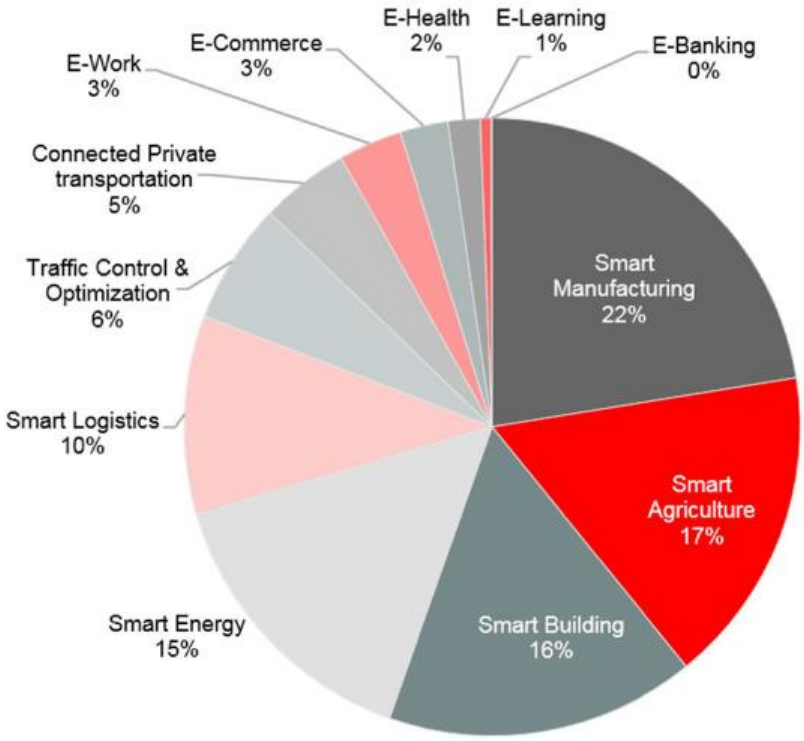


Figure 1, expected CO^2 abatement potential per sector.

[54] https://www.gsma.com/newsroom/press-release/mobile-technologies-enabling-huge-carbon-reductions-in-response-to-climate-emergency/

[55] Global eSustainabilty Initiative

Figure 2 shows the abatement potential of ICT for a number of use cases as also analysed by GeSI, with a 2030 timeline. These are based on conservative estimate not taking into account the future advanced capabilities of SNS platforms. For this reason, the SNS initiative has set itself an objective of 20 to 30 % energy reduction in at least two key industrial sectors, automotive and factories being identified at this stage. Reaching these objectives will require a clear involvement of the target industries, and the setup of pan European trials with Member States infrastructures in a number of cases (automotive, energy..)



b) <u>Energy efficiency of SNS platforms</u>

The telecommunications sector accounts for roughly 4% of global electricity consumption[56]. As explained in the core text, energy consumption of network platforms are set to increase over the next decade by a factor of about 10 if no specific action is undertaken. Several factors are contributing to such an increase:

- the continued growth of mobile traffic, with typical yearly growth rate between 50% and 100% as data usages get popular and high performance 4G networks get available;

- the densification of networks. This is a long term trend that will shift power consumption patterns from transmission towards computing. Today, the main source of energy consumption of mobile networks is in the radio access transmission, i.e. transporting information from the user device/smartphone to the access radio Base Station. This represents about 70 to 80% of the total energy consumption. Future networks will deploy much denser radio access points, closer to the users, to optimise capacity and reduce network latency. This

[56] 5G PPP Metro Haul project White Paper:"Optics Research for Future Smart Networks and Services", January 2020, developed by British Telecom, ADVA, Lexdens, University Politecnico de Catalunya, Fraunhofer HHI.

has two impacts: i) the device being closer to the radio access point, the needed transmitted power decreases; ii) as the device gets connected to many more access points during a mobile session, the computing power increases. As the need to process information closer to the user increases, computing becomes dominant in the energy consumption pattern of both the network and the device[57].

This evolution is well understood by the community and considered unsustainable in the longer term, and non-compatible with the objectives of the Paris agreement, to cap temperature increase at 1,5° maximum. In that context, the industry has already taken steps to drastically reduce energy consumption and carbon footprint, as exemplified by the release of the science-based pathway to reduce Greenhouse Gas (GHG) emissions across the telecoms sector[58]. This supports the GSMA's commitment to helping the mobile industry achieve Net Zero carbon emissions by 2050.

The new Science-Based Target (SBT) is the result of a collaboration between the International Telecommunication Union (ITU, the telecom agency of the United Nations), the Global eSustainability Initiative (GeSI), the GSM Association (GSMA), and the Science Based Target initiative[59] (SBTi) to develop a sector-specific decarbonisation pathway that allows ICT companies to set targets in line with the latest climate science. It includes emissions reductions trajectories for mobile, fixed and data centre operators to meet the Paris Agreement goal of limiting global warming to 1.5°c, designed to substantially reduce the risks and effects of climate change.

The SBT sets emissions trajectory reductions over the decade (2020-2030) for each ICT sub-sector. Mobile network operators adopting the SBT are required to reduce emissions by at least 45 per cent over this period. The initiative is based on an extended use of renewables for SNS platforms that will help to reduce carbon footprint. The SNS initiative is designed to support these industry objectives and to extend them further by a reduction of the energy needs of the infrastructure itself, targeted to 1/10 compared to the planned evolution. This later objective would keep energy needs of SNS platforms comparable to those of 2015, an objective considered as possible by GeSI for other industrial sectors[60] supported by SNS. Therefore, SNS sets an objective that is in line with that of other industrial sectors.

Reaching this objective requires a full value chain perspective, as energy consumption is diversely spread over terminals/device, network, and computing platform as described above. Therefore, SNS will develop energy consumption models, technologies and architectures enabling to decrease energy footprint of these platforms in line with the above objectives, as part of its R&I and industrial roadmap.

[57] A. Mämmelä and A. Anttonen, "Why will computing power need particular attention in future wireless devices?" IEEE Circuits and Systems Magazine, vol. 17, pp. 12-26, First Quarter 2017, work supported by the EU COHERENT project, http://www.ict-coherent.eu/

[58] https://www.gsma.com/gsmaeurope/news/sbti/

[59] A partnership between CDP, UN Global Compact, WRI and WWF.

[60] GeSI report #SMARTer2030, ICT Solutions for 21st Century Challenges, pages 8, 17.