



# Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe

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## **Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe**

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# Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe

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**Table of Contents**

**PART I. IMPACT ASSESSMENT STUDIES FOR THE CANDIDATE INSTITUTIONALISED EUROPEAN PARTNERSHIPS**

- 1. Overarching context to the impact assessment studies ..... 8
- 2. EU-Africa Global Health Candidate Institutionalised European Partnership ..... 33
- 3. Candidate Institutionalised European Partnership on Innovative Health ..... 156
- 4. Candidate Institutionalised European Partnership in High Performance Computing ..... 289
- 5. Candidate Institutionalised European Partnership in Key Digital Technologies ..... 415
- 6. Candidate Institutionalised European Partnership in Smart Networks and Services ..... 588
- 7. Candidate Institutionalised European Partnership in Metrology ..... 755
- 8. Candidate Institutionalised European Partnership on Transforming Europe’s Rail System .... 901
- 9. Candidate Institutionalised European Partnership for Integrated Air Traffic Management ... 1073
- 10. Candidate Institutionalised European Partnership on Clean Aviation ..... 1238
- 11. Candidate Institutionalised European Partnership on Clean Hydrogen ..... 1398
- 12. Candidate Institutionalised European Partnership on Safe and Automated Road Transport ..... 1584
- 13. Candidate Institutionalised European Partnership for a Circular Bio-based Europe ..... 1768
- 14. Candidate Institutionalised European Partnership for Innovative SMEs ..... 1945

**PART II. HORIZONTAL STUDIES**

- 1. Horizontal Analysis of Efficiency and Coherence in Implementation ..... 2088
- 2.. Impact Modelling of the Candidate Institutionalised European Partnerships ..... 2189

## Introduction

This Impact Assessment Study had the primary objective to support and provide input to the impact assessments of the first set of 13 European Institutionalised Partnerships based on Articles 185 and 187 of the Treaty on the Functioning of the EU (TFEU) that are envisaged to be funded under the new Framework Programme for Research and Innovation, Horizon Europe.

In addition, the Impact Assessment Study team contributed to future European policymaking on the overall European Partnership landscape by means of a horizontal analysis of the coherence and efficiency in the implementation of European partnerships. The purpose of this analysis was to draw the lessons learned from the implementation of the impact assessment methodology developed for this study and to formulate recommendations for the refinement and operational design of the criteria for the selection, implementation, monitoring, evaluation and phasing-out for the three types of European Partnerships. Finally, an impact modelling exercise was conducted in order to estimate the potential for longer-term future impacts of the candidate Institutionalised European partnerships in the economic and environmental sustainability spheres.

Technopolis Group was responsible for the overall coordination of the 13 specific impact assessment studies, the development of the common methodological framework, and the delivery of the horizontal analysis. It also conducted specific analyses that were common to all studies, acting as a 'horizontal' team, in collaboration with CEPS, IPM, Nomisma, and Optimat Ltd. For the implementation of the individual impact assessment studies, Technopolis Group collaborated with organisations that are key experts in specific fields covered by the candidate Institutionalised European Partnerships. These partner organisations were Aecom, Idate, Steer, Think, and Trinomics. Cambridge Econometrics took charge of the impact modelling exercise.

The Impact Assessment Study was conducted between July 2019 and January 2020. The 13 Impact Assessment Studies were conducted simultaneously, based upon a common methodological framework in order to maximise consistency and efficiency. The meta-framework reflected the Better Regulation Guidelines and operationalised the selection criteria for European Partnerships set out in the Horizon Europe Regulation. The 'Horizontal analysis of efficiency and coherence of implementation' was conducted in the same time period, building upon the information available on the 44 envisaged European Partnerships landscape as in May 2019, complemented with information on five envisaged European Partnerships as decided by the European Commission in October and November 2019.

This final report contains the reports of all individual impact assessment studies and the 'horizontal' analyses. It is structured in two parts, reflecting the two strands of analysis:

### **PART I. Impact Assessment Studies for the Candidate Institutionalised European Partnerships**

#### **1. Overarching context to the impact assessment studies**

This report sets out the overall policy context and methodological framework underlying the impact assessment studies for the candidate Institutionalised European Partnerships. It describes the changes in approach to the public-private and public-public partnerships under Horizon Europe compared to the previous EU Framework Programmes. An example is the requirement that all envisaged European Partnerships be implemented as either co-programmed, co-funded or institutionalised. The impact assessment studies will consider these three scenarios as the different options to be assessed, in compliance with the Better Regulation guidelines and against the functionalities that the candidate partnerships are expected to fulfil. The report describes the common methodological framework to assess the envisaged initiatives accordingly. The report also presents the landscape of European Partnerships at the level of Horizon Europe Pillar 2 clusters, which lay the grounds for all

of the impact assessment studies except the candidate Institutionalised European Partnership for Innovative SMEs.

## **2. EU-Africa Global Health Candidate Institutionalised European Partnership**

This initiative focuses on research and innovation in the area of infectious diseases, with a particular focus on sub-Saharan Africa. It will address the challenges of a sustained high burden of infectious diseases in Africa, as well as the (re)emergence of infectious diseases worldwide. Its objectives will thus be to contribute to a reduction of the burden of infectious diseases in sub-Saharan Africa and to the control of (re)emerging infectious diseases globally. It will do so through investments in relevant research and innovation actions, as well as by supporting the further development of essential research capacity in Africa. The study concluded that an Institutionalised Partnership under Art. 187 of the TFEU is the preferred option for the implementation of this initiative.

## **3. Candidate Institutionalised European Partnership on Innovative Health**

This initiative focuses on supporting innovation for health and care within the EU. It will address the EU-wide challenges raised by inefficient translation of scientific knowledge for use in health and care, insufficient innovative products reaching health and care services and threats to the competitiveness of the health industry. Its main objectives are to create an EU-wide health R&I ecosystem that facilitates translation of scientific knowledge into innovations; foster the development of safe, effective, patient-centred and cost-effective innovations that respond to strategic unmet public health needs currently not served by industry; and drive cross-sectoral health innovation for a globally competitive European health industry. The study concluded that an Institutionalised Partnership based on Article 187 of the Treaty on the Functioning of the EU (TFEU) is the preferred option for the implementation of this initiative.

## **4. Candidate Institutionalised European Partnership in High Performance Computing**

The initiative focuses on coordinating efforts and resources in order to deploy a European HPC infrastructure together with a competitive innovation ecosystem in terms of technologies, applications, and skills. It will address the challenges raised by underinvestment, the lack of coordination between the EU and MS, fragmentation of instruments, technological dependency on non-EU suppliers, unmet scientific demand, and weaknesses in the endogenous HPC supply chain. The initiative has as its main objectives to enhance EU research in terms of HPC and related applications, continued support for the competitiveness EU HPC industry, and fostering digital autonomy in order to ensure long-term support for the European HPC ecosystem as a whole. The study concluded that an Institutionalised Partnership is the preferred option for the implementation of this initiative as it maximises benefits in comparison to the other available policy options.

## **5. Candidate Institutionalised European Partnership in Key Digital Technologies**

This initiative focusses on enhancing the research, innovation and business value creation of European electronics value chains in key strategic market segments in a sustainable manner to achieve technological sovereignty and ultimately make European businesses and citizens best equipped for the digital age. It will address the risks of Europe losing the lead in critical industries and services and emerging KDTs. It will also tackle Europe's limited control over digital technologies that are critical for EU industry and citizens. It has as main objectives to strengthen KDTs which are critical for the competitive position of key European industries in the global markets, to establish European leadership in emerging technologies with high socioeconomic potential and to secure Europe's technological sovereignty to maintain a strong and globally competitive presence in KDTs. The study concluded that the Institutionalised Partnership is the preferred option for the implementation of this initiative.

## **6. Candidate Institutionalised European Partnership in Smart Networks and Services**

This initiative focuses on the development of future networks infrastructure and the associated services. This includes bringing communication networks beyond 5G and toward 6G capabilities, but also the development of the Internet of Things and Edge Computing technologies. It will address the challenges raised by Europe delay in the deployment of network infrastructure and failure to fully benefit from the full potential of digitalisation. It has as main objective to ensure European technological sovereignty in future smart networks and digital services, to strengthen the uptake of digital solutions, and to foster the development of digital innovation that answers to European needs and that are well aligned with societal needs. The study concluded that an institutionalised partnership under article 187 is the preferred option for the implementation of this initiative.

## **7. Candidate Institutionalised European Partnership in Metrology**

This initiative focuses on metrology - that is the science of measurement and the provision of the technical infrastructure that underpins accurate and robust measurements throughout society; measurements that underpin all domains of science and technology and enable fair and open trade and support innovations and the design and implementation of policy and regulations. It will address challenges in the fragmentation of national metrology systems across Europe and the need to meet ever-increasing demands on metrology infrastructure to support the measurement needs of emerging technologies and important policy domains in climate, environment, energy and health. The main objective of the initiative is to establish a sustainable coordinated world-class metrology system in Europe that will increase and accelerate the development and deployment of innovations and contribute to the design and implementation of policy, regulation and standards. The study concluded that an A185 Institutionalised Partnership is the preferred option for the implementation of this initiative.

## **8. Candidate Institutionalised European Partnership on Transforming Europe's Rail System**

This initiative focuses on the development of a pan-European approach to research and innovation in the rail sector. It will address the challenges raised by the lack of alignment of research and innovation with the needs of a competitive rail transport industry and the consequent failure of the European rail network to make its full contribution to European societal objectives. It will also strengthen the competitiveness of the European rail supply industry in global markets. Accordingly, the objectives of the initiative are to ensure a more market-focused approach to research and innovation, improving the competitiveness and modal share of the rail industry and enhancing its contribution to environmental sustainability as well as economic and social development across the European Union. The study concluded that an institutionalised partnership under article 187 is the preferred option for the implementation of this initiative.

## **9. Candidate Institutionalised European Partnership for Integrated Air Traffic Management**

This initiative focuses on the modernisation of the Air Traffic Management in Europe - an essential enabler of safe and efficient air transport and a cornerstone of the European Union's society and economy. The proposed initiative will address the challenges raised by an outdated Air Traffic Management system with a non-optimised performance. The current system needs to be transformed to enable exploitation of emerging digital technologies and to accommodate new forms of air vehicle including drones. The objective is therefore to harmonise European Air Traffic Management system based on high levels of digitalisation, automation and connectivity whilst strengthening air transport, drone and ATM markets competitiveness and achieving environmental, performance and mobility goals. This would create €1,800b benefits to the EU economy if the current initiative can

be built on and accelerated. The study concluded that an Institutionalised Partnership under Art. 187 TFEU is the preferred option for the implementation of this initiative.

#### **10. Candidate Institutionalised European Partnership on Clean Aviation**

This initiative focuses on further aeronautical research and innovation to improve technology leading to more environmentally efficient aviation equipment. It will address the challenges raised by the growing ecological footprint of aviation and the challenges and barriers faced by the aviation industry towards climate neutrality. It will also strengthen the competitiveness of the European aeronautical industry in global markets. Accordingly, the objectives of the initiative are to ensure that aviation reaches climate neutrality and that other environmental impacts are reduced significantly by 2050, maintain the leadership and competitiveness of the European aeronautics industry and ensure safe, secure and efficient air transport of passengers and goods. The Impact Assessment study assessed the options for implementation that would allow for an optimal attainment of these objectives. The study concluded that an institutionalised partnership under Art. 187 TFEU is the preferred option for the implementation of this initiative.

#### **11. Candidate Institutionalised European Partnership on Clean Hydrogen**

The report assesses the impact of potential initiatives to support, through research and innovation, the growth and development of clean hydrogen, among which an Institutionalised European Partnership is one of the options assessed. The existing challenges for clean hydrogen include the limited high-level scientific capacity and fragmented research activities, the insufficient deployment of hydrogen applications, and consequently weaker EU scientific and industrial value chains. Environmental, health and mobility pressures are also driving the need for cleaner hydrogen generation, deployment and use. An initiative for clean hydrogen must have as a main objective the strengthening and integration of EU scientific capacities, to support the creation, capitalisation and sharing of knowledge. This is necessary to accelerate the development and improvement of advanced clean hydrogen applications, the market entry of innovative competitive clean solutions, to strengthen the competitiveness of the EU clean hydrogen value chains (and notably the SMEs within them), and to develop the hydrogen-based solutions necessary to reach climate neutrality in the EU by 2050. The study concluded that an Institutionalised Partnership under Art. 187 TFEU is the preferred option for the implementation of this initiative.

#### **12. Candidate Institutionalised European Partnership on Safe and Automated Road Transport**

This initiative focuses on Connected, Cooperative and Automated Mobility: the use of connected and automated vehicles to create more user-centred, all-inclusive mobility, while also increasing safety, reducing congestion and contributing to decarbonisation. With current road traffic collisions and negative local and global environmental impacts not reducing quickly enough, it will address the challenges raised by the current fragmentation of research across the field, and the threat to European competitiveness if the research agenda does not advance quickly enough. The initiative will focus on strengthening EU scientific capacity and economic competitiveness in the field of CCAM, whilst contributing to wider societal benefits including improved road safety, less environmental impact, and improved accessibility to mobility. The study concluded that a co-programmed partnership is the preferred option for the implementation of this initiative.

#### **13. Candidate Institutionalised European Partnership for a Circular Bio-based Europe**

This initiative focuses on intensifying research and innovation allowing to replace, where possible, non-renewable fossil and mineral resources with biomass and waste for the production of renewable products and nutrients, in order to drive forward sustainable and climate-neutral solutions that accelerate the transition to a healthy planet and respect



planetary boundaries. It will address the challenges raised by the fact that the EU economy does not operate within planetary boundaries, is not sufficiently circular and is predominantly fossil based. It will also address the insufficient research and innovation (R&I) capacity and cross-sectoral transfer of knowledge and bio-based solutions, as well as risks posed to the European bio-based industry's global competitiveness. The study concluded that Institutionalised European Partnership based upon Article 187 TFEU is the preferred option for the implementation of this initiative.

#### **14. Candidate Institutionalised European Partnership for Innovative SMEs**

The initiative is envisaged as a continuation of the Eurostars 2 programme which is managed by the Eureka network. The initiative focuses on international collaborative R&D of innovative companies, facilitated through a network of national funding organisations as included in the Eureka network. The funded projects are bottom-up and involve small numbers of project partners. The candidate partnership addresses a niche issue namely limited opportunities for international bottom-up collaboration. The partnership provides thus an opportunity for SMEs for international R&D collaboration but does not address specific technological, social, or environmental challenges. Its main objective is to improve the competitiveness of European SMEs through collaborative funding. The study concluded that a co-funded partnership is the preferred option for the implementation of this initiative.

### **PART II. Horizontal studies**

#### **1. Horizontal Analysis of Efficiency and Coherence in Implementation**

The focus of this report is on the coherence and efficiency in the current European Partnership landscape under Horizon Europe and the potential to enhance efficiency in the European Partnerships' implementation.

European Partnerships are geared towards playing a pivotal role in tackling the complex economic and societal challenges that constitute the R&I priorities of the Horizon Europe Pillar II and are in a unique position to address transformational failures. Multiple potential interconnections and synergies exist between the candidate European Partnerships within the clusters, but few are visible across the clusters.

As for the improvement of the efficiency in implementation of institutionalised partnerships under Art. 187, potential efficiency and effectiveness gains could be achieved with enhanced collaboration. An option for a common back-office sharing operational implementation activities is worth exploring further through a detailed feasibility study in order to assess whether efficiency gains can be made. Ideally this would be co-designed as a common Partnership approach, leading to a win-win situation for all partners.

#### **2. Impact Modelling of the Candidate Institutionalised European Partnerships**

This report presents the results of the use of a macroeconomic model to assess the economic and environmental impacts of the preferred options identified in the individual 13 impact assessment studies. The model used is E3ME. It includes explicit representation for each EU Member State with a detailed sectoral disaggregation.

The impact modelling estimated the impacts of the envisaged initiatives at an aggregated as well as individual level. In total, 14 macroeconomic models have been run, one per reviewed initiative with a time horizon of 2035 and one that combines all initiatives with a time horizon of 2050. The results of each of these models were compared with those of a baseline scenario, which corresponds to a situation where the initiatives would be funded through regular Horizon Europe calls rather than European Partnerships.

# **Part I. Impact Assessment Studies for the Candidate Institutionalised European Partnerships**

## ***1. Overarching Context to the Impact Assessment Studies***

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## **Introduction**

This report sets out the overall policy context of the impact assessment studies for the candidate Institutionalised European Partnerships and the methodological framework that was developed for the impact assessment studies.

It describes the changes in approach to the public-private and public-public partnerships under Horizon Europe compared to the previous EU Framework Programmes. An example is the requirement that all envisaged European Partnerships be implemented as either co-programmed, co-funded or institutionalised. The impact assessment studies will consider these three scenarios as the different options to be assessed, in compliance with the Better Regulation guidelines and against the functionalities that the candidate partnerships are expected to fulfil. The report describes the common methodological framework to assess the envisaged initiatives accordingly.

The report also presents the landscape of European Partnerships at the level of Horizon Europe Pillar 2 clusters, which lay the grounds for all of the impact assessment studies except the candidate Institutionalised European Partnership for Innovative SMEs. This analysis is presented in more depth in the report on the 'Horizontal analysis of efficiency and coherence of implementation' in Part II of the Impact Assessment Study report.

The report is structured around two main headings:

- Chapter 1: Background and context to European Partnerships in Horizon Europe and focus of the impact assessment– What is decided
- Chapter 2: The Candidate European Partnerships under Horizon Europe – What needs to be decided

## Table of Contents

1	Background and context to European Partnerships in Horizon Europe and focus of the impact assessment– What is decided .....	10
1.1	The political and legal context .....	10
1.2	Typical problems and problem drivers .....	14
1.3	Description of the options .....	15
2	The Candidate European Partnerships under Horizon Europe – What needs to be decided ....	18
2.1	Portfolio of candidates for Institutionalised Partnerships under Horizon Europe .....	18
2.2	Assessing the necessity of a European Partnership, possible options for implementation and their cost-effectiveness.....	20
2.3	Cross-partnership challenges in Horizon Europe clusters.....	27

## Table of Figures

Figure 1:	Targeted impacts under Horizon Europe by priority .....	11
Figure 2:	Contribution of Candidate European Institutionalised Partnerships to the Horizon Europe priorities in Pillars II and III .....	14
Figure 3:	Landscape of European Partnerships under Horizon Europe (2019) .....	20
Figure 4:	Flow of the analysis.....	22
Figure 5:	R&I priorities and higher-level objectives of the Horizon Europe Cluster 1 – Health.....	28
Figure 6:	R&I priorities and higher-level objectives of the Horizon Europe Cluster 4 – Digital, Industry and Space .....	29
Figure 7:	R&I priorities and higher-level objectives of the Horizon Europe cluster Climate, Energy and Mobility .....	30
Figure 8:	R&I priorities and higher-level objectives of the Horizon Europe Cluster 6 – Food, Bioeconomy, Natural Resources, Agriculture and Environment.....	31

## List of Tables

Table 1:	Horizon Europe selection criteria for the European Partnerships .....	21
Table 2:	Intensity of additional costs compared with HEU Calls (for Partners, stakeholders, public and EC).....	24
Table 3:	Cost-efficiency matrix.....	25

## **1 Background and context to European Partnerships in Horizon Europe and focus of the impact assessment– What is decided**

### *1.1 The political and legal context*

#### 1.1.1 Shift in EU priorities and Horizon Europe objectives

Horizon Europe is to be set in the broader context of the pronounced **systemic and holistic approach** taken to the design of the new Framework Programme and the overarching Multi-annual Financial Framework (MFF) 2021-27.

The future long-term budget will be a budget for the Union's priorities. In her Political Guidelines for the next European Commission 2019 – 2024, the new President of the European Commission put forward six overarching priorities for the next five years, which reach well beyond 2024 in scope: A European Green Deal; An economy that works for people; A Europe fit for the Digital Age; Protecting our European way of life; A stronger Europe in the world; and A new push for European democracy. These priorities build upon A New Strategic Agenda for 2019–2024, adopted by the European Council on 20 June 2019, which targets similar overarching objectives. Together with the United Nations Sustainable Development Goals (SDGs), they will shape future EU policy responses to the challenges Europe faces and will steer the ongoing transitions in the European economy and society,

The MFF 2021-27 strives to provide a framework that will ensure a more coherent, focused and transparent response to Europe's challenges. A stronger focus on European added value, a more streamlined and transparent budget, more flexibility in order to respond quickly and effectively to unforeseen demands, and above all, an effective and efficient implementation are among the key principles of the MFF. The objective is to strengthen the alignment with Union policies and priorities and to simplify and reform the system in order to "unlock the full potential of the EU budget" and "turn ambitions into reality". Investment from multiple programmes is intended to combine in order to address key crosscutting priorities such as the digital economy, sustainability, security, migration, human capital and skills, as well as support for small businesses and innovation.<sup>1</sup>

These principles underlying the MFF 2021-27 are translated in the intent for Horizon Europe "to play a vital role, in combination with other interventions, for creating new solutions and fostering innovation, both incremental and disruptive."<sup>2</sup> The new Framework Programme finds its rationale in the daunting challenges that Europe is facing, which call for "a radical new approach to developing and deploying new technologies and innovative solutions for citizens and the planet on a scale and at a speed never achieved before, and to adapting our policy and economic framework to turn global threats into new opportunities for our society and economy, citizens and businesses."

In the Orientations towards the first Strategic Plan for Horizon Europe, the need strategically to prioritise and "direct a substantial part of the funds towards the areas where we believe they will matter the most" is emphasised. The Orientations specify, "Actions under Pillar II of Horizon Europe will target only selected themes of especially high impact that significantly contribute to delivering on the political priorities of the Union."

Figure 1, below, which gives an indicative overview of how the EU political priorities are supported under Horizon Europe, shows the major emphasis placed on contributing to the priority 'A European Green Deal', aimed at making Europe the first climate-neutral

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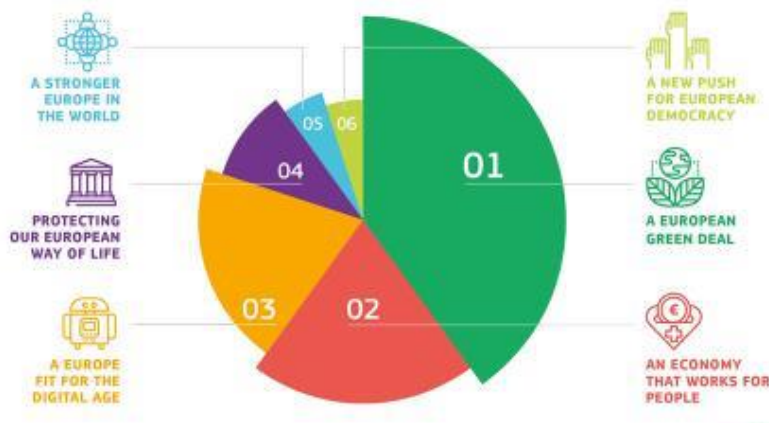
<sup>1</sup> EC (2018) *A Modern Budget for a Union that Protects, Empowers and Defends. The Multiannual Financial Framework for 2021-2027*. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2018) 321 final

<sup>2</sup> EC (2019), *Orientations towards the first Strategic Plan for Horizon Europe*.

continent in the world. At least 35 % of the expenditure from actions under the Horizon Europe Programme will address the Sustainable Development Goal 13: Climate Action.

Especially the R&I activities funded under Pillar II, including seven Partnership Areas (see below), are expected to contribute to the attainment of these objectives in an interconnected manner.

Figure 1: Targeted impacts under Horizon Europe by priority



Note: Preliminary, as described in the General orientations towards the first Strategic Plan implementing Horizon Europe.  
Source: European Commission (2019) Orientations towards the first Strategic Plan for Horizon Europe, December 2019.

### 1.1.2 Renewed ambition for European Partnerships

Reflecting its pronounced systemic nature aimed at ‘transformation’ of the European R&I system, Horizon Europe intends to make a more effective use of these partnerships with an **ambitious approach** that is impact oriented and ensures complementarity with the Framework Programme. The **rationalisation** of the partnership landscape, both in terms of number of partnership forms and individual initiatives, constituted a first step in the direction of the strategic role that these policy initiatives are expected to play in the context of Horizon Europe. Future partnerships are expected to “provide mechanisms to consistently aggregate research and innovation efforts into more effective responses to the policy needs of the Union”.<sup>3</sup> The expectation is that they will act as **dynamic change agents**, strengthening linkages within their respective ecosystems and with other related ecosystems as well as pooling resources and efforts towards the common objectives in the European, national and regional landscape. They are expected to develop *close synergies* with national and regional programmes, bring together a *broad range of actors* to work towards a common goal, translate *common priorities* into concrete roadmaps and coordinated activities, and turn research and innovation into *socio-economic results and impacts*.

The exact budget dedicated to European Partnerships under Horizon Europe will be agreed only upon decisions on the multiannual financial framework (MFF) 2021-2027 and the overall budget for Horizon Europe. In December 2017, the Council nevertheless introduced the principle of a “possible capping of partnership instruments in the FP budget”.<sup>4</sup> Accordingly, it reached the common understanding, with the European Parliament, that “the majority of the budget in Pillar II [€52.7bn] shall be allocated to actions outside of

<sup>3</sup> European Commission (2019) *Orientations towards the first Strategic Plan implementing the research and innovation framework programme Horizon Europe*. Co-design via web open consultation. Summer 2019.

<sup>4</sup> Council of the European Union (2017) *From the Interim Evaluation of Horizon 2020 towards the ninth Framework Programme*. Council conclusions 15320/17.

European Partnerships” (Article 8.2(a) of the Common Understanding on the proposal for a regulation establishing Horizon Europe).<sup>5</sup>

### 1.1.3 Key evolutions as regards the partnership approach

The European R&I partnerships were initially conceived as a means to increase synergies between the European Union and the Member States (Article 181 of the Treaty on the Functioning of the European Union TFEU). Their objectives were to pool the forces of all the relevant actors of R&I systems to achieve breakthrough innovations; strengthen EU competitiveness; and, tackle major societal challenges. The core activities of the European partnerships consist therefore of building critical mass mainly through collaborative projects, jointly developing visions, and setting strategic agendas. They help accelerate the emergence of a programming approach in European R&I with the involvement of all relevant actors and provide flexible structures for partnerships that can be tailored to their goals.<sup>6</sup>

In the consecutive Framework Programmes up to the current Horizon 2020, the partnerships and their forms have mushroomed, leading to an increasing complexity of the partnership landscape. The Horizon 2020 interim evaluation highlighted that the overall landscape of EU R&I funding had become overly complex and fragmented, and a need to improve the partnerships’ openness and transparency. The Lamy report suggested that the European Partnerships should focus on those areas with the greatest European Added Value, contribute to EU R&I missions and would need a simplified and flexible co-funding mechanism.

The Competitiveness Council conclusions of December 2017 called on the Commission and the Member States to jointly consider ways to rationalise the EU R&I partnership landscape. In 2018, the ERAC Ad-hoc Working Group on Partnerships concluded, “the rationalisation of the R&I partnership landscape is needed in order to ensure that the portfolio of R&I partnerships makes a significant contribution to improving the coherence, functioning and quality of Europe's R&I system and that the individual initiatives are able to fully achieve their potential in creating positive scientific and socio-economic impacts and/or in addressing societal challenges”.

Horizon Europe has taken on board these concerns. The Impact Assessment of Horizon Europe gave a clear analysis of the achievements of Partnerships so far as well as the expectations for the new generation of Partnerships. Greater transparency and openness of the partnerships were considered as essential, as well a clear European added value and long-term commitments of the stakeholders involved.

A list of criteria to decide how European Partnerships will be selected, implemented, monitored, evaluated and phased-out was attached as an Annex III to the proposal to establish Horizon Europe (as revised by the partial political agreement). The rationalisation of the Partnership portfolio in Horizon Europe is expected to allow for a reduction from the current 120 to between 45 and 50 partnerships.

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<sup>5</sup> Council of the European Union (2019) *Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rule for participation and dissemination*. Common understanding 7942/19.

<sup>6</sup> European Commission (2011) *Partnering in Research and Innovation*. Communication from the Commission COM(2011) 572 final.

#### 1.1.4 Overview of legal provisions

The Horizon Europe Regulation (common understanding) defines 'European Partnership' as "an initiative where the Union, prepared with early involvement of Member States and/or Associated Countries, together with private and/or public partners (such as industry, universities, research organisations, bodies with a public service mission at local, regional, national or international level or civil society organisations including foundations and NGOs), commit to jointly support the development and implementation of a programme of research and innovation activities, including those related to market, regulatory or policy uptake." It stipulates that "parts of Horizon Europe may be implemented through European Partnerships".

The Horizon Europe Regulation (common understanding) also stipulates that the European Partnerships are expected to adhere to the "principles of Union added value, transparency, openness, impact within and for Europe, strong leverage effect on sufficient scale, long-term commitments of all the involved parties, flexibility in implementation, coherence, coordination and complementarity with Union, local, regional, national and, where relevant, international initiatives or other partnerships and missions." The provisions and criteria set out for the selection and implementation of the European Partnerships reflect these principles.

#### 1.1.5 Overview of the eight Partnership areas

The Horizon Europe Regulation also identifies the following "Areas for possible institutionalised European Partnerships on the basis of Article 185 TFEU or Article 187 TFEU":

- Partnership Area 1: Faster development and safer use of health innovations for European patients, and global health.
- Partnership Area 2: Advancing key digital and enabling technologies and their use, including but not limited to novel technologies such as Artificial Intelligence, photonics and quantum technologies.
- Partnership Area 3: European leadership in Metrology including an integrated Metrology system.
- Partnership Area 4: Accelerate competitiveness, safety and environmental performance of EU air traffic, aviation and rail.
- Partnership Area 5: Sustainable, inclusive and circular bio-based solutions.
- Partnership Area 6: Hydrogen and sustainable energy storage technologies with lower environmental footprint and less energy-intensive production.
- Partnership Area 7: Clean, connected, cooperative, autonomous and automated solutions for future mobility demands of people and goods.
- Partnership Area 8: Innovative and R&D intensive small and medium-sized enterprises.

Considering the realm of these partnership areas, potential synergies exist with the future **missions**. Horizon European introduced these cross-discipline and cross-sector policy instruments as part of its core objective of stimulating further excellence-based and impact-driven R&I. In contrast with the challenges targeted in Horizon 2020, the missions aim at the achievement of well-defined goals to provide solutions, within a specified timeframe, to scientific, technological, economical and/or societal problems. As part of the preparation of Horizon Europe, the European Commission set up five boards to formulate the future missions in the following areas:

- Adaptation to climate change including societal transformation



- Cancer
- Healthy oceans, seas, coastal and inland waters
- Climate-neutral and smart cities
- Soil health and food

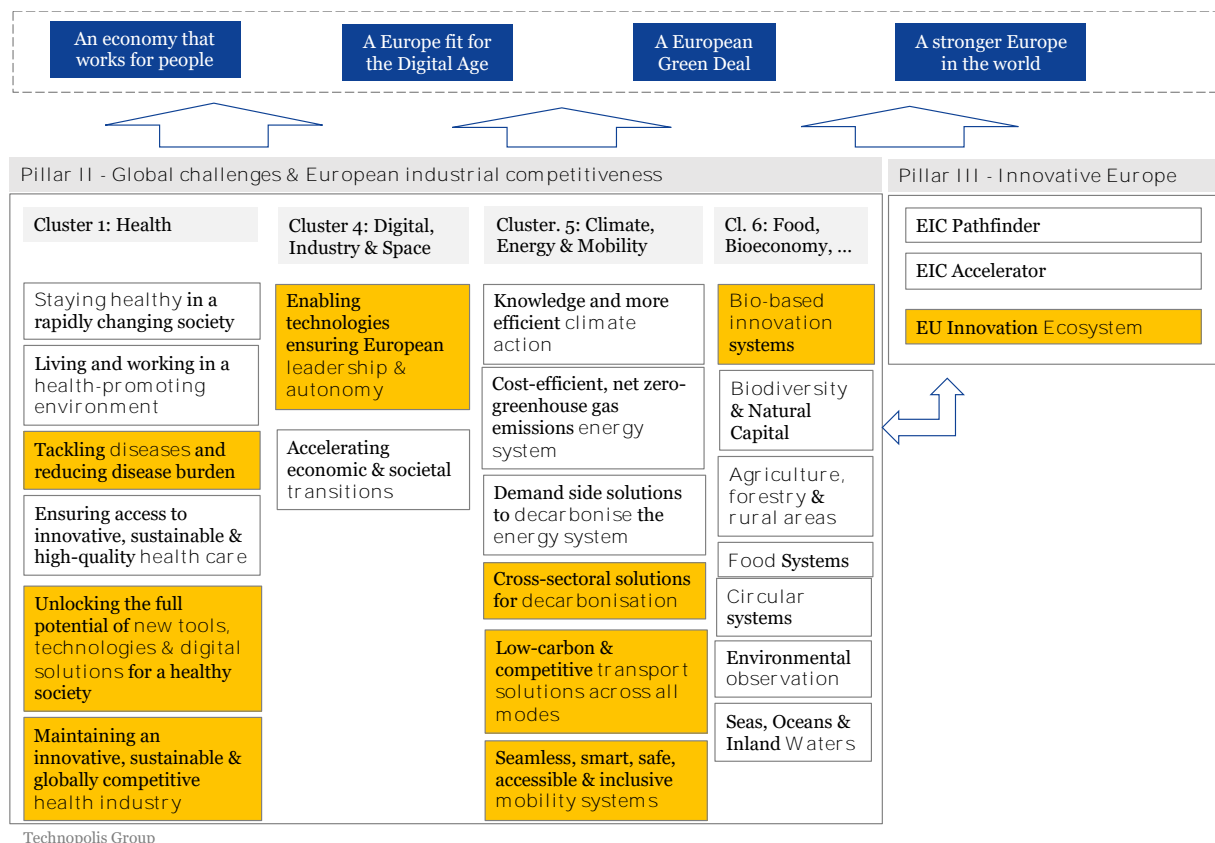
### 1.2 Typical problems and problem drivers

The European Partnerships are integral part of the framework programme and its three-pillar structure. They are predominantly funded under Pillar 2 “Global Challenges and European industrial competitiveness” and four of its thematic clusters. These clusters cover sectors and technologies, in which research and innovation activities are deemed of crucial importance in solving pressing scientific, societal or economic challenges and ensuring the scientific, technological and industrial leadership of Europe. Only one European Partnership, targeting innovative and R&D intensive SMEs, will instead act under Pillar 3 “Innovative Europe”.

The European Partnerships are intended to contribute to the attainment of the pillars’ and clusters’ **challenges and R&I priorities**. Overarching EU policy priorities addressed are predominantly the European Green Deal, a people-centred economy, the fit for the Digital Age, and a stronger Europe in the world.

In Figure 2, below, the R&I priorities in the Pillars II and III to which the candidate *Institutionalised* Partnerships intend to contribute are highlighted in yellow.

Figure 2: Contribution of Candidate European Institutionalised Partnerships to the Horizon Europe priorities in Pillars II and III



The European Partnerships under Horizon Europe most often find their rationale in addressing **systemic failures**. Their primary function is to create a platform for a strengthened collaboration and knowledge exchange between various actors in the European R&I system and an enhanced coordination of strategic research agenda and/or R&I funding programmes.

The concentration of efforts and resources and pooling of knowledge, expertise and skills on common priorities in a view of solving complex and multi-faceted societal and economic challenges is at the core of these initiatives. Enhanced cross-disciplinary and cross-sectoral collaboration and an improved integration of value chains and ecosystems are among the key objectives of these policy instruments. In the light of Horizon Europe, the aim often is to drive system transitions and transformations.

Especially in fast-growing technologies and sectors such as ICT, the envisaged European Partnerships also react on emerging opportunities and address systemic failures such as shortage in skills or critical mass or cross-sectoral cooperation along the value chains that would hamper attainment of future European leadership and/or strategic autonomy.

**Transformational failures** addressed aim at reaching a better alignment of the strategic R&I agenda and policies of public and private R&I funders in order to pool available resources, create critical mass, avoid unnecessary duplication of research and innovation efforts, and leverage sufficiently large investments where needed but hardly achievable by single countries.

Market failures are less commonly addressed and relate predominantly to enhancing industry investments thanks to the sharing of risks.

### *1.3 Description of the options*

The proposal for a regulation establishing Horizon Europe<sup>7</sup> stipulates that parts of the Horizon Europe Framework Programme may be implemented through European Partnerships and establishes three implementation modes: Co-programmed European Partnerships, Co-funded European Partnerships, and Institutionalised Partnerships in accordance with Article 185 TFEU or Article 187 TFEU.

#### **1.3.1 Baseline option – Traditional calls under the Framework Programme**

Under this option, strategic programming for research and innovation in the field will be done through the mainstream channels of Horizon Europe. The related priorities will be implemented through traditional calls under the Framework Programme covering a range of activities, but mainly calls for R&I and/or innovation actions. Most actions involve consortia of public and/or private actors in ad hoc combinations, some actions are single actor (mono-beneficiary). There will be no dedicated implementation structures and no further support other than the Horizon Europe actions foreseen in the related Horizon Europe programme or cluster.

Strategic planning mechanisms in the Framework Programmes allow for a high level of flexibility in their ability to respond to particular needs over time, building upon additional input in co-creation from stakeholders and programme committees involving MS. The broad scope of the stakeholders providing their input to the research agenda, however, implies a lower level of directionality than what can be achieved through the partnerships. Often, the long-term perspective of the stakeholder input is limited, which risks reducing strategic capacity in addressing priorities.

The Horizon Europe option also implies a lower level of EU budgetary long-term commitment for the priority. Without a formal EU partnership mechanism, it is also less likely that the stakeholders will develop a joint Strategic Research Agenda and commit to its implementation or agree on mutual financial commitments beyond the single project participation.

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<sup>7</sup> Proposal for a Regulation of the European Parliament and of the Council establishing Horizon Europe - the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination - Common understanding', March 2019

### 1.3.2 European Partnership

All European Partnerships will be designed in line with the new policy approach for more objective-driven and impactful partnerships. They are based on the common criteria in Annex III of the Horizon Europe Regulation, with few distinguishing elements for the different forms of implementation. All European Partnerships will be based on an agreed Strategic Research and Innovation Agenda / roadmap agreed among partners and with the Commission. For each of them the objectives, key performance and impact indicators, and outputs to be delivered, as well as the related commitments for financial and/or in-kind contributions of the partners will be defined ex-ante.

#### Option 1 - Co-programmed European Partnership

This form of European Partnership is based upon a *Memorandum of Understanding* or a *Contractual Arrangement* signed by the European Commission and the private and/or public partners. Private partners are typically represented by one or more industry association, which also functions as a back-office to the partnership. It allows for a *high flexibility* in the profile of organisation involved, objectives pursued, and/or activities implemented.

Co-programmed European Partnerships address *broader communities* across a diverse set of sectors and/or value chains and where the actors have *widely differing capacities and capabilities*. They may encompass one or more associations of organisations from industry, research, NGOs etc as well as foundations and national R&I funding bodies, with no restriction on the involvement of international partners from Associated and non-associated third countries. Different configurations are possible: private actors only, public entities only, or a combination of the two.

The basis, as for all European Partnerships, is the rationale is to create a *platform for 'concertation'*, i.e. in-depth and ongoing consultation of the relevant actors in the European R&I system for the co-development of a strategic research and Innovation agenda, typically covering the period of the next 10 years. The primary ambition is to generate *commitment to a common strategic research and innovation agenda* (SRIA). For the private actors involved, this would allow for a de-risking of their R&I investments and provide predictability of investment paths, for the public actors, it serves as a means to: inform national policy-makers on EU investments and allows for coordination and alignment of their efforts to support R&I in the field at the national level.

The *level of 'additionality is possibly lower than for other partnerships*. There is no expectation of a legally binding commitment from the partners to taking an integrated approach in their individual R&I implementation and it is based on 'best efforts'. However, the Union contribution to the partnership is defined for the full duration and has a comparable level of certainty for the partnerships than in the other forms of implementation. The priorities for the calls, proposed by the partnership members for integration in the Framework Programme Work Programmes, are subject to further input from Member States (comitology) and Commission Services. The full implementation of the Union contribution in the Framework Programme implies that the full array of Horizon Europe funding instruments in the related Pillar can be used, ranging from RIAs to CSAs and including grants, prizes, and procurement.

#### Option 2 – Co-funded European Partnership

The Co-funded Partnership is based on a Grant Agreement between the Commission and the consortium of partners, resulting from a call for a proposal for a programme co-fund action implementing the European Partnerships in the Horizon Europe Work Programme. Programme co-fund actions provide co-funding to a programme of activities established and/or implemented by entities managing and/or funding research and innovation programmes. Therefore, this form of implementation only allows to address public partners

at its core (comparable to the Article 185 initiatives below), while industry can nevertheless be addressed by the activities of the partnerships, but not make formal commitments and contributions to it. The expectation is that these entities would cover most if not all EU Member States (MS). Also 'international' funding bodies can participate as partners, which creates the potential for an efficient interaction with strategic international partners. Legal entities in countries that are not part of the programme co-fund consortium, are usually excluded from funding under the calls launched by the consortium.

The basic rationale for this partnership option is to bring MS together to invest at scale in key R&I issues of general and common interest. The joint programme of activities is agreed by the partners and with the EU and typically focuses on societal grand challenges and specifically, areas of high public good where EU action will add value while reflecting national priorities and/or policies. The ultimate intent is to create the greatest possible impact by pooling and/or coordinating national programmes and policies with EU policies and investments, helping to overcome fragmentation of the public research effort. Member States that are partners in this partnership become the 'owners' of the priority and take sole responsibility for its funding. Commitments of the partners and the European Union are ensured through the Grant Agreement.

Based on national programmes, this partnership option shows a particularly high level of flexibility in terms of activities to be implemented - directly by the national funding bodies (or governmental organisation "owning" institutional programmes), or by third parties receiving financial support (following calls for proposals launched by the consortium). The broad range of possible activities include support for networking and coordination, research, innovation, pilot actions, and innovation and market deployment actions, training and mobility actions, awareness raising and communication, dissemination and exploitation, any relevant financial support, such as grants, prizes, procurement, as well as Horizon Europe blended finance or a combination thereof.

### Option 3 – Institutionalised European Partnership

This type of Partnership is the most complex and high-effort arrangement and will be based on a Council Regulation (Article 187) or a Decision by the European Parliament and Council (Art 185) and implemented by dedicated structures created for that purpose. The legal base for this type of partnership limits the flexibility for a change in core objectives, partners, and/or commitments as these would require amending legislation.

The basic rationale for this type of partnership is the need for a strong integration of R&I agenda's in the private and/or public sectors in Europe in order to address a strategic challenge or realise an opportunity. The focus is on major long-term strategic challenges and priorities beyond the framework of a single Framework Programme where collective action – by private and/or public sectors – is necessary to *achieve critical mass* and *address the full extent of the complexities* of the ecosystem concerned.

The long-term commitment expected from the European Union and its partners is therefore much larger than for any of the other options, given the considerably higher investment in the preparation and implementation of the Partnership. As a result, this type of partnership can be selected only if 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. The commitment for contributions by the partnership members is expected to be at least equal to 50% and may reach up to 75% of the aggregated European Partnership budgetary commitments.

The partnership members have a high degree of autonomy in developing the strategic research agenda and annual work programmes and call topics, based on a transparent and accessible process, and subject to the approval of the Commission Services. The choice of topics addressed in the (open) calls are therefore strongly aligned with the needs defined. Normally, the strategic priorities are fully covered by the annual work programmes in the

partnership, even though it is in principle possible to keep certain topics for calls in the FP thus complementing the activities in the partnership. The full integration in the Framework Programme implies that the full array of Horizon Europe funding instruments in the related Pillar can be used, ranging from RIAs to CSAs and including grants, prizes, and procurement.

Two forms of Institutionalised Partnerships are of direct relevance to this study, influencing the constellation of partners involved.

### **Institutionalised Partnerships based upon Art 185 TFEU**

Article 185 of the TFEU allows the Union to participate in programmes jointly undertaken by Member States and limits therefore the scope of partners to Member States and Associated Third countries. This type of Institutionalised Partnership aims therefore at reaching the greatest possible impact through the integration of national and EU funding, aligning national strategies in order to optimise the use of public resources and overcome fragmentation of the public research effort.

It brings together R&I governance bodies of most if not all EU Member States (legal requirement: at least 40% of Member States) as well as Associated Third Countries that designate a dedicated legal entity (Dedicated Implementation Structure) for the implementation. By default, membership of non-associated Third Countries is not foreseen. Such membership is possible only if it is foreseen in the basic act and subject to conclusion of an international agreement. Eligibility for participation and funding follows by default the rules of the Framework programme, unless a derogation is introduced in the basic act.

### **Institutionalised Partnerships under Art. 187 TFEU**

This type of Institutionalised Partnership aims at reaching the greatest possible impact by integrating the strategic R&I agendas of private and/or public actors and by leveraging the partners' investments in order to tackle R&I and societal challenges and/or contribute to Europe's wider competitiveness goals.

It brings together a stable set of partners with a strong commitment to taking a more integrated approach and requires the set-up of a dedicated legal entity (Union body, Joint Undertaking) that carries full responsibility for the management of the partnership and implementation of the calls.

Different configurations are possible: partnerships focused on creating strategic industrial partnerships where, most often, the partner organisations are represented by one or more industry associations, or in some cases individual private partners; partnerships coordinating national ministries, public funding agencies, and governmental research organisations in the Member States and Associated Countries; or a combination of the two (the so-called tripartite model). By default, membership of non-associated Third Countries is not foreseen. Such membership is possible only if it is foreseen in the basic act and subject to conclusion of an international agreement. Eligibility for participation and funding follows by default the rules of the Framework programme, unless a derogation is introduced in the basic act.

## **2 The Candidate European Partnerships under Horizon Europe – What needs to be decided**

### *2.1 Portfolio of candidates for Institutionalised Partnerships under Horizon Europe*

#### **2.1.1 The process for identifying the priorities for Institutionalised Partnerships under Horizon Europe**

In May 2019, the European Commission consulted the Member States on a list of 44 possible candidates for European Partnership which it had identified as part of the preparation of the first Strategic Planning of Horizon Europe. This list was also part of the

Orientations towards the first Strategic Plan implementing Horizon 2020<sup>8</sup> which served as a basis for an Open Public Consultation from July to October 2019. In October and November 2019, the European Commission and the Member States agreed on increasing the number of candidate European partnerships to 49. Subsequent discussions until the adoption of Horizon Europe will focus on ensuring the overall consistency of the EU partnership landscape and its alignment with the EU overarching priorities and on defining the precise implementation modalities.

In parallel, the European Commission completed inception impact assessments on the candidate institutionalised European partnerships. Stakeholders had the opportunity to provide their feedback on these inception impact assessments in August 2019. A web-based open public consultation to collect opinions on all candidate institutionalised partnerships (but the candidate EuroHPC partnership) was organised between September and October 2019.

### 2.1.2 Overview of the overall landscape of candidate European Partnerships subject to the impact assessment

Figure 3, below, gives an overview of all European Partnerships that are currently envisaged for funding under Horizon Europe. The candidate Institutionalised Partnerships that are the subject for this impact assessment study are coloured in dark orange.

The European Partnerships can be categorised into two major groupings: '*horizontal*' partnerships focused on the development of technologies, methods, infrastructures and resources/materials, and '*vertical*' partnerships focused on the needs and development of a specific application area, be it industrial or societal.

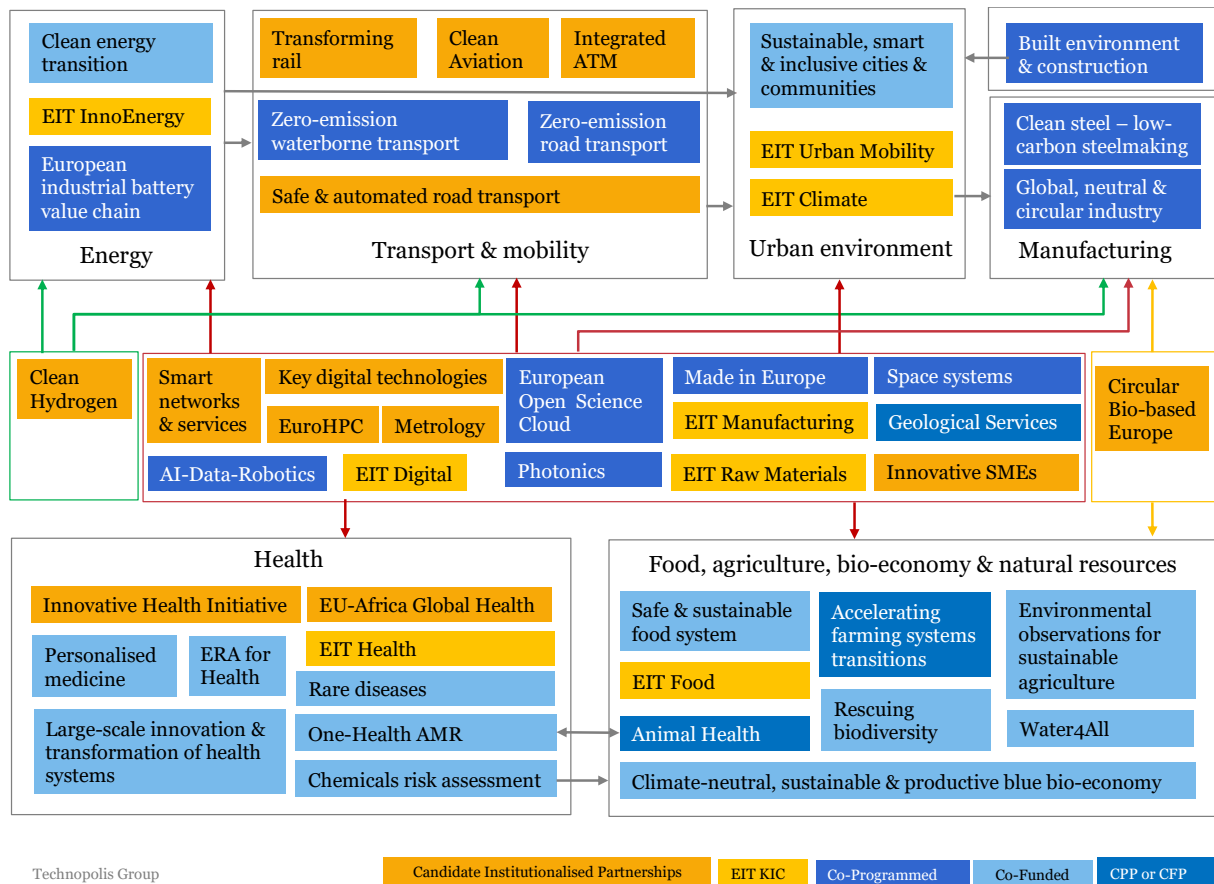
The diagram below shows the central position of the '**horizontal**' partnerships in the overall landscape, developing methodologies, technologies or data management infrastructures for application in the other priority areas. These 'horizontal' partnerships are predominantly proposed as Institutionalised or Co-programmed Partnerships, in addition to a number of EIT KICs. The European Open Science Cloud (EOSC) partnership, for example, will support research partnerships by providing an infrastructure for the storage, management, analysis and re-use of research data.

The upper banner of the diagram groups the **industry-oriented 'vertical' partnerships**. Under Horizon Europe, they have in common a pronounced focus on enhancing sustainability. In this context, the banner includes also one of the most recent agreed-upon partnerships focused on the urban environment. This partnership illustrates the introduction under Horizon Europe of *challenge-oriented* cross-cluster partnerships. Multiple interconnections are envisaged among the 'vertical' partnerships in the different industry sectors covered. In the transport sector, the partnerships are predominantly proposed as Institutionalised Partnerships. In the other sectors, we see a mix of Co-Programmed Partnerships and EIT KICs. There are only two Co-Funded Partnerships.

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<sup>8</sup> Orientations towards the first Strategic Plan implementing the research and innovation framework programme Horizon Europe, Co-design via Web Open Consultation (2019), see more here [https://ec.europa.eu/research/pdf/horizon-europe/ec\\_rtd\\_orientations-towards-the-strategic-planning.pdf](https://ec.europa.eu/research/pdf/horizon-europe/ec_rtd_orientations-towards-the-strategic-planning.pdf)

Figure 3: Landscape of European Partnerships under Horizon Europe (2019)



The lower banner includes the **'vertical' partnerships in the societal application areas**. Striking is the dominance of the Co-Funded Partnerships (to be noted that in the Food/agriculture cluster, the partnership type still needs to be decided for several envisaged partnerships). We also note the limited interconnections that are envisaged between the two areas. An exception is the newly envisaged cross-cluster European Partnerships 'One Health AMR'.

## 2.2 Assessing the necessity of a European Partnership, possible options for implementation and their cost-effectiveness

In this section we set out the methodological framework that underpins the impact assessment studies. In line with the Better Regulation Guidelines, the impact assessment is intervention logic-based and impact-oriented.

The impact assessment allowed also for the conduct of the 'necessity test' for a European Partnership as set out in the Horizon Europe regulation. Pivotal in this context was the identification of the Horizon Europe calls as Option 0 as well as Baseline Option, allowing for a comparative analysis of the three partnership forms (Options 1-3) along all of the assessment dimensions – in relation to each other as well as to the Horizon Europe calls. The options assessment therefore incorporated the required 'necessity test'.

### 2.2.1 Assessment of the selection criteria

The common methodological framework that we defined for the 13 individual Impact Assessment studies reflects the approach defined in the Better Regulation guidelines. It also integrates the specific criteria for the use of the different types of European Partnerships as they are defined in the Horizon Europe Common Understanding (Article 8 and Annex III). Specifically this regards the **selection criteria** which have to be demonstrated as a minimum in order to justify the necessity of a European Partnership instead of regular Horizon Europe calls only and the implementation criteria in Article 8



1(a), (b) and (c) with certain elements distinguishing the use of the different partnership implementation modes (Table 1).

Table 1: Horizon Europe selection criteria for the European Partnerships

Common selection criteria and principles	Specifications
<b>More effective (Union added value) clear impacts for the EU and its citizens</b>	<ul style="list-style-type: none"> <li>• delivering on global challenges and research and innovation objectives</li> <li>• securing EU competitiveness</li> <li>• securing sustainability</li> <li>• contributing to the strengthening of the European Research and Innovation Area</li> <li>• where relevant, contributing to international commitments</li> </ul>
<b>Coherence and synergies</b>	<ul style="list-style-type: none"> <li>• within the EU research and innovation landscape</li> <li>• coordination and complementarity with Union, local, regional, national and, where relevant, international initiatives or other partnerships and missions</li> </ul>
<b>Transparency and openness</b>	<ul style="list-style-type: none"> <li>• identification of priorities and objectives in terms of expected results and impacts</li> <li>• 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</li> <li>• clear modalities for promoting participation of SMEs and for disseminating and exploiting results, notably by SMEs, including through intermediary organisations</li> </ul>
<b>Additionality and directionality</b>	<ul style="list-style-type: none"> <li>• common strategic vision of the purpose of the European Partnership</li> <li>• 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</li> <li>• demonstration of expected qualitative and significant quantitative leverage effects, including a method for the measurement of key performance indicators</li> <li>• exit-strategy and measures for phasing-out from the Programme</li> </ul>
<b>Long-term commitment of all the involved parties</b>	<ul style="list-style-type: none"> <li>• a minimum share of public and/or private investments</li> <li>• 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</li> </ul>

The **Better Regulation guidelines** remained the primary point of reference for the 13 individual Impact Assessment studies. The different steps of the IA process were carried out in a consistent manner in the 13 individual IA studies, supported by horizontal analyses (i.e. common to all studies) such as bibliometrics/patent analysis, social network analysis, the partnership portfolio mapping and analysis, as well as the analysis of the Open Public Consultation data.

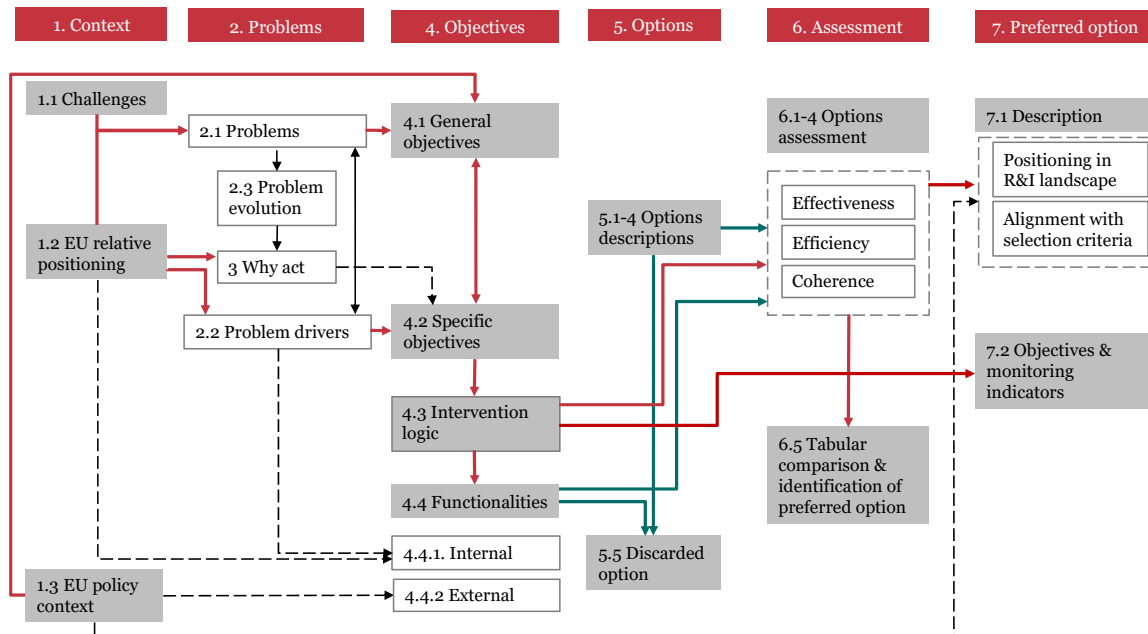


The **selection criteria** for the European Partnerships related to effectiveness and coherence fit reasonably well in the Better Regulation impact assessment structure. More problematic was the coverage of the other three criteria groupings, i.e. the criteria of Openness and Transparency, Additionality and Directionality, and the Ex-ante demonstration of commitment.

The solution was the introduction of a section on the '**Functionalities of the initiative**', in which set out our view on *how* the initiative should *concretely* respond to the selection criteria of 'coherence and synergies', 'openness and transparency' and 'additionality and directionality' in order to reach its objectives. We focused on those aspects that are not covered in other sections of this report, such as coherence and synergies, and covered those elements that from our analysis of the partnership options resulted being **key distinguishing features** of the partnership options, i.e. the composition of the partnership ('openness', including from a geographical perspective), the type of activities implemented ('flexibility'), and the level of directionality and integration of the stakeholders' R&I strategies needed ('directionality and additionality').

The logical process is summarised in Figure 4, below. The diagram shows how the 'functionality' sections constituted an important passage from the objectives and intervention logic sections to the options assessment. Building upon information collected in the previous sections (context, problem and objectives analysis) and in combination with the description of the available options, the description of the desirable 'functionalities' allowed for, on the one hand, the identification of the discarded option(s) and, on the other hand, the options assessment against coherence and against the selection criteria of 'Openness and Transparency' and 'Additionality and Directionality'. In the final chapter of the Impact Assessment report, the alignment of the preferred option with the criteria for the selection of European Partnerships was described, emphasising the outcomes of the 'necessity test'.

Figure 4: Flow of the analysis



Notes: the numbers indicate the related chapters or sections in the Impact Assessment reports

## 2.2.2 Methodological approach

### Overview of the methodologies employed

The understanding of the overall context of the candidate institutionalised European Partnerships relies on a desk research partly covering the main impacts and lessons learned

from their predecessor partnerships (if any). This was complemented with a set of quantitative analyses of the Horizon 2020-funded partnerships, or in case these did not exist, the H2020-funded projects in the field. 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 (see below).

Public consultations (open and targeted) supported the comparative assessment of the policy options. Each study interviewed up to 50 relevant stakeholders (policymakers, business including SMEs and business associations, research institutes and universities, and civil organisations, among others). They also used the results from the Open Public Consultation organised by the European Commission (Sep – Nov 2019) and the feedback on the Inception Impact Assessments of the 13 candidate institutionalised European Partnerships that the European Commission received in September 2019.

The timing of the Impact Assessment studies, in parallel to the negotiations between the European Commission and the existing Joint Undertakings on the specific implementation of the rules for the future European Partnership, as well as the ongoing discussions within the existing partnership on their future research directions, has set potential limits to the validity of the input and feedback collected from the stakeholders during the consultations.

A more detailed description of the methodology is provided in the Annexes C of each impact assessment report.

### **Method for identifying the preferred choice**

The four policy options were compared along a range of key parameters. The comparison along these parameters was carried out in an evidence-based manner. A range of quantitative and qualitative evidence was used, including ex-post evaluations; foresight studies; statistical analyses of Framework Programmes application and participation data and Community Innovation Survey data; analyses of science, technology and innovation indicators; econometric modelling exercises producing quantitative evidence in the form of monetised impacts; reviews of academic literature on market and systemic failures and the impact of research and innovation, and of public funding for research and innovation; sectoral competitiveness studies; expert hearings; etc.

### **Options assessment related to effectiveness and coherence**

On the basis of the evidence collected and gathered, the Impact Assessment study teams assessed the effectiveness of the retained policy options along three dimensions corresponding to the different categories of likely impacts: scientific, economic and technologies, and societal (including environmental) impacts. The Impact Assessment study teams considered to which extent the retained policy options fulfilled the desirable 'functionalities' and were therefore likely to produce the targeted impacts. This analysis resulted in a scoring of the policy options along a three-point scale.<sup>9</sup> Instead of a compound score, the assessment of the effectiveness of the policy options concluded on as many scores as there are expected impacts.

Likewise, the impact assessment study teams attributed scores (using the same approach as above) reflecting the potential of each retained policy option for ensuring coherence with programmes and initiatives within (internal coherence) and beyond (external coherence) Horizon Europe.

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<sup>9</sup> Scores vary from + to +++, where + refers to low potential for presenting a low potential for reaching the likely impacts, ++ to a good potential, and +++ to a high potential.

Scores were justified in a consistent and detailed manner in order to avoid arbitrariness and spurious accuracy. A qualitative or even quantitative explanation was provided of why certain scores were given to specific impacts.

When assessing the respective efficiency of the retained policy options, the Impact Assessment study teams considered the scores related to effectiveness and the identified costs to conduct a “value for money” (or cost-effectiveness) analysis. They accordingly attributed a comparative score to each of the options ranging from 1 (option with the highest costs) to 3 (options with the lowest costs).

## Options assessment related to efficiency

### **A standard cost model**

The ‘horizontal’ team has reviewed the cost categories and costs for each of the four policy options, at some length. Our first model used published data from past partnerships and Horizon 2020 calls working with the Commission’s standard accounting codes (Title 1, Title 2, Title 3). The analysis revealed wide-ranging differences in costs across partnerships and functions, which was thought to be too complex to be helpful to the current exercise. As a result, we created a static, common model using average costs as a means by which to indicate the order of magnitude of effort and thereby reveal the principal differences between each of the policy options.

The model was developed jointly with the European Commission services and is presented in the study Data report (D1.2), along with an explanation of the data sources used and the assumptions made.

It is important to note that the costs identified are theoretical and do not reflect the actual costs of any existing individual partnership. In light of this fact, and to avoid any risk of misunderstanding, we have transposed the financial estimates into a qualitative presentation using + / - system in order to compare the various cost elements for each policy option with the equivalent costs for the baseline policy options (see Table 2).

The principal differences in costs as compared with regular Horizon Europe calls relate to the European Partnerships’ one-off costs (e.g. developing the proposal and Strategic Research and Innovation Agenda), additional supervision by the European Commission and any additional programme management effort. The main difference between the three types of European Partnership are twofold: (i) the extent to which a partnership will need to run a limited or comprehensive programme management unit and (ii) the extent to which a new partnership may benefit from a pre-existing programme management unit that will greatly reduce or eliminate the set-up costs that would apply to a wholly new partnership.

Table 2: Intensity of additional costs compared with HEU Calls (for Partners, stakeholders, public and EC)

Cost items	Option 0	Option 1	Option 2	Option 3 -Art. 185	Option 3 -Art. 187
Preparation and set-up costs					
Preparation of a partnership proposal (partners and EC)	0	++	++	++	++
Set-up of a dedicated implementation structure	0	0	0	Existing: + New: ++	Existing: ++ New: +++
Preparation of the SRIA / roadmap	0	++	++	++	++

Cost items	Option 0	Option 1	Option 2	Option 3 -Art. 185	Option 3 -Art. 187
Ex-ante Impact Assessment for partnership	0	0	0	+++	+++
Preparation of EC proposal and negotiation	0	0	0	+++	+++
Running costs (Annual cycle of implementation)					
Annual Work Programme preparation	0	+	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	0	0	0	+++
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

### ***Rationale for the comparative scoring on 'overall costs' and 'cost-efficiency' in the scorecard***

In the scorecard analysis, the scores related to the set-up and implementation costs will allow the study teams to consider the scale of the expected benefits and thereby allow a simple "value for money" analysis (cost-effectiveness).

Table 3 shows how we translated the cost analysis into a series of numerical scores.

Table 3: Cost-efficiency matrix

	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 2: Co-funded	Option 3: Institutionalised
Overall cost	3	2	1	1
Cost-efficiency	3	3	2	2

For the 'overall cost' dimension, we assigned a score 1 to the option with the highest additional costs and a score 3 to the option with the lowest additional costs compared to the baseline. This was based on the following considerations:

- **Horizon Europe regular calls** will have the lowest overall cost among the policy options and have therefore been **scored 3** on this criterion, using a scale of 1-3 where 3 is best (lowest additional costs). This adjudged score is based on two facts: firstly, that Horizon Europe will not entail any additional one-off costs to set up or discontinue

the programme, where each of the other policy options will require at least some additional set-up 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 policy option and has therefore been given a **score of 2**, using a scale of 1-3 where 3 is best (lowest additional costs). 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.
- The **Co-Funded Partnership** (Option 2 – CFP) has been **scored 1** on overall cost, using a scale of 1-3 where 3 is best (lowest additional costs). 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 1** on overall cost, using a scale of 1-3 where 3 is best (lowest additional costs). 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.

In relation to **cost-efficiency**, we considered that while there is a clear gradation in the overall costs of the policy options, the cost differentials are less marked when we take into account financial leverage (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 and CPP policy options – and the least cost-efficient – the CFP and IP. We have therefore assigned a score of 3 to the baseline Option 0 and CPP options for cost-efficiency (no or minor additional costs, as compared with the baseline) and a score of 2 for the CFP and IP policy options (medium additional costs, as compared with the baseline).

### ***Scorecard analysis for the final options assessment***

The scorecard analysis built a hierarchy of the options by individual criterion and overall. The scorecard exercise supported the systematic appraisal of alternative policy options across multiple types of monetary, non-monetary and qualitative dimensions. It also allowed for easy visualisation of the pros and cons of alternative options.

Each option was attributed a value of 1 to 3, scoring the adjudged performance against each criterion with the three broad appraisal dimensions of effectiveness, efficiency and coherence.

Scores were justified in a consistent and detailed manner in order to avoid arbitrariness and spurious accuracy. A qualitative or even quantitative explanation was provided of why certain scores were given to specific impacts, and why one option scores better or worse than others.

The scorecard analysis allowed for the identification of a single preferred policy option or in case of an inconclusive comparison of options, a number of 'retained' options or hybrid. The final selection is a policy decision.

### 2.3 Cross-partnership challenges in Horizon Europe clusters

In this section we set the envisaged and candidate partnerships in the context of the Horizon Europe clusters and the related higher-level EU policy objectives and priorities. We focus on the evolution of the policy context including the new European Green Deal/climate neutrality objectives, the Horizon Europe Framework relevant to this cluster, and the link to the relevant Sustainable Development Goals. Seeing the focus on the Pillar II clusters, this section excludes the candidate *Institutionalised Partnership for Innovative SMEs*.

#### 2.3.1 Cluster 1 – Health

Research and innovation (R&I) actions under this cluster will aim at addressing the major socio-economic and societal burden that diseases and disabilities pose on citizens and health systems of the EU and worldwide.

The R&I activities funded under the Pillar II Cluster Health aim at contributing to the achievement of the Sustainable Development Goal 'Ensuring healthy lives and promoting well-being for all at all ages' resulting from investments in research and innovation focused on three overarching EU policy objectives: 'An economy that works for people', 'A Europe fit for the Digital Age', and 'A European Green Deal' (see Figure 5, below). The Horizon Europe proposal for a regulation defined the areas for possible institutionalised European partnerships on the basis of Article 185 TFEU or Article 187 TFEU as "*Partnership Area 1: Faster development and safer use of health innovations for European patients, and global health*".

At the core in this cluster are the R&I orientations that aim at ensuring that citizens *stay healthier throughout their lives* due to improved health promotion and disease prevention and the adoption of healthier behaviours and lifestyles, the development of *effective health services* to tackle diseases and reduce their burden, and an improved access to *innovative, sustainable and high-quality health care*. These objectives require an unlocking of the full potential of *new tools, technologies and digital solutions* and ensuring a *sustainable and globally competitive health-related industry* in the EU, allowing for the delivery of, e.g. personalised healthcare services. Last but not least, the citizens' health and well-being need to be *protected from environmental degradation and pollution*, addressing a.o. climate-related challenges to human health and health systems.

Figure 5, below, shows that the portfolio of envisaged European Partnerships in this cluster<sup>10</sup> aims to contribute to all of the R&I orientations in this cluster. However, there is a pronounced focus on the 'tackling diseases and reducing the disease burden' objective, addressed by five out of the ten partnerships (amongst which there is one candidate Institutionalised Partnership). The objectives focused on an improved exploitation of digital solutions and competitiveness of the EU health-related industry are addressed by two partnerships amongst which one is a candidate Institutionalised Partnership.

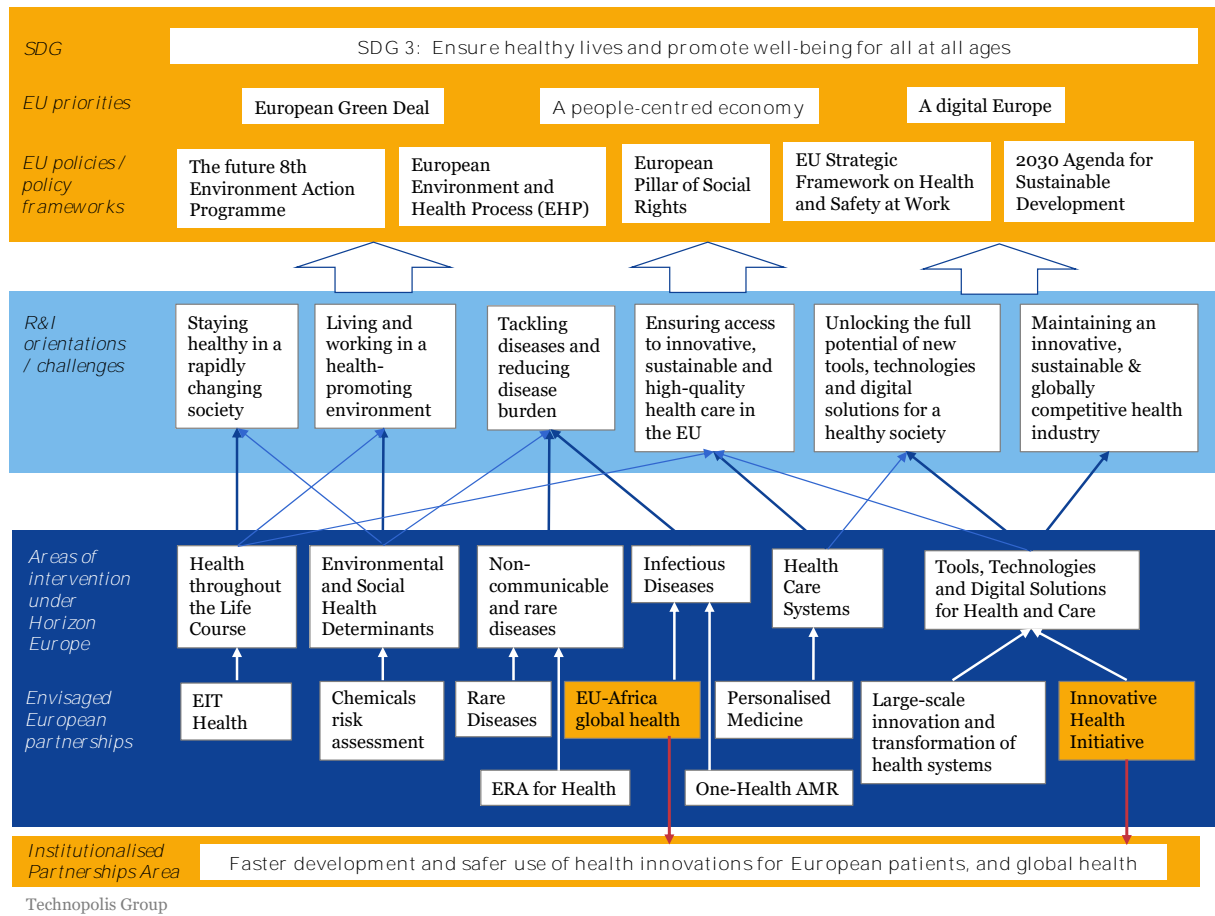
In this context, it should be noted that the portfolio of European Partnerships in this cluster predominantly encompasses Co-funded Partnerships, focused on joining the R&I programmes and investments at the national level. There is therefore overall a limited level of involvement of the private sector in the development of the SRIAs (i.e. as partners of the envisaged partnerships), be it from the supply or user side in the value chains. The only exceptions are the Innovative Health Initiative and the EIT KIC Health. European Partnerships also provide limited support for the assessment of environmental and social health determinants, uniquely addressed from a chemical risks perspective.

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<sup>10</sup> As proposed in the Horizon Europe 'Orientations towards the first Strategic Plans', dd. December 2019

The description of the interconnections between the partnerships in this cluster and the ones funded in the context of other clusters, provided in the reports of the individual impact assessment studies, sheds more light on this topic.

Figure 5: R&I priorities and higher-level objectives of the Horizon Europe Cluster 1 – Health



### 2.3.1 Cluster 4 – Digital, Industry and Space

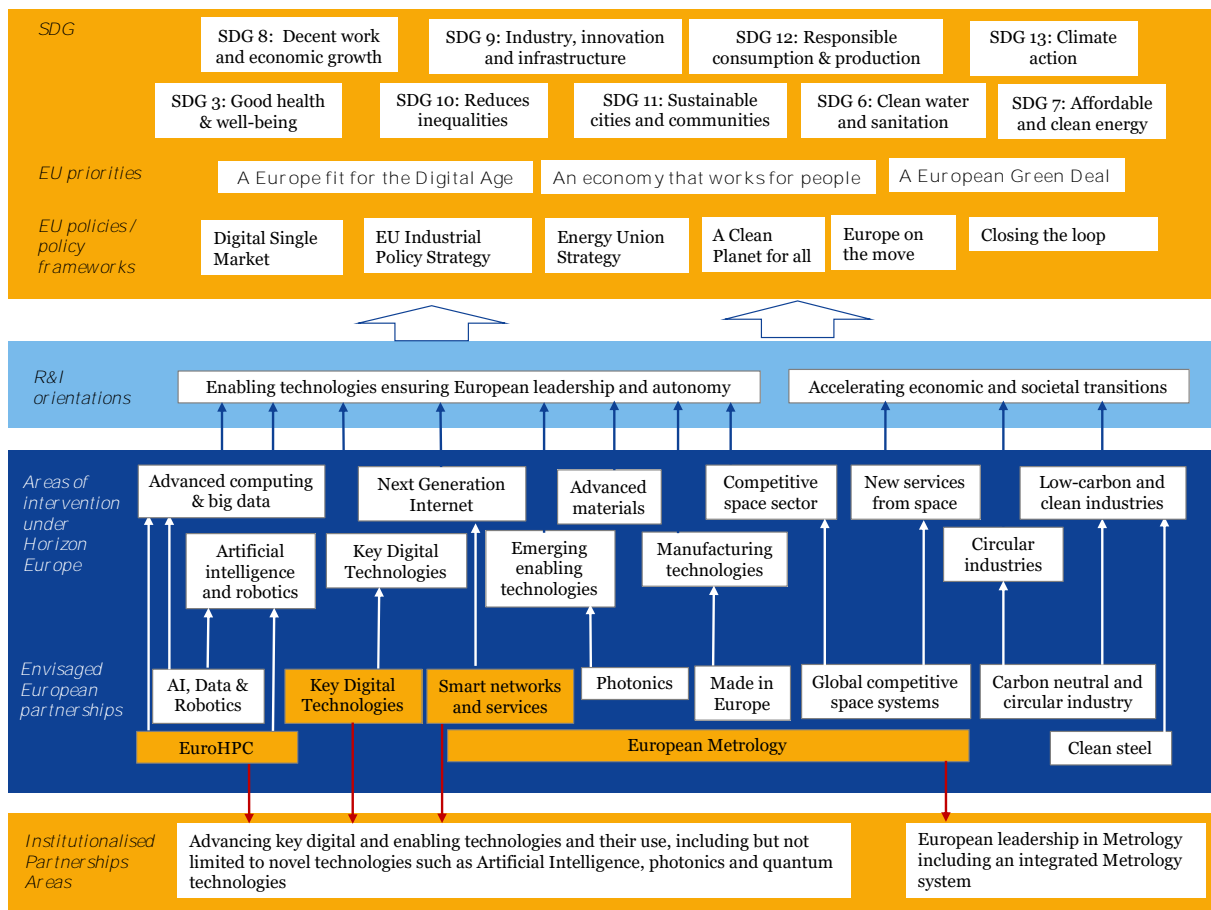
In this cluster the focus is on the digitisation of European industry and on advancing key enabling, digital and space technologies which will underpin the transformation of our economy and society at large. The overarching vision for R&I investments in this cluster is “a European industry with global leadership in key areas, fully respecting planetary boundaries, and resonant with societal needs – in line with the renewed EU Industrial Policy Strategy.” The expected effects on the European economy and society imply that the R&I activities under this cluster will contribute to various Sustainable Development Goals and respond to three key EU policy priorities: ‘A European Green deal’, ‘A Europe fit for the digital age’, and ‘An economy that works for people’ (Figure 6).

The cluster pursues three objectives: 1) ensuring the competitive edge and sovereignty of EU industry; 2) fostering climate-neutral, circular and clean industry respecting planetary boundaries; and 3) fostering social inclusiveness in the form of high-quality jobs and societal engagement in the use of technologies. A human-centred approach will be taken, i.e. technology development going hand in hand with European social and ethical values.

The key R&I priorities are grouped in two general categories: (I) Enabling technologies ensuring European leadership and autonomy; and (II) Accelerating economic and societal transitions (these will be complemented by priorities of other clusters). European Partnerships envisaged to support the R&I in the specific intervention areas are mainly co-programmed partnerships. Exceptions are the three candidate Institutionalised Partnerships in the digital field and the candidate Institutionalised Partnership in metrology, reflecting their related Partnership Areas.



Figure 6: R&I priorities and higher-level objectives of the Horizon Europe Cluster 4 – Digital, Industry and Space



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Multiple convergences exist between the technologies that are covered in the first strand of the priorities in this cluster, i.e. “enabling technologies ensuring European leadership and autonomy”. In their function of ‘enabling’ technologies, they will also make critical contributions to the attainment of the desired ‘transitions’ in the ‘vertical’ industry sectors targeted in the second strand of priorities in this cluster as well as in the other clusters. A major contribution from this perspective can be expected from the four candidate Institutionalised Partnerships as well as from the ‘Made in Europe’ partnership, focused on manufacturing technologies.

### 2.3.2 Cluster 5 – Climate, Energy and Mobility

The main objectives of this cluster are to fight climate change, improve the competitiveness of the energy and transport industry as well as the quality of the services that these sectors bring to society. This is supportive of several Sustainable Development Goals including affordable and clean energy (SDG7); industry, innovation & infrastructure (SDG9); sustainable cities & communities (SDG11); sustainable consumption & production (SDG12); and climate action (SDG13). The cluster is most closely aligned to the EU priority for ‘A European Green Deal’ but also has synergy with two of the other five priorities; ‘An economy that works for people’ and ‘A Europe fit for the Digital Age’. This extends across various policies including a Clean Planet for all, the Energy Union strategy, Single European Railway Area, European ATM Master Plan, Single European Sky, and Europe on the Move (Figure 7).

The cluster is directly relevant to several of the areas for possible institutionalised European partnerships on the basis of Article 185 TFEU or Article 187 TFEU, namely:

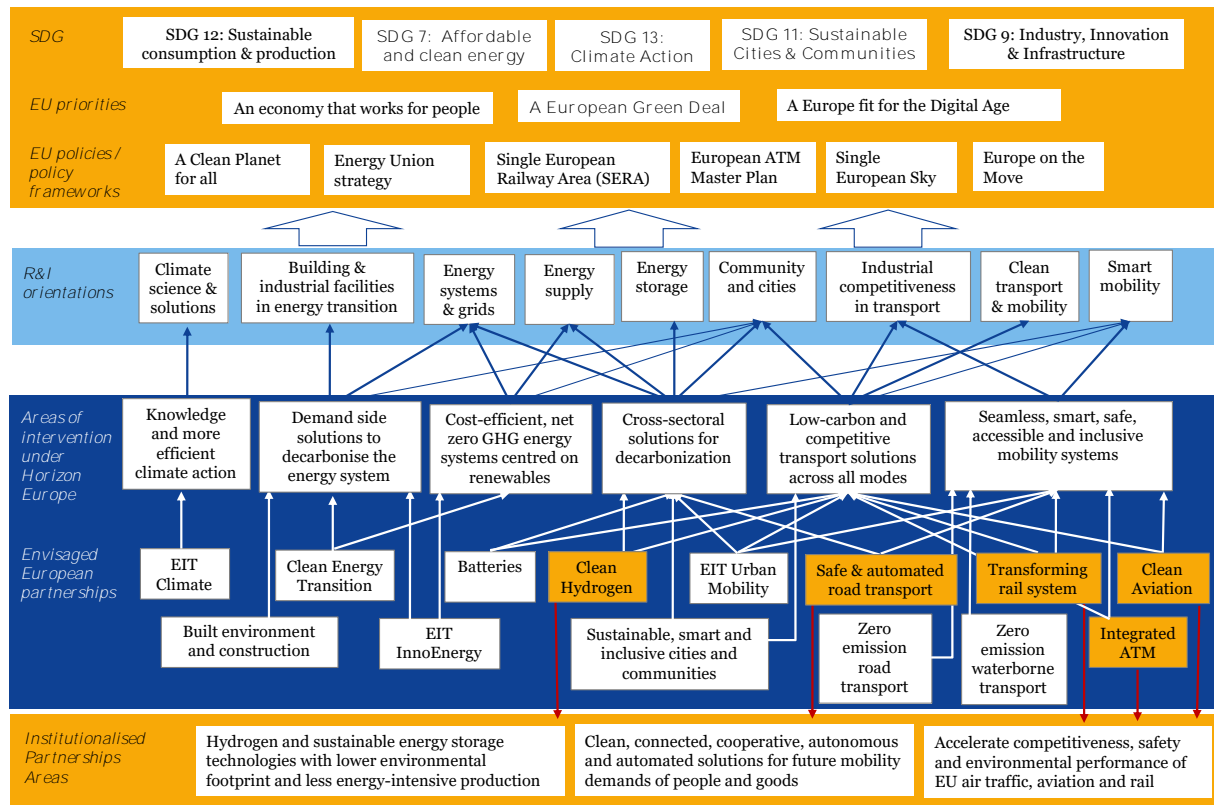
- Partnership Area 4: Accelerate competitiveness, safety and environmental performance of EU air traffic, aviation and rail



- Partnership Area 6: Hydrogen and sustainable energy storage technologies with lower environmental footprint and less energy-intensive production
- Partnership Area 7: Clean, connected, cooperative, autonomous and automated solutions for future mobility demands of people and goods

Cluster 5 is structured under six areas of intervention under Horizon Europe and nine R&I orientations. Figure 7, below, shows the portfolio of envisaged European Partnerships that are relevant to this cluster and their link to the areas of intervention.

Figure 7: R&I priorities and higher-level objectives of the Horizon Europe cluster Climate, Energy and Mobility



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There are 14 candidate Partnerships that align with this cluster of which eight are possible Institutionalised Partnerships, including five Article 187 initiatives and three EIT-KICs. There are no candidate Article 185 Partnerships in this cluster. The other partnerships are envisaged as either Co-programmed and/or Co-funded Partnerships.

The diagram above shows the strong orientation of the possible Institutional Partnerships towards the mobility area and more limited direct synergies between the envisaged Partnerships and the 'climate science & solutions' priority. Of course, the climate change challenge underpins the whole of this cluster, except where the focus is on industrial competitiveness, but this will also be at least partially dependent on innovation related to clean energy and mobility products and services.

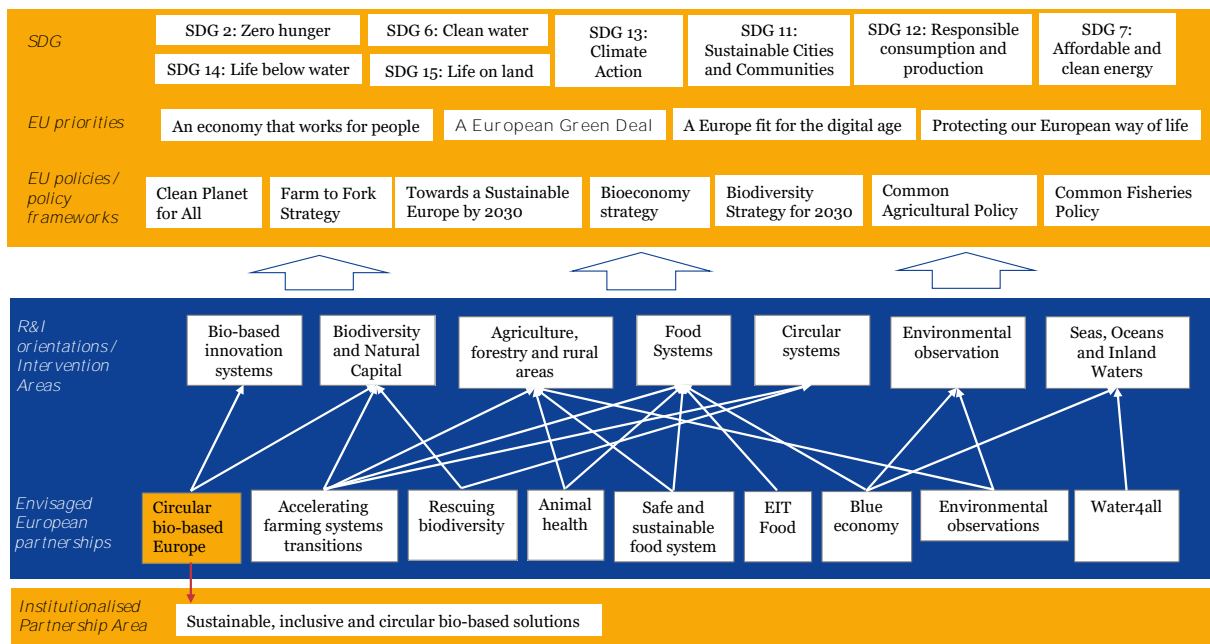
### 2.3.3 Cluster 6 – Food, Bioeconomy, Natural Resources, Agriculture and Environment

The key objective of Cluster 6, 'Food, Bioeconomy, Natural Resources, Agriculture and Environment' is to advance knowledge, expand capacities and deliver innovative solutions to accelerate the transition towards the sustainable management of natural resources (such as biodiversity, water and soils). The cluster has a large realm and aims to address a wide range of challenges relating to climate change, biodiversity and ecosystems, natural resources, and the production and consumption patterns that may affect them. It encompasses a single area for possible institutionalised European Partnerships aimed at the development of "sustainable, inclusive and circular, bio-based solutions".

The R&I activities funded under the Pillar II Cluster 6 contribute first and foremost to the ‘European Green Deal’. More precisely, they will be instrumental to the announced climate change actions, the Biodiversity Strategy for 2030, the “Farm to Fork Strategy”, the zero-pollution ambition, the New Circular Economy Action Plan, and the comprehensive strategy on Africa and trade agreements. However, through cooperation with the other clusters, Cluster 6 may make some contribution to the other EU overarching policy priorities. The R&I activities funded under this cluster therefore aim to contribute to the achievement of several United Nations SDGs including: SDG 2: Zero hunger; SDG 6: Clean water and sanitation; SDG 7: Affordable and clean energy; SDG 11: Sustainable cities and communities; SDG 12: Responsible consumption and production; SDG 13: Climate action; SDG 14: Life below water; and, SDG 15: Life on land.

Cluster 6 is structured around six targeted impacts and seven research and innovation orientations, as shown in Figure 8, below. The R&I activities funded under this cluster aim to (1) develop solutions for mitigation of, and adaptation to, *climate change*; (2) halt the *biodiversity* loss and foster the restoration of *ecosystems*; (3) encourage the sustainable (and circular) management and use of *natural resources*; (4) stimulate inclusive, safe and health *food and bio-based systems*; (5) a better understanding of the determinants of *behavioural, socio-economic and demographic changes* to accelerate system transformation; and, (6) improve solutions for *environmental observations and monitoring systems*.

Figure 8: R&I priorities and higher-level objectives of the Horizon Europe Cluster 6 – Food, Bioeconomy, Natural Resources, Agriculture and Environment



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The European Commission envisages nine partnerships under Cluster 6, two of which would be institutionalised (Circular bio-based Europe and EIT Food), four would be either co-programmed or co-funded (Animal Health; A climate-neutral, sustainable and productive Blue Economy; Safe and Sustainable Food Systems for People, Planet and Climate; Water4All), and three would be co-funded (Accelerating Farming System Transition; Agriculture for Data; Rescuing Biodiversity to safeguard life on Earth).

There is seemingly a good balance between the three types of partnerships. However, industry may have some interest in being involved in the design of the Strategic Research and Innovation Agendas regarding living labs and other research infrastructure (‘Towards more sustainable Farming’ envisaged partnership) to develop solutions for accelerating the transition of farming systems, and technologies to collect agriculture data.

The proposed portfolio of European Partnerships covers the full range of R&I orientations under Cluster 6.

All but one of the proposed partnerships contribute to orienting R&I activities towards the development of food systems that will ensure both sustainable and healthy diets and food and nutrition security for all. The food system has an impact on several challenges. It directly relates to nutrition and diets, access to food, food security, and has an influence on the use of natural resources, water and soil pollution, climate change. Food waste is a key component of circular systems and biomass has strong potential to offer bio-based energy solutions. Finally, the transformation of food systems should take into consideration demographic changes and the accelerating urbanisation (which reduces lands available for food production but offers opportunities for new types of agriculture such as urban farming).

Two R&I orientations are covered by less than half of the proposed partnerships: Environmental Observations (even though achievement in this area could make significant contribution to the other areas) and Bio-based innovation systems (which is nevertheless at the core of the candidate institutionalised partnership for a circular bio-based Europe).



EUROPEAN COMMISSION

# **Part I. Impact Assessment Studies for the Candidate Institutionalised European Partnerships**

## ***7. Candidate Institutionalised Partnership in Metrology***

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**technopolis**  
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## **Abstract**

*This document is the final report of the Impact Assessment Study for the candidate Institutionalised European Partnership in Metrology under Horizon Europe. The study was conducted by Technopolis Group from July to December 2019. The methodological framework reflects the Better Regulation Guidelines and operationalises the selection criteria for European Partnerships set out in the Horizon Europe Regulation.*

*This initiative focuses on **metrology** - that is the science of measurement and the provision of the technical infrastructure that underpins accurate and robust measurements throughout society; measurements that underpin all domains of science and technology and enable fair and open trade and support innovations and the design and implementation of policy and regulations. It will address challenges in the fragmentation of national metrology systems across Europe and the need to meet ever-increasing demands on metrology infrastructure to support the measurement needs of emerging technologies and important policy domains in climate, environment, energy and health. The main objective of the initiative is to establish a sustainable coordinated world-class metrology system in Europe that will increase and accelerate the development and deployment of innovations and contribute to the design and implementation of policy, regulation and standards.*

*The study concluded that an A185 Institutionalised Partnership is the preferred option for the implementation of this initiative.*

## Executive Summary

This document is the final report of the Impact Assessment Study for the candidate Institutionalised European Partnership in Metrology under Horizon Europe. The methodological framework for the study reflects the Better Regulation Guidelines and operationalises the selection criteria for European Partnerships set out in the Horizon Europe Regulation.

This initiative focuses on **metrology** - the science of measurement and the provision of a technical metrology infrastructure that provides robust measurements throughout society that underpin all fields of science and technology and support fair and open trade, innovation and effective policymaking. The initiative will build upon the activities of the A185 European Metrology Partnership for Innovation and Research under H2020. The initiative is focused on the need for a coordinated metrology system in Europe that addresses three challenges: the ever-increasing demands on the metrology infrastructure for new capabilities; the fragmentation of national metrology systems across Europe; and low awareness and understanding of metrology throughout the research, innovation and policy-making systems.

The objective of the initiative is to establish a sustainable coordinated world-class metrology system and maximise its economic and societal impact by providing the metrology capabilities to meet the needs of emerging technologies and important policy domains in climate, environment, energy and health. To achieve this requires long-term sustainable mechanisms to increase and deepen coordination and pool resources, not only among national metrology institutions in Europe, but also along the entire metrology value-chain to bring metrology expertise closer to end-users across a wide range of industries and policymakers. It also requires a long-term strategy to identify and direct the research and innovation activities required to meet user needs and ensure Europe remains a world-leader in metrology.

The relevant policy options for this assessment were Horizon Europe calls (Option 0), a Co-funded European Partnership and an A185 Institutionalised Partnership. Our conclusion is that the A185 Institutionalised Partnership is the preferred option. It was considered that the particular nature of national institutional arrangements for metrology, where metrology research and services are provided (in most countries) by government institutes, requires direct participation and long-term support of the ministries responsible for metrology in Member States and Associated Countries. It also requires strong central governance processes and mechanisms to provide directionality to research and innovation activities and to design and support coordination structures, in the form of European Metrology Networks, in key technology, application and policy domains. These Networks will provide single points of access for researchers and end-users to metrology expertise and capabilities and improve linkages and coherence across Horizon Europe as well as with EU policymakers in climate, environment, energy and health and the wider international metrology community.

## Résumé exécutif

Ce document est le rapport final de l'étude de support à l'analyse d'impact pour la proposition de partenariat européen institutionnalisé pour la métrologie dans le cadre d'Horizon Europe. Le cadre méthodologique de cette étude tient compte des lignes directrices pour une meilleure réglementation et opérationnalise les critères de sélection des partenariats européens définis dans le règlement d'Horizon Europe.

Cette initiative concerne la métrologie (la science de la mesure) et la mise en place d'une infrastructure de métrologie technique fournissant des mesures fiables dans l'ensemble de la société et soutenant tous les domaines scientifiques et technologiques. Elle doit pouvoir favoriser des relations commerciales équitables et ouvertes, l'innovation et une élaboration efficace des politiques. Cette initiative s'appuiera sur les activités du Programme européen d'innovation et de recherche en métrologie (EMPIR) au titre de l'article 185 du TFUE dans le cadre de H2020. L'initiative se concentre sur la nécessité de mettre en place un système métrologique coordonné en Europe réglant trois problématiques : les demandes en constante augmentation pour de nouvelles capacités de l'infrastructure métrologique ; la fragmentation des systèmes métrologiques nationaux dans toute l'Europe ; et le manque de connaissance et de compréhension de la métrologie dans le cadre des systèmes de recherche, d'innovation et d'élaboration des politiques.

L'objectif de cette initiative est d'établir un système de métrologie coordonné et durable à l'échelle internationale et d'optimiser son impact économique et sociétal en fournissant des capacités métrologiques qui répondent aux besoins des technologies émergentes et des domaines de politique importants en termes de climat, d'environnement, d'énergie et de santé. Pour y parvenir, des mécanismes durables à long terme sont nécessaires pour augmenter et renforcer la coordination et mettre en commun les ressources, non seulement au sein des institutions nationales de métrologie en Europe, mais aussi sur l'ensemble de la chaîne de valeur métrologique. L'objectif étant de mettre cette expertise au service d'utilisateurs finaux venant d'un large spectre de secteurs et d'instances de décision publique. Une stratégie à long terme s'avère également indispensable pour identifier et orienter les activités de recherche et d'innovation nécessaires pour répondre aux besoins des utilisateurs et faire en sorte que l'Europe reste leader dans le domaine de la métrologie à l'échelle mondiale.

Les options stratégiques pertinentes pour cette analyse sont les appels à projets d'Horizon Europe (option 0), les partenariats européens cofinancés et les partenariats institutionnalisés au titre de l'article 185. Nous avons conclu que le partenariat institutionnalisé au titre de l'article était la meilleure option. En effet, la nature spécifique des arrangements institutionnels nationaux pour la métrologie, où la recherche et des services métrologiques sont assurés (dans la plupart des pays) par des instituts gouvernementaux, nécessite une participation directe et un soutien sur le long terme des ministères responsables de la métrologie dans les États membres et les pays associés. Des processus et des mécanismes solides de gouvernance centrale doivent également être mis en place pour déterminer l'orientation des activités de recherche et d'innovation et pour concevoir et soutenir des structures de coordination, sous la forme de Réseaux européens de métrologie, dans les principaux domaines de la technologie, des applications et des politiques. Ces Réseaux feront office de points uniques d'accès à l'expertise et aux capacités métrologiques pour les chercheurs et les utilisateurs finaux et amélioreront les corrélations et la cohérence au sein d'Horizon Europe, pour les dirigeants politiques européens dans les domaines du climat, de l'environnement, de l'énergie et de la santé et dans la communauté internationale de métrologie au sens large.



## Table of Contents

1	Introduction: Political and legal context .....	763
1.1	Emerging challenges in the field .....	763
1.2	EU relative positioning.....	765
1.3	EU policy context beyond 2021.....	768
2	Problem definition.....	770
2.1	What are the problems? .....	771
2.2	What are the problem drivers? .....	774
2.3	How will the problem(s) evolve? .....	778
3	Why should the EU act?.....	778
3.1	Subsidiarity: Necessity of EU action .....	778
3.2	Subsidiarity: Added value of EU action .....	779
4	Objectives: What is to be achieved?.....	779
4.1	General objectives .....	779
4.2	Specific objectives .....	780
4.3	Intervention logic and targeted impacts of the initiative.....	782
4.4	Functionalities of the initiative .....	789
5	What are the available policy options?.....	793
5.1	Option 0: Horizon Europe calls (baseline).....	793
5.2	Option 1: Co-programmed European Partnership .....	795
5.3	Option 2: Co-funded European Partnership .....	796
5.4	Option 3: Institutionalised European Partnership .....	797
5.5	Options discarded at an early stage .....	800
6	Comparative assessment of the policy options.....	800
6.1	Assessment of effectiveness.....	800
6.2	Assessment of coherence.....	810
6.3	Comparative assessment of efficiency .....	812
6.4	Comprehensive comparison of the options and identification of the preferred option .....	813
7	The preferred option .....	816
7.1	Description of the preferred option.....	816
7.2	Objectives and corresponding monitoring indicators.....	817
Appendix A	Bibliography.....	821
Appendix B	Synopsis report on the stakeholder consultation – Focus on the candidate European Partnership for Metrology .....	823
Appendix C	Methodological Annex.....	873
Appendix D	Additional information related to the metrology value-chain .....	875

Appendix E	Additional information related to the problem definition .....	876
Appendix F	Additional information related to the objectives definition .....	877
Appendix G	Outcomes and (expected) Impacts of Predecessor A185 Initiatives .....	878
Appendix H	Detailed analysis of functionalities for each option.....	882
Appendix I	Additional information related to the policy options descriptions.....	891
Appendix J	Additional information related to the problem definition .....	893
Appendix K	Additional information related to the policy options descriptions.....	895

## List of Figures

Figure 1: Investment in metrology: comparison of change.....	766
Figure 2: Most prolific organisations in the field of metrology (publications 2010-2018) .....	767
Figure 3: Problem tree for the initiative in metrology .....	771
Figure 4: Objectives tree for the initiative on Metrology.....	781
Figure 5: Impact pathway leading to scientific impacts.....	783
Figure 6: Impact pathway leading to economic/technological impacts .....	785
Figure 7: Impact pathway leading to societal impacts .....	788
Figure 8: Operational objectives of the initiative .....	818
Figure 9: Relevance of the European Metrology partnership in the national context...	826
Figure 10: National interest to participate with the existing programmes in the field of Metrology.....	827
Figure 11: Language of the consultation (N=1635).....	836
Figure 12: Type of respondents (N=1635) .....	838
Figure 13: Capacity in which respondents were involved in Horizon 2020 or in the Framework Programme 7 (N=1303) .....	839
Figure 14: Role of respondents in a partnership (N=1035).....	842
Figure 15: Needs assessment (N=1363).....	846
Figure 16: Needs assessment, open answers to "Other" field (N=734) .....	847
Figure 17: Main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) (N=1551) .....	848
Figure 18: Relevant problems to address.....	849
Figure 19: Options to address challenges.....	850
Figure 20: Stakeholders to involve in setting joint long-term agenda's .....	851
Figure 21: Relevance of actors for pooling and leveraging resources .....	852
Figure 22: Assessment of the partnership composition .....	852

Figure 23: Relevance of activities to implement.....	853
Figure 24: Relevance of setting up a legal structure (funding body) .....	854
Figure 25: Assessment of the proposed scope and coverage of the candidate European Partnerships .....	855
Figure 26: Relevant impacts of future European Partnerships .....	856
Figure 27: Needs assessment (N=225) .....	858
Figure 28: Needs assessment, open answers to "Other" field (N=95).....	858
Figure 29: Main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) (N=199).....	859
Figure 30: Relevant problems to address in relation to metrology.....	860
Figure 31: Options to address the challenges .....	861
Figure 32: Assessment of open answers to explain their choice institutionalised partnership in the assessment of the Horizon Europe intervention (N=110).....	862
Figure 33: Stakeholders to involve in setting joint long-term agenda's .....	863
Figure 34: Relevance of actors for pooling and leveraging resources .....	864
Figure 35: Relevant principles for the partnership composition .....	864
Figure 36: Relevance of activities to implement.....	865
Figure 37: Relevance of setting up a legal structure (funding body) .....	866
Figure 38: Scope and coverage proposed for the European Metrology Partnership ....	867
Figure 39: Scope and coverage proposed for this candidate Institutionalised Partnership (N=57) .....	867
Figure 40: Comparable initiatives to link with the partnership (N=47) .....	868
Figure 41: Other comparable initiatives – open question (N=59) .....	869
Figure 42: Relevance of the candidate European Institutionalised Partnership to various impacts.....	870
Figure 43: Composition analysis of EMPIR participant by organisation type .....	879
Figure 44: Composition analysis of EMPIR participant by country and by organisation type .....	880

## List of Tables

Table 1: Scientific impact of EURAMET and internationally comparable NMIs (2008 - 2015) .....	766
Table 2: Piloted and proposed European Metrology Networks .....	784
Table 3: Key characteristics of Option 0.....	793
Table 4: Key characteristics of Option 1.....	795
Table 5: Key characteristics of Option 2.....	796
Table 6: Key characteristics of Option 3: Institutionalised Partnership Art 185.....	798

Table 7: Key characteristics of Option 3: Institutionalised Partnership Art 187.....	799
Table 8: Likely impacts of the initiative .....	801
Table 9: Overview of the options' potential for reaching the scientific impacts .....	805
Table 10: Overview of the options' potential for reaching the likely economic/technological impacts .....	807
Table 11: Overview of the options' potential for reaching the likely societal impacts..	809
Table 12: Overview of the options' potential for ensuring and maximizing coherence	812
Table 13: Intensity of additional costs compared with HEU Calls (for Partners, stakeholders, public and EC).....	812
Table 14: Matrix on 'overall costs' and 'cost-efficiency'.....	813
Table 15: Scorecard of the policy options .....	815
Table 16: Alignment with the selection criteria for European Partnerships.....	816
Table 17: Monitoring indicators for the operational objectives .....	818
Table 18: Monitoring indicators in addition to the Horizon Europe key impact pathway indicators .....	819
Table 19: Number of interviews per stakeholder category.....	829
Table 20: Country of origin of respondents (N=1635) .....	836
Table 21: Size of organisations that represent consultation respondents (N=1635)...	838
Table 22: Partnerships in which consultation respondents participated (N=1035) .....	840
Table 23: Future partnerships for which consultation respondents provide responses (N=1613).....	842
Table 24: Overview of campaigns across partnerships.....	844
Table 25: Overview of responses of campaign participants (N=35) .....	870
Table 26: Type and composition of actors (including openness and roles) .....	891
Table 27: Type and range of activities (including flexibility and level of integration) ..	893
Table 28: Type and composition of actors (including openness and roles) .....	895
Table 29: Type and range of activities (including flexibility and level of integration) ..	897
Table 30: Directionality .....	899
Table 31: Coherence (internal and external) .....	900

## Glossary

AI	Artificial Intelligence
DI	Designated Institute
CEF	Connecting European Facility
DEP	Digital Europe Programme
EMPIR	European Metrology Programme for Innovation and Research
EMRP	European Metrology Research Programme
EP	European Partnerships
(EU) MS	EU Member States
IoT	Internet of Things
IP	Institutionalised Partnership
MFF	Multi-annual Financial Framework
NMI	National Metrology Institute
RTO	Research and Technology Organisation
SDG	Sustainable Development Goals
SRIA	Strategic Research and Innovation Agenda
R&I	Research and Innovation
S&T	Science and Technology

## 1 Introduction: Political and legal context

This document presents the impact assessment of the candidate institutionalised partnership in metrology, which is one of the initiatives that will implement the Commission's vision for the period beyond 2020 under the Horizon Europe Pillar II, specifically the Cluster 4. It is the only envisaged European Partnerships in the Partnership Area "Metrology".

### 1.1 Emerging challenges in the field

Metrology, the science of measurement, provides the accurate and trustworthy measurement data that underpins all domains of science, technology and innovation and therefore all of the challenges and trends that drive science, technology and innovation are pertinent to metrology.

#### 1.1.1 Social trends and challenges

The ageing population in Europe places increased demands on the health system for new technological (as well as social) solutions to diagnose, monitor, treat and manage medical conditions and enable healthy lives. Many medical innovations are conceptualised and developed but, before they are adopted by healthcare providers, they must be demonstrated to be both safe and effective. This creates a challenge to ensure that appropriate measurement tools and techniques are available to assess the performance and safety of medical innovations (see 'technological trends and challenges' below). A particular challenge is establishing a system of metrology for robust measurement of biochemical and biological parameters as well as the measurement techniques needed to assess new medical technologies and interventions. This pushes metrology beyond its traditional base in physical measurements and requires new measurement capabilities.

#### 1.1.2 Technological trends and challenges

Emerging technologies in digital (such as big data, AI, robotics, industry 4.0),<sup>1</sup> additive manufacturing, quantum technologies, biotechnologies, new materials and low carbon technologies are expected to contribute to future innovation to and address societal challenges in sustainable economic growth, addressing climate change and ensuring healthy and safe citizens.<sup>2</sup> These technologies place new and challenging demands on the metrology infrastructure, creating requirements for increasingly accurate measurements and often requiring entirely new forms of metrology to assess new technologies and support the innovation process.

Accurate measurement, enabled by metrology, provides the means of demonstrating and validating the performance and functionality of novel concepts, technologies, products and services. A key role in the metrology value-chain (Appendix D) is the sensors and instrumentation sector that provides the tools to measure, test and validate innovations, control production processes and manage complex infrastructure systems such as communications, energy and even financial systems. The digitisation and automation of manufacturing, transport and consumer products is driving considerable growth in this

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<sup>1</sup> Metrology for the Digitization of the Economy and Society (2017), BIPM, PTB  
[https://www.bipm.org/cc/PARTNERS/Allowed/2017\\_October/2017-Metrology-for-the-Digitalisation-of-Economy-and-Society.pdf](https://www.bipm.org/cc/PARTNERS/Allowed/2017_October/2017-Metrology-for-the-Digitalisation-of-Economy-and-Society.pdf) ; Advanced Metrology and Intelligent Quality Automation for Industry 4.0-Based Precision Manufacturing Systems (2017) Markopoulos, A. P., Vosniakos, G. C. *Scientific.net*  
<https://www.scientific.net/SSP.261.432>

<sup>2</sup> For example: End-user needs for large volume applications of metrology, EMPIR JRP-i05 LaVA  
<http://empir.npl.co.uk/lava/wp-content/uploads/sites/51/2019/04/LaVA-poster.pdf>

sector at a rate of 8%-10% a year.<sup>3</sup> However increased reliance on automation requires high levels of trusts in the data behind automated decisions and a corresponding need for appropriate underpinning metrology to ensure measurement data is robust.

### 1.1.3 Economic trends and challenges

Europe's economy will continue to be based on high-value products and services. Innovation is critical to Europe's economic growth and, importantly, to sustainable growth. Metrology not only enables innovation by enabling the performance of novel concepts, technologies, products and services to be validated, it also provides the means to demonstrate and validate the superior performance and quality of European high-value innovative products compared to cheaper and lower quality alternatives.

The trend in Europe is towards a more coherent Innovation Union with more coordinated infrastructures of innovation support to ensure equal access to support across Europe and increase efficiency by reducing fragmentation and duplication. However, the metrology system is still largely a national policy concern and there are considerable benefits to a more integrated European approach to metrology in support of innovation but also many challenges to improving coordination and reducing fragmentation.

### 1.1.4 Environmental/societal challenges

The shift to sustainable growth and a carbon-neutral Europe (the European Green Deal) is driven by increasing public desire in Europe to address climate change and protect the environment. This requires both policy responses and regulations that are both effective and efficient (see section below) and innovation to generate the new low-carbon energy sources, low-carbon products and low-carbon transport solutions required to become carbon-neutral.

### 1.1.5 Political, policy and regulatory framework

Public policy, and any resulting regulation, is increasingly directed at well-defined societal challenges in environment, energy, health, etc. Policy-makers require reliable and better evidence and data to identify and assess risks and to design and implement effective policy, regulation and standards to mitigate them. Reliable and better evidence and data includes reliable assessments of physical, chemical and biological parameters (such as Essential Climate Variables or water and air quality data) underpinned by appropriate metrology capabilities.

The breadth of challenges facing metrology and their commonality across all national economies puts significant pressure on National Metrology Institutes (NMIs) and Designated Institutes (DIs)<sup>4</sup> across Europe to develop metrology capabilities (comprising physical infrastructure, knowledge, techniques, skills, etc) to meet an ever-expanding set of economic and societal needs. These institutes are responsible for maintaining and providing national measurement systems and ensuring global comparability of measurements, as well conducting research to ensure national measurements systems can meet emerging and future measurement needs.

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<sup>3</sup> <https://www.ama-sensorik.de/en/association/sector-information/sensor-industry-statistics-2017>  
[https://cdn.southampton.ac.uk/assets/imported/transforms/content-block/UsefulDownloads\\_Download/47523AE5DBC34BFF86A5BAA8BE59558C/Nigel%20Rixrevised.pdf](https://cdn.southampton.ac.uk/assets/imported/transforms/content-block/UsefulDownloads_Download/47523AE5DBC34BFF86A5BAA8BE59558C/Nigel%20Rixrevised.pdf)

<sup>4</sup> In some countries Designated Institutes (DI) share the national role of providing national measurement systems with NMIs. NMIs and DIs work together via international treaties and bodies to ensure measurements as consistent worldwide <https://www.bipm.org/en/about-us/> <https://www.bipm.org/en/committees/cipm/>



Almost all **stakeholders interviewed** across the value-chain interviewed reported that metrology underpins research and innovation in almost all sectors of the economy and most technology domains as well as key policy fields in climate, environment and health and safety. These same stakeholders also reported on the need for the continual development of metrology capabilities to provide accurate measurement data in new technologies and fields and to ensure capabilities in existing metrology domain remain relevant to continually evolving needs.

**Stakeholders interviewed** identified a range of challenges across many sectors that require the development of new methods of measurement, and the validation and certification of new technologies. Challenges identified by the stakeholders interviewed included (for example) references to metrology to ensure accurate measurement of chemical and biological materials and processes, soft-matter, digital technologies, quantum and new materials.

**Stakeholders interviewed** from across different stakeholder groups also identified challenges associated with the uptake of new technologies innovation (e.g. quantum technologies or 5G) and integration of innovation within existing complex systems (e.g. integration of renewables into the energy system) via a require coordinated standardisation to ensure pan-European uptake.

## 1.2 EU relative positioning

### 1.2.1 Competitive positioning of Europe in the field

Europe is seen as a world leader in metrology, home to two of the top three National Measurement Institutes (NMIs) worldwide in terms of scientific quality and breadth of service provision.<sup>5</sup> Europe has played a key role in the formal institutions of international metrology since their origin in 1875, providing 13 out of 16 Presidents of the International Committee for Weights and Measures (CIPM) and all the Directors of the International Bureau for Weights and Measures (BIPM). European nations play a key role in the working practices of CIPM and BIPM that ensure measurements and measurement data are the same worldwide. European countries hold 39% of seats on the current International Committee for Weights and Measures (CIPM), chair 42% of the CIPM's Consultative Committees and chair 53% of the Consultative Committee's Working Groups.<sup>6</sup>

In terms of the research that underpins and develops the metrology system, Europe is also a world-leader. Table 1 shows the collective research performance of 38 NMIs in Europe (i.e. the membership of EURAMET, the European Association of National Metrology Institutes) in comparison to the institutes in the USA, Japan, South Korea and China for the period 2008 to 2015. In terms of citations and highly-cited papers, Europe performs second to the USA and in terms of journal impact factor third after the USA and South Korea.

Europe's leading global position is challenged by increased investment in Asia. China, in particular, has been increasing its investment in metrology rapidly since 2005 (Figure 1) and its scientific output has increased correspondingly. While the quality of China's National Institute of Metrology (NIM) publications may not have, as yet, reached that of the USA and Europe (Table 1) it now publishes the highest quantity of papers of any single organisation worldwide (Figure 2). Furthermore, other Chinese research institutions (such

<sup>5</sup> Unpublished report by the UK's National Physical Laboratory and reported by interviewed stakeholders. (The top three being: the NIST in the USA, PTB in Germany and NPL in the UK. Europe is also home to other high-quality national metrology institutes both within the EU, in for example, France and Italy, and in non-EU states such as Switzerland and Norway.)

<sup>6</sup> BIPM website: <https://www.bipm.org/en/committees/cipm/> <https://www.bipm.org/en/committees/cc/>



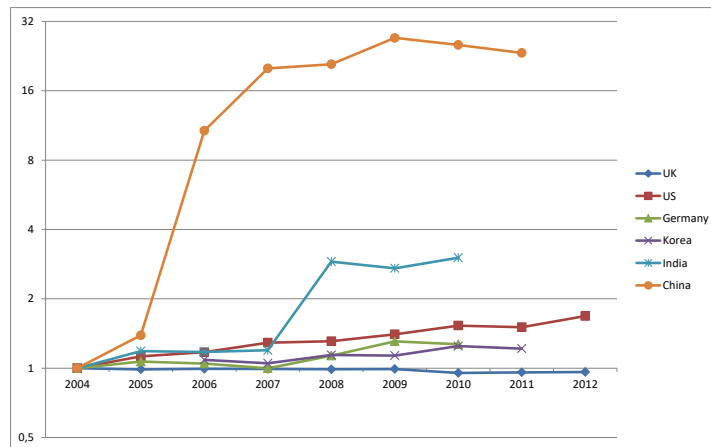
as the Chinese Academy of Sciences) are also publishing large numbers of papers in metrology.

Table 1: Scientific impact of EURAMET and internationally comparable NMIs (2008 - 2015)

National Metrology Institutes	Total no. of papers	Scientific impact		
		ARIF	HCP <sub>10%</sub>	ARC
Total – EURAMET NMIs	9,579	1.06	10%	1.08
NIST – National Institute of Standards and Technology (USA)	13,563	1.36	17%	1.62
KRISS – Korea Research Institute of Metrology	2,912	1.15	9%	0.89
NIM - Chinese National Institute of Metrology	2,052	0.48	3%	0.38
NIMJ – National Metrology Institute of Japan	1,422	0.87	8%	0.80

Source: Science Metrics (2016), internal report for EURAMET

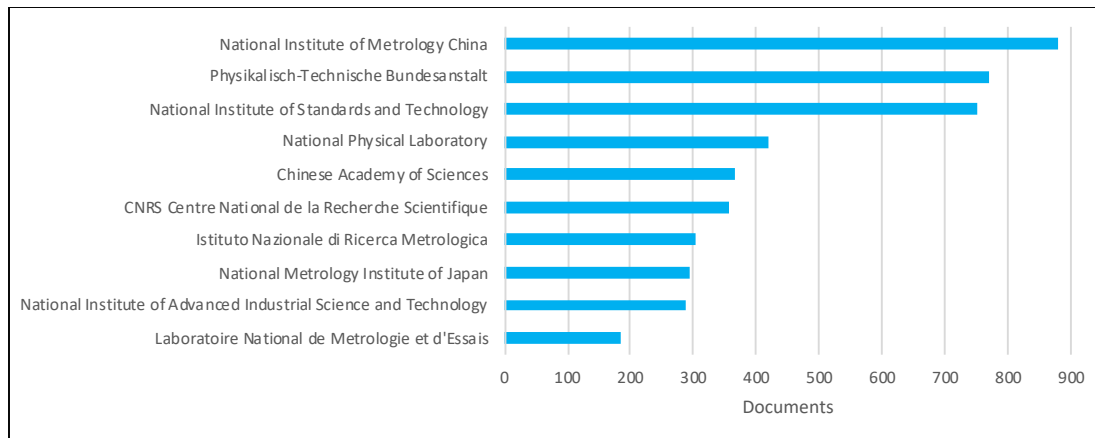
Figure 1: Investment in metrology: comparison of change<sup>7</sup>



Source: EURAMET

<sup>7</sup> Rate of change of expenditure on national metrology systems, EURMET, 2012

Figure 2: Most prolific organisations in the field of metrology (publications 2010-2018)



Source: Scopus, calculation: Technopolis Group

### 1.2.2 Support for the field in the previous Framework Programme

In the previous Horizon 2020 Framework Programme support for metrology R&I was provided via an A185 initiative the European Metrology Programme for Innovation and Research (EMPIR). European Union funding for this initiative is €300M invested alongside €300M from Member States. Within the Framework Programme more generally, there has been no thematic priority or calls for the type of research that develops the underpinning metrology system since FP5. Therefore the EU investment via the EMPIR Partnership is the total European for funding for metrology.

The key lessons learned from EMPIR are: it is a well-run programme that is starting to achieve scientific, management and financial coordination of national metrology research and that EURAMET (the implementation body) can be trusted with delegated responsibility for a A185.<sup>8</sup>

The initiative has brought the national metrology institutes (the NMIs and DIs) much closer together and have been very successful at coordinating research activities. Before these initiatives it was estimated that no more than 5% of research was conducted collaboratively amongst NMI/DIs. Now around 25% of national research budgets are aligned via the partnership.<sup>9</sup> Country participation is broad with 28 participants (23 Member States and 5 Associated States)<sup>10</sup> while links with the research base<sup>11</sup> and measurement users in the industrial, standards and policymaking communities are improving. In terms of the fundamental underpinning system of units (the SI system), the EMPIR (and its predecessor initiatives) played a key role in coordinating the European research that made a significant contribution to the recent internationally agreed redefinition of the seven measurement base units.<sup>11</sup> Further details of the evaluations are provided in Appendix G.

<sup>8</sup> Final Evaluation of the European Metrology Research Programme (EMRP) and Interim Evaluation of the European Metrology Programme for Innovation and Research (EMPIR), Expert Group Report, European Commission, 2017 <https://publications.europa.eu/en/publication-detail/-/publication/eac61c51-ae2e-11e7-837e-01aa75ed71a1/language-en>

<sup>9</sup> Data provided by EURAMET during a stakeholder interview

<sup>10</sup> Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Bosnia-Herzegovina, Serbia, Turkey, Norway, Switzerland

<sup>11</sup> The SI system of units was redefined in its totality by international vote under the auspices of the International Committee for Weights and Measures (CIPM) in November 2018, with this change coming into effect in May 2019. This is first time such a comprehensive change to the metrology system has taken place since the original Convention de Metre was signed in 1875. See for example an article in Nature

The evaluation identified the key areas for action. These are focused on long term coordination of metrology research among NMIs and DIs alongside increased engagement with the metrology user/beneficiary base (in the industrial, academic and policy-making communities) at a strategic level rather than just at the level of individual research projects - in order to create a much more integrated community that can better respond to society's needs. The evaluation specifically reported that while the predecessor initiative has gone a long way towards increasing coordination in the metrology system across Europe, the changes are not yet firmly embedded or sustainable for the longer-term. The evaluation also highlighted that there is more to be done to involve and develop the capacities of smaller metrology institutes.

### *1.3 EU policy context beyond 2021*

The candidate European Metrology Partnership sits within the Horizon Europe Pillar II Cluster 4 - Digital, Industry and Space.

Metrology ensures measurements made are traceable to internationally agreed definitions and measurement standards. This is the basis of national and international metrology systems that create the accurate, reliable and trustworthy measurements that underpin a wide range of economic activities and public services - from manufacturing and communications systems to climate monitoring and public healthcare provision. As such the candidate Metrology Partnership is relevant to a wide range of European policies.

#### **The Single Market**

The metrology system enables fair and open trade. It ensures that measurements of the quantity, performance and quality of products and services are consistent whenever and wherever they are made and traded, by ensuring they are traceable back to national and international measurement standards. In doing so, the metrology system ensures that what we buy, as consumers, businesses or public agencies, is what the seller says it is. This reduces transaction costs by providing confidence in the measurements everyone uses to trade. At business-to-business level, reliable and consistent measurement enables complex global manufacturing supply-chains to function, where components from around the world must fit together and perform as designed. It is essential that the metrology system continues to develop to keep pace with emerging technologies and the changing needs of industry.

#### **The Innovation Union**

Metrology research plays an important role in innovation. Firstly, state-of-the-art reliable and trustworthy metrology capabilities support innovation by providing the means to demonstrate and validate the performance and functionality of novel scientific concepts, technologies, products and services across a wide range of sectors - from aerospace and engineering to medical devices and ICT. It also supports the market for high quality innovative products and services by enabling businesses to demonstrate, and provide quality assurance, that their products and services are superior to cheaper alternatives. Secondly, metrology research creates new metrology knowledge, tools and techniques that feed into and stimulate innovation in industry and a wide range of service sectors including healthcare, communications, financial services, environmental monitoring.

#### **Climate Action, Environmental Policies and Regulations**

Accurate and traceable measurements support climate and environmental policy-making in two ways. Firstly, enabling accurate and robust assessment of the state of the climate and the environment to identify the need for action. Secondly, enabling effective design,

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<https://www.nature.com/articles/d41586-018-07424-8> and the New York Times  
<https://www.nytimes.com/2018/11/16/science/kilogram-physics-measurement.html>

monitoring and enforcement of appropriate environmental regulations through providing accurate and reliable data for the essential climate variables that support the Paris Agreement on Climate Change and for environmental parameters such as air and water quality. Metrology research creates new and enhanced measurement capabilities that improve the accuracy and robustness of climate and environmental data as well as innovative tools and techniques to improve the effectiveness and efficiency of their assessment and monitoring.

### **Energy Union Strategy**

Metrology supports a wide range of activities in the energy infrastructure. It provides the accurate traceable measurements that underpin the legal system of trading and taxing energy fuels. Traditionally this has involved the measurement of the quantity and quality of fossil fuels but new traceability systems and measurement capabilities are required for new lower-carbon fuels such as biofuels and hydrogen that are essential to a European Green Deal and achieving a climate-neutral Europe. Similarly, metrology research is needed to ensure there is a reliable and robust measurement infrastructure to support development, testing and standardisation of the instrumentation required to operate smart grids – the grids that are needed to manage and distribute energy originating from a wide range of different low carbon sources.

### **Digital Single Market**

Accurate state-of-the-art measurement capabilities enable modern digital services, such as communications and financial services, to function. State-of-the-art metrology capabilities enable, for example, each and every digital data packet to be accurately time-stamped so that communications content can be accurately 'stitched back together' when it reaches its destination. Metrology research is essential to ensure measurement capabilities are in place to test and validate and design standards for 5G and future generation communications technologies and systems. In financial services metrology enables each financial trade to be accurately time-stamped to provide traceable evidence of transactions and ensure compliance with European financial regulations.<sup>12</sup> As communications systems get faster the underpinning time measurement and time-stamping systems need to be able to respond faster.

### **Public Health**

Accurate measurement capabilities enable healthcare interventions to be delivered safely and effectively ensuring, for example, that accurate doses of pharmaceuticals or radiotherapy are delivered to patients and that medical diagnostic tools provide robust results. Metrology research ensures the metrology system can support accurate measurements for new innovative medical technologies, diagnosis techniques and therapies.

### **Relevant other European initiatives in the Partnership area [and programmes under the MFF 2021-27]**

The European Metrology Partnership is placed within the Horizon Europe Pillar 2 Digital, Industry and Space Cluster as the robust accurate measurements provided by metrology make a critical contribution across manufacturing sectors, particularly to high-precision manufacturing of high-value-added products such as aerospace, high-performance ICT and space equipment and pharmaceuticals. However, the use of robust accurate measurements is much wider than this and therefore the candidate European Metrology Partnership is relevant to a wide range of other European Partnerships and Policies.

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<sup>12</sup> MiFIDD II - Markets in financial instruments and amending Directive 2002/92/EC <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0065&from=EN>

The Metrology Partnership's aim is to create a European infrastructure that performs research, provides services, supports policy development and ensures technological expertise to support metrology needs across a wide range of research and innovation actors. The proposed activities will be grouped into themes that include Industry, Environment, Energy and Health.

Since metrology is an enabler of all scientific and technological fields, improvements in metrology capabilities can accelerate scientific advancement and industrial developments to help address challenges related e.g. to health, environment, climate change, social protection and cultural heritage. For instance, better metrology systems and measurement capabilities will make a direct contribution to the rolling out of 5G application and to the installation and operation of smart electrical grids and therefore serve the objectives of the Partnership for Smart Networks and Services and the partnership for Clean Energy Transition. Metrology is also important to ensuring accurate measurements in health diagnostics and delivery and therefore synergies can be explored with partnerships related to the use of health technologies in health, i.e. the Innovative Health Initiative and the partnership for Large-scale innovation and transformation of health systems in a digital and ageing society.

It is expected that the European Metrology Partnership would also create and exploit linkages with several other envisaged partnerships under Horizon Europe, such as Carbon Neutral and Circular Industry; Made in Europe; Key Digital Technologies; Artificial Intelligence, data and robotics; Towards zero-emission road transport (2Zero); Safe and Automated Road Transport; Clean Aviation; and the Global Competitive Space Systems partnership. Potential synergies may exist with the European Open Science Cloud partnership which offers a similar infrastructure but for the storage, management, analysis and re-use of research data.

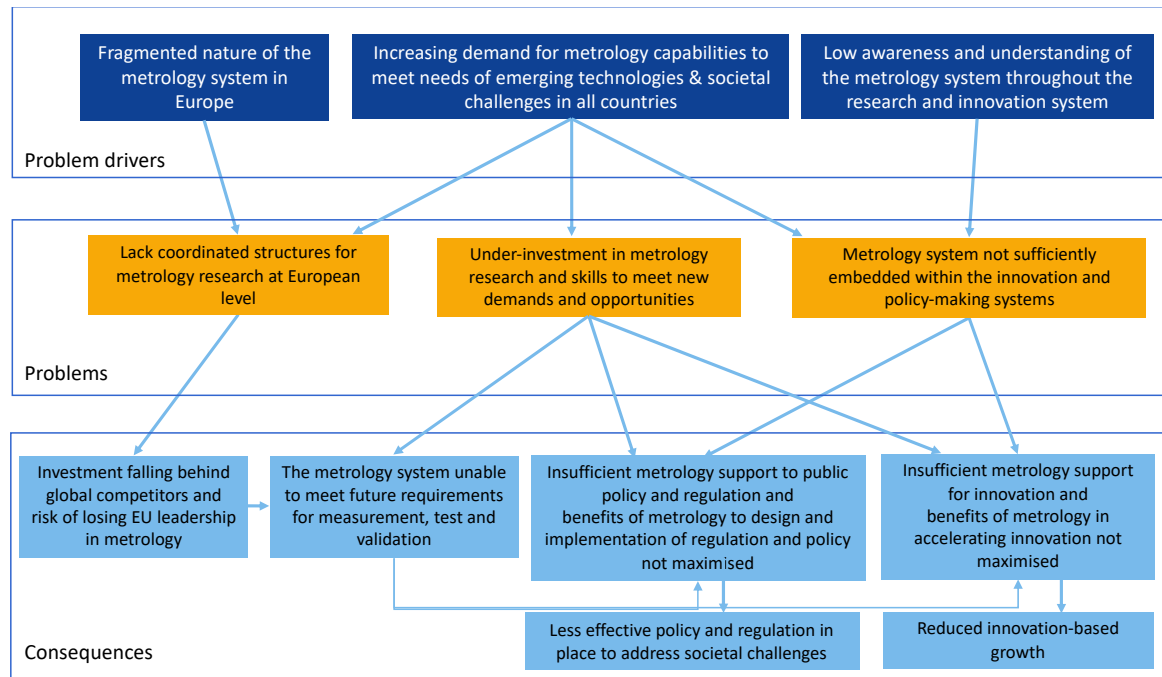
Therefore, while the European Metrology Partnership primarily contributes to the Horizon Europe Pillar 2 Digital, Industry and Space Cluster, it also contributes to the Health and the Climate, Energy and Mobility clusters.

## **2 Problem definition**

This section provides a discussion of the problems to be addressed in relation to the emerging challenges presented in Section 1.1, drawing on evidence from desk research and the findings of the stakeholder consultation undertaken as part of this study.

A problem tree portraying related problems, their drivers and consequences is presented in Figure 3 and described in detail in the following sections.

Figure 3: Problem tree for the initiative in metrology



## 2.1 What are the problems?

### 2.1.1 Under-investment in metrology research to meet new demands and opportunities

Metrology provides the accurate and reliable measurements that underpin a wide range of economic and social activities from weights and measure legislation, to manufacturing quality control and assessing climate change. As a technical infrastructure and *General-Purpose Technology*<sup>13</sup> with the characteristics of a public good, the metrology system is largely provided by the state. National governments worldwide invest in a range of activities to provide and maintain the metrology infrastructure as well the research necessary to ensure the infrastructure can continue to meet the evolving needs of society.

Emerging technologies and the need to address significant and evolving societal challenges create a requirement for metrology in entirely new areas while demands for the existing capabilities of the metrology infrastructure do not decrease - in fact they also continue to evolve, requiring improvements in the accuracy and range of capabilities in existing fields of metrology. These new and evolving needs place increasing demands on national metrology systems and institutes to conduct the research required to provide new metrology capabilities. However national budgets for metrology in Europe are fairly static and new needs will be unmet without additional investment in metrology research. These increasing demands on metrology are faced by countries worldwide and while national budgets in Europe are fairly static, the USA continues to outspend Europe in metrology and China continues to rapidly increase its metrology investments (as shown in Figure 1). Increasing investments in China are evident in the rapid rise of its NMI to become the most prolific publisher of scientific papers in metrology (Figure 2).

<sup>13</sup> Swann, G. M. P. (2009) The Economics of Metrology and Measurement, Report for National Measurement Office, Department for Business, Innovation and Skills, Innovative Economics Limited. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/297870/pr-of-swann-report-econ-measurement-revisited-oct-09.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297870/pr-of-swann-report-econ-measurement-revisited-oct-09.pdf)

### 2.1.2 Lack of coordinated structures for metrology research at European level

The European Single Market, the Innovation Union, the Green Deal and climate action, amongst other policy domains, fundamentally rely on consistent and reliable measurements of physical, chemical and biological characteristics (of products, process, services and of environmental and health parameters) provided by metrology.<sup>14</sup> A fragmented metrology system reduces the effectiveness and efficiency of the Single Market and the Innovation Union and the effectiveness of policy and regulatory responses to European and global challenges. At present metrology is a national policy concern and the research to ensure it evolves and remains fit-for-purpose is also largely designed and managed at national level.

A fragmented system of metrology research is an inefficient solution to meeting the increasing demands on national metrology systems across Europe (**Problem 1**) and it reduces Europe's ability to provide the metrology infrastructure required for emerging technologies and important policy domains at European level. NMIs and DIs worldwide face the same increasing demands for new and improved metrology capabilities and in Europe, with 38 national metrology systems,<sup>15</sup> there is duplication of research efforts particularly among the Member States with large NMIs. At the same time, metrology capabilities are variable across Europe, varying in scale, scope and ability to conduct the quantity and quality of research needed to meet all their needs.

Formal coordination processes among NMIs/ DIs are largely focused on ensuring worldwide comparability of measurements while research collaboration is less formally structured. The current A185 initiative under H2020 has enabled increased research collaboration but it remains largely on a project by project basis with no sustainable structures for long-term commitment to coordination.<sup>16</sup>

Therefore, each national system creates, or attempts to create, its own solutions to addressing existing and envisaged future needs, when those needs have a high degree of commonality. A more efficient solution would be structures that support strategic and long-lasting coordination and pooling of European metrology research excellence to develop and provide access to metrology capabilities for all Member States and Associated States.

### 2.1.3 Metrology system not embedded within the innovation and policy-making systems

The metrology system is not fully embedded within the innovation systems or policy-making systems that address societal challenges and, as a result, its benefits to society are not maximised. National metrology systems are not as open and engaged with measurement users and the wider research community as they could be and vice versa.<sup>17</sup> Furthermore, there is no formal structured way for the national systems in Europe to 'speak as one voice' to existing and potential beneficiaries of metrology.

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<sup>14</sup> See section 1.3 for further details of the role and importance of metrology in these policy domains

<sup>15</sup> The members of the European Association of National Metrology Institutes represent the EU 28 plus Norway, Switzerland, Albania, Bosnia and Herzegovina, Iceland, Moldova, Montenegro, North Macedonia, Serbia, Turkey

<sup>16</sup> Final Evaluation of the European Metrology Research Programme (EMRP) and Interim Evaluation of the European Metrology Programme for Innovation and Research (EMPIR), Expert Group Report, European Commission, 2017 <https://publications.europa.eu/en/publication-detail/-/publication/eac61c51-ae2e-11e7-837e-01aa75ed71a1/language-en>

<sup>17</sup> Final Evaluation of the European Metrology Research Programme (EMRP) and Interim Evaluation of the European Metrology Programme for Innovation and Research (EMPIR), Expert Group Report, European Commission, 2017 <https://publications.europa.eu/en/publication-detail/-/publication/eac61c51-ae2e-11e7-837e-01aa75ed71a1/language-en>

Metrology R&I plays an important role in innovation by creating state-of-the-art measurement capabilities that provide the means to demonstrate and validate the performance and functionality of novel scientific concepts, technologies, products and services across all technology domains, as well as supporting market adoption and quality assurance of high quality innovative products and services by enabling businesses to demonstrate their superiority to cheaper alternatives. In addition, metrology research creates new metrology knowledge, tools and techniques that contribute to innovation in the metrology value-chain - providing novel concepts for the instrumentation sector that enable novel approaches and solutions in manufacturing, healthcare, communications, financial services, environmental and climate monitoring.

The accurate measurements provided by metrology are also essential to well-designed policy and regulation. Public policy, and any resulting regulation, is increasingly directed at well-defined societal challenges in health, climate change, environment, energy, etc. Policy-makers require reliable and better evidence to identify and assess risks and to design and implement effective policy, regulation and standards to mitigate them. Reliable and better evidence includes reliable assessments of physical, chemical and biological parameters including for example, the essential climate variables (ECVs), vehicle emissions, water and air quality, doses of pharmaceuticals or radiotherapy or performance of low-carbon technologies.

Researchers in the metrology community (metrologists),<sup>18</sup> based in NMIs and DIs, aim to pre-empt user needs when designing their research activities but, while they tend to be well-connected with first-tier users of metrology in the value-chain in the sensors and instrumentation and calibration laboratory sectors, they are less well-connected to the end-users of metrology in wider industry and among policy-makers. This limits the widespread adoption of the best and latest metrology research knowledge and capabilities research and fails to maximise its impact for the economy and society.

To widen the reach of metrology R&I and increasing R&I collaboration requires addressing the low awareness of metrology beyond the first-tier users and developing a better understanding of end-users needs among NMIs and DIs. This is particularly the case where the end-users are policy-makers and regulators who traditionally have a more limited engagement with the research base in general and are not particularly well-engaged with NMIs and DIs. There are exceptions to this, some NMIs and DIs for example are well-connected to the UN's World Meteorology Organisation, a key partner in the Global Climate Observing System, but there is still much to do.



Almost all **stakeholders interviewed** reported on the fragmentation of metrology research (and in the provision of metrology capabilities) and identified the need for coordination of metrology research at the European level. Many stakeholders interviewed remarked that coordination of metrology was necessary to support European competitiveness.

Respondents to the **open consultation** considered that European research and innovation efforts in metrology would be most relevant to addressing the innovation gap in the EU and would support widespread metrology system application to support emerging technologies and industrial deployment.

Most **stakeholders interviewed** commented on the lack of connection between metrology systems and innovation and policy systems. Many of the industry and policy stakeholders had a limited view on the metrology R&D activities across Europe but instead

<sup>18</sup> Where the term 'metrology community' is used in this report it denotes the community of metrology researchers (and other staff) within NMIs and DIs. It does not include, for the purposes of this report, the commercial calibration laboratories, commercial metrology equipment providers or those responsible for the measurement capabilities within businesses or other organisations.



relied on their national metrology institutes as and when needed. Some stakeholders reported that there was both a lack of awareness of the metrology system and metrology research in particular, but also that was an expectation that the required metrology (and the measurements it enables) would be readily available whenever needed.

**Interviews with industry stakeholders** highlighted that the metrology community was less likely to engage directly with industry end-users in the broadest sense, with the majority of their connections being with instrumentation manufacturing sector.

Some **stakeholders interviewed** also highlighted the different capabilities and resources available within the NMIs and DIs across Europe as a barrier to providing equal access to metrology expertise and support across Europe. For interviewees from smaller Member States, pressure on resources was a significant challenge to developing and providing metrology services to emerging industries. Reflecting on this, some metrology stakeholders interviewed agreed that a structure for coordinated metrology research allows NMIs/DIs to 'specialise' in certain areas, reducing duplication and improving the quality of services available to both EU and national industry and policy makers.

Around half respondents to the **open consultation** indicated that European research and innovation efforts would be very relevant for addressing the limited collaboration and pooling of resources between public actors (i.e. NMIs/DIs) and private actors (i.e. service providers, instrument manufacturers and end users), and addressing the increasing costs of a complex and specialist metrology infrastructure.

## 2.2 What are the problem drivers?

The key problem drivers affecting R&I performance in metrology in Europe are discussed in more detail in the following paragraphs.

### 2.2.1 Increasing demand for metrology capabilities to meet needs of emerging technologies and societal challenges

Emerging technologies and the need to address significant societal challenges place new demands on national metrology systems, while the needs of existing users of metrology systems do not diminish. The metrology needs of traditional industries are not static. Their needs continually develop and change, creating new requirements in terms of increased measurement accuracy, measurement range and new measurement methods. For example, ever-increasing demands for faster and smaller ICT components and systems, requires a corresponding ability to measure, test and validate new components and control the processes used to manufacture them. Likewise, the shift to industry 4.0, based on sensor systems, digitisation, data, autonomous systems and AI, is creating new demands in terms of measurement techniques, instrumentation and robust management of measurement data. More generally, the digitisation and automation of a wide range of services such as transport, healthcare and energy infrastructures rely on complex sensor systems and automated data processing and analysis. These physical and digital systems require appropriate metrology to ensure the data used is accurate and reliable and that automated decisions are robust.

At the same time emerging technologies put further pressures on the metrology system and, in some cases, require entirely new types of measurement. Quantum and bio-based technologies, for example, require new metrology capabilities, skills and infrastructure and in some cases require entirely new forms of measurement<sup>19,20</sup> Emerging technologies also

<sup>19</sup> Coxon, C. H., Longstaff, C., Burns, C., Applying the science of measurement to biology: Why bother?, 2019, PloS, <https://doi.org/10.1371/journal.pbio.3000338>

<sup>20</sup> <https://www.nist.gov/topics/bioscience/metrology-biology>

create opportunities to develop the metrology system itself, offering solutions for the long-term development of the SI system.<sup>21</sup>

Traditionally metrology has focused on physical parameters and characteristics and metrology based on physics but demands for more accuracy and robustness in chemical and biological measurements are increasing. These areas are particularly important for the assessment of the quality of the environment and monitoring the effects of environmental regulation and in the safe and effective implementation of innovative healthcare diagnostics and therapies. More broadly, as recognised by UNIDO, addressing societal challenges and sustainable development goals in climate change, environment protection, sustainable energy and healthcare relies on metrology capabilities for robust identification and assessment of risks and the design and implementation of effective policy, regulation and standards to mitigate them.<sup>22</sup> Addressing new challenges and/or improving policy responses to existing challenges place new demands on the metrology system – in terms of increased measurement accuracy, new measurement parameters and faster and cheaper measurement tools.

Creating and maintaining metrology capabilities (physical infrastructure and skilled metrologists) and conducting metrology research within NMIs and DIs has high fixed costs<sup>23,24</sup> which, in a scenario of fairly static national metrology budgets, limits the ability of individual NMIs/DIs to respond effectively to all new needs (**Problem 1**).

### 2.2.2 Fragmented nature of metrology system in Europe

In Europe, the formal metrology infrastructure is implemented at national level for reasons of history and, in some countries, regulation in the form of national weights and measures legislation. Therefore, Europe does not have a single system or single centre of excellence for metrology (such as the NIST in the USA) and it relies on the collection of NMIs and DIs across Member States. EURAMET, the European Association of National Metrology Institutes, has members from 38 European countries covering the EU Members States countries plus the wider European geography.<sup>25</sup> This results in a fragmented system that lacks directionality in terms of both a strategic approach to meeting long-term needs and a coordinated approach to the delivery of new high-cost metrology capabilities and, ultimately, this leads to inefficient solutions to meeting new technological and societal needs (**Problem 2**). Governance and administrative processes are required to enable better coordination of national metrology policies, funding, infrastructural and human and financial resources.

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<sup>21</sup> To be accurate and reliable all measurements should be traceable to the International System of Units, referred to as the 'SI system'. This system is internationally agreed under Convention de Metre of 1875 (and subsequent updates) and is overseen by the International Committee for Weights and Measures (CIPM) and the International Bureau for Weights and Measures (BIPM)

<sup>22</sup> UNIDO, Bernardo Calzadilla Sarmiento, Director, Department of Trade, Investment and Innovation, Metrology in Support of the Sustainable Development Goals  
<https://www.bipm.org/utis/common/pdf/CGPM-2018/Presentation-CGPM26-Sarmiento-SDG.pdf>  
<https://www.unido.org/news/advancing-sdgs-through-quality-and-standards>  
[https://www.unido.org/sites/default/files/2017-05/SDG\\_Metrology\\_brochure\\_FINAL\\_pages\\_0.pdf](https://www.unido.org/sites/default/files/2017-05/SDG_Metrology_brochure_FINAL_pages_0.pdf)

<sup>23</sup> Swann, G. M. P. (2009) The Economics of Metrology and Measurement, Report for National Measurement Office, Department for Business, Innovation and Skills, Innovative Economics Limited.  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/297870/pr-of-swann-report-econ-measurement-revisited-oct-09.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297870/pr-of-swann-report-econ-measurement-revisited-oct-09.pdf)

<sup>24</sup> Department for Business, Energy and Industrial Strategy, UK, The Value of Measurement: Supporting information for the UK Measurement Strategy, March 2017  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/605605/uk-measurement-strategy-supporting-information.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/605605/uk-measurement-strategy-supporting-information.pdf)

<sup>25</sup> <https://www.euramet.org/about-euramet/members/members/>

In addition, investment in metrology research is skewed towards the larger European countries while smaller NMIs / DIs and smaller countries have less ability to develop new capabilities or access new capabilities in other countries, creating a risk of even access to the state-of-the-art capabilities.

### 2.2.3 Low awareness and understanding of the metrology system throughout the research and innovation system

Metrology infrastructures are an essential but largely 'invisible' infrastructure within national technological infrastructures and innovation systems. Like transport or communications, when it is working well it goes largely un-noticed and there is an expectation that it 'automatically' provides all the capabilities required. Metrology is often viewed as specialist and niche discipline by those who do, and could, benefit from it. As a result, there is a problem of demand articulation as potential beneficiaries of metrology are either not able to identify a problem or issue as metrology-related or to recognise that the required metrology may not be available. While the metrology community aims to pre-empt emerging user needs by various forms of end user engagement, there is significant potential for this process to be more effective, better coordinated and, as a result, for metrology to have more impact (**Problem 3**).

There is also a problem of insufficient diffusion of metrology knowledge. As described in **problem 3**, the metrologists in NMIs and DIs, tend to be well-connected with first tier of metrology users in the value-chain and are less well-connected with the broader value-chain in industry and so understand their needs less. Correspondingly, industry (in the many end-user sectors that rely on accurate measurements) are not fully aware, and do not maximise the benefits, of metrology to their businesses, particularly the value of metrology to the innovation process.

The metrology community is less engaged with the policy-makers and regulators that design and implement policies to address to societal challenges. Metrologists are reasonably well-connected with the European standardisation bodies such as CEN-Cenelec and ETSI (and their international and national counterparts - ISO, IEEE, etc.) that develop the standards that underpin the implementation of regulation and policy (such as methodologies and tolerances for vehicle emission measurements, air and water quality measurements, radiological safety). However, it is less common for metrologists to participate in the design of policy and regulation despite the wealth of expert knowledge and skills. There is significant potential for increased interaction between the metrology and policy-making communities to better understand emerging policy needs and ensuring that the measurement requirements of policies are well-designed.

**The three problem drivers are connected.** New technologies and solutions to societal problems often require new metrology capabilities to support them. Increased and deepened engagement with metrology users in business and among policy-makers at the European level provides a means to better understand, define and prioritise needs as well as providing a means to increase and maximise diffusion and adoption of metrology knowledge, skills and facilities and stimulate pathways to economic and societal impact. Developing metrology capabilities to meet these needs at European level reduces fragmentation and duplication of the system and increases the efficiency of investments and ensures that metrology capabilities fulfil the needs of European policies.



All **stakeholders interviewed** (and the feedback to the **inception impact report**) recognised that metrology research is necessary to keep pace with the rapid change associated with emerging technologies in the areas of digital transition and industry 4.0 (roboticisation, IoT, AI, 5G and quantum), energy, health. All stakeholders interviewed affirmed that new measurement and testing tools will be required to assure compliance with regulation and governance, and to support transparency, safety, security and quality.

The majority of **stakeholders interviewed** also noted the increasing need for metrology for policy development, particularly in the areas of environmental challenges. In this sense, new metrology methods and standards are required for the development of policy and the implementation and enforcement of regulation around issues such as air quality, water quality, emissions, and climate monitoring. Feedback to the **inception impact assessment** included references to the negative effect of retrospective harmonisation of measurement and regulation (e.g. in the pharmaceuticals industry) and highlighted the need for proactive, coordinated and streamlined adoption mechanisms of measurement and standardisation.<sup>26</sup>

The majority of **stakeholders interviewed** and those responding to the **open consultation** agreed that a lack of understanding or knowledge about metrology was a key problem, and a majority also agreed this was a key barrier to the uptake of metrology innovations. As a result, the stakeholders from within the metrology community also noted that the metrology system was not well connected to the regulatory/policy making system. Indeed, the process of securing input from policy-makers via the interviews also highlighted low levels of awareness and connection with the metrology community. Many stakeholders approached for interviews in the context of this impact assessment had limited awareness of the relevance or application of metrology research for policy. Interviews with the metrology community also indicated that this sometimes resulted an expectation that the required metrology (and the measurements it enables) would be readily available to industry or policy-makers whenever needed.

The majority of stakeholders responding to the **open consultation** agreed that a lack of understanding or knowledge about metrology was a key problem, and a majority also agreed this was a key barrier to the uptake of metrology innovations.<sup>27</sup>

The majority of stakeholders responding to the **open consultation** agreed that European research and innovation efforts would address the lack of understanding or knowledge about metrology, and the lack of understanding of the benefits metrology brings to emerging new technologies. However, this was perceived to be somewhat less relevant to SMEs and large companies.

While **industry stakeholders (interviewed)** involved in the instrumentation sector have a stronger direct link with the metrology system, they also noted that their customers (the end-users of metrology) would likely have limited understanding of the metrology system at either national or EU level. A small number of interviewees also acknowledged that industry and NMI/DI 'view the world' in different ways: industry from the perspective of application areas and NMI/DIs from the perspective of specific measurement units. As a result, the routes of access metrology were often difficult to identify (for end-users) and dispersed across the metrology system. The exception to this was national metrology institutes large enough to handle a range of different services and areas of metrology and therefore able to handle a range of industry problems 'in-house'. Reflecting this, most respondents to the **open consultation** indicated that European research and innovation efforts would be very relevant for increasing the consideration of industrial and regulatory user needs when building metrology capacity and the quality infrastructure for emerging technologies.

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<sup>26</sup> The consultation on the Inception Impact Assessment for Metrology includes feedback from only four respondents.

<sup>27</sup> The Open Consultation secured 225 responses. Of these respondents, 36 (16%) were citizens, 112 (50%) were from academic and research institutions, 28 (12%) from public authorities, 32 (14%) respondents from businesses and 3 from business associations (1%).

### 2.3 How will the problem(s) evolve?

The metrology needs of businesses and policy-makers will continue to grow and change as new technologies emerge and new policies are developed in response to societal needs. Long-standing national metrology systems have always sought to adapt and evolve to meet changing needs. This will continue at national level focused on national needs and within the boundaries of national budgets and, despite the commonality of problems, national metrology systems will continue exist and evolve individually.

Without concerted action the three inter-connected problem drivers are highly likely to persist. This is highly likely to lead to sub-optimal provision of metrology capabilities and/or an unequal provision of, and access to, metrology capabilities across Europe. This risks a loss of European leadership in metrology and an inability to meet Europe's metrology needs.

Where metrology research is concerned, research collaboration will continue at sub-optimal levels via a series of individual projects with limited directionality. National metrology research resources will likely remain static and research unnecessarily duplicated and, from a European perspective, deployed inefficiently. As the majority of European metrology research budgets are in larger countries, smaller countries may struggle to access research outputs and this may limit access for their stakeholders in industry and policy-making to the highest-quality metrology capabilities.

Key to maximising the impact of metrology research is efficient deployment of national and leveraged European resources via a stable strategic and operational coordination of national metrology research. While authorities and stakeholders in Europe have been willing to engage in closer cooperation in metrology under previous EU actions the community is still far from achieving a sustainable coordinated European-wide metrology system.



Most **stakeholders interviewed** acknowledged that as technology evolves, so too will the metrology needs. Some stakeholders gave details of a range of specific short, medium and long-term challenges depending on the state of technology development. Examples included: medical imaging where metrology is needed to improve sensitivity and resolution of existing technologies, but it is expected that in the longer-term, metrology capabilities will be necessary to support unlabelled *in vivo* imaging, using very different tools and techniques that which involves tagging molecules in a human subject and understanding how they move through the body; and quantum technologies, where testing and validating of new quantum-based sensors is pushing at the boundaries of existing metrology capabilities. Such new tools and techniques based on different technologies or even different branches of science can require a completely new approach (and new skills) to the underpinning metrology.

Some **stakeholders interviewed** also acknowledged that the differences in capability and resourcing of NMIs/DIs across Europe will continue to grow and evolve as the national needs and political contexts change, fostering greater fragmentation and inequality of service provision.

## 3 Why should the EU act?

### 3.1 Subsidiarity: Necessity of EU action

The problems in the future provision of metrology capabilities to meet industrial and policy needs are of a nature and magnitude that action at EU level is needed:

- Metrology is a cross-border concept, where consensus on how to measure a certain quantity are its very basis. Metrology is currently implemented at national level but national metrology institutes also have roles at international level to maintain the international system of units and ensure international mutual recognition arrangements

are respected. However, there is no embedded structure for metrology research at EU level to support innovation and a European response to common societal challenges.

- Metrology to support emerging technologies requires a European approach, since the level of complexity cannot be solved by one country alone, and the critical mass for new metrology infrastructure requires transnational competences and resources. Creating critical mass is most efficient at a European level and will avoid fragmentation of Europe's capacity and ensure a global leadership in metrology.
- In a closely integrated European market, the metrology infrastructure has to be ready to enable an effective trade system and the industrial uptake of innovations and to ensure a valid and traceable quality and certification chain across country borders.
- The national metrology institutes and their key stakeholders need also to collaborate closely with policy makers to support policy initiatives and regulation formed at a European level such as new communication standards, climate change monitoring, and vehicle emission standards. Only an action at EU level can enable a strategic and sustainable approach to this support.

### 3.2 *Subsidiarity: Added value of EU action*

Added-value of EU action is in the creation of a sustainable integrated system of metrology capability and infrastructure across Europe that supports innovation in key emerging technologies and is closely aligned to the policy needs and solutions to address societal challenges in a carbon-neutral future, environment protection and improved public health. Taking a strategic pan-European approach to designing and implementing the metrology infrastructure needed to meet growing demands will create a system with greater scale and scope than can be delivered nationally and will reduce duplication of metrology capabilities, making the most efficient use of national resources. It will also increase access across all Member States to state-of-the-art metrology skills and services.



Most **stakeholders interviewed** agreed that a pan-European investment in metrology would be necessary to maintain European leadership. It was largely understood that a coordinated approach to metrology research is necessary to ensure harmonisation and consensus-building regarding methods, language and standards emerging from metrology research across Europe. Some interviewees, such as those within the legal metrology community, highlighted that coordinated metrology was necessary to underpin a coordinated European quality infrastructure.

Moreover, many **stakeholders interviewed** noted that expertise and capabilities across Europe needed to be coordinated and leveraged to address challenges that NMIs/DIs cannot address alone. In this sense, the value of 'pooling resources' is vital for addressing the problems and challenges faced by the sector.

## 4 **Objectives: What is to be achieved?**

Based upon the problems and problem drivers presented above, this section defines the objectives of the initiative and effects needed in order to address the problems – taking account of the Horizon Europe priorities and objectives.

### 4.1 *General objectives*

In order to tackle the problems identified in Section 2, it is important to clarify the objectives of EU action in the field of research and innovation. We have identified three general objectives corresponding to the main problems discussed in Section 2.1.

To address the identified problems three general objectives are proposed for the potential partnership initiative in metrology: one focused on scientific capabilities and knowledge - in this case focused on metrology capabilities and knowledge; one each focused on economic and social impact (Figure 3).

The breadth of use of metrology means the proposed initiative it will have an impact across several sustainable development goals (SDG) and each relevant SDG is provided under the descriptions of the Economic and Societal objectives below.

The **scientific objective** is establishing a sustainable coordinated world-class metrology system based on high-quality science and open access and industrial and societal needs. The objective is focused on maximising the quantity, quality and relevance of metrology research in Europe in the most efficient and coordinated way that will deliver high-quality metrology knowledge, skills and capabilities aligned with society's needs, and ensure the European metrology system is deeply interconnected with, and integral to, the innovation system and policy-making. Achieving this will ensure Europe remains a world-leader in metrology and, as such, is directly aligned with the Horizon Europe scientific objective plus the objective to strengthen and increase the impact and attractiveness of the European Research Area.

The **economic objective** to increase and accelerate the development and deployment of innovation in Europe through effective use of metrology capabilities, is focused on ensuring that state-of-the-art metrology capabilities are deployed by innovators (in industry, academia and among other actors) in the development, testing and validation of innovations. As a general purpose technology, metrology has a wide remit and will support breakthrough innovations that will contribute to sustainable economic growth as well as contribute to innovative solutions for societal challenges, in for example, addressing climate change, environment and health. This directly aligns with the Horizon Europe economic objective to foster all forms of innovation. The use of robust measurement data provided by metrology is essential to understanding and demonstrating the characteristics and performance of innovations and therefore plays an important role in market deployment innovations.

#### Relevant SDGs

GOAL 9: Industry, Innovation and Infrastructure

GOAL 12: Responsible Consumption and Production

GOAL 8: Decent Work and Economic Growth

The **societal objective** is to increase the contribution of metrology to the design and implementation of standards and regulation that underpin public policies addressing societal challenges. It is focused on ensuring that state-of-the-art metrology capabilities metrology knowledge and capabilities are created, effectively diffused and adopted by policy-makers and regulators to assess risks and design and implement policies to mitigate those risks. These will focus, in particular, on standards and regulation for climate, environment and health. This directly aligns with the Horizon Europe societal objective.

#### Relevant SDGs

GOAL 3: Good Health and Well-being

GOAL 6: Clean Water and Sanitation

GOAL 7: Affordable and Clean Energy

GOAL 13: Climate Action

GOAL 14: Life Below Water

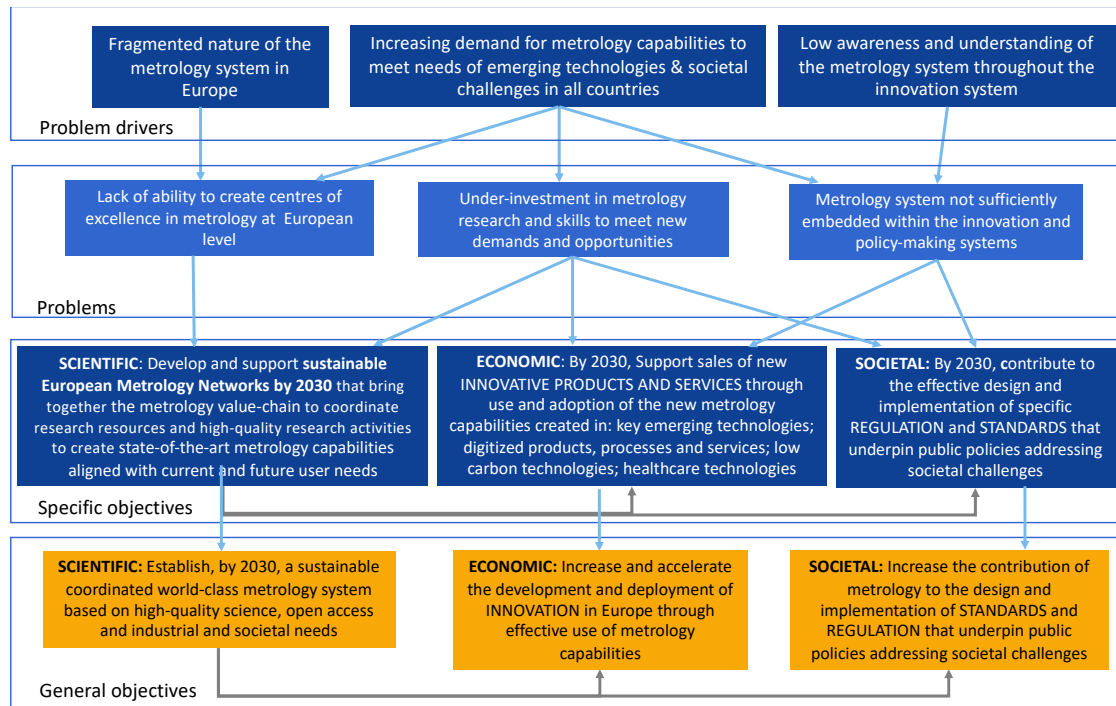
## 4.2 Specific objectives

In order to achieve the general objectives, we defined three specific objectives. These specific objectives respond to each of the problem drivers discussed in Section 2.2.

The relationship between the general and specific objectives is shown in Figure 4.



Figure 4: Objectives tree for the initiative on Metrology



Three specific objectives and three general objectives align with the scientific, economic and social impact domains of Horizon Europe.

### Specific objective 1: Scientific

Develop and support sustainable European Metrology Networks by 2030 that bring together the metrology value-chain to coordinate research resources and high-quality research activities to create state-of-the-art metrology capabilities aligned with current and future user needs

This objective focuses more specifically on the creation of European Metrology Networks (by 2030) that will act as focal points for bringing together metrology researchers with the metrology value-chain to identify metrology research needs and coordinate high-quality metrology research resources and activities. The networks will, in partnership with the initiative’s research activities, deliver high-quality research outputs and state-of-the-art capabilities. The measure of success will not simply be the number of networks created but also the composition of participants across the value-chain (be they conducting research, contributing to needs identification or users of outputs) and the quality and collaborative-nature of the research outputs.

### Specific objective 2 : Economic

By 2030, support sales of new INNOVATIVE PRODUCTS AND SERVICES through use and adoption of the new metrology capabilities created in: key emerging technologies; digitized products, processes and services; low carbon technologies; healthcare technologies

This objective focuses on the use of the metrology capabilities by business to support their innovation activities whether that be in the use of new metrology capabilities to test and validate new products, processes or services or by directly exploiting new measurement methods or technologies developed by the research. The measure of success will be in terms of turnover of innovations that have exploited or made use of the metrology capabilities developed through the initiative.



### Specific objective 3: Societal

By 2030, contribute to the effective design and implementation of specific REGULATION and STANDARDS that underpin public policies addressing societal challenges

This objective focuses on the use of metrology knowledge to contribute to: the development of specification standards ensuring, for example, they include appropriate and fit-for-purpose measurement methodologies, testing protocols, etc; and the development of metrology capabilities to directly support the implementation of current regulation (and regulation under development) by ensuring the appropriate metrology capabilities are in place. The measure of success will be in terms of metrology knowledge inputs to specific standards and regulation focused on key societal challenges in climate, environment and health.

It is important to note that although the contribution of metrology to innovation is captured under the economic objective, the innovations created will not only contribute to economic performance of the businesses concerned but will also, in some cases, support social objectives through delivering the innovations needed to, for example, achieve a carbon-neutral Europe and improve health diagnosis and treatment.



Almost all **stakeholders interviewed** agreed that the proposed objectives of the partnership were appropriate to meet the challenges and needs. Supporting greater engagement of industry and end-users was noted by many stakeholders from industry and policy-makers and the ministries responsible for metrology, as well as by the NMIs and DIs themselves. With this engagement being reported as important for increasing the influence of metrology across the value chain. The use of networks to achieve greater engagement was also noted as being valuable for supporting influence on policy by creating a set point of contact for policy makers to connect with stakeholders from across the metrology, industry and end-user groups in particular policy areas. Many **stakeholders interviewed** also reflected that these networks could have a strong influence on the economic and societal impact of an EU investment in metrology by broadening and increasing engagement.

#### 4.3 Intervention logic and targeted impacts of the initiative

The sections below present the intervention logic for the proposed initiative. It illustrates the linkages between the specific objectives presented above, the results or outputs of the initiatives activities and the scientific, economic and societal impacts they are expected to lead to.

##### 4.3.1 Likely scientific impacts

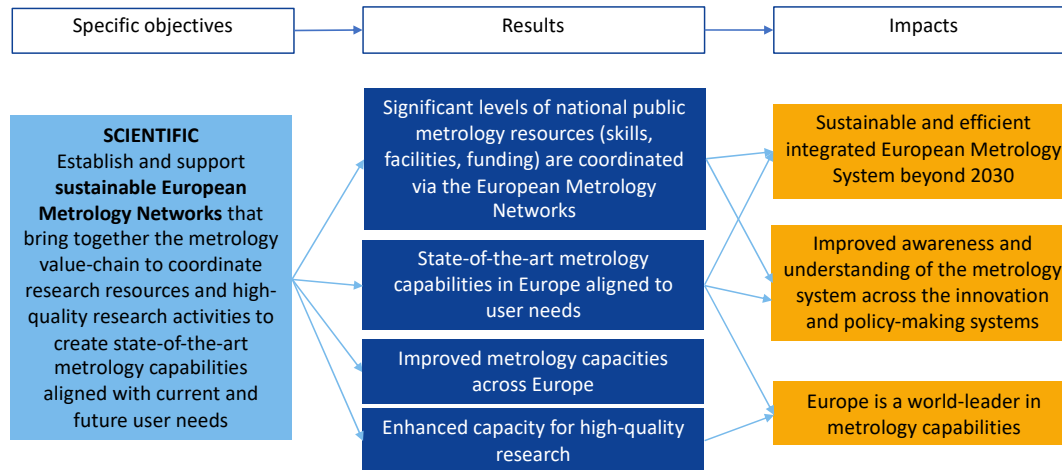
The initiative is likely to lead to three key scientific impacts as illustrated in Figure 5.

Investments in metrology research made via the proposed initiative leverage and coordinate national and European public investments. The metrology research, conducted via collaborative European Joint Research Projects, creates new high-quality scientific knowledge (**impact pathway 1**)<sup>28</sup> that forms the basis of the new and enhanced human and physical capital (**impact pathway 2**) in metrology that contributes to the stock of knowledge regarding, in particular increased measurement accuracy, new measurement tools and techniques, and the performance of new technologies. In the first instance the new knowledge and skills are situated within the metrology community (NMIs and DIs) in

<sup>28</sup> The Horizon Europe impact pathways are defined in: [https://ec.europa.eu/info/sites/info/files/research\\_and\\_innovation/contact/documents/horizon\\_europe\\_impact\\_assessment\\_book\\_web\\_version.pdf](https://ec.europa.eu/info/sites/info/files/research_and_innovation/contact/documents/horizon_europe_impact_assessment_book_web_version.pdf)

the form of new state-of-the-art metrology capabilities.<sup>29</sup> Creating this knowledge via the European Metrology Networks creates a pan-European solution to the provision of, and open access to, the new capabilities and ensure they are aligned to user needs. These state-of-the-art capabilities, and the knowledge embedded within them, will secure Europe's position as a world-leader in metrology.

Figure 5: Impact pathway leading to scientific impacts



Likely scientific impacts will be focused on metrology knowledge in new technologies such as quantum-based measurement standards to implement the re-defined SI system,<sup>30</sup> enhanced metrology capabilities for: quantum technologies; digitisation of manufacturing (Industry 4.0); advanced materials; robust climate and environmental observation; low carbon technologies and energy gases; smart grids; novel medical diagnostics and healthcare therapies.

The new knowledge and strengthened human and physical capital will lead to measurable scientific impacts in terms of bibliometric indicators for the performance of European NMIs compared their global peers.

The capacity building activities will increase the ability of smaller, developing NMIs and DIs to play a larger role in metrology research and act as bridge to improve access for stakeholders in these countries to the state-of-the-art new metrology capabilities.

Coordinating research via the European Metrology Networks is designed to improve awareness of metrology in the innovation and policy-making systems and provide a direct route to fostering the diffusion of knowledge and open science (**impact pathway 3**) to industry and policy-makers. In addition, academic researchers would be involved both as sources of expert scientific knowledge for metrology and as beneficiaries who use the state-of-the-art metrology to explore new concepts and technologies.<sup>31</sup>

<sup>29</sup> Items under-lined indicate the results and impacts presented in the impact pathway figures

<sup>30</sup> The SI system of units was redefined in its totality by international vote under the auspices of the International Committee for Weights and Measures (CIPM) in November 2018, with this change coming into effect in May 2019. This is was first time such a comprehensive change to the metrology system has taken place since the original Convention de Metre was signed in 1875. See for example an article in Nature <https://www.nature.com/articles/d41586-018-07424-8>

<sup>31</sup> Academic researchers are both providers of new knowledge for metrology but also users of metrology - to test new concepts and manage high-tech experiments. CERN, for example, has an in-house metrology laboratory to ensure the correct alignment of its experiments and the quality of the data produced. Scientists at CERN collaborate with NMIs to access the latest capabilities <https://home.cern/tags/metrology> [https://www.euramet.org/publications-media-centre/news/?tx\\_news\\_pi1%5B%40widget\\_0%5D%5BcurrentPage%5D=32&tx\\_news\\_pi1%5Bnews%5D=529&](https://www.euramet.org/publications-media-centre/news/?tx_news_pi1%5B%40widget_0%5D%5BcurrentPage%5D=32&tx_news_pi1%5Bnews%5D=529&)

The activities to create European Metrology Networks should lead to a stable group of networks that will continue after the proposed initiative and act as thematic focal points for continued coordinated development of metrology capabilities for the future and in doing so, create an integrated metrology system that is sustainable for the longer-term. The metrology community has identified a set of European Metrology Networks with the potential for high impact in a wide of economic and societal application domains (Table 2).

The short-term scientific impact will be in terms of scientific peer-reviewed publications with an increase in publications co-authored by researchers from across the NMI/DI community in Europe and across a range of stakeholders. The community would continue to publish in metrology specific journals to share its outputs with the wider international NMI/DI community, but would also increase its publications in journals in other high-technology fields to improve wider awareness and adoption of high-quality metrology research. By the very specialist nature of the underpinning science of metrology, publication in metrology-specific journals is critical to sharing Europe's research outputs and to influencing the application of the latest research outputs within metrology labs worldwide and maintaining Europe's status as a global leader and influencer in metrology.

Table 2: Piloted and proposed European Metrology Networks

Industry / Digital	Green Growth	Health
Advanced manufacturing	Clean energy	Laboratory medicine
Quantum technologies	Smart electricity grids	Biotechnology for Health
Digitalisation	Energy gases	Innovation
	Climate and ocean observation	Food Safety
	Environmental monitoring	Radiation protection



Most **stakeholders interviewed** agreed that European investment in metrology would support high-quality scientific knowledge. This was understood in terms of having an impact on scientific knowledge through both the development of new scientific knowledge relevant to metrology as well as supporting academic research communities as 'end users' of cutting-edge metrology. Many metrology stakeholders highlighted that European investment in metrology would be necessary to support both fundamental and application focused metrology research.

Many **stakeholders interviewed** recognised the significant investment in metrology research in China and confirmed that a coordinated, partnership approach would be necessary to maintain competitiveness in Europe.

The majority of **interviewees** identified the need to create better ways for NMIs/DIs to engage with end-users of metrology to better capture needs, increase the use of metrology capabilities and, ultimately, increase impact of metrology. Interviewees, especially industry stakeholders, agreed that arranging metrology research around application areas would support greater uptake by industry partners and improve understanding and awareness of the metrology system in Europe. Reflecting this, the majority of respondents to the **open consultation** indicated the inclusion of Member States, Associated Countries, and industry partners, as being very relevant for long-term agenda setting of European investment in metrology, and very relevant for pooling and leveraging resources.

#### 4.3.2 Likely economic/technological impacts

The likely key economic/technological impacts of the initiative are presented in Figure 6.

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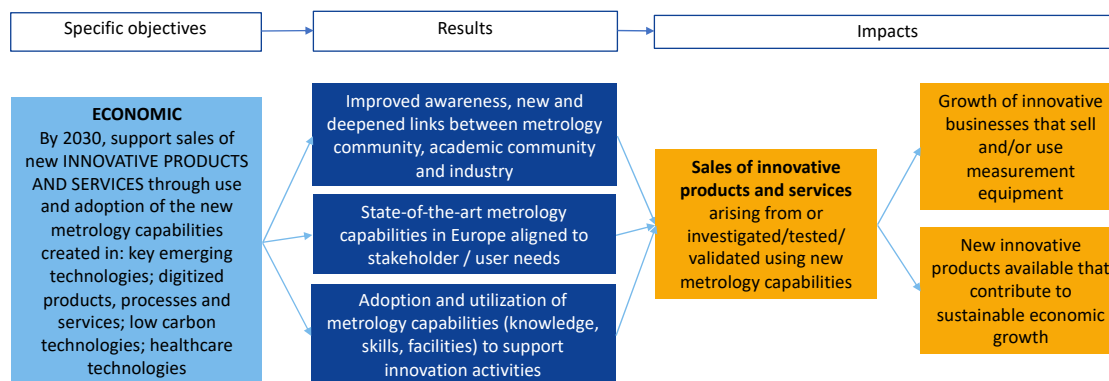
[tx\\_news\\_pi1%5Bcontroller%5D=News&tx\\_news\\_pi1%5Baction%5D=detail&cHash=ecf83beb53a598301b04db7f04cdd998](#)

Metrology supports the innovation process by providing the capability to test, assess and validate the performance of new concepts, new technologies and innovative products and services. By enabling the superior performance of innovations to be robustly demonstrated to the market, metrology not only supports innovation but, with state-of-the-art capabilities available to assess emerging technologies, can accelerate the innovation process.

The metrology skills and state-of-the-art metrology capabilities developed, particularly those developed and coordinated via the European Metrology Networks will be clearly aligned with industrial needs. Each network will include participants from the relevant stakeholder groups across the value-chain and so improve awareness and deepen links between the metrology community and industry. They will provide opportunities for stakeholders to influence the research agenda, participate in collaborative research and access the new metrology capabilities to support their own innovation processes. The businesses that participate in the European Metrology Networks and collaborative research will also enhance their own metrology knowledge and skills.

The direct and immediate economic impact of the metrology initiative is sales of innovative products and services (**impact pathway 7**) whose development relied on, and is attributable to (in whole or in part), the new metrology capabilities. The sectors impacted by metrology are extremely broad. For the sensors, measurement and test instrumentation sector the impact is fairly direct as the highest quality metrology capabilities are critical to demonstrate the performance of new their products. A large proportion of these businesses are SMEs.<sup>32</sup> In turn their products are critical to process control and quality assurance in advanced manufacturing and in energy and communication they are critical to network management and control.

Figure 6: Impact pathway leading to economic/technological impacts



In the immediate term, sales of innovative products and services will accrue to the businesses that participate in the European Metrology Networks and collaborative research projects and may contribute to business growth in the medium to longer-term. These will be high-tech, high value- add sectors so business growth can lead to high-value jobs (**impact pathway 8**). In the medium-term benefits will accrue to a wider group of businesses that are customers of these businesses or who access the new metrology capabilities as they become mainstream. In advanced manufacturing, for example, improved measurement and process control capabilities (accessed through improved measurement and process control sensors and equipment) contributes to higher

<sup>32</sup> A report on the UK sensors sector, for example, showed SMEs as 80% of the sensor sector by number and a third by turnover.

<https://connect.innovateuk.org/documents/2864009/16573727/UK+Sensor+Community+Mapping.pdf/7aec2b7f-ffb0-43e4-94a2-a341dda725d4>

productivity and through the introduction of more efficient processes contribute to lower waste and cleaner industries.<sup>33</sup>

Importantly coordination of metrology knowledge via the European Metrology Networks enables the metrology community to 'speak with one voice' to businesses and business organisations and provide a single-point of access to metrology capabilities.

Studies demonstrate positive economic benefits to businesses that engage directly with NMIs and DIs in terms of innovation levels and additional employment.<sup>34</sup> Benefit-to-cost ratios for public investment in metrology programmes at NMIs and DIs range from 3:1 to 5:1, with much higher ratios successful individual R&I projects.<sup>35</sup> Based on previous metrology research, impact in terms of sales of innovative products and services among industry who have directly engaged with research at NMIs and DIs is estimated to be of the order of €50M per year.<sup>36,37</sup>

These estimates do not include the economic benefits further down the value-chain to users of robust and reliable measurements and society in general via the ability to use measurement equipment and the data it provides with a high degree of confidence.

In the long run metrology research is essential to the functioning of the internal market and to international trade, as comparable and reliable measurement, trusted and used by everyone, is the basis of demonstrating the performance of products and services and demonstrating compliance with product standards.



**Stakeholders interviewed** acknowledged that the economic impact of EU investment in metrology would contribute to improving the quality of products as well as confidence in product quality for end-users. Many interviewees acknowledged that metrology was an essential part of the European quality infrastructure and as such plays a key role in demonstrating the performance of products, particularly new innovative products, and assuring compliance of products and services with any relevance product standards and regulation. Through quality assurance and standardisation, metrology thus supports the uptake of innovation into society and further industry led collaborative R&D. For example, interviewees often highlighted the high-levels of regulation in the healthcare industry as a driver for the need for high-quality consistent measurements. Most interviewees were unable to provide a sense of the scale of this impact, with some highlighting that while metrology is an essential part of innovation, it is one of many contributing factors and, therefore, it is very challenging to attribute economic benefit directly to metrology capabilities or services.

**Stakeholders interviewed** struggled to define any particular sector(s) that would likely benefit the most from a coordinated European investment in metrology over and above others, but highlighted the difference in the type and scale of this impact depending on how developed the sectors and individual companies are. In this sense, some stakeholders maintained that the economic benefits to established industries might be small, incremental improvements made to existing processes. By contrast, economic benefits in

<sup>33</sup> Probst, L., Monfardini, E., Frideres, L., Clarke, S., Demetri, D., Kauffmann, A., PwC Luxembourg, EC Business Innovation Observatory (.): Advanced Manufacturing - Measurement Technologies and Robotics, 2013

<sup>34</sup> Department for Business, Innovation and Skills (BIS), UK, Analysis Paper, Estimating the effect of UK direct public support for innovation, November 2014.  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/369650/bis-14-1168-estimating-the-effect-of-uk-direct-public-support-for-innovation-bis-analysis-paper-number-04.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/369650/bis-14-1168-estimating-the-effect-of-uk-direct-public-support-for-innovation-bis-analysis-paper-number-04.pdf)

<sup>35</sup> Ibid

<sup>36</sup> EURAMET  
[https://www.euramet.org/index.php?eID=tx\\_securedownloads&p=541&u=0&g=0&t=1606410692&hash=7a112b30c19921b7d61ce9d3e6b22ff9d87a0eba&file=Media/docs/EMRP/EURAMET\\_Impact\\_of\\_the\\_EMRP\\_v1.pdf](https://www.euramet.org/index.php?eID=tx_securedownloads&p=541&u=0&g=0&t=1606410692&hash=7a112b30c19921b7d61ce9d3e6b22ff9d87a0eba&file=Media/docs/EMRP/EURAMET_Impact_of_the_EMRP_v1.pdf)

<sup>37</sup> See footnote 33

emerging technical areas were perceived to be based on demonstrating and validating new technologies, where there is the potential for large impacts of metrology in terms of facilitating, or even accelerating, their adoption.

Almost all **stakeholders interviewed** referred to the role of metrology in supporting the effective functioning of the European internal market. The feedback to the **inception impact assessment** echoed this point, with the respondents noting that European level standards and regulation should be underpinned by European-level metrology to ensure competitiveness. Industry respondents to the **open consultation**, particularly large companies, noted that joint R&I projects and the co-creation of solutions with end-users would be very relevant for ensuring the proposed partnership would meet its objectives

**Feedback to the inception impact assessment** included references to the negative effect of retrospective harmonisation of measurement and regulation (e.g. in the pharmaceuticals industry) and highlighted the need for proactive, coordinated and streamlined adoption mechanisms of measurement and standardisation.

#### 4.3.3 Likely societal impacts

The scientific and economic/technological impacts discussed above will also support the attainment of societal impacts shown in Figure 7.

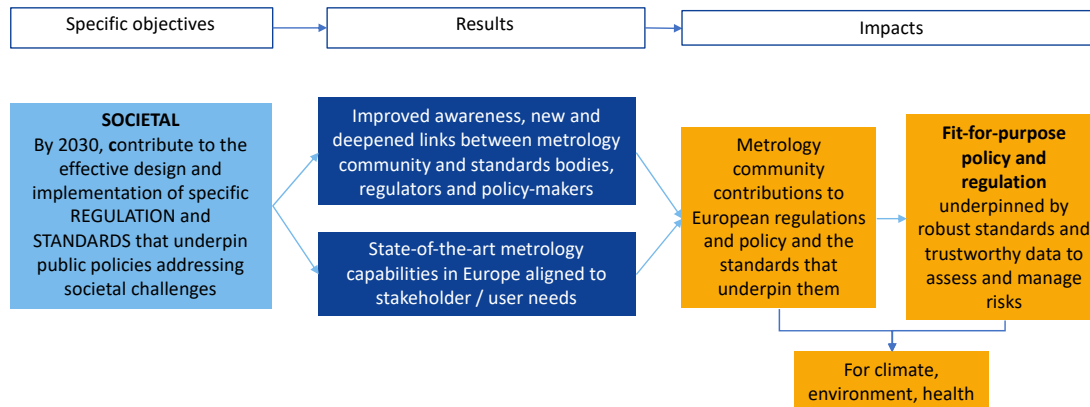
The accurate measurements provide by metrology are essential to well-designed policy and regulation. Public policy, and any resulting regulation, is increasingly directed at well-defined societal challenges in health, climate change, environment, energy, etc. Policy-makers require reliable and better evidence to identify and assess risks and to design and implement effective policy, regulation and standards to mitigate them.

The metrology skills and state-of-the-art metrology capabilities developed, particularly those developed and coordinated via the European Metrology Networks will be clearly aligned with a number of key societal needs. As for the industry focused networks, each one will include participants from the relevant stakeholder groups across the value-chain and so improve awareness and deepen links between the metrology community and policy-makers, regulators and standardisation bodies as well as businesses that help them meet their needs. The networks will provide opportunities for stakeholders to influence the research agenda, participate in collaborative research and access the new metrology capabilities to support their needs.

The policy-makers, regulators and standardisation bodies that participate in the European Metrology Networks and collaborative research will also enhance their own metrology knowledge. The direct and immediate societal impact of the metrology initiative is contributions from the metrology community to European regulations and policies and the standards that underpin them (**impact pathway 4**). Metrology knowledge is important to creating well-designed policy, regulation and standards by ensuring that any defined measurements and tests to identify and/or mitigate societal risks are fit-for-purpose. Importantly coordination of metrology knowledge via the European Metrology Networks enables the metrology community to 'speak with one voice' to European policy-makers, regulators and standards facilitating more coherent and efficient contributions.



Figure 7: Impact pathway leading to societal impacts



### Likely environmental impacts

As shown in Table 2 several of the proposed the European Metrology Networks will target environmental impacts, including:

- **Climate and ocean observation:** ensuring that assessments of essential climate variables (ECVs) are robust and continually improved, as well as monitoring and demonstrating compliance with European (and international) climate policies
- **Environmental monitoring:** ensuring that measurements of air and water pollutants are available and improved. This includes measurement capabilities to ensure compliance with stricter regulations for vehicle and industrial emissions and air and water quality
- **Smart grids and energy gases:** ensuring that measurement capabilities exist to: monitor and manage the smart electricity grids that are required to incorporate low carbon energy sources; and assess the quantity and quality of low(er) carbon energy gases, including hydrogen.

Therefore the new metrology knowledge and capabilities will contribute to effective policies, regulation and standards to assess risks and ensure the required measurement capabilities to monitor and enforce regulation are in place.

In addition, some of the innovative products and services developed utilising metrology (described in section 4.3.2) will be focused on low carbon technologies and low carbon energy sources and sensors and instrumentation to support the circular economy and cleaner industry.

### Likely social impacts

The key social impact domain for metrology research is health of European citizens and citizens worldwide. As for environmental impacts, several proposed European Metrology Networks will target health, including:

- **Biotechnology for Health Innovation:** biological measurements is an emerging field for metrology and entirely new metrological capabilities are required to ensure robustness and comparability of biological measurements and assessments
- **Laboratory medicine:** ensuring the robustness of in vitro diagnostics (IVDs)<sup>38</sup> within and across healthcare providers and over time, and supporting effective implementation of EU medical device regulation

<sup>38</sup> In vitro diagnostics (IVDs) are used inform a large number of medical decisions, with IVDs used in a high proportion of healthcare encounters, estimated to be between 35% and 75%  
<http://jalm.aaccjnls.org/content/1/4/410>

As for environmental impacts, new metrology knowledge and capabilities will contribute to effective policies, regulation and standards to assess and mitigate health risks. In addition, the capabilities will enable the efficacy and safety of innovative medical and healthcare interventions to be tested and validated and so ensure they are implemented safely and effectively and in line relevant regulations and standards.

#### 4.3.4 Likely impacts on simplification and/or administrative burden

The proposed European Metrology Networks, once embedded as a new way of organising European metrology, are intended to provide a streamlined coordinated approach to developing and delivering new metrology capabilities. Each network will take time to become fully established and embedded but by the end of the initiative, coordination of research and new capabilities, in the domains of the networks, should be self-managed and reduce the administrative burden. It is possible that not all will be as successful as others, but the learning gained will be used to adjust the network approach and improve future networks.

#### 4.3.5 Likely impacts on fundamental rights

While the proposed initiative is not directly targeting fundamental rights, robust and comparable measurements traceable to the capabilities at NMIs and DIs are used to protect consumers (via legal metrology)<sup>39</sup> and underpin quantitative evidence used in courts of law.



All **stakeholders interviewed** recognised the societal impact of a coordinated approach to European investment in metrology, primarily through the development of new technologies to address and improve methods of identifying problems and improving the quality of the data used to make decisions. For example, many interviewees highlighted the role of metrology in supporting innovation in the energy sector to facilitate decarbonisation and move towards addressing climate change, as well as role of metrology in providing reliable data on climate and environmental assessments (air, water, soil, etc) on which public policy decisions are made.

The impact of metrology for the health sector was also highlighted by interviewees as an example of the expected societal impact. These stakeholders interviewed noted that coordinated metrology research in metrology would be integral to establishing and maintaining product quality (e.g. dose and potency of medicines) and calibration and maintenance of medical devices and technologies used throughout the patient pathway (from diagnosis via imaging or laboratory testing to treatment).

Most **stakeholders interviewed** noted that the impact of metrology on fundamental rights as being an indirect impact as a result of regulation or standardisation by supporting high-quality, standardised products.

### 4.4 Functionalities of the initiative

This section outlines the functionalities that need to be considered when assessing the policy options in Section 6, reflecting the selection criteria for European Partnerships defined in the Commission proposal for the Horizon Europe Regulation.<sup>40</sup> In the following paragraphs, we discuss the implications of the criteria relating to the type and composition of the actors involved, the range of activities to be undertaken and the directionality required if the initiative is to deliver the objectives discussed above. We also consider the

<sup>39</sup> E.g. weights and measures laws and regulations

<sup>40</sup> European Commission (2018), Proposal for a Regulation of the European Parliament and of the Council establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018PC0435&from=EN>



complementarities and synergies with other, related initiatives under Horizon Europe and beyond.

#### 4.4.1 Internal factors

##### **Type and composition of the actors involved**

This functionality relates to the criterion “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”. It concerns the need to involve the full range of stakeholders that can usefully contribute to delivering the future R&I agenda.

Based on the outcomes of the evaluations of previous initiatives in metrology<sup>41</sup> and the more general need for a more systemic approach to innovation, the results and impacts of the initiative can best be achieved if the proposed initiative involves a broad range of participants from across the NMI/DI landscape in Europe and, more importantly, among the broad base on beneficiaries of the metrology across the value-chain (presented in Appendix D) as well as the wider research base - to increase openness and engage with them throughout the R&I process; from designing research strategies, through conducting collaborative research to enhanced and proactive dissemination of research outputs to facilitate their adoption.

To establish and implement a long-term common strategic vision for metrology capabilities at European level requires the majority, if not all, European NMIs and DIs participate i.e. the 38 members of EURAMET. This will not only enhance the coherence of the European metrology system but also build capacities and links between the NMI/DIs with the highest levels of metrology capabilities and the broader base of national and regional NMIs/DIs who are close to their own end-user communities.

Furthermore, as the majority of NMIs and DIs are government laboratories, the creation of a long-term common strategic vision and decisions to commit public resources to its implementation requires the ministries responsible for metrology policy and funding to be involved.<sup>42</sup> The exact governance models and relationships between NMIs and DIs and the ministry responsible for metrology, vary country to country. Some NMIs and DIs are fully embedded within ministries, some are arms-length bodies and a small number are in the private sector<sup>43</sup> but none are able to make fully autonomous decisions where long-term policy and funding decisions are concerned. In most European countries responsibility for metrology policy and funding is held within ministries of the economy, business or industry and these are the ministries that would need to be involved.

As a general-purpose technology, metrology has many applications, but as a technical capability it requires specific scientific and technical knowledge, skills and facilities. The scientific development of its underpinning concepts requires quite particular metrology-specific research utilising the skill base of NMIs and DIs aligned with the latest relevant academic thinking. However, metrology research to develop the technical capabilities for end-users requires collaboration with experts in the broad user-base, from the high-

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<sup>41</sup> See Appendix G.

<sup>42</sup> Metrology has a role in national weights and measures legislation and therefore many (but not all) NMI and DIs are government laboratories. The country pages of the WELMEC (European Cooperation in Legal Metrology) website provides details of the roles and responsibilities of NMIs and DIs across Europe. <https://www.welmec.org/welmec/country-info/>; Nearly two thirds of NMI/DIs are governed by a public ministry (Study on Coordination in Metrology, Optimat, Dec 2016)

<sup>43</sup> NMIs in the private sector work under contract to the relevant ministry and are conferred the authority to act as the NMI, representing the national government, in relevant national and international fora such as EURAMET and BIPM

technology sensors and instrumentation sector to businesses and end-users further down the value-chain. Therefore, for both the research and the networks to be successful, participation of stakeholders along the value-chain is required. This means, in addition to the NMIs and DIs:

- Businesses from the sectors that are direct beneficiaries of metrology research (sensors, measurement, test and analytical instrumentation manufacturers) as well as end-user sectors. The beneficiary end-users sectors are very broad and would need to be tailored to each European Metrology Network but would include: aerospace, automotive, pharmaceuticals, manufacturing equipment manufacturers, medical device manufacturers, ICT manufacturers, telecommunication network providers, utilities, defence
- Regulators and standards bodies - such as environment agencies, health protection and pharmaceutical and medical device regulators, CEN-Cenelec, ETSI
- In addition, the academic researchers who are both users of metrology to test new concepts or manage high-tech experiments, and providers of new knowledge to develop and improve metrology

The initiative would also benefit from research collaborations with the other high-quality international NMIs such as NIST in the USA, KRISS in South Korea, NMIJ in Japan and NIM in China, to keep aligned with latest thinking in metrology worldwide and maintain European influence in metrology.

### Type and range of activities

This functionality relates to the criterion “Approaches to ensure flexibility of implementation and to adjust to changing policy, societal and/or market needs, or scientific advances”. It concerns the types of activity that the initiative is intended to encourage, such that it is able to respond effectively to the challenges and problems described in Section 2.

The proposed initiative in metrology will need to undertake the following activities to address the objectives set:

- Strong **governance processes** are required to provide strategic direction to developing new ways of coordinating metrology research and the new capabilities created, as well as to provide effective management of operational management of activities to implement the strategy
- Develop a long-term **Strategic Research and Innovation Agenda** (SRIA) for European Metrology that encompasses changing the structures to enable new ways of coordinating metrology services and capabilities, as well as the research required to ensure European metrology capabilities remain world-class and meet economic and societal needs
- Design the principles for **European Metrology Networks**<sup>44</sup> to facilitate their creation in key domains identified in the SRIA and to support their implementation. The networks will need to bring together the whole value-chain in key domains to develop strategies for the design and co-creation of the metrology capabilities and infrastructure required to meet their needs. Thematic areas for the networks will focus on emerging technologies and innovation that will support European industrial competitiveness and green growth and wider EU policy objectives in climate, environment and health.

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<sup>44</sup> Study on Coordination in Metrology, Optimat, Dec 2016

- Design and run calls for proposals (driven by the SRIA) and undertake **collaborative joint research projects** that
  - Support the development of the underpinning metrology system (the SI system)
  - Support innovation
  - Support standardisation and regulation for EU policy with a focus on climate, environment and health
- Support actions for **capacity building** in metrology in countries small and developing NMIs and DIs in order to increase their skills and knowledge and bring the highest quality metrology to their national and regional economics and societies, and so decrease fragmentation and enhance the coherence of the European metrology system.

### Directionality and additionality required

This functionality relates to the criteria “Common strategic vision of the purpose of the European Partnership” and “*Creation of qualitative and significant quantitative leverage effects*”. The former highlights the importance of ensuring that all participating stakeholders have a common understanding of the purpose of the policy intervention and the direction of the R&I activity it is intended to encourage. The leverage effects relate to the creation of spillover effects of the knowledge gained in the broader community as well as the crowding-in effects on private investments in R&I – both among participating stakeholders and in the broader community, and/or the pooling of resources from EU Member States.

Implementing a new coordinated approach to metrology research and the provision of metrology capabilities is a significant change that requires a high level of directionality and long-term commitment. It involves metrology policy-makers, funding, people and facilities as well as NMI/DI users, that all need to be moving in the same direction.

The management processes and cultures of national institutions such as research laboratories do not change quickly. If the long-term solution to a coherent metrology system is not simply coordinated research, but also a coordinated and networked European-wide access to the state-of-the-art metrology capabilities, then long-term funding and policy commitment is required by the ministries responsible for metrology policy and funding.<sup>45</sup> NMIs and DIs will not be able to make such a long-term commitment without the corresponding commitment from their ministries. The resulting European solution may, in some cases, involve some NMIs/DIs providing certain aspects of a new capability and other NMIs/DIs providing others. This requires the long-term commitment from NMI and DI leaders to the SRIA, as well as buy-in from metrology researchers. A more coordinated and coherent system will reduce fragmentation in the metrology system, make more effective use of national and European resources and ensure additionality by making the coordinated solution more effective than the sum of its parts.

Directionality not only requires long-term commitment from metrology policy-makers, funders and institutes but also strong central governance across NMIs and DIs and their respective ministries to drive and implement the strategy for greater European coordination. Furthermore, the direction taken needs to be closely aligned with the wider new knowledge and emerging technologies coming from the research base and end-user needs.

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<sup>45</sup> The “Study on Coordination in Metrology, Optimat, Dec 2016” proposed that Ministries need to be central to the leadership of long-term coordination between NMI/DIs

#### 4.4.2 External factors

The proposed Regulation for Horizon Europe also identifies the need to consider “Coordination and complementarity with Union, local, regional, national and, where relevant, international initiatives or other partnerships and missions” when assessing the case for a partnership. It concerns the potential for linkages with other relevant R&I initiatives proposed or planned for the forthcoming Framework Programme, at the EU level in the context of the MFF 2021-27, and beyond.

As describe above the initiative needs to be connected to new knowledge and technologies a coming from the research base. This is a mutually beneficial connection to ensure that new knowledge and technologies are utilised in pursuit of the highest quality metrology and, equally, that the appropriate metrology capabilities are available to support the development of emerging technologies. The initiative also needs to be connected with European policy-makers who can and will utilise metrology in, for example, developing the Green Deal, designing and implementing climate and environmental regulation.

Finally, as described under ‘type and composition of the actors involved’, the participation of external actors from among the international NMIs and DIs is important.

Depending on the type of stakeholder, participation would entail membership of advisory boards and committees of European Metrology Networks and/or participation in individual collaborative research projects.

### 5 What are the available policy options?

In this section, we provide an overview of the key characteristics of the policy options for this initiative. The Horizon Europe regulations put forward three forms of European Partnerships that constitute the policy options for this initiative; standard Horizon Europe calls are a fourth option while acting also as a baseline against which the three partnership options will be compared.

To ensure a correct assessment of the different options and their effectiveness, it is crucial to take into consideration both the objectives and the functional requirements outlined in Section 4.4. The descriptions of the options in the sections below therefore focus on the implications of the options’ characteristics related to these functionalities. They are based on the options’ characteristics specifically related to the functionalities listed in Section 4.4. A full description of the options is provided in the report on the overarching context to the impact assessment studies.

#### 5.1 Option 0: Horizon Europe calls (baseline)

Under this option, strategic programming for research and innovation in the field will be done through the mainstream channels of Horizon Europe. The related priorities will be implemented through traditional calls under the Framework Programme covering a range of activities, but mainly calls for R&I and/or innovation actions, and reliant on the standard mechanisms for managing open calls.

Table 3: Key characteristics of Option 0

	Implications of option
Enabling appropriate profile of participation ( <i>actors involved</i> )	<ul style="list-style-type: none"> <li>Traditional calls enable a broad range of R&amp;I actors to participate in calls - from academia, public research organisations and industry from any sector. This includes NMIs/DIs, with historically the larger NMI/ DIs being the ones with the experience and capacity to participate in, and particularly lead, large collaborative projects.</li> </ul>

	Implications of option
	<ul style="list-style-type: none"> <li>NMI/DIs from outside Europe could participate in Horizon Europe calls where there is an agreement with the EU or participate as unfunded partners. External partners from the policy-making communities such as those covering: climate, energy, environment and health, such as environment agencies, health protection and pharmaceutical and medical device regulators, CEN-Cenelec, ETSI - could in theory participate but many not have a history of doing so</li> </ul>
<p><b>Supporting implementation of R&amp;I agenda (activities)</b></p>	<ul style="list-style-type: none"> <li>The majority of activities undertaken under this option would be <b>collaborative research projects</b> on a range of topics across the Horizon Europe work programme.</li> <li>Individual NMIs /DIs may lead project consortia or join consortia made up of industrial and academic partners where metrology features in a call of a Horizon Europe Work Programme. The Horizon Europe traditional calls will involve consortia of public and/or private actors in ad hoc combinations.</li> <li>There will be no dedicated implementation structures and no further support other than the Horizon Europe actions foreseen in the related Horizon Europe programme or cluster.</li> <li>There is no formal process to develop a Strategic Research and Innovation Agenda and this would need to be created via the leadership and processes of the national NMI/DIs</li> </ul>
<p><b>Ensuring alignment with R&amp;I agenda (directionality)</b></p>	<ul style="list-style-type: none"> <li>Strategic planning mechanisms in the Framework Programmes allow for a high level of flexibility in responding to particular needs over time, building upon additional input in co-creation from stakeholders and programme committees involving MS. These mechanisms allow for a broad scope of the stakeholders to provide input to the research agenda.</li> <li>Metrology is a scientific domain with broad application and, although the proposed metrology initiative is situated within cluster 4 (Digital, Industry and Space) of Pillar II of the Horizon Europe Programme, its application areas span all 'technical' clusters. There is not expected to be a dedicated thematic priority in Horizon Europe for metrology research and therefore metrology priorities will need to be included in the Horizon Europe via the strategic planning mechanisms of Pillar II clusters to enable metrology priorities in climate, environment, energy and health to be addressed and maybe even Pillar I (European Research Council) where there is a need for more fundamental metrology research. Therefore, NMIs and DIs will need to engage with the strategic planning mechanisms and with stakeholders across the value-chain to ensure this happens. Metrology priorities and projects, if they are included, would therefore be likely to be distributed across the Horizon Europe Programme.</li> </ul>
<p><b>Securing leveraging effects (additionality)</b></p>	<ul style="list-style-type: none"> <li>Standard Horizon Europe matched funding rules would apply to the various actors (academia, industry, etc.) for collaborative R&amp;I projects and therefore typical Horizon Europe leveraging effects would be expected to be achieved.</li> </ul>

## 5.2 Option 1: Co-programmed European Partnership

This form of European Partnership is based upon a *Memorandum of Understanding* or a *Contractual Arrangement* signed by the European Commission and the private and public partners. Table 4 presents the key characteristics of the option.

Table 4: Key characteristics of Option 1

	Implications of option
<b>Enabling appropriate profile of participation (actors involved)</b>	<ul style="list-style-type: none"> <li>• This type of partnership is suitable for all type of partners, including MS, industry associations and RTOs and is open to Associated Countries and to 3<sup>rd</sup> countries</li> <li>• It is flexible and can cover a large and changing community.</li> <li>• The calls are included in the Horizon Europe Work Programme and Horizon Europe rules apply to calls. Therefore, any legal entity can apply. 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.</li> </ul>
<b>Supporting implementation of R&amp;I agenda (activities)</b>	<ul style="list-style-type: none"> <li>• A broad range of coordinated activities from low TRL to uptake are possible under the standard actions of Horizon Europe</li> <li>• Participation from industry associations enables building further on the results of previous projects, including activities related to regulations and standardisation and developing synergies with other funds</li> <li>• EU contribution is implemented via calls for proposals published in the Work Programmes of Horizon Europe based on the input from partners (adopted via comitology)</li> <li>• The control of the precise call definition, resulting projects and outcomes by the partners, is limited as they are implemented by EC agencies</li> </ul>
<b>Ensuring alignment with R&amp;I agenda (directionality)</b>	<ul style="list-style-type: none"> <li>• The strategic R&amp;I agenda/roadmap is agreed between partners and EC and the objectives and commitments are set in the contractual arrangement</li> <li>• The input to Horizon Europe annual Work Programmes is drafted by partners and finalised by EC (comitology). The commitments are political/best effort, but they are usually fulfilled</li> <li>• Coherence among partnerships and with different parts of the Horizon Europe annual Work Programmes can be ensured by partners and EC, however exploitation of synergies with non-FP programmes is limited.</li> <li>• Synergies with industrial strategies is ensured through the industrial partners</li> </ul>
<b>Securing leveraging effects (additionality)</b>	<ul style="list-style-type: none"> <li>• Under the new regulation for this type of partnership financial contribution of MS and industry is possible and the agreed contribution can be part of the Contractual Agreement.</li> </ul>



### 5.3 Option 2: Co-funded European Partnership

The Co-funded European Partnership is based on a Grant Agreement between the Commission and a consortium of partners, resulting from a specific call in the Horizon Europe Work Programme

Table 5: Key characteristics of Option 2

	Implications of option
<p><b>Enabling appropriate profile of participation (<i>actors involved</i>)</b></p>	<ul style="list-style-type: none"> <li>• This form of implementation is principally directed at public partners. These public partners provide co-funding to a programme of activities established and/or implemented by entities managing and/or funding national research and innovation programmes. Typically the public partners are national agencies that manage and fund R&amp;I activities via calls for R&amp;I projects.</li> <li>• In the case of metrology, the grant recipients (i.e. those who sign the co-fund grant agreement) would be NMIs and DIs. The recipients of the EU co-funding and would implement the actions. The expectation is that these entities would cover most if not all EU Member States and Associated Countries. The consortium would be led by a single NMI or DI or EURAMET (a legal entity representing NMIs and DIs across Europe)</li> <li>• NMIs and DIs that are not members of the consortium would not be able to receive funding under the calls launched by the consortium.</li> <li>• In theory, there is the possibility to introduce new members to the consortium (via a Request for Grant Amendment) but the EU budget would be fixed for the duration of the contract and therefore the original members of the consortium would need to agree a modified grant share.</li> <li>• Industry cannot be formal partners of a Co-funded European Partnership meaning that they cannot sign the grant agreement and can only receive funding if this is allowed under the funding rules of the national entity that does sign the grant agreement. In the case of metrology the signatories are the NMIs and DIs, which are not funding bodies but recipients of institutional funding from the national ministries responsible for metrology policy and funding. Industry and academia could participate in projects with their own funding, but they will not be able (as NMIs and DIs are not funding bodies) to receive any of the EU co-funding except under a subcontract agreement.</li> <li>• NMIs and DIs from 3rd countries would be able to participate, as self-funded partners, if their national rules allow.</li> </ul>
<p><b>Supporting implementation of R&amp;I agenda (<i>activities</i>)</b></p>	<ul style="list-style-type: none"> <li>• The aim of this form of partnership is to bring Member States, NMIs and DIs in this case, together to invest together in key R&amp;I issues of general and common interest. A joint programme of activities would be agreed by the partners and with the EU in areas of high public good (which metrology is) that will benefit from closer alignment and reduced fragmentation of public research.</li> <li>• The partnership would entail a joint programme of R&amp;I activities implemented by the participating NMIs and DIs based on a jointly agreed research agenda. In this option, calls for proposals for collaborative research projects would essentially be 'internal' calls among NMIs and DIs with national and EU R&amp;I funding managed in a decentralised manner under national rules</li> </ul>

	Implications of option
	<ul style="list-style-type: none"> <li>• The Co-fund would be lead by a single NMI or EURAMET</li> <li>• The co-fund consortium would support a range of activities: <ul style="list-style-type: none"> <li>○ Coordination activities to facilitate NMI and DI cooperation for, at least, the duration of the co-fund. These might take the form of the European Metrology Networks identified in the objectives</li> <li>○ Calls among NMIs and DIs for collaborative European joint research projects aligned with the strategic research programme</li> <li>○ Capacity building activities</li> </ul> </li> </ul>
<b>Ensuring alignment with R&amp;I agenda (<i>directionality</i>)</b>	<ul style="list-style-type: none"> <li>• The Co-funded European Partnership would aim to pool and/or coordinate national programmes and policies with EU policies and investments and the Member States that are partners, via their NMIs and DIs. Therefore, the NMIs and DIs would agree a strategic programme of coordinated activities for the lifetime of the grant agreement for the Partnership. Each NMI / DI's activities would be funded via EU funds alongside their national institutional funding.</li> </ul>
<b>Securing leveraging effects (<i>additionality</i>)</b>	<ul style="list-style-type: none"> <li>• The partnership will use national funding rules and processes to allocate funds to individual NMIs and DIs, with EU funding allocated in appropriate levels (as defined in the grant agreement) and according to the total EU Co-funding agreed across all projects per NMI and DI. The leverage between national and Eu funding would be expected to be 50:50.</li> <li>• There would be very limited industrial leverage. It would only occur where industry are willing to participate in R&amp;I activities as unfunded partners and/or choose to engage in any strategy development or coordination activities.</li> </ul>

#### 5.4 Option 3: Institutionalised European Partnership

##### 5.4.1 Institutionalised Partnerships under Art 185 TFEU

The Institutionalised Partnership is the most complex and high-effort arrangement and, in the case of metrology, centred on public research laboratories, would be based on Article 185 of the TFEU and Co-Decision by the European Parliament and Council. The rationale for this type of partnership is the need for a strong integration of R&I agenda of public sector funding organisations in Europe in order to address a strategic challenge or realise an opportunity. The focus is on major long-term strategic challenges and priorities beyond the period of a single Framework Programme where collective action is necessary to achieve critical mass and address the full extent of the complexities of the ecosystem concerned. Specifically, Article 185 of the TFEU allows the Union to participate in programmes jointly undertaken by Member States and Associated Countries, aimed at achieving the greatest possible impact through the integration of national and EU funding, aligning national strategies in order to optimise the use of public resources and overcome fragmentation of the public research investments.



Table 6: Key characteristics of Option 3: Institutionalised Partnership Art 185

	Implications of option
<p><b>Enabling appropriate profile of participation</b> <i>(actors involved)</i></p>	<ul style="list-style-type: none"> <li>• An Article 185 Institutionalised Partnership for Metrology would be a partnership agreed by a co-decision of the Commission and European Parliament along with the Ministries of Member States and Associated States responsible for NMI/DI policy and funding. It is expected that the majority of MS would participate along with several Associated Countries.</li> <li>• It will bring together R&amp;I governance bodies of most if not all EU Member States (legal requirement: at least 40% of Member States) as well as Associated Countries that designate a legal entity (Dedicated Implementation Structure) for the implementation. Eligibility for participation and funding follows, by default, the rules of the Framework programme, unless a derogation is introduced in the basic act.</li> <li>• This option would ensure participation of the Ministries responsible for metrology policy and funding and the NMI/DIs that they either own and fund or, if they do not own them, support and fund.</li> <li>• Each project or activity funded would be via calls for proposals run under Horizon Europe rules. This enables grant funded and self-funded external participants from the industrial and academic communities to participate in projects as well as international NMIs and DIs.</li> </ul>
<p><b>Supporting implementation of R&amp;I agenda</b> <i>(activities)</i></p>	<ul style="list-style-type: none"> <li>• The A185 mechanism would be managed by a dedicated implementation body. This would be EURAMET, the European Association for National Metrology Institutes, a legal entity representing NMIs and DIs across Europe.</li> <li>• The Institutionalised Partnership would be governed by participating countries via a committee with processes managed and implemented by EURAMET. Each country would be represented by a senior leader from the NMI, in agreement with the national ministry responsible for metrology policy. EURAMET itself is governed by a Board of Directors elected by its members.</li> <li>• A dedicated programme management function within EURAMET, led by a professional programme manager, would administer activities undertaken by Institutionalised Partnership members and undertake a range of supporting activities themselves. The implementation body and programme management function would be funded by cash contributions from Member States.</li> <li>• An Institutionalised Partnership would enable activities in the form of: <ul style="list-style-type: none"> <li>○ Governance process (as described above)</li> <li>○ Coordination activities to facilitate NMI and DI cooperation to come together to design, agree and implement new structures for long-term cooperation in metrology research and provision of metrology capabilities. The governance committee would oversee implementation to ensure new structures involve relevant academic, industrial and policy-making stakeholders across the value-chain.</li> <li>○ Calls for European Joint Research Projects in priority areas defined by the SRIA, with an open pre-call processes that allows for research ideas to be submitted from the wider research and innovation stakeholders.</li> </ul> </li> </ul>

	Implications of option
	<ul style="list-style-type: none"> <li>○ A programme of support actions for capacity building activities in smaller and developing NMIs and DIs that enables more experienced NMIs and DIs to support less experienced peers in a range of domains and activities important to being a national institute</li> <li>○ Annual work programmes for all activities are shared with the Commission</li> </ul>
<b>Ensuring alignment with R&amp;I agenda (<i>directionality</i>)</b>	<ul style="list-style-type: none"> <li>• Directionality of the partnership will be provided by the governance processes. The governance committee will develop a long-term Strategic Research and Innovation Agenda (SRIA) for the lifetime of the partnership and into the longer-term future and will identify the coordination activities required to achieve the objectives. The governance committee will be advised by EURAMET’s Research Council made up of senior and experienced experts from academia, industry, public agencies and relevant trade and professional associations.</li> </ul>
<b>Securing leveraging effects (<i>additionality</i>)</b>	<ul style="list-style-type: none"> <li>• The commitment for contributions by the Institutionalised Partnership members will be at least 50% of the aggregated European Partnership budgetary commitments. Additional leverage would be achieved via the unfunded participation of industry.</li> </ul>

#### 5.4.2 Institutionalised Partnerships under Art. 187 TFEU

The Art 187 TFEU is a complex and high-effort arrangement and is based on a Council Regulation and implemented by dedicated structures created for that purpose. It can 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.

Table 7: Key characteristics of Option 3: Institutionalised Partnership Art 187

	Implications of option
<b>Enabling appropriate profile of participation (<i>actors involved</i>)</b>	<p>This option is suitable for all types of partner and therefore MS and private partners such as industry and RTOs can participate</p> <p>Non-associated third countries can only be included as partners if foreseen in the basic act and subjected to conclusion of dedicated international agreements</p> <p>In addition to MS, companies and research organisations from all countries that are relevant major players can participate, but are subject to policy considerations</p> <p>Horizon Europe rules apply by default, so any legal entity can apply to partnership calls</p> <p>The option requires a rather stable set of partners</p> <p>Basic act can foresee exceptions for participation in calls / eligibility for funding</p>

<p><b>Supporting implementation of R&amp;I agenda (activities)</b></p>	<p>The standard actions of the Horizon Europe can be supported, these allow a broad range of activities from research to market uptake</p> <p>The back-office allows dedicated staff to implement integrated portfolio of projects, allowing to build a “system” via a pipeline of support to accelerate the take-up of results of the partnership, including those related to regulations and standardisation and developing synergies with other initiatives</p> <p>It allows the integration of national and Union funding into the joint funding of projects</p> <p>There is limited flexibility in changing the objectives, range of activities and partners as such changes need changes in the Regulation of the partnership, and negotiation in the Council</p>
<p><b>Ensuring alignment with R&amp;I agenda (directionality)</b></p>	<p>The strategic R&amp;I roadmap is agreed between MS, other partners and the EC</p> <p>The objectives and commitments are set in the legal base</p> <p>The annual work programme is drafted by the partners and approved by EC which has veto right</p> <p>Commitments include the obligation for financial contributions, including contributions to the administrative costs</p>
<p><b>Securing leveraging effects (additionality)</b></p>	<p>The commitment for contributions by the partnership members is expected to be at least equal to 50% and may reach up to 75% of the aggregated European Partnership budgetary commitments.</p>

### 5.5 Options discarded at an early stage

The Co-Programmed partnership (**Option 2**) and an Institutionalised Partnership created under Article 187 of the TFEU are not considered relevant for the impact assessment of the candidate Institutionalised Partnership in Metrology.

The initiative requires the long-term coordination of public institutions, government ministries and public funding in metrology. From this perspective, the option of a co-programmed European Partnership or an Article 187 partnership - with their tendency to focus on public-private partnership and for co-programmed partnerships a medium-term time horizon, would be insufficient to meet the objectives proposed. We are not aware of stakeholder groups championing either of these types of partnership in the context of metrology.

## 6 Comparative assessment of the policy options

### 6.1 Assessment of effectiveness

Based on the intervention logic, the initiative aims to deliver scientific, economic/technological and societal (including environmental) impacts through a set of pathways (Section 4.3), which require a set of critical factors in place to be achieved in the best possible way (Section 4.4).

This section assesses the extent to which each retained policy option has the potential to allow for the attainment of the likely impacts in the scientific, economic/technological and societal sphere, based upon its characteristics (Section 5). At the end of each section we

summarise the outcomes of the assessment by assigning a non-numerical score to each option for each impact desired.

The assessments in this section set the basis for the comprehensive *comparative* assessment of all retained options against all dimensions in Section 6.4.

Table 8 lists the desired impacts in the three impact areas.

Table 8: Likely impacts of the initiative

Impact area	Likely impacts
Scientific impact	Sustainable and efficient integrated European Metrology System beyond 2030
	Improved awareness and understanding of the metrology system across the innovation and policy-making systems
	Europe is a world-leader in metrology capabilities
Economic / technological impact	Sales of innovative products and services (that will lead to growth of innovative businesses that sell and/or use measurement equipment)
	Sales of innovative products and services (that will lead to new innovative products available that contribute to sustainable economic growth)
Societal impact	Metrology community contributions to European regulations and policy and the standards that underpin them - for climate, environment, health.
	Leading t in the longer-term to: fit-for-purpose policy and regulation underpinned by robust standards and trustworthy data to assess and manage risks

### 6.1.1 Scientific impacts

#### Option 0: Horizon Europe calls (baseline)

Horizon Europe is large in scale and its traditional calls provide the opportunity for collaborative R&I across a wide-range of disciplines and application areas. As a general-purpose technology with numerous applications, metrology's applications stretch across almost the entire Horizon Europe programme in Pillar II (everything except perhaps Cluster 2 - Culture, Creativity and Inclusive Society) and arguably Pillars I and III as well. Therefore, while metrology currently sits within *Pillar II's Cluster 4: Digital, industry and space*, its relevance is much wider, and, as described in the problem definition section (Section 2), it is also a rather 'hidden' piece of the research and innovation system. This presents a significant challenge to ensure metrology R&I priorities are sufficiently reflected in the thematic Work Programmes amongst more 'obvious' thematic challenges. This is likely to **result in sub-optimal levels of metrology research** at the European level (and a corresponding **sub-optimal leverage and alignment of national resources**) and therefore not adequately address the issue (problem) of meeting the increasing needs /demand for metrology capabilities as a result of under-investment in their creation. The total scale of metrology R&I in Europe matters, it needs to be sufficient to enable breadth in R&I to meet the many economic and societal needs that metrology contributes to as well as depth in the key underpinning scientific concepts **to ensure Europe remains a world-leader**.

In addition to sub-optimal quantities of research investment, metrology R&I activities are likely to be distributed across the clusters, thematic priorities and work programmes, with a low level of strategic **directionality** and a rather ad hoc selection of which metrology needs are prioritised. This would also lead to a distribution of national investment across a range of priorities as there is **no underlying process to coordinate** the most appropriate national expertise to where it can create most impact and reduce the overall

**fragmentation** in a system of NMIs and DIs driven by national policy. Furthermore, as this option provides no opportunities for coordination activities there is no central structure to stimulate and drive networking structures that are essential to influence the direction of the research and increase opportunities for adoption of research outputs (this is further developed in the Economic and Social impact sections in 6.1.2 and 6.1.3).

The key to maximising the scientific quality and impact of metrology research is collaboration among the European NMIs and DIs and collaborations between NMIs/DIs with the best relevant academic research - bringing the NMIs and DIs with the highest international scientific reputations together with latest academic thinking, but also bringing in the smaller and developing NMIs and DIs with niche and/or emerging capabilities, to widen the skills and knowledge base across Europe and bring it closer to end-users. Under traditional calls this form of project level collaboration is possible, although there is a risk that only the large, more experienced NMIs and DIs, with higher research resources, skills and management and administrative support would participate, **limiting the openness** of individual projects and limiting opportunities for building **capacity in metrology** across Europe.

Under this Option, the scientific publication outputs, in terms of numbers, citations and co-authorship, would be expected to be, at best, the same as current levels (such as in Table 1 and Figure 2). Publication levels, particularly those created collaboratively across Europe, may reduce as the current partnership in metrology comes to an end.

**Traditional calls are very open** in terms of actors and are designed to create R&I collaborations with industry and other end-users and this is absolutely essential for conducting the most relevant metrology research relevant to real identified needs. However, to widen the reach of metrology R&I and collaborate across the value-chain (and not only with first-tier users) requires addressing the widespread low awareness of metrology and better developing a better understanding of end-users needs, before such businesses and other end-users are likely to collaborate. This is particularly the case where the end-users are policy-makers and regulators who, firstly have a more limited engagement with the research base in general, and are not particularly well-engaged with NMIs and DIs. Traditional calls will not serve to create new collaborations between NMIs/DIs and policy-makers and regulators in key policy fields.

## Option 2: Co-Funded European Partnership

A Co-funded European Partnership provides the opportunity for greater investment in and greater coordination of metrology R&I. It enables national NMI/DI research activities to **be aligned to a greater extent and provides opportunities to steer R&I activities via an agreed research agenda**, at least for the lifetime of the Co-funded Partnership.

The Co-funded European Partnership instrument is designed to support national funding agencies to enable alignment of national R&I activities in fields of common interest, whereby national calls are run to align with the Co-fund strategy and, where possible enable specific parallel R&I projects to be aligned across Member States and Associated Countries. Where public funding for metrology is concerned, the national public funding is not allocated to an R&I funding agency as it is institutional funding i.e. it is allocated directly to NMIs and DIs as public/government laboratories. Therefore, at the national level the metrology funding cannot go to other R&I bodies (or if it can, it is a very small proportion of the total) and it is not allocated by national calls. **This significantly reduces the openness of the partnership.** To be successful the Co-funded European Partnership would need participation of the majority of NMIs and DIs across Europe. Reasonably high levels of participation would be expected, but there might be a slight skew towards the larger research-intensive NMIs and DIs who are prepared to undertake the complexities of managing the administrative processes of aligning national and EU funding. **This may restrict the breadth of participation of NMIs/DIs**, with some smaller countries, with

smaller NMI/DIs, less likely to participate. Once the grant agreement is signed, participation in calls is limited to those that have signed. It would be possible, in principle, to involve other actors (e.g. academia, industry, policy-makers, regulators and standards bodies) mostly likely on a self-funded basis<sup>46</sup> but this would be subject to project-by-project decisions by the grant recipients. However, this 'offer' may not be sufficiently attractive to these stakeholders for them to dedicate time and resources, especially among those who are currently less connected to the NMI/DI community.

Coordination and support actions could be put in place to stimulate the development of coordination structures to support strategy making among NMIs and DIs in specific sub-fields or application areas. Due to the limitations on non-NMI/DI participants and nature of the Co-fund design, these might be expected to focus on an NMI/DI view of future needs and last only for the duration of the partnership. Central governance would be at a moderate level as much of the authority for expenditure lies with the national systems and national rules. Therefore, there would be a **reasonable level of directionality during the partnership, it may cease once the partnership comes to an end.**

Nevertheless, the Co-funded European Partnership would create a significant uplift in metrology R&I with greater alignment of national research, reducing duplication to some extent and creating new knowledge and skills among the NMI/DI community (measured by increased peer-reviewed publications) and **helping to retain European global leadership and raising metrology R&I skills among the participants.**

Under this Option, the scientific publication outputs, in terms of numbers, citations and co-authorship, would be expected to continue at current levels (such as in Table 1 and Figure 2).

### Option 3: Institutionalised Art 185

An A185 Institutionalised Partnership is a complex structure to establish. It is more complex than using the standard processes of Horizon Europe and there is an increased level of complexity compared to the Co-funded European Partnership particularly during the start-up phase. However once established it makes use of centralised and clearly-defined work programme planning and call processes and uses the standard instruments of Horizon Europe.

An A185 Institutionalised Partnership provides the opportunity for **greater leverage of national funding and significant level of coordination of metrology R&I** through creating new structures and processes for coordination. The design of these structures with backing from national ministries responsible for metrology **policy provides long-term directionality and significantly increases the likelihood that these structures are sustainable beyond Horizon Europe.** Participation among the NMI and DI community would be expected to be high, somewhat higher than under the Co-funded European Partnership due to the attraction of a centralised call process using standard, well-designed and reasonably familiar Horizon Europe instruments and, also due to the simple fact that, once a national Ministry has signed the co-decision (albeit a rather complex process) all that country's NMIs and DIs are eligible to participate. 20 Member States and four Associated countries have already expressed an interest (via their relevant ministries) in participating in an A185 Institutionalised Partnership in metrology.<sup>47</sup>

The A185 Institutionalised Partnership offers the possibility to create a greater degree of coordination of national NMI and DI R&I activities, than under the Co-funded European Partnership, due to the **stronger governance processes** backed by national ministries. Not only is the development of Strategic Research and Innovation Agenda a legal requirement, but the governance can develop a strategy, right from the start, that allocates

<sup>46</sup> EU co-funding budget might also be utilized, for example by paying for subcontracted expertise

<sup>47</sup> Data provided by the Commission



a proportion of collaborative research project funding for stakeholders external to the 'internal' NMI and DI participants to facilitate and enable their participation in the partnership and so, **increasing the openness of participation** particularly to those in the industrial and policy-making communities. Furthermore, the A185 Institutionalised Partnership, using its governance processes, can develop its own coordination instrument to implement European Metrology Networks to meet the proposed general and specific objectives. The governance processes can also be used to set clear objectives and criteria for the networks, such as participation of stakeholders across the value-chain to ensure the networks are able to identify and meet real needs. The external participants (i.e. non-NMI/DI participants) are essential to identifying needs and designing joint research projects to meet them. The partnership would also continue to support joint research projects to develop the fundamental underpinning SI system and would continue to create scientific impact.

The European Metrology Networks are intended to re-structure processes to identify needs, plan and conduct metrology research and, ultimately ensure access to new metrology capabilities across Europe. These centralised virtual centres of excellence will improve access to metrology capabilities and, through wider engagement with users, increase adoption of the metrology R&I outputs. The **networks will reduce duplication of research and reduce fragmentation in both the development and access to state-of-the-art metrology capabilities.**

The scientific impact will be significantly greater than in option 0, not least because the total investment levels are likely to be higher, but also due to greater directionality of the research conducted whereby metrology research across Europe can be more effectively coordinated across portfolios of projects working in related areas.

Under this Option, the scientific publication outputs, in terms of numbers, citations and co-authorship, would be expected to increase from current levels, with a particular increase in co-authorship among NMIs/DIs, between different research communities and geographically across Europe. Europe would be expected to retain key roles in international metrology and be perceived by international metrology peers as a world-leader.



**Stakeholders interviewed** were very clear that a coordinated and systematic model of implementation, such as that provided via the networks, provides the structure to include the widest range of stakeholders and ensures the inclusion of SMEs as well as smaller NMIs/DIs, smaller universities and smaller research institutes. **Interviewees** and **respondents to the open consultation** agreed that a European initiative in metrology needed to be supported by the strategic oversight and long-term planning provided by the partnership model and a specific legal structure.

A small proportion of highlighted that metrology needs were often overlooked in regular FP projects, and that where metrology capability was required in projects, it was expected to be readily available. As a result, **interviewees** noted that the expected time and resources required for metrology was regularly under-estimated. Metrology stakeholders also noted that regular FP call processes would not support any significant change the metrology infrastructure and therefore have limited sustainable impact beyond the FP.

The significant majority of **respondents to the open consultation** agreed that the candidate partnership was very relevant for generating new scientific knowledge and reinforcing EU scientific capabilities; providing new measurement techniques and protocols for emerging technologies; and providing more accurate and precise calibration services for any scientific discipline.

## Summary

Table 9, below, lists the scores we assigned for each of the policy options, based upon the assessments above, as well as taking into account the support expressed by the different stakeholders.

Table 9: Overview of the options' potential for reaching the scientific impacts

	Option 0 Horizon Europe calls	Option 2 Co-funded	Option 3 Institutionalised A185
<b>Sustainable and efficient integrated European Metrology System beyond 2030</b>	+	++	+++
<b>Improved awareness and understanding of the metrology system across the innovation and policy-making systems</b>	+	++	+++
<b>Europe is a world-leader in metrology capabilities</b>	++	++ +	+++

Notes: Score +++ : Option presenting a *high* potential; Score ++: Option presenting a *good* potential; Score +: Option presenting a *low* potential

### 6.1.2 Economic/technological impacts

The sections that follow refer back to the scientific impact in section 6.1.1 above, as the economic impacts are closely related to the quality of the scientific research outputs but also the extent to which the research is aligned with industry needs and research is conducted collaboratively with industry across the value-chain. Therefore, the consideration of the ability to create and support application focused European Metrology Networks are key to enabling and maximising economic impact.

#### Option 0: Horizon Europe calls (baseline)

As described under scientific impact in section 6.1.1 this option would enable collaborations between NMI/DIs and industry and this will create useful scientific and technical knowledge on a project by project basis, but due to the ad hoc nature of the projects, the collection for projects would have **limited directionality** and impacts would be limited to marginal gains over a national approach to metrology R&I just as they are for scientific impact, and for the same reasons - sub-optimal investment, an ad hoc collection of R&I activities addressing a narrow range of priorities and economic needs with little strategic direction.

The lack of processes to develop and support coordination of research among, and closer engagement with, metrology users across the value-chain, i.e. no ability to develop European Metrology Networks effects the directionality of the research. More importantly it reduces the ability to collaborate with metrology users in the private sector and so reduces the adoption of research outputs to support innovation, product development and business growth. As SMEs in the instrumentation sector play a key role in the metrology value-chain, this restricts the ability to support SME innovation and growth.

Economic impact would still be created by the projects undertaken under option 0 and NMIs and DIs will continue to engage with industry at national level, but the impact would be at a lower level than the €50M a year estimated in section 4.3.2. The exact reduction is difficult to specify but one might reasonably expect impact to be focused in traditional areas of metrology (based on the physical sciences) and some emerging technologies in related /adjacent fields but with very limited impact in areas such as those based on chemistry and biology and the technologies (such as biotechnology) that are based on



them or on complex integrated technologies. Impact would be reduced due to sub-optimal levels of investment, limited directionality of the research and duplication of research in national metrology systems.

### Option 2: Co-funded European Partnership

As described under scientific impact (section 6.1.1) the Co-funded European Partnership would enable increased investment in metrology R&I and improved alignment of national metrology research among NMIs/DIs. The Co-funded Partnership would enable some form of networking with industry and this might take the form of European Metrology Networks, but the design of the Co-funded Partnership, and its funding arrangements in particular (where national and EU funding is largely allocated to NMI/DIs) creates limited incentives, at least financially, for industry to participate. This will have an effect on the extent of directionality of the research and, more importantly, reduce opportunities for ensuring research is relevant to industry and reduce opportunities for research outputs to be adopted to support innovation, product development and business growth.

Economic impacts would be expected to be greater than in Option 0 as there would be more coordination efforts among NMI/DIs and some increased coordination with industry in specific emerging technology domains. The extent to which the estimate of additional sales of €50M a year (to businesses that engage directly with NMI/DI R&I activities, section 4.3.2) would be reached depends on the extent to which businesses can influence the research agenda but the limitations of likely industrial engagement, over and above that which might occur under Option 0, would suggest the impact would not be maximised.

### Option 3: Institutionalised Art 185

As described under scientific impact (section 6.1.1) the A185 Institutionalised Partnership creates the opportunity, via the European Metrology Networks, to increase the relevance of the research undertaken. These European Metrology Networks are intended to re-structure processes to identify needs and to plan and conduct metrology research by working closely with the metrology users in industry (and among policy-makers). Therefore, the networks will enable NMI/DIs to work more closely with technology developers in academia and businesses and create (and even co-create) state-of-the-art metrology capabilities that directly support their innovation processes. The networks enable coordination across NMIs and DIs to identify needs in specific emerging technologies and applications (from quantum technologies and laboratory medicine to digital manufacturing and smart grids) ensure the right metrology capabilities are available for the industries of the future as well as continuing to support traditional industries.

This type of coordination activity should move Europe towards single points of access to specific metrology capabilities, especially in new technology areas, making it easier to raise awareness of the new metrology capabilities and simpler for businesses to access them.

The relationships developed between NMI/DIs and industry within the networks will be key to facilitating the adoption of high-quality measurement techniques and instrumentation by businesses along the value-chain through increased direct interaction with these stakeholder groups via the networks. Therefore, the A185 Institutionalised Partnership provides the potential to maximise the direct economic impact of metrology R&I on the businesses that engage with the partnership so much more likely to reach the estimated €50M per year detailed in section 4.3.2.



Most **stakeholders interviewed** agreed that economic impact would be greater within models that supported involvement of stakeholders external to the NMI/DI community. In this sense, most stakeholders agreed that the A185 Institutionalised Partnership model would provide the best mechanism for engaging with end-users. Respondents to the **open consultation** also viewed

collaborative R&I projects and a joint R&I programme as being very relevant for the achievement of the initiative’s objectives.

The majority of **respondents to the open consultation**, particularly large companies, agreed that the proposed candidate institutionalised partnership would have a significant impact on the uptake of innovation and improved quality assurance of innovative products. Respondents, particularly SMEs, also agreed that this would have an impact on supporting more innovative technology-based business and increasing employment and providing higher added-value innovative products. In this **open consultation**, industry stakeholders also rated the proposed partnership as being very relevant for leveraging industry resources more than other stakeholder groups.

### Summary

Table 10, below, lists the scores we assigned for each of the policy options, based upon the assessments above, as well as taking into account the support expressed by the different stakeholders.

Table 10: Overview of the options’ potential for reaching the likely economic/technological impacts

	Option 0 Horizon Europe calls	Option 2 Co-funded	Option 3 Institutionalised A185
<b>Sales of innovative products and services (that will lead to growth of innovative businesses that sell and/or use measurement equipment)</b>	+	++	+++
<b>Sales of innovative products and services (that will lead to new innovative products available that contribute to sustainable economic growth)</b>	+	++	+++

Notes: Score +++ : Option presenting a *high* potential; Score ++: Option presenting a *good* potential; Score +: Option presenting a *low* potential

### 6.1.3 Societal impacts

The sections that follow refer back to the scientific impact in section 6.1.1 above as the societal impacts are closely related to the quality of the scientific research outputs but also the extent to which the research is aligned with the needs of policy-makers, regulators and standards-making bodies and therefore the extent to which they can influence the research agenda and, where appropriate, participate in collaborative research alongside NMI/DIs. As for economic impact the creation and support of application focused European Metrology Networks are key to enabling and maximising societal impact.

As a general purpose technology, metrology makes what is often be a small contribution to a large number of application areas. In some cases this contribution may be critical but often it is a piece of a much larger endeavour and therefore quantifying its impact is extremely difficult. The social challenges that the initiative will focus on are centred, in particular, on the policy area of the Green Deal (measuring climate variables and environmental parameters, and measurements to enable a low carbon energy system) and health (measurements for reliable laboratory medicine, food safety, etc) and the form of the impact, and how it might be quantified, will vary greatly.

### Option 0: Horizon Europe calls (baseline)

As described under scientific impact in section 6.1.1, traditional Horizon Europe calls would enable collaborations between NMI/DIs and industry and to a lesser extent with policy-

makers and regulators. While research to address important social challenges is a key feature of Horizon Europe, close and direct linkages between NMIs and DIs and policy-makers and regulators is limited and therefore the awareness of the benefits metrology can bring among this group of stakeholders is still relatively low and the precise nature of their metrological needs (which are often unarticulated) are not well known. This restricts the ability to identify the most important metrology needs and restricts the ability to engage policy-makers and regulators in traditional calls as a method to meet those needs.

This option will provide opportunities for the NMI/DIs and industry to work together to develop solutions to some social challenges but it is less likely to be highly directed to policy-makers' needs. Where metrology is concerned, technological measurement solutions tend to be directed at enabling existing regulation to be complied with effectively, rather than working with policy-makers to ensure that future regulations are well-designed (in terms of parameters that need to be measured and assessed) and can be complied with effectively. This option will not serve to create and develop new collaborations between NMIs/DIs and policy-makers and regulators in key policy fields.

### **Option 2: Co-funded European Partnership**

As described under scientific impact in section 6.1.1, the Co-funded European Partnership will provide scope for increased networking and engagement with policy-makers and regulators but it is unlikely to provide an opportunity for NMIs and DIs to make a step-change in these relationships. The design of the Co-funded European Partnership, and its funding processes, creates a high degree of ownership by the main beneficiaries i.e. the NMIs and DIs and does not create sufficient incentives to develop lasting and deepened relationships. While NMI/DIs are reasonably well-connected with the standards-making bodies but this is generally focused on specific technical domains and standards for regulations already in place, but less so with the 'end-users' - that is the policy-makers and regulators themselves, with the ultimate end-users being European citizens.

As described under option 0 above, NMI/DIs are not yet playing a significant role in influencing the design of appropriate, fit-for-purpose measurement methods in policy and regulation from the very beginning, and the full potential contribution of metrology to addressing societal challenges is not being reached. This is particularly the case for climate, environmental and energy policies where the need to measure and quantify environmental features to monitor the compliance with regulation and also the success (or otherwise) of policies is critical. This is not to say that, under this option, some level of societal impact would not be made, but with insufficient engagement with policy-makers and regulators, it will be limited.

### **Option 3: Institutionalised Art 185**

As for economic impact above, the European Metrology Networks provide the opportunity to increase engagement with those designing and implementing public policy to address important societal challenge in climate change, environmental protection and sustainable development and in safe and effective healthcare. The increased interaction with, and understanding of the needs of, policy-makers and regulators, will help to increase the adoption of metrology knowledge, skills and capabilities to support them in addressing societal challenges. The networks will also help to bring businesses with technical innovations to address societal challenges closer to the needs of policy-makers and regulators.

This type of engagement with policy-makers and regulators is a challenge for NMIs and DIs. While interactions exist in a few regulatory areas within some countries, this is an area where much improvement is required and significant impact to be made. This is a long-term endeavour; it will take time to raise awareness of the role metrology among policy-makers and to build strong relationships between NMIs/DIs and policy-makers and regulators across the breadth of societal challenges. The directionality and long-term

commitment provided by the A185 Institutionalised Partnership and the creation of the European Metrology Networks is critical here. Impact is also likely to be achieved on longer term timescales. The experts from NMIs and DIs can build on their existing relationships with standards-making bodies at the European level and build on the relationship recently developed between EURAMET and CEN-Cenelec to increase opportunities to contribute to standards under development (that directly support policy and regulation) and in time, as relationships deepen and credibility increase, work to influence 'upwards' to policy-makers directly. Importantly, coordination of metrology knowledge via the European Metrology Networks enables the metrology community to 'speak with one voice' to European policy-makers, regulators and standards-makers facilitating more coherent and efficient contributions and ultimately increased impact.

As described in section 4.3.1, several of the proposed the European Metrology Networks will target environmental impacts, including: climate and ocean observation to improve our knowledge of the state of the climate; monitoring of air and water quality; and measurement technologies for low carbon technologies and energy. The European Metrology Networks will also support the adoption of health innovations and improved safety and effectiveness of medical interventions.



**Stakeholders interviewed** largely agreed that the partnership models, in particular the A185 Institutionalised Partnership model, would be most appropriate for supporting the involvement of regulators through well-structured networks. Some policy makers interviewed also acknowledged the value of having a single contact point to approach to metrology expertise and one that that included access to both organisations from metrology and industry. The majority of **respondents to the open consultation** agreed that a specific legal structure with robust governance was relevant or very relevant to making the changes in the metrology system necessary to support better links to regulators and harmonisation of standards.

The majority of **respondents to the open consultation** (predominantly research institutions, NGOs and Public Authorities) agreed that the candidate partnership under the A185 model would support reliable and trusted data exchange in the fields of health, environment, social protection and cultural heritage.

### Summary

Table 11, below, lists the scores we assigned for each of the policy options, based upon the assessments above, as well as taking into account the support expressed by the different stakeholders.

Table 11: Overview of the options' potential for reaching the likely societal impacts

	Option 0 Horizon Europe calls	Option 2 Co-funded	Option 3 Institutionalised A185
<b>Metrology community contributions to European regulations and policy and the standards that underpin them - for climate, environment, health</b>	+	++	+++

Notes: Score +++ : Option presenting a *high* potential; Score ++: Option presenting a *good* potential; Score +: Option presenting a *low* potential

## 6.2 Assessment of coherence

### 6.2.1 Internal coherence

In this section we assess the extent to which the policy options show the potential of ensuring and maximising coherence with other programmes and initiatives under Horizon Europe, in particular European Partnerships.

#### Option 0: Horizon Europe calls (baseline)

Traditional Horizon Europe calls may create linkages and opportunities to exploit synergies with other clusters if, and where, the metrology community is able to exercise influence and introduce metrology priorities into work programmes. However this will be an ad hoc process rather than a strategic one (from a metrology perspective) and opportunities to do make connections are likely to be very limited.

#### Option 2: Co-Funded European Partnership

A Co-funded European Partnership provides an opportunity to bring a large proportion of the European NMIs and DIs together and, at least for the lifetime of the partnership, to facilitate relationships with industry, academics, policy-makers and regulators. The consortium lead can act as a single point of access to (and outreach from) NMIs and DIs making it easier to create synergies across Horizon Europe to develop relationship with other partnerships such as other partnerships in the Digital, Industry and Space Cluster in Pillar II, as well as those in Climate, Energy and Transport and Health Clusters in Pillar II.

#### Option 3: Institutionalised Art 185

The A185 Institutionalised Partnership supports the widest possible participation of NMIs and DIs in Europe plus a mechanism - the European Metrology Networks - to support new, and deepen existing, relationships with industry, academics, policy-makers and regulators. It is also likely to result in a higher level of national budgets coordinated.

Moving outwards to the wider Horizon Europe landscape, the implementation body, EURAMET provides a single point of access to (and outreach from) NMIs and DIs within the context of Horizon Europe, making it easier to ensure synergies with other partnerships are maximised. Once established the Europe European Metrology Networks will provide specialist 'nodes' for specific technical fields and applications. The climate and environment focused networks can interact and collaborate with the Climate, Energy and Transport Cluster in Pillar II, the health-focused networks with the Health Cluster and so on - with a particular focus on other Institutionalised Partnerships as they provide access points to a wider community within their thematic coverage.



**Stakeholders interviewed** largely agreed that the A185 Institutionalised Partnership model would support a greater level of internal coherence by providing centralised coordination and management, and including the majority, if not all, member states.

Respondents to the **open consultation** noted that the proposed candidate partnership was relevant or very relevant for supporting more buy-in and long-term commitment from other partners. Reflecting this, many **interviewees** noted the A185 Institutionalised Partnership would provide a clear and coherent mechanism for supporting the widest possible engagement with stakeholders as the centralised coordination and management would provide oversight required for coordinated engagement outside the NMI/DI community.

## 6.2.2 External coherence

In this section we assess the extent to which the policy options show the potential of ensuring and maximising coherence with EU-level programmes and initiatives beyond the Framework Programme and/or national and international programmes and initiatives.

### Option 0: Horizon Europe calls (baseline)

Traditional Horizon Europe calls, where metrology priorities are included, provides some opportunities engage with international NMIs through collaborative research projects. However there are unlikely to be any linkages with European policy-makers addressing the Green Deal, the Energy Union and Strategy, Environment Policy and Public Health.

### Option 2: Co-Funded European Partnership

The Co-funded European Partnership provides some opportunities to engage with international NMIs through collaborative research projects but also via any networking functionalities created. However linkages with European policy-makers addressing the Green Deal, the Energy Union and Strategy, Environment Policy and Public Health may be limited.

### Option 3: Institutionalised Art 185

The A185 Institutionalised Partnership provides the opportunity to engage with international NMIs through collaborative research projects and via the European Metrology Networks to ensure the highest quality research and European influence over the direction of international metrology developments and decisions.

As the European Metrology Networks become established a key aim, is to develop closer links with European policy-makers addressing the Green Deal, the Energy Union and Strategy, Environment Policy and Public Health.



The majority of **stakeholders interviewed** believed that a A185 Institutionalised Partnership would provide a central point of contact for coordinating engagement with large international partners in the field of metrology such as the International Bureau of Weights and Measures (BIPM), as well as sector specific organisations dealing with standards.

The feedback to the **inception impact assessment** also included requests for coordination with sector specific organisations, such as the European Medicines Agency, the European Directorate for the Quality of Medicines and the World Health Organisation in the case of the health sector.

A number of **stakeholders interviewed** and those responding to the **open consultation** indicated potential links between metrology and key application areas, e.g. key digital technologies or smart networks. Around half respondents to the open consultation agreed the candidate partnership could be rationalised and/or better linked with comparable initiatives. However, the majority of stakeholders interviewed and around half of those responding to the open consultation also highlighted that metrology is a horizontal activity and therefore should retain centralised coordination and connection across Europe. The majority of **respondents to the open consultation** agreed that establishing a specific legal structure was relevant or very relevant to facilitating synergies with EU/national programmes and facilitating collaboration with other partnerships, though this was stronger (more relevant) from the perspective of research institutes and public authorities).



## Summary

Table 12, below, lists the scores we assigned for each of the policy options, based upon the assessments above, as well as taking into account the support expressed by the different stakeholders.

Table 12: Overview of the options' potential for ensuring and maximizing coherence

	Option 0 Horizon Europe calls	Option 2 Co-funded	Option 3 Institutionalised A185
<b>Internal coherence</b>	+	++	+++
<b>External coherence</b>	+	++	+++

Notes: Score +++: Option presenting a *high* potential; Score ++: Option presenting a *good* potential; Score +: Option presenting a *low* potential

### 6.3 Comparative assessment of efficiency

In order to compare the policy options under common standards, we developed a standard cost model for all 13 candidate Institutionalised Partnership studies. The model and the underlying assumptions and analyses are set out in the report on the overarching context to the impact assessment studies.

Table 13 below shows the intensity of additional costs against specific cost items for the various options as compared to the baseline, i.e. Option 0 (Horizon Europe calls). In this table we have taken into account that for Option 3 (Institutionalised Partnership) there would be a moderate additional cost for the set-up of a dedicated implementation structure where such a structure already exists.

Table 13: Intensity of additional costs compared with HEU Calls (for Partners, stakeholders, public and EC)

Cost items	Option 0	Option 2	Option 3: Art. 185
<b>Preparation and set-up costs</b>			
Preparation of a partnership proposal (partners and EC)	0	++	++
Set-up of a dedicated implementation structure	0	0	Existing: + New: ++
Preparation of the SRIA / roadmap	0	++	++
Ex-ante Impact Assessment for partnership	0	0	+++
Preparation of EC proposal and negotiation	0	0	+++
<b>Running costs (Annual cycle of implementation)</b>			
Annual Work Programme (AWP) preparation	0	0	+
Call and project implementation	0	+	+
<b>Cost to applicants</b>	Comparable, unless there are strong arguments of major differences in oversubscription		

Cost items	Option 0	Option 2	Option 3: Art. 185
Partners costs not covered by the above	0	0	+
Additional EC costs (e.g. supervision)	0	+	+
Winding down costs			
EC	0	0	0
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 scores related to the costs set out above will allow for a “value for money” analysis (cost-effectiveness) in the final scorecard analysis in Section 6.4. For this purpose, in Table 15 where we provide the scores for the scorecard analysis, based on our insights and findings and based on the scores above, we assign a score 1 to the option with the highest costs and a score 3 to the lowest.

We considered that while there is a clear gradation in the overall costs of the policy options, the cost differentials are less marked when we take into account financial leverage (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 Option 0 and the Co-Programmed policy options (though Co-programmed was not considered in this specific impact assessment) – and the least cost-efficient i.e. Co-Funded and Institutionalised Partnership options. We have therefore assigned a score of 3 to the Option 0 and the Co-Programmed policy options for **cost-efficiency** and a score of 2 for the Co-Funded and Institutionalised Partnership policy options. It should be noted that the potential for the creation of crowding-in effects for industry has been taken into account when assessing the effectiveness of the policy options in the sections above.

Table 14: Matrix on ‘overall costs’ and ‘cost-efficiency’

	Option 0 Horizon Europe calls	Option 2 Co-funded	Option 3 Institutionalised A185
Overall cost	3	1	1
Cost-efficiency	3	2	2

Notes: Score 1 = Substantial additional costs, as compared with the baseline; score 2 = Medium additional costs, as compared with the baseline; score 3 = No or minor additional costs, as compared with the baseline

#### 6.4 Comprehensive comparison of the options and identification of the preferred option

Building upon the outcomes of the previous sections, this section presents a comparison of the options’ ‘performance’ against the three dimensions of effectiveness, efficiency and coherence.

In Section 6.4.1, we first compare the policy options against each other for each criterion in the effectiveness and coherence dimensions, resulting in a scorecard with scores from 1 to 3 where 3 stands for a substantially higher performance. Combined with the results



from the comparative assessment for efficiency in Section 6.3, above, the final scorecard will allow for the identification of the preferred option in Section 6.4.2, taking all dimensions and criteria into account.

#### 6.4.1 Comparative assessment

##### Effectiveness

The baseline option (Option 0), traditional calls under Horizon Europe, both restricts the level of metrology research undertaken in Europe and does not lead to significant change in coordination structures between NMI/DIs themselves and, more importantly, among the users of metrology. This limits the creation of high-quality research and scientific impact to keep Europe at the forefront of metrology capabilities and reduces its ability to ensure adoption of metrology research and capabilities to create economic and societal impact.

Compared to Option 0 both Options 2 and 3 would support a greater quantity of metrology research in Europe and result in research that is more coordinated and more directional directed among NMIs and DIs, so reducing fragmentation and duplication, but also integrating a wide range of knowledge, skills and capabilities to create the highest quality research outputs. There is a scale and scope difference between Options 2 and 3 as more NMI/DIs are likely to participate in option 2 than option 1 and the directionality would be higher in Option 3 due to the participation of the policy-owning ministries and the stronger governance processes.

A key driver of differences in effectiveness between the options, i.e. in the scale of impacts created, is the participation of metrology users across the value-chain in the academic, public and private sectors. Option 0 leads to ad hoc collaboration with metrology users while Options 2 and 3 offer the ability to undertake strategic coordination activities. Option 2 is largely driven the NMI/DIs as the recipients of Co-funded Partnership funding and coordination structures are likely to be time-limited by the Co-funded Partnership lifetime. By comparison Option 3, with long-term Ministerial level commitment to the initiative in terms of both policy and funding, and the resulting strong governance processes of an Institutionalised Partnership, creates a platform for developing and embedding a different approach to structuring how metrology research is coordinated and, in some cases, how metrology services are delivered in future. This re-structuring, via the European Metrology Networks in particular, is essential to increased and deepened engagement with metrology users (and potential metrology users) in industry and policy-making to increase adoption of metrology research outputs and new capabilities in the innovation and policy-making systems to create economic and social impact. The Networks once in action, with their own governance structures, members and activities, are sustainable coordination structures beyond the initiative.

##### Coherence

As above, a key driver of differences in coherence between the options, are the linkages and participation of metrology users across the value-chain in the academic, public and private sectors and, importantly, users across a wide range of different application domains -environment, climate, health, industry. Again, the European Metrology Networks are central to this.

Option 0 leads to ad hoc collaboration with metrology users and so greatly limits coherence across Horizon Europe and also across policy-making domains more broadly. Options 2 and 3 offer the ability to undertake sustainable strategic coordination activities but Option 3 provides the means to create, via European Metrology Networks, open-access focal points (each in a specific application domain) for metrology experts in NMIs and DIs to engage and collaborate with industry and policy-makers and regulators and academics to identify metrology research needs, create and co-create solutions, and enhance adoption of metrology research to create economic and social impact.

In summary, for both effectiveness and coherence Options 2 and 3 provide significant benefits over Option 0 and, as described above, Option 2 provides greater opportunities to maximise impacts and coherence.

Table 15: Scorecard of the policy options

	Criteria	Option 0 Horizon Europe calls	Option 2 Co-funded	Option 3 Institutionalised A185
Effectiveness	<b>Scientific impacts</b>			
	Sustainable and integrated European Metrology System beyond 2030	1	2	3
	Improved awareness of metrology system across the innovation and policy-making systems	1	2	3
	Europe is a world-leader in metrology capabilities	2	2	3
	<b>Economic/technological impacts</b>			
	Sales of innovative products and services (leading to growth of innovative business that sell or use measurement equipment)	1	2	3
	Sales of innovative products and services (leading to innovative products available to contribute to sustainable economic growth)	1	2	3
	<b>Societal impacts</b>			
	Metrology community contributions to European regulations and policy and the standards that underpin them - for climate, environment and health	1	2	3
Coherence	<b>Internal coherence</b>	1	2	3
	<b>External coherence</b>	1	2	3
Efficiency	<b>Overall cost</b>	3	1	1
	<b>Cost-efficiency</b>	3	2	2

Notes: Scores for effectiveness and coherence: 3 = *substantially higher performance*; 2 = *higher performance*; 1 = *lower performance*. Scores for efficiency: 1 = *substantial additional costs*, as compared with the baseline; 2 = *medium additional costs*, as compared with the baseline; 3 = *No or minor additional costs*, as compared with the baseline

#### 6.4.2 Identification of the preferred option

The scorecard assessment in Table 15 presents an unweighted scoring of each option and assumes that each dimension (effectiveness, efficiency, coherence) is equally important to the other dimensions and that each subsidiary element is similarly of equal importance.

In summary, Option 0, while the highest in terms of efficiency, is underpowered in terms of impact and coherence and provides no underlying directionality. Option 2 is a reasonably

credible solution, providing greater impact than Option 0 but less than Option 3, especially where economic and societal impact is concerned. It also offers less long-term directionality than Option 3. Its coherence is reasonably high but lower than Option 3, especially for external coherence. Option 3, the A185 Institutionalised Partnership provides the highest levels of impact, especially societal impact, and coherence while being the middle scorer in terms of efficiency.

In conclusion, this unweighted analysis shows the institutionalised partnership in a dominant first place, being the preferred option in terms of effectiveness and coherence. For this reason, an Institutionalised Partnership under Article 185 would be the preferred option to implement as a result of this impact assessment study.

## 7 The preferred option

### 7.1 Description of the preferred option

An A185 Institutionalised Partnership in metrology provides the ability to create a truly European metrology system that coordinates metrology research ensuring the highest quality scientific outputs to maintain Europe's leading global position and ensures the new world-class metrology capabilities created are relevant to, and developed in partnership with, users in the public and private sectors and subsequently are deployed to create economic and social impact. The European Metrology Networks will act as focal points for actors across Horizon Europe and beyond, linking the metrology experts in NMIs and DIs with the wider research community, industry and policy-makers and regulators.

In Table 16, below, we indicate the alignment of the preferred option with the selection criteria for European Partnerships defined in Annex III of the Horizon Europe Regulation. Seeing that the design process of the candidate Institutionalised Partnerships is not yet concluded and several of the related topics are still under discussion at the time of writing, the criteria of additionality/directionality and long-term commitment are covered in terms of *expectations* rather than *ex-ante* demonstration.

Table 16: Alignment with the selection criteria for European Partnerships

Criterion	Alignment of the preferred option
<b>Higher level of effectiveness</b>	As discussed in section 6, the preferred option, an A185 Institutionalised Partnership, would score higher than the baseline policy option (traditional calls under Horizon Europe) considered in terms of effectiveness. Under this scenario, the widest possible group of stakeholders across the value-chain would come together not only to conduct a programme of strategic collaborative research but also to create sustainable enduring structures, the European Metrology Networks, for cooperation and coordination of metrology R&I. Lasting beyond the programme, these networks ensure impact into the future and an 'exit strategy' that avoids a 'cliff-edge' at the end of the partnership.
<b>Coherence and synergies</b>	The preferred option presents the most coherent choice to maximise synergies within the EU research and innovation landscape. Due to the breadth of metrology applications and users, an A185 Institutionalised Partnership provides a visible central focus for metrology R&I in Europe as well application specific European Metrology Networks to act as access points between the metrology community and the wider elements of Horizon Europe - other partnerships, clusters and pillars - and importantly, a focal point for interactions between NMIs/ DIs with industry and with European policy-makers addressing the Green Deal, the Energy Union and Strategy, Environment Policy and Public Health

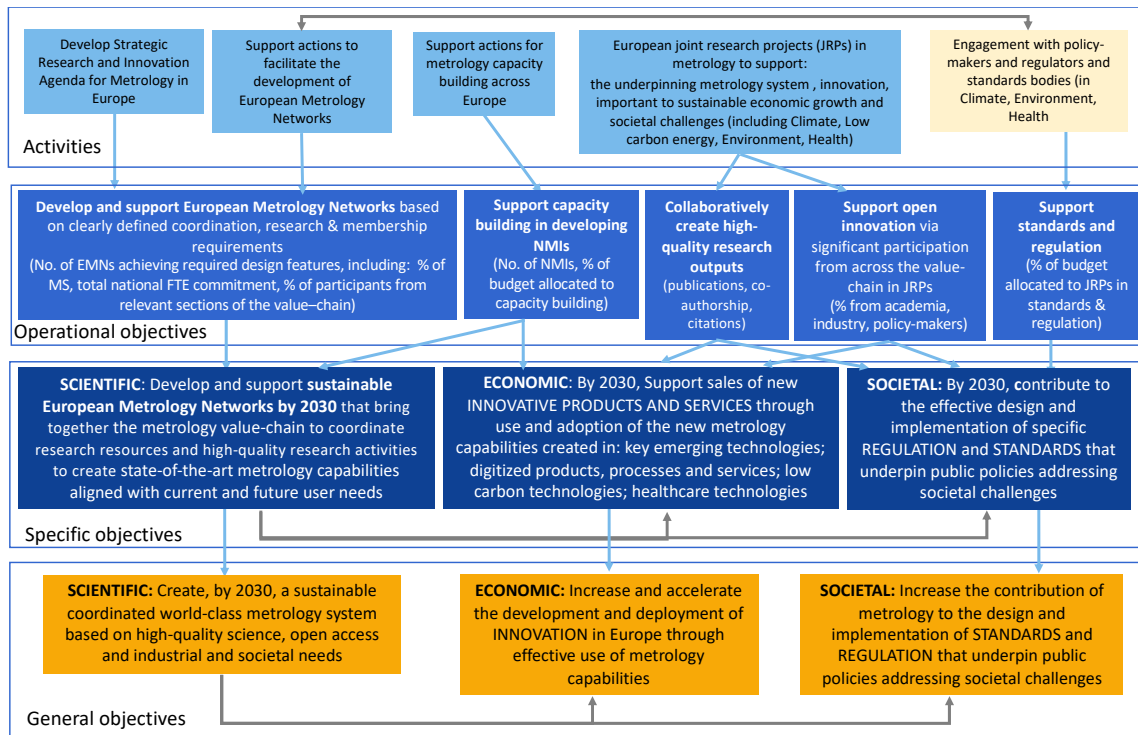
Criterion	Alignment of the preferred option
<b>Transparency and openness</b>	A185 Institutionalised Partnership will maximise its impacts by being open and transparent, involving relevant stakeholders along the value-chain - from NMI/DIs and academia to industry and policymakers and regulators. Despite what might seem like restrictions in such a partnership underpinned by legislation, the previous partnership has shown how the model can be open to participation beyond the 'core' community (in this case the ministries, NMIs and DIs) when this community is willing to do so. Using standard Horizon Europe instruments and abiding by all its rules ensures that the partnership is transparent.
<b>Additionality and directionality</b>	The premise of the A185 Institutionalised Partnership is additionality and directionality. Member States and Associated Countries will make a long-term policy and financial commitment to the partnership, committing funds of a minimum of 50% of the total budget including a cash contribution to support its management function that no other option would deliver. This commitment also signals an expectation that the NMIs and DIs, via the implementing body, act with a high degree of strategic directionality, working at a European level, above and beyond national interests. Where metrology is concerned there is considerable motivation to work together as no one country can manage the increasing demands on the metrology system and therefore there is a commitment to utilise the governance structure of the A185 Institutionalised Partnership to make this happen.
<b>Long-term commitment</b>	The expectation is that the majority of Member States will participate (greater than the number in the Horizon 2020 partnership) with a commitment of at least 50% matching funding from Member States

## 7.2 Objectives and corresponding monitoring indicators

### 7.2.1 Operational objectives

Figure 8, below, lists a range of actions and activities, going also beyond the R&I activities that can be implemented under Horizon Europe (highlighted in yellow). This reflects the definition of European Partnerships in the Horizon Europe regulation as initiatives where the Union and its partners "commit to jointly support the development and implementation of a programme of research and innovation activities, including those related to market, regulatory or policy uptake."

Figure 8: Operational objectives of the initiative



### 7.2.2 Monitoring indicators

Monitoring indicators are presented below. However, as the design process of the candidate Institutionalised Partnerships is still under discussion the type of indicator is defined but the actual targets for the initiative are currently undefined. Table 17 presents the indicators for the operational objectives. These are focused on the allocation of resources to the Partnership activities. Table 18 presents the indicators against the specific objectives over the short, medium and longer-term. The short-term indicators are largely the same as the operational indicators plus some additional output indicators to capture the achievements at the end of the initiative.

Table 17: Monitoring indicators for the operational objectives

Operational objectives	Indicators*
Develop and support European Metrology Networks (EMNs) based on clearly defined coordination, research & membership requirements	Establish at least XX Networks driving partnership research activities, each with <ul style="list-style-type: none"> <li>Strategic and operational plans to at least 2030</li> <li>A minimum of XX countries involved per network</li> <li>A minimum of total commitment from national resources per network of XX FTEs per year</li> </ul> Across all Networks: <ul style="list-style-type: none"> <li>No. of EMNs achieving required design features above</li> <li>XX% of Networks' advisory /steering groups from measurement users in industry, regulators, policymakers, standards developing organisations</li> </ul>
Collaboratively create high-quality research outputs	XX% of research budget allocated to non-metrology community researchers (e.g. academia and other research institutes)
Support open innovation	

Operational objectives	Indicators*
	XX% of research participants from industry and €XXM in co-funding of research from industry
Support regulation and standards	XX% of research budget allocated to normative research (& relevant support for impact projects?)
Support capacity building in developing NMIs	XX% of research budget allocated to capacity building activities

\*The exact value of the indicators would be defined by the Commission

Table 18: Monitoring indicators in addition to the Horizon Europe key impact pathway indicators

	Short-term*	Medium-term	Long-term
<b>Scientific impact</b>			
<p>A sustainable and efficient integrated European Metrology System beyond 2030</p> <p>Improved awareness and understanding the of metrology system across the innovation and policy-making systems</p> <p>Europe is a world-leader in metrology capabilities</p>	<p>Establish at least XX networks driving partnership research activities, each with</p> <ul style="list-style-type: none"> <li>• Strategic and operational plans to at least 2030</li> <li>• A minimum of XX countries involved per network</li> <li>• A minimum of total commitment from national resources per network of XX FTEs per year</li> </ul> <p>Across all Networks:</p> <ul style="list-style-type: none"> <li>• No. of EMNs achieving required design features above</li> <li>• XX% of Networks’ advisory /steering groups from measurement users in industry, regulators, policymakers, standards developing organisations</li> </ul>	<p>Continued existence of European Metrology Networks (<i>similar number in total but content may change to align with emerging needs</i>)</p> <p>Leveraged R&amp;I funding driven by / aligned with network remit</p> <p>Increased participation by non-NMI/DI stakeholders in terms of:</p> <ul style="list-style-type: none"> <li>• XX% of Networks’ advisory /steering groups from measurement users in industry, regulators, policymakers, standards developing organisations</li> </ul>	<p>Continued existence of European Metrology Networks (<i>similar number in total but content may change to align with emerging needs</i>)</p> <p>Leveraged R&amp;I funding driven by / aligned with network remit</p> <p>Increased participation by non-NMI/DI stakeholders in terms of:</p> <ul style="list-style-type: none"> <li>• XX% of Networks’ advisory /steering groups from measurement users in industry, regulators, policymakers, standards developing organisations</li> </ul>

	Short-term*	Medium-term	Long-term
	XX% of research budget allocated to non-metrology community researchers (e.g. academia and other research institutes) No. of peer-reviewed publications No of co-authored publications among <ul style="list-style-type: none"> <li>• NMI/DIs (including those in receipt of capacity building support)</li> <li>• NMI/DIs and academics</li> <li>• NMI/DIs and industry</li> </ul>	No. of citations compared to international norms in the relevant fields No. of patents	Europe a world-leading in metrology, as evidence by leadership roles in international metrology Research collaborations and co-authored publications leading NMIs/DIs outside Europe (USA, Japan, China, etc)
Economic / technological impact			
Sales of innovative products and services	XX% of research participants from industry and €XXM in co-funding of research from industry	€50M p.a. sales of innovative products whose development relied on and is attributable (in part) to new or enhanced metrology capabilities	Growth among the innovative businesses that have engaged with the partnership
Societal impact			
Metrology community contributions to European regulations and policy and the standards that underpin them - for climate, environment and health	XX% of research budget allocated to normative research	No. of contributions to specific standards that underpin policy / regulation in climate, environment and health	Assessment of policy-making / regulation community as to the value of the metrology contributions

\*The short-term indicators are largely the same as those for the operational objectives but they are presented to align with the specific objectives rather than the operational objectives and contain some additional output indicators

## **Appendix A Bibliography**

AMA: Association for Sensors and Measurement (Germany) <https://www.ama-sensorik.de/en/association/sector-information/sensor-industry-statistics-2017>

BIPM, PTB, Metrology for the Digitization of the Economy and Society (2017) [https://www.bipm.org/cc/PARTNERS/Allowed/2017\\_October/2017-Metrology-for-the-Digitalisation-of-Economy-and-Society.pdf](https://www.bipm.org/cc/PARTNERS/Allowed/2017_October/2017-Metrology-for-the-Digitalisation-of-Economy-and-Society.pdf)

Council of the European Union (2019), Proposal for a Regulation of the European Parliament and of the Council establishing Horizon Europe - the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination - Common understanding, Interinstitutional File: 2018/0224(COD) - available at: <https://www.consilium.europa.eu/media/38902/st07942-en19.pdf>

Council of the European Union (2019), Proposal for a Regulation of the European Parliament and of the Council establishing Horizon Europe - the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination - Common understanding, Interinstitutional File: 2018/0224(COD) - available at: <https://www.consilium.europa.eu/media/38902/st07942-en19.pdf>

Coxon, C. H., Longstaff, C., Burns, C., Applying the science of measurement to biology: Why bother?, 2019, PloS, <https://doi.org/10.1371/journal.pbio.3000338>

EC (2019), European Partnerships under Horizon Europe: results of the structured consultation of Member States. Draft Report for the meeting of the Shadow Configuration of the Strategic Programme Committee on 27 June 2019

EC (2019), Orientations towards the first Strategic Plan implementing the research and innovation framework programme Horizon Europe. Co-design via Web Open

EC (2018), Proposal for a Regulation of the European Parliament and of the Council establishing the Digital Europe programme for the period 2021-2027, COM(2018) 434 final

EC (2018), Proposal for a Regulation of the European Parliament and of the Council establishing the Connecting Europe Facility and repealing Regulations (EU) No 1316/2013 and (EU) No 283/2014, COM(2018) 438 final

EC, COM(2013) 497 final, SWD(2013) 250 final: Impact Assessment Accompanying the document Proposal for a Decision of the European Parliament and of the Council on the participation of the Union in a European Metrology Programme for Innovation and Research jointly undertaken by several Member States

EC, COM(2013) 497 final, EMPIR Impact Assessment,

EC COM(2018), 385, Proposal for a European Commission, Proposal for a Regulation of the European Parliament and of the Council establishing a Programme for the Environment and Climate Action (LIFE) and repealing Regulation (EU) No 1293/2013,

EC Expert Panel Report, Interim Evaluation of the European Metrology Research Programme (EMRP), Expert Panel Report, European Commission, 2012 [https://ec.europa.eu/research/evaluations/pdf/emrp-empir\\_expgrp\\_report\\_final.pdf](https://ec.europa.eu/research/evaluations/pdf/emrp-empir_expgrp_report_final.pdf)

EC Expert Panel Report, Final Evaluation of the European Metrology Research Programme (EMRP) and Interim Evaluation of the European Metrology Programme for Innovation and Research (EMPIR), Expert Group Report, European Commission, 2017 <https://publications.europa.eu/en/publication-detail/-/publication/eac61c51-ae2e-11e7-837e-01aa75ed71a1/language-en>



EC Directive, MiFIDD II - Markets in financial instruments and amending Directive 2002/92/EC <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0065&from=EN>

EU, Decision No 555/2014/EU of the European Parliament and of the Council of 15 May 2014

EU, Decision No 91/2009/EC of the European Parliament and of the Council of 16 September 2009

EPRS (2018), Connecting Europe Facility 2021-2027 - Financing key EU infrastructure networks, BRI(2018)628247

EURAMET Report to the Expert Group for the final evaluation of EMRP and interim evaluation of EMPIR and on the EURAMET website. [https://www.euramet.org/index.php?eID=tx\\_securedownloads&p=541&u=0&g=0&t=1598175457&hash=9323599ed88dbfde0700761a58c2f808262f1d41&file=Media/docs/EMRP/EURAMET\\_Impact\\_of\\_the\\_EMRP\\_v1.pdf](https://www.euramet.org/index.php?eID=tx_securedownloads&p=541&u=0&g=0&t=1598175457&hash=9323599ed88dbfde0700761a58c2f808262f1d41&file=Media/docs/EMRP/EURAMET_Impact_of_the_EMRP_v1.pdf) <https://www.euramet.org/metrology-for-societys-challenges/>

EURAMET EMPIR Joint Research Project JRP-i05 LaVA, End-user needs for large volume applications of metrology, EMPIR <http://empir.npl.co.uk/lava/wp-content/uploads/sites/51/2019/04/LaVA-poster.pdf>

Knowledge Transfer Network (2014), The current state of the sensors community and technology in an increasingly sensed world, strategy and funding opportunities [https://cdn.southampton.ac.uk/assets/imported/transforms/content-block/UsefulDownloads\\_Download/47523AE5DBC34BFF86A5BAA8BE59558C/Nigel%20Rixrevised.pdf](https://cdn.southampton.ac.uk/assets/imported/transforms/content-block/UsefulDownloads_Download/47523AE5DBC34BFF86A5BAA8BE59558C/Nigel%20Rixrevised.pdf)

Optimat, Study on Coordination in Metrology, Dec 2016

Probst, L., Monfardini, E., Frideres, L., Clarke, S., Demetri, D., Kauffmann, A., PwC Luxembourg, EC Business Innovation Observatory (.): Advanced Manufacturing - Measurement Technologies and Robotics, 2013

Swann, G. M. P. (2009) The Economics of Metrology and Measurement, Report for National Measurement Office, Department for Business, Innovation and Skills, Innovative Economics Limited. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/297870/prof-swann-report-econ-measurement-revisited-oct-09.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297870/prof-swann-report-econ-measurement-revisited-oct-09.pdf)

Scientific.net, Advanced Metrology and Intelligent Quality Automation for Industry 4.0-Based Precision Manufacturing Systems (2017) Markopoulos, A. P., Vosniakos, G. C. <https://www.scientific.net/SSP.261.432>

UNIDO, Calzadilla Sarmiento, Director, Department of Trade, Investment and Innovation, UNIDO, Metrology in Support of the Sustainable Development Goals <https://www.bipm.org/utis/common/pdf/CGPM-2018/Presentation-CGPM26-Sarmiento-SDG.pdf>

<https://www.unido.org/news/advancing-sdgs-through-quality-and-standards>

[https://www.unido.org/sites/default/files/2017-05/SDG\\_Metrology\\_brochure\\_FINAL\\_pages\\_0.pdf](https://www.unido.org/sites/default/files/2017-05/SDG_Metrology_brochure_FINAL_pages_0.pdf)

## **Appendix B Synopsis report on the stakeholder consultation – Focus on the candidate European Partnership for Metrology**

*Disclaimer: the views expressed in the contributions received are those of the respondents and cannot under any circumstances be regarded as the official position of the Commission or its services.*

### **B.1 Introduction**

Following the European Commission's proposal for Horizon Europe in June 2018,<sup>48</sup> 12 candidates for institutionalised partnerships within 8 partnership areas have been proposed, based on the political agreement with the European Parliament and Council on Horizon Europe reached in April 2019<sup>49</sup>. Whether these proposed institutionalised partnerships will go ahead in this form under the next research and innovation programme is subject to an impact assessment.

In line with the Better Regulation Guidelines,<sup>50</sup> the stakeholders were widely consulted as part of the impact assessment process, 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,<sup>51</sup> gathering 350 replies for all 12 initiatives;
- A structured consultation of Member States performed by the EC services over 2019;
- 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 total of 608 Interviews performed as part of the thematic studies by the different study teams between August 2019 and January 2020.

This document is the synopsis report for the initiative “European Metrology”. It provides an overview of the responses to the different consultation activities. A full analysis of the results is provided in the study Data Report.

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<sup>48</sup> [https://ec.europa.eu/commission/presscorner/detail/en/IP\\_18\\_4041](https://ec.europa.eu/commission/presscorner/detail/en/IP_18_4041)

<sup>49</sup> [https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT\\_19\\_2163](https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_19_2163)

<sup>50</sup> [https://ec.europa.eu/info/files/better-regulation-guidelines-stakeholder-consultation\\_en](https://ec.europa.eu/info/files/better-regulation-guidelines-stakeholder-consultation_en)

<sup>51</sup> The full list of inception impact assessments is available here. They were open for public feedback until 27 August 2019.

## **B.2 Feedback to the inception impact assessment on candidate initiatives for institutionalised partnerships**

Following the publication of the inception impact assessment, a feedback phase of 3 weeks allowed any citizen to provide feedback on the proposed initiatives on the “Have your say” web portal. In total 312 feedbacks were collected for all initiatives.

For the initiative “European Metrology” 4 individual feedbacks were collected, from two business associations, one small company and one EU citizen.<sup>52</sup> Among the elements mentioned were:

- The positive impact of metrology and good measurement practices on product quality, and the need for cross-border/pan-European metrology supported regulation.
- The negative effect of retrospective harmonisation of measurement and regulation (e.g. in the pharmaceuticals industry) and highlighted the need for proactive, coordinated and streamlined adoption mechanisms of measurement and standardisation
- European level standards and regulation should be underpinned by European-level metrology to ensure competitiveness
- Requests for coordination with sector specific organisations, such as the European Medicines Agency, the European Directorate for the Quality of Medicines and the World Health Organisation in the case of the health sector, and the need to review landscape of metrology work that might be done in other sectors to ensure cross-pollination.

## **B.3 Structured consultation of the member states on European partnerships**

A structured consultation of Member States through the Shadow Strategic Configuration of the Programme Committee Horizon Europe in May/ June 2019 provided early input into the preparatory work for the candidate initiatives (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.

The feedback provided by 30 countries (all Member States, Iceland and Norway) has been analysed and summarised in a report, with critical issues being discussed at the Shadow Strategic Programme Committee meetings.

*B.3.1 Key messages overall for all candidate Institutionalised Partnerships are the following:*

### **Overall positive feedback on the proposed portfolio, but thematic coverage could be improved**

The results indicate a high level of satisfaction with the overall portfolio, the level of rationalisation achieved, and policy relevance. While delegations are in general satisfied with the thematic coverage, the feedback suggests the coverage could be improved in cluster 2 “Culture, creativity and inclusive society” and cluster 3 “Civil Security for Society”.

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<sup>52</sup> Feedback on inception impact assessment to be found on [https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2019-4972449/feedback\\_en?p\\_id=5722347](https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2019-4972449/feedback_en?p_id=5722347)

## **Large number (25) of additional priorities proposed for partnerships by delegations**

Despite high satisfaction with the portfolio and candidates put forward by the Commission, countries put forward a high number of additional priorities to be considered as European Partnerships. A closer examination suggests that these additional proposals are motivated by very different reasons. Whilst some proposals are indeed trying to address gaps in the portfolio and reach a critical mass, then, others are driven by the wish to maintain existing networks, currently not reflected in the Commission proposal (e.g. those based on JPIs, ERA-NETs). In addition, some proposals reflect worries over some topics not being sufficiently covered in the existing proposals but could be possibly well covered within the scope of existing partnerships, or by traditional calls under the Framework Programme.

## **Critical view on the high number and openness of Joint Undertakings**

Country feedback suggests dissatisfaction with the high number of proposed Article 187 TFEU partnerships. Notably smaller as well as EU-13 countries raise concerns with regards to the potential insufficient transparency and openness of the partnership model. In the feedback, countries either directly support or ask to carefully analyse whether the objectives of this proposal could be reached with the co-programmed model.

For those partnerships that will be set up on the basis of Article 187, the country feedback stresses the need to ensure a clear shift towards openness in the governance, membership policy and allocation of funding of these partnerships. Notably, it is emphasised that the JU rules should not have any limitations or entry barriers to the participation of SMEs and other partners, including from academia.

Although the feedback suggests a general criticism, there are few concrete and broadly supported proposals, including to reduce the number of institutionalised partnerships mergers or by alternative implementation modes.

## **Lack of cross-modal perspective and systematic approach to mobility**

The current proposal foresees 5 partnerships in the area of transport (for rail, air traffic management, aviation, connected and automated driving, zero-emission road transport), and 2 that in closely related technologies for radically reducing carbon emissions (hydrogen, batteries). Several delegations would wish to see a systemic approach to developing mobility and addressing related challenges (optimisation of overall traffic, sustainable mobility solutions for urbanisation), and do not support a mode-dependent view only. This suggests the need to discuss how to ensure greater cooperation between transport modes and cross-modal approaches in establishing partnerships in the area of mobility.

## **Partnership composition: the role of Member States in industry partnerships**

The composition and types of partners is an important element for the success of a partnership, e.g. to ensure the right expertise and take-up of results. Ensuring broad involvement without overly complicating the governance of the partnership remains an important an important challenge in the design of future partnerships.

In the feedback, several Member States express their interest to join as a partner in partnerships that have traditionally been industry-led. However, individual comments suggest there are different views on what their involvement means in practice, with some countries expressing readiness to commit funding, while others support limiting their involvement to alignment of policies and exploiting synergies. This suggests the need to discuss further what the involvement of Member States means in practice (notably in terms of contributions, in the governance), and what would be possible scenarios/options in

Horizon Europe. There is special interest in testing and deployment activities, in synergies with Cohesion Funds and CEF priorities and investments.

Although it is too early to determine the interest of industry/ businesses in the topics proposed for partnerships where the main partners are public authorities, their involvement in in public centric partnerships will also be an important question in the design and preparation of future proposals.

### Some proposals are more mature than others

The analysis of feedback per partnership candidates suggests that some proposals are more mature, while others would need more time to determine the scope, objectives, partner composition and contribution and appropriate mode of implementation. This relates to in particular to partnerships with no predecessors and those where the main partners are public. It suggests that the proposals would need to be developed at different paces in order to achieve good quality, and thus, not all partnership proposals may be ready for implementation at the start of Horizon Europe.

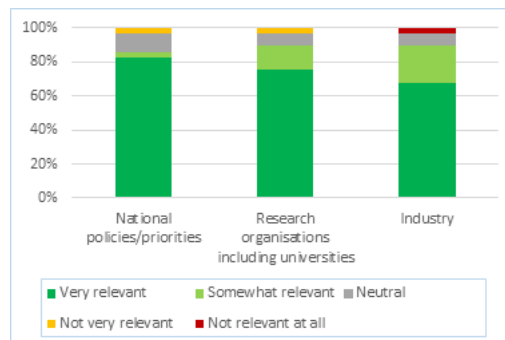
#### B.3.2 Overall feedback for the initiative "European Metrology"

Delegations strongly support the proposed European Metrology partnership, with high relevance in the national context, and the vast majority interested to participate in the partnership. The use of Article 185 is fully supported. Openness and inclusive towards all Member States is considered key.

### Relevance and positioning in a national context

The results of the Member State consultation confirm strongly the overall relevance of the proposed European Metrology partnership. 89% consider it relevant for their research organisations, including universities, and 86% consider it relevant for national policies and priorities. The proposed partnership is considered relevant for their industry by 89% of the countries (Figure 9).

Figure 9: Relevance of the European Metrology partnership in the national context



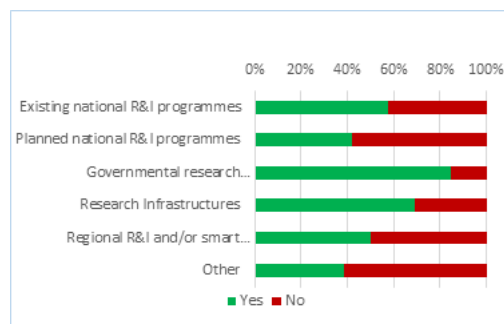
On the question of existing national/regional R&I strategies, plans and / or programmes in support of the proposed Metrology partnership, 27 countries report to have relevant elements in place. National R&I strategies or plans were identified most frequently (79%, AT, CY, CZ, DE, DK, EE, ES, FI, FR, HR, IE, IT, LV, NL, PL, PT, RO, SE, SI, UK, IS, NO), followed by national economic / sectoral strategy and/or plan with a strong emphasis on research and / or innovation (60%, AT, BE, DE, DK, EE, ES, FI, FR, HR, LV, NL, RO, SE, SI, UK, NO) and dedicated R&I funding programme or instrument (47%, BE, CY, CZ, DE, DK, ES, FI, FR, RO, SI, UK).

Delegations identified a number of aspects that could be reinforced in the proposal for this partnership that would increase its relevance for national priorities, e.g.15:

- A number of delegations stress the importance of EU leadership in Metrology for their economic growth, competitiveness and industry and as a key-enabler for innovation;
- Several delegations mention the need for continued strong support for end-users and stakeholders;
- Long-term goals should also include metrological solutions in response to present and anticipated needs associated to regulation;
- Increased focus on digitalisation developments and addressing smart specialisation needs would assist to bridge R&D activities with entrepreneurship and innovations;
- Need to ensure links with other partnerships such as Key Digital Technologies and Photonics Europe;

The majority of countries (61%) are at this stage interested to participate, with 10 countries undecided (DK, GR, HR, LU, LV, MT, RO, SE, SK, IS) and only CY excluding participation. Governmental research organisations (85%) are identified as main potential partners or contributors (Figure 10).

Figure 10: National interest to participate with the existing programmes in the field of Metrology



Most countries (96%) expressed interest in having access to results produced in the context of the partnership.

### Feedback on objectives and impacts

Overall there is a strong agreement (96%) on the use of a partnership approach in addressing this specific priority. There is broad agreement (88%) that the partnership is more effective in achieving the objectives and delivering clear impacts for the EU and its citizens, and to lesser degree (67%) that it would contribute to improving the coherence and synergies within the EU R&I landscape.

There is unanimous agreement with the proposed objectives at short, medium and long term and the expected scientific, economic and societal impacts at European level. 96% consider the impacts relevant in the national context. There is good agreement (96%) with the envisaged duration of the proposed partnership. The development of a sustainable, coordinated European metrology network is perceived as a significant step beyond the objectives of the predecessors. Some additional comments made by individual delegations reiterate points made previously under elements to be reinforced. Additional individual comments address the following aspects:

- Ensure inclusiveness towards all Member States and openness to other participants than National Metrology Institutes;
- Increase the transfer of results and impact to the economy;
- Specify the end date / phasing out;
- Need to broaden the objectives.

## Views on partners, contributions and implementation

There is broad agreement (92%) between countries on the type and composition of partners. External partnership is welcome as long as the National Metrology Institutes remain the main drivers of projects. Industry and academia participation are supported.

At this stage most countries (67%) would need more information on contributions and level of commitments expected from partners, while 22% agree with the proposal. Contributions up to the current level are deemed acceptable. Networks should be open to international collaboration.

The majority of countries (63%) agree with the proposed implementation mode as Article 185, with 37% expecting more details in order to be able to make an informed decision. A number of delegations mention the well-functioning predecessors as good example to support the proposed implementation mode.

### **B.4 Targeted consultation of stakeholders related to the initiative "Metrology"**

In addition to the consultation exercises coordinated by EC services, the external study thematic teams performed targeted consultations with businesses, research organisations and other partners on different aspects of potential European Partnerships.

#### *B.4.1 Approach to the targeted consultation*

The stakeholder interviews constitute a primary source of information that will feed in all impact assessment sections of the final report, complementing the analyses based on desk research and primary and secondary data. Stakeholders provided feedback and validation of the problem definition outlined in Section 2, the rationale of EU action in Section 3 and detail of the objectives of the proposed partnership and the expected impacts (Section 4). Specifically, this regards the sections in Section 6 with the comparative options assessment described in terms of effectiveness (section 6.1), coherence (section 6.2) and efficiency (6.3).

The stakeholder input spans the value-chain for metrology with input from the ministries that own metrology policy and funding, to the metrology community itself – both the formal institutions of metrology (the national metrology institutes and designated institutes) and the organisations in the metrology traceability chain (such as accredited laboratories and accreditation bodies) – to metrology end-users in industry, policy-makers and the public sector.

Initial invitations to interviewees were sent via email. Email reminders were sent 4-8 working days after the initial invitation. In a subset of cases, a third reminder email or telephone call was made, a further 4-8 working days later. These third reminders focussed primarily on securing interviews with stakeholders from categories with otherwise lower response rates (especially Academia/Research, Industry and Policy). Additional stakeholders were invited throughout the process based on suggestions made by previous interviewees. For example, instrumentation manufacturers were able to recommend and facilitate contact with end user industry organisations.

118 stakeholders were approached initially. Of these, 37 interviews were secured. 23 stakeholders declined citing either lack of availability within the specified timeframe or lack of sufficient knowledge to contribute meaningfully to the impact assessment. This was particularly the case for policy stakeholders at the national and EU level, many of whom deferred to the NMIs/DIs as a more appropriate point of contact.

#### *B.4.2 Overview of respondents to the targeted consultation*

The distribution of interviewees between the different stakeholder groups is a result of the number of individuals that were targeted initially but also the extent to which these were



willing to participate in the interview programme. Perhaps as expected, the majority of interviewees are those from within the metrology community (49%) given their high-level of interest and involvement in the proposed partnership. By contrast, stakeholders from academia/research was initially a smaller stakeholder group and also suffered from very low response rates. Industry stakeholders account for 1/3 of the interviewees.

Table 19: Number of interviews per stakeholder category

Stakeholder category	Number	Share (%)
Academia/Research	1	3%
Industry	11	30%
Metrology Community	19	41%
Policy Stakeholder	5	14%
Partnership Implementation Body	1	3%
<b>TOTAL</b>	<b>37</b>	

### B.4.3 Key results/messages from the targeted consultation

#### Political and legal context

##### Emerging Challenges in the field

Almost all stakeholders interviewed recognised that metrology underpins research and innovation in almost all sectors and domains. Stakeholders interviewed identified a range of challenges across this wide range of sectors that require the development of new methods of measurement, and the validation and certification of new technologies and techniques.

Challenges identified by the stakeholders interviewed included references to a range of technical measurement challenges including measurements of chemical and biological materials and processes, soft-matter, digital technologies, quantum, new materials etc. Stakeholders interviewed often also identified challenges associated with the uptake of innovation and integration with existing systems, whereby emerging and increasingly complexity (e.g. integration of renewables into the energy system) as well as new technologies (e.g. quantum technologies or 5G) requires coordinated standardisation to ensure pan-European uptake.

##### Previous Metrology Partnerships

More than half of stakeholders made reference to the previous 185 partnerships in Metrology (EMPIR or EMRP) in relation to the proposed European Partnership in Metrology. Most highlighted examples of impact from the previous partnership as a potential indicator for future impact for the proposed partnership. For example, a handful of stakeholders highlighted the role of previous partnerships in supporting the redefinition of base units for the fundamental SI system of units as a significant impact of the previous partnerships.

Many stakeholders from within the metrology community remarked that the previous partnerships had been very valuable for increasing collaboration between NMIs/DIs across Europe and for supporting capability building in smaller EU member states. Some of these metrology stakeholders also remarked that now the metrology community is better



connected, it is now in a better position to increase coordination and collaboration with wider stakeholders.

## Problem definition

### What are the problems?

Almost all stakeholders recognised the fragmentation of metrology research and provision and identified the need for coordination of metrology research at the European level. Many stakeholders interviewed remarked that coordination of metrology was necessary to support effective and efficient trade within Europe and European competitiveness. In this sense, most stakeholders acknowledged that coordination metrology was necessary to support the establishment of EU standards, and to a lesser extent the coordination in the quality infrastructure.

Most stakeholders interviewed commented on the lack of connection between metrology systems and innovation and policy systems. Many of the industry and policy stakeholders had a limited view on the metrology R&D activities across Europe but instead relied on their national metrology institutes as and when needed.

Some stakeholders interviewed reported that there was both a lack of awareness of the metrology system and metrology research in particular, but also an expectation that the required metrology (and the measurements it enables) would be readily available whenever needed.

Interviews with industry stakeholders highlighted that the metrology community was less likely to engage directly with industry end-users in the broadest sense with most of their connections being with instrumentation manufacturers. Interviews with policy stakeholders and the metrology community highlighted that direct engagement with NMIs/DIs highlighted that policy makers and regulators was limited.

Some stakeholders interviewed also highlighted the different capabilities and resources available within the NMI/DIs across Europe as a barrier to providing equal access to metrology expertise and support across Europe. For stakeholders from smaller Member States, pressure on resources was a significant challenge to developing and providing metrology services to emerging industries. Reflecting on this, some metrology stakeholders interviewed agreed that a structure for coordinated metrology research allows NMIs/DIs to 'specialise' in certain areas, reducing duplication and improving the quality of services available to EU industry and policy makers.

### What are the problem drivers?

All stakeholders interviewed recognised that metrology research is necessary to keep pace with the rapid change associated with emerging technologies in the areas of digital transition and industry 4.0 (roboticisation, IoT, AI, 5G and quantum), energy, health. All stakeholders interviewed affirmed that new measurement and testing tools will be required to assure compliance with regulation and governance, and to support transparency, safety, security and quality.

The majority of stakeholders interviewed also noted the increasing need for metrology for policy development, particularly in the areas of environmental challenges. In this sense, new metrology methods and standards are required for the development of policy and the implementation and enforcement of regulation around issues such as air quality, water quality, emissions, and climate monitoring.

Interviews with policy-making and industry stakeholders highlighted the low levels of awareness of the metrology system in Europe, which was confirmed by interviews with the NMI/DI community. As a result, the stakeholders from within the metrology community also noted that the metrology system was not well connected to the regulatory/policy

making system. Indeed, the process of securing input from policy-makers, and to a lesser extent industry stakeholders, also highlighted the low levels of awareness and connection with the metrology community. Many stakeholders approached for interviews in the context of this impact assessment study had limited awareness of the relevance or application of metrology research for policy.

While industry stakeholders involved in the instrumentation sector have a stronger direct link with the metrology system, they also noted that their customers (the end-users of metrology) would likely have limited understanding of the metrology system at either national or EU level. A small number of stakeholders also acknowledged that industry and NMI/DI 'view the world' in different ways: industry from the perspective of application areas and NMI/DIs from the perspective of specific measurement units. As a result, the routes of access metrology were often difficult to identify and dispersed across the metrology system. The exception to this was national metrology institutes large enough to handle a range of different services and areas of metrology and therefore able to handle a range of industry problems 'in-house'.

### **How will the problems evolve?**

Most stakeholders acknowledged that as technology evolves, so too will the metrology needs. Some stakeholders gave details of a range of short to long-term challenges depending on the state of technology development. For example, in the field of medical imaging, metrology is needed to improve sensitivity and resolution however it is expected that in the longer-term, metrology capabilities will be necessary to support unlabelled *in vivo* imaging which involves tagging molecules in a human subject and understanding how they move through the body. Many stakeholders noted that future innovation and development will also depend upon the

Some metrology stakeholders also acknowledged that the differences in capability and resourcing of NMIs/DIs across Europe will continue to grow and evolve as the national needs and political contexts change, fostering greater fragmentation and inequality of service provision.

### **Why Should the EU Act?**

Most stakeholders interviewed agreed that a pan-European investment in metrology would be necessary to maintain European leadership. It was largely understood that a coordinated approach to metrology research is necessary to ensure harmonisation and consensus building of methods, language and standards emerging from metrology research across Europe. Some interviewees highlighted that coordinated metrology was necessary to underpin coordinated European quality infrastructure.

Moreover, many stakeholders interviewed noted that expertise and capabilities across Europe needed to be coordinated and leveraged to address challenges that NMIs/DIs cannot address alone. In this sense, the value of 'pooling resources' is vital for addressing the problems and challenges faced by the sector.

### **Objectives: What is to be achieved**

Almost all stakeholders interviewed agreed that the proposed objectives of the partnership were appropriate to meet the challenges and needs. Supporting greater engagement of industry and end-users was noted by the majority stakeholders interviewed as being important for increasing the influence of metrology across the value chain. Many stakeholders agreed that the use of networks to achieve this was also noted as being valuable for supporting influence on policy by creating a set point of contact for policy makers to connect with stakeholders from across the metrology, industry and end-user groups in particular policy areas. Many stakeholders also reflected that these networks

could have a strong influence on the economic and societal impact of an EU investment in metrology by increasing engagement.

## Targeted impacts of the initiative

### Likely scientific impacts

Most stakeholders agreed that European investment in metrology would support high-quality scientific knowledge. This was understood to have an impact on scientific knowledge through both the development of new scientific knowledge pertaining specifically to metrology as well as supporting academic research communities as 'end users' of cutting-edge metrology to deliver high-quality science. Many metrology stakeholders highlighted that European investment in metrology would be necessary to support both fundamental and application focussed metrology research.

The majority of all stakeholders recognised the EMNs as a valuable route to increasing industry aligned metrology research and industry engagement with NMIs/DIs. As a result, many stakeholders and especially industry stakeholders, agreed that this application focussed coordinated research would support greater uptake of metrology by industry partners and improve understanding and awareness of the metrology system in Europe.

The majority of stakeholders interviewed, in particular metrology stakeholders, recognised that the EMNs marked a significant shift in the structure of the metrology system. Metrology stakeholders remarked that this would foster increased understanding and connectivity with industry needs, as well as a novel mechanism for NMIs/DIs to interact with each other. For some metrology stakeholders, the EMNs provided a valuable mechanism for coordinating research activities and building relationships that would extend beyond the lifetime of the initiative.

Many stakeholders interviewed recognised the significant investment in metrology research in China and confirmed that a coordinated, partnership approach would be necessary to maintain competitiveness.

### Likely economic/technological impacts

Almost all stakeholders acknowledged that the economic impact of EU investment in metrology worked to improve the quality of products and improve the confidence in quality for end-users. Many stakeholders acknowledged that metrology was an essential part of the European quality infrastructure and as such plays a key role in assuring compliance of products and services. Through quality assurance and standardisation, metrology thus supports further innovation and the uptake of innovation into society. For example, some stakeholders highlighted the high-levels of regulation in the healthcare industry as a driver for high-quality, coordinated measurements. Most stakeholders were unable to provide a sense of the scale of this impact, with some highlighting that while metrology is essential part of innovation, it was very challenging to attribute innovation or economic benefit directly to metrology capabilities or services.

Many stakeholders struggled to define any particular sector(s) that would likely benefit the most from a coordinated European investment in metrology but highlighted the difference in the type and scale of this impact depending on how developed the sectors and companies were. In this sense, some stakeholders maintained that the economic benefits to established industries (e.g. automotive manufacturing) would be small, incremental improvements made to existing processes. By contrast, economic benefits in emerging technical areas were perceived to be around demonstrating and validating new technologies that would allow for widespread uptake into society and the development of further products and services. The sectors highlighted most often by stakeholders were health and energy, whilst many stakeholders also noted underpinning technologies such as 5G, Quantum

Almost all stakeholders referred to the role of metrology in supporting the effective functioning of the European internal market, either directly or through supporting capacity for trade through standard setting and ensuring compliance. Some industry stakeholders also highlighted positive impact upon supporting B2B R&D collaboration.

### **Likely societal impacts**

Almost all stakeholders recognised the societal impact of a coordinated European investment in metrology, primarily through the development of new technologies to address and improve methods of identifying problems and improving the quality of the data used to make decisions. For example, many stakeholders highlighted the role of metrology in supporting innovation and innovation uptake within the energy sector to facilitate decarbonisation and work towards addressing climate change. The impact of metrology for the health sector was also highlighted as integral to establishing and maintaining product quality (e.g. dose and potency of medicines) and calibration and maintenance of medical devices and technologies used throughout the patient pathway (diagnosis to treatment).

Most stakeholders noted that the impact of metrology on fundamental rights as being an indirect impact as a result of regulation or standardisation by supporting high-quality, standardised products.

### **Comparative assessment of the policy options**

#### **Assessment of effectiveness of the different policy options**

##### ***Long-term coordination and sustainability***

Many stakeholders highlighted that the European metrology research needed to be supported by the strategic oversight and long-term planning provided by the partnership models, especially the A185 Institutionalised Partnership. Metrology stakeholders in particular recognised that while the A185 model might be less flexible from their perspective, the legally binding structure provided transparency around management and stronger commitment required for supporting long-term impact.

Some metrology stakeholders also noted that regular FP/Horizon would not support any significant change to the metrology infrastructure and therefore have limited sustainable impact beyond the funding period.

##### ***Engagement***

Stakeholders were very clear that a coordinated and systematic model of implementation, such as that provided via the networks, provides the structure to include the widest range of stakeholders and ensures the inclusion of SMEs as well as smaller NMIs/DIs, smaller universities and smaller research institutes.

Most stakeholders agreed that the 185-partnership model would provide the best mechanism for engaging with end-users through the structured networks. Some stakeholders also noted that the engagement of end-users with the metrology community under regular FP/Horizon projects would be limited to pre-existing relationships, while others were not clear on how the Co-fund model would support the engagement of new industry partners.

Stakeholders interviewed largely agreed that the partnership models, in particular the A185 partnership model, would be most appropriate for supporting the involvement of regulators through well-structured networks. Some policy makers interviewed also acknowledge the value having a single contact point to approach that included organisations from both industry and metrology.

### ***Impact of different policy options***

Most stakeholders interviewed agreed that economic and social impact of a European initiative in metrology would be greater within models that supported by involvement of stakeholders external to the NMI/DI community. As a result, many stakeholders agreed that the Co-fund and regular FP/Horizon options would likely have lower economic and social impacts than the A185 Institutionalised Partnership. Similarly, some stakeholders acknowledged that the impact of metrology research conducted under Co-fund or regular FP/Horizon may also be stronger in areas with pre-existing connections to the metrology community and therefore could underserve emerging sectors or policy issues.

A small proportion of stakeholders interviewed highlighted that metrology needs were often overlooked in regular FP/Horizon projects, and that where metrology capability was required, it was expected to be readily available. As a result, some stakeholders noted that the expected time and resources required for metrology was regularly under-estimated within applications to regular calls.

Moreover, some metrology stakeholders also expressed concern over the degree to which regular FP/Horizon calls would sufficiently support fundamental metrology research without any clear application areas. As a result, some stakeholders posited that the scientific impact of research conducted under FP/Horizon may be limited by the availability of funding for fundamental metrology.

### **Assessment of coherence**

#### ***Internal coherence***

Stakeholders interviewed largely agreed that the partnership 185 model would support a greater level of internal coherence by providing centralised coordination and management. Some metrology stakeholders articulated the value of the 185 partnership for including all member states.

Reflecting this, many stakeholders interviewed noted the institutionalised partnership would provide a clear and coherent mechanism for supporting the widest possible engagement with stakeholders as the centralised coordination and management would provide oversight required for coordinated engagement outside the NMI/DI community.

#### ***External coherence***

The majority of stakeholders believed 185 Partnership would be most appropriate for supporting international collaboration and coordinating. The 185 partnership would provide a central point of contact for coordinating engagement with large international partners in the field of metrology such as the International Bureau of Weights and Measures (BIMP), as well as sector specific organisations dealing with standards.

A number of stakeholders interviewed indicated potential links in relation to key application areas, e.g. Key Digital Technologies, Smart Networks, Quantum. The majority of stakeholders interviewed highlighted that metrology is a horizontal activity and therefore should retain centralised coordination and connection across Europe.

## **B.5 Open public consultation on the Candidate institutionalised European Partnerships**

### *B.5.1 Approach to the open public consultation*

The consultation was open to everyone via the EU Survey online system.<sup>53</sup> The survey contained two main parts and an introductory identification section. The two main parts collected responses on general issues related to European partnerships (in Part 1) and specific responses related to 1 or more of the 12 candidate initiatives (as selected by a participant).

The survey contained open and closed questions. Closed questions were either multiple choice questions or matrix questions that offered a single choice per line, on a Likert-scale. Open questions were asked to clarify individual choices.

The survey was open from 11 September till 12 November 2019. The consultation was available in English, German and French. It was advertised widely through the European Commission's online channels as well as via various stakeholder organisations.

The analysis of the responses was conducted by applying descriptive statistic methods to the answers of the closed questions and text analysis techniques to the analysis of the answers of the open questions. The keyword diagrams in this report have been created by applying the following methodology: First, the open answer questions were translated into English. This was followed by cleaning of answers that did not contain relevant information, such as "NA", "None", "no comment", "not applicable", "nothing specific", "cannot think of any", etc. In a third step, common misspellings were corrected, such as "excellence" instead of "excellence", or "partnership" instead of "partnership". Then, the raw open answers were tokenised (i.e. split into words), tagged into parts of speech (i.e. categorised as a noun, adjective, preposition, etc) and lemmatised (i.e. extraction of the root of each word) with a pre-trained annotation model in the English language. At this point, the second phase of manual data cleaning and correction of the automatic categorisation of words into parts of speech was performed. Finally, the frequency of appearance and co-occurrences of words and phrases were computed across the dataset and the different subsets (e.g. partnerships, stakeholder groups). Data visualisations were created based on that output.

The keyword graphs in the following sections have been built based on the relationships between words in the open responses of the survey participants. It features words that appear in the same answer either one after the other or with a maximum distance of two words between them. Each keyword is represented as a node and each co-occurrence of a pair of words is represented as a link. The size of the nodes and the thickness of the links vary according to the number of times that keywords are mentioned and their co-occurrence, respectively. In order to facilitate the visualisation of the network, the keyword graphs have been filtered to show the 50 most common co-occurrences. Although the keywords do not aim to substitute a qualitative analysis, they assist the identification of the most important topics covered in the answers and their most important connections with other topics, for later inspection in the set of raw qualitative answers.

### *B.5.2 Overview of respondents to the open public consultation*

#### **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

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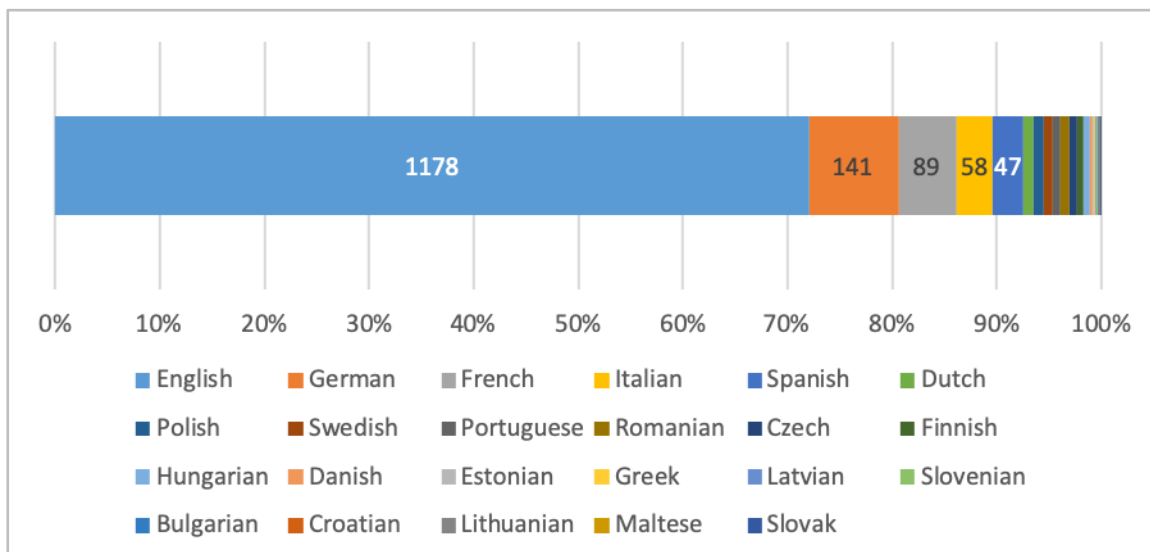
<sup>53</sup> <https://ec.europa.eu/eusurvey/runner/ConsultationPartnershipsHorizonEurope>

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. In addition, 162 respondents in the 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 analysed separately from the general analysis.

Among the 1635 respondents, 1178 (72.05%) completed the online consultation in English, 141 (8.62%) in German, 89 (5.44%) in French, 58 (3.55%) in Italian and 47 (2.87%) in Spanish, see Figure 11. Respondents that belong to the 11 campaigns follow the same pattern of language distribution, with English being the dominant language of respondents in that group. Table 20 shows that over 50% of respondents come from 4 Western and Southern European countries – Germany, Italy, France and Spain. Overall, the number of respondents from Eastern and Northern Europe is lower, while among non-EU countries the greater number of respondents come from Switzerland, Norway and Turkey, which are countries associated to the Framework Programme. In the group of respondents labelled as campaigns, most respondents are from Germany (48 respondents or 17.65%), France (39 respondents or 14.34%), Italy (37 respondents or 13.6%), Belgium (23 respondents or 8.46%), the Netherlands (21 respondents or 7.72%) and Spain (17 respondents or 6.25%). Hence, a similar pattern of country of origin is observed in the entire sample of respondents and for the campaigns.

Across all respondents 40.80% indicated to answer to the open public consultation in a public way (non-anonymous) and 20.67% of all respondents indicated their Transparency Register number.

Figure 11: Language of the consultation (N=1635)



Notes: Non-campaign replies; Aggregation of responses of all candidate initiatives

Table 20: 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%

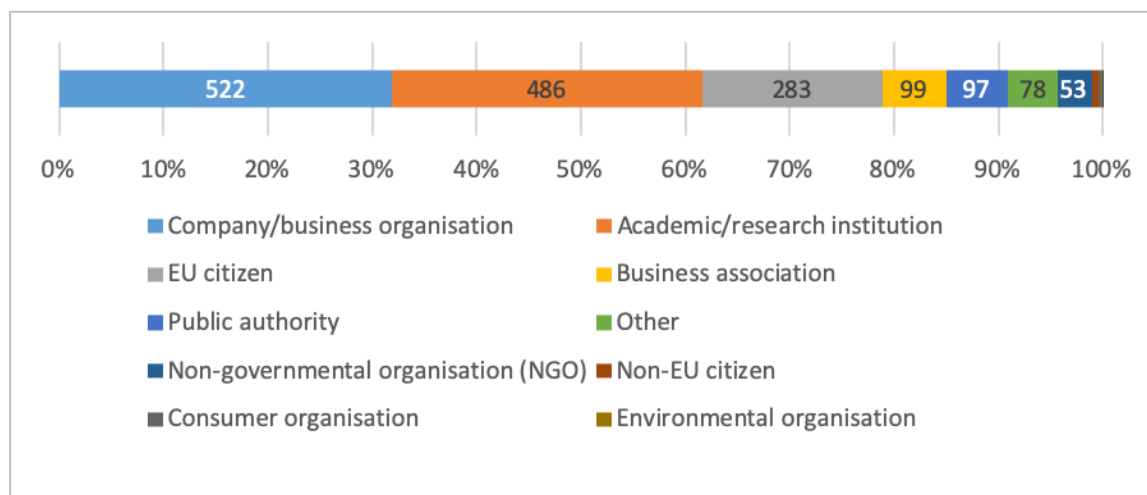


Country	Number of respondents	Percentage of respondents
Spain	173	10.58%
Belgium	140	8.56%
The Netherlands	86	5.26%
Austria; United Kingdom	61	3.73%
Finland	49	3.00%
Sweden	48	2.94%
Poland	45	2.75%
Portugal	32	1.96%
Switzerland	28	1.71%
Czechia	24	1.47%
Greece	23	1.41%
Norway; Romania	22	1.35%
Denmark	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%

According to Figure 12, the three biggest groups of respondents are companies and business organisations (522 respondents or 31.93%), academic and research institutions (486 respondents or 29.72%) and EU citizens (283 respondents or 17.31%). Business associations, representing multiple businesses, were the fourth largest responding group (99 respondents or 6.05%), no other types of associations were presented amongst the selectable options for respondents. Among the group of respondents that are part of campaigns, most respondents are provided by the same groups of stakeholders, namely companies and business organisations (121 respondents or 44.49%), academic and research institutions (54 respondents or 19.85%) and EU citizens (42 respondents or 15.44%).



Figure 12: Type of respondents (N=1635)



Notes: Non-campaign replies; Aggregation of responses of all candidate initiatives

Respondents were asked to indicate the organisational size of the companies, organisations and institutions they work for. Based on Table 21, a greater number of respondents work in large companies and business organisations (295 respondents out of 522 or 56.51%) and large academic and research institutions (348 respondents out of 486 or 71.60%). A greater number of respondents that are employed by business associations and NGOs indicated an organisation size of 1 to 9 employees. Among the group of respondents that are marked as campaigns, a greater number of respondents work in large companies and business organisations (82 respondents out of 121 or 67.77%) and academic and research institutions (39 out of 54 respondents or 72.22%).

Table 21: Size of organisations that represent consultation respondents (N=1635)

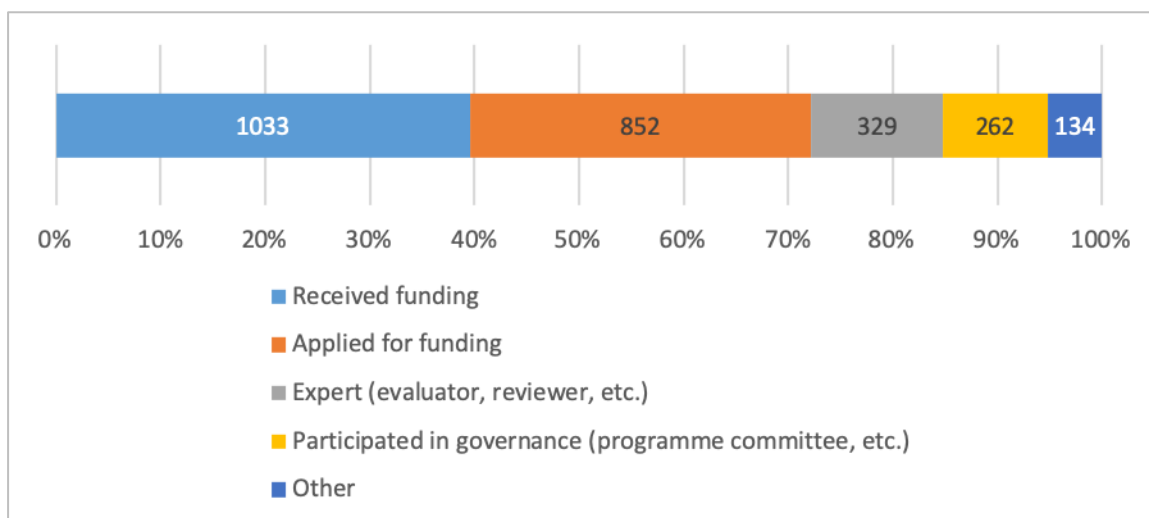
Type of respondents' organisations	Organisation size			
	Large (250 employees or more)	Medium (50 to 249 employees)	Small (10 to 49 employees)	Micro (1 to 9 employees)
Company/business organisation	295	66	90	71
Academic/research institution	348	95	31	12
Business association	15	6	34	44
Public authority	58	33	6	0
Non-governmental organisation (NGO)	7	9	11	26
Consumer organisation	1	0	2	1
Environmental organisation	0	0	1	0
Trade union	0	0	1	0
Other	24	16	19	19

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 Horizon2020 or in the preceding Framework Programme 7 were asked to indicate in which capacity they were involved in these programmes, the majority stated that they were a beneficiary (1033 respondents or 39.58%) or applicant (852 respondents or 32.64%).

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 (see distribution in Figure 13). However, a few stakeholder categories have mainly been involved in the capacity of "Received funding" and/or "Applied for funding", this applies to business associations, NGOs and public authorities.

Figure 13: Capacity in which respondents were involved in Horizon 2020 or in the Framework Programme 7 (N=1303)



Notes: Non-campaign replies; Aggregation of responses of all candidate initiatives

Among those who have been involved in the on-going research and innovation framework programme 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 22, the table also shows 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.

Table 22: 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 organisations (<250)	Company/business organisations (250+)	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	28 (2.71%)	26 (3.19%)	15	0	3	1	2	0	2

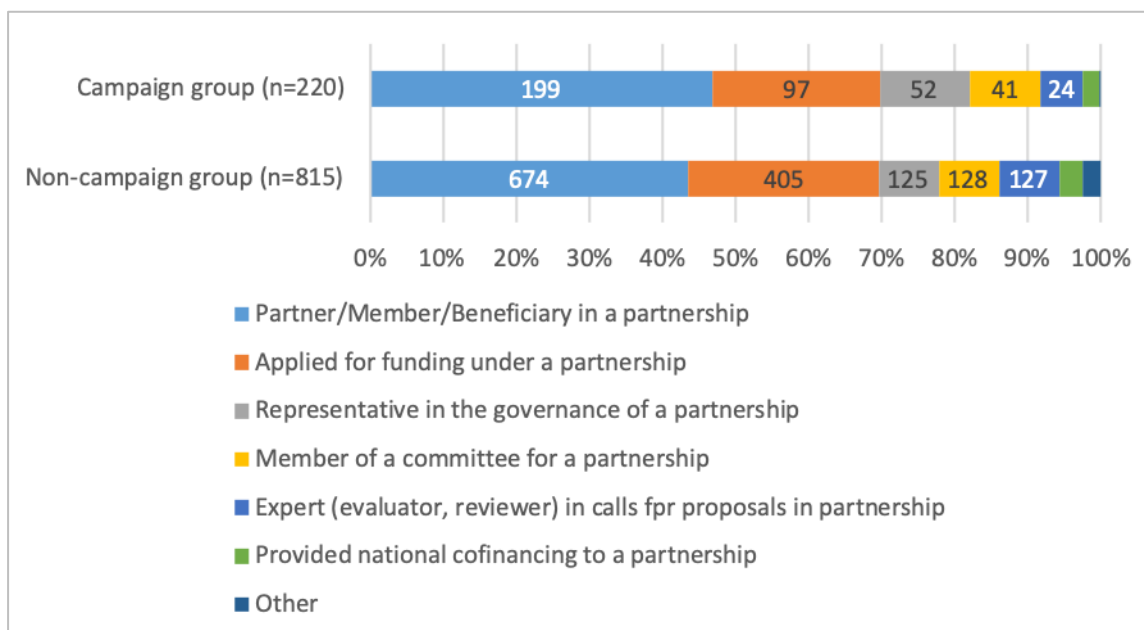
Name of the partnership	Number and % of respondents from both groups (n=1035)	Number and % of respondents from a non-campaign group (n=815)	Academic/research institutions	Business associations	Company/business organisations (<250)	Company/business organisations (250+)	EU citizens	NGOs	Public authority
Innovation in the Mediterranean Area (PRIMA)									
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-Performance Computing Joint Undertaking (EuroHPC)	22 (2.13%)	18 (2.21%)	6	0	2	3	5	0	2

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 (see Figure 14).

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.

The few respondents that selected "Other" as their role were provided with the opportunity to outline their role. A total of 25 people did provided description. The answers provided were very varied and could not be clustered in sub-groups, a few examples are: former communication and stakeholder relationship officer, chair of steering board, system engineer, grant manager, Joint Programming Initiative (JPI), or a role in advocacy of the partnership.

Figure 14: Role of respondents in a partnership (N=1035)



In the open public consultation respondents could provide their views on each of the candidate Institutionalised European Partnerships, and each respondent could select multiple partnerships to provide their views on. The table below presents the number and percentage of respondents for each partnership. It is visible that the majority of respondents (31.37%) provided their views on the Clean Hydrogen candidate partnership. More than 45% of respondents from the campaigns selected this partnership. Around 15% of all respondents provided their views for the candidate partnerships 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 23: Future 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)	Academic/research institutions	Business associations	Company/business organisations (<250)	Company/business organisations (250+)	EU citizens	NGOs	Public authority
Clean Hydrogen	506 (31.37%)	382 (28.49%)	123	21		55	74	8	13
European Metrology	265 (16.43%)	225 (16.78%)	112	3	21	11	34	3	28
Clean Aviation	246 (15.25%)	191 (14.24%)	57	5	21	34	54	3	8
Circular bio-based Europe: sustainable Innovation for	242 (15%)	215 (16.03%)	63	19	36	35	31	7	13

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)	Academic/research institutions	Business associations	Company/business organisations (<250)	Company/business organisations (250+)	EU citizens	NGOs	Public authority
new local value from waste and biomass									
Transforming Europe's rail system	184 (11.41%)	151 (11.26%)	29	14	23	39	31	2	7
Key Digital Technologies	182 (11.28%)	162 (12.08%)	55	13	20	22	35	5	7
Innovative SMEs	111 (6.88%)	110 (8.20%)	19	12	39	4	14	4	10
Innovative Health Initiative	110 (6.82%)	108 (8.05%)	35	6	9	12	16	16	5
Smart Networks and Services	109 (6.76%)	107 (7.98%)	34	9	12	17	21	2	6
Safe and Automated Road Transport	108 (6.70%)	102 (7.61%)	25	12	11	19	10	3	9
Integrated Air Traffic Management	93 (5.77%)	66 (4.92%)	8	7	4	24	9	2	7
EU-Africa research partnership on health security to tackle infectious diseases – Global Health	49 (3.04%)	47 (3.50%)	15	2	4	3	12	6	4

### Campaigns per candidate Institutionalised European Partnership

As was mentioned above, 11 campaigns were identified, the largest of them includes 57 respondents. The table below presents the campaigns that replied for each candidate partnership. As presented, the candidate Institutionalised Partnership Clean Hydrogen has the highest number of campaigns, namely 5. A few partnerships, such as Innovative SMEs, Smart Networks and Systems, were not targeted by campaigns. Some campaign respondents decided to provide opinions about several partnerships, therefore, campaign #2 and #6 feature in several partnerships.

Table 24: Overview of campaigns across partnerships

Name of the candidate Institutionalised European partnership	Number of a campaign group (total number of respondents in a campaign)	Number of respondents that provided views about a partnership
Clean Hydrogen	Campaign #1 (57 respondents)	57 respondents
	Campaign #2 (41 respondents)	25 respondents
	Campaign #7 (18 respondents)	18 respondents
	Campaign #9 (14 respondents)	13 respondents
	Campaign #11 (10 respondents)	9 respondents
Clean Aviation	Campaign #2 (41 respondents)	17 respondents
	Campaign #6 (19 respondents)	19 respondents
	Campaign #8 (14 respondents)	13 respondents
Integrated Air Traffic Management	Campaign #2 (41 respondents)	10 respondents
	Campaign #6 (19 respondents)	12 respondents
European Metrology	Campaign #3 (36 respondents)	35 respondents
Circular bio-based Europe: sustainable Innovation for new local value from waste and biomass	Campaign #5 (20 respondents)	20 respondents
Transforming Europe's rail system	Campaign #4 (31 respondents)	29 respondents
Key Digital Technologies	Campaign #10 (12 respondents)	12 respondents
Innovative SMEs	-	-
Innovative Health Initiative	-	-
Smart Networks and Services	-	-
Safe and Automated Road Transport	-	-
EU-Africa research partnership on health security to tackle infectious diseases – Global Health	-	-

### B.5.3 Responses to the open public consultation at programme level

The following section of the report presents the analysis of responses at programme level, meaning all respondents (excluding campaigns) were included, independent of which candidate European Partnerships respondents selected to provide their views on. The results for responses as part of campaigns are presented separately.

#### 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 15, 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 (companies with less than 250 employees) value 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 18.27%), both EU and non-EU citizens, that participated in the open public consultation 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.

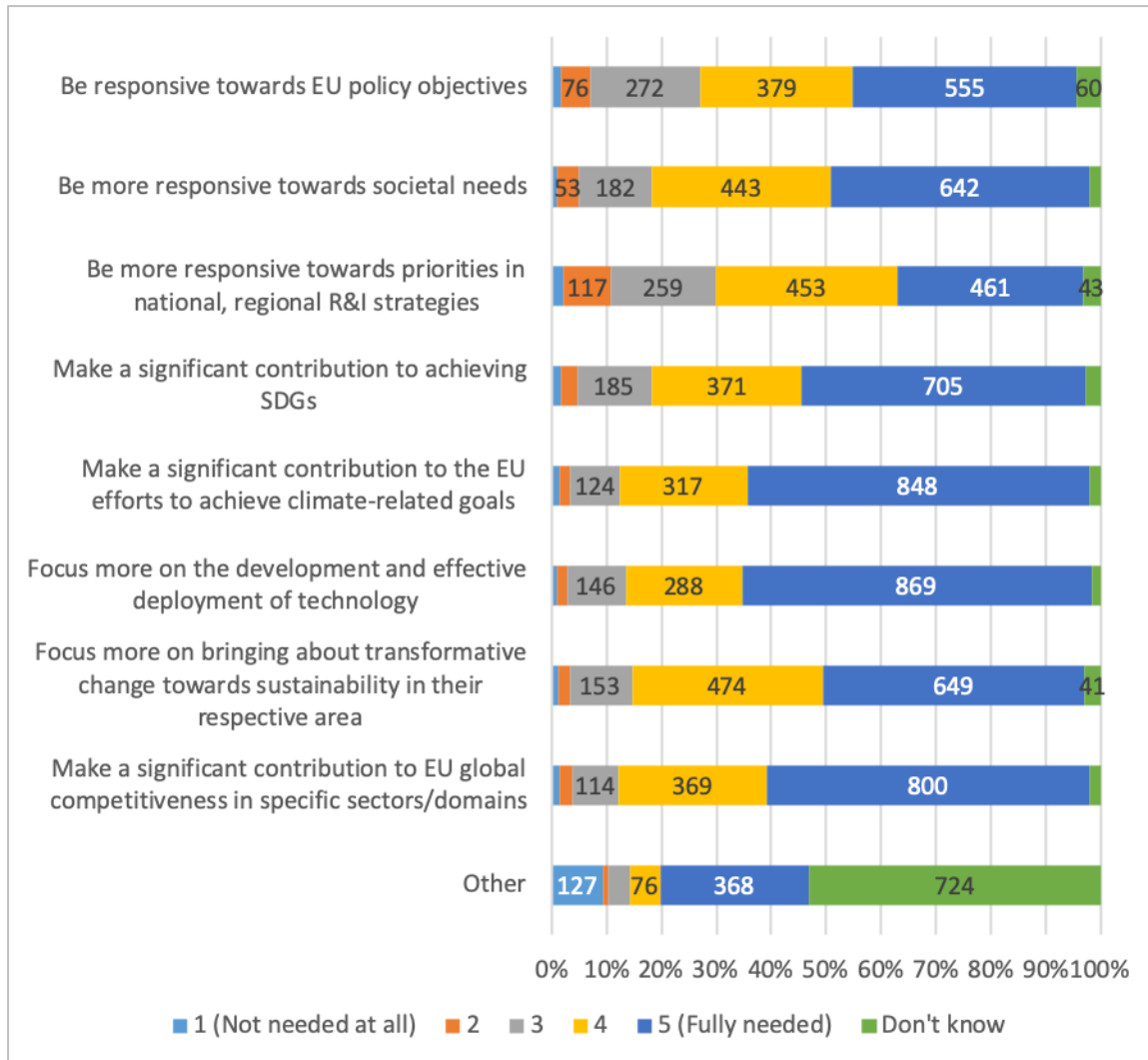
Among 272 respondents that are classified as **campaigns**, the majority (86.76%) indicated that the future European Partnerships should focus more on the development and effective deployment of technology. Other categories of presented needs that received a high score among many campaign respondents are the need to make a significant contribution to the EU efforts to achieve climate-related goals, Sustainable Development Goals and to EU global competitiveness in specific sectors/domains. The least number of campaign respondents valued the need to be more responsive towards priorities in national, regional R&I strategies (54 respondents gave a score "5 Fully needed", or 19.85%) and to be more responsive towards societal needs (71 respondents gave a score "5 Fully needed", or 26.10%).

Similarly as for non-campaign respondents, we find only minor differences between the main stakeholder categories amongst campaign respondents. Academic/research institutions indicated that the future European Partnerships need to focus a little less on development and effective deployment of technology than other respondents. On the contrary, large companies find the focus on the development and effective deployment of technology a little more needed than other respondents, as do public authorities. Furthermore, large companies feel responsiveness towards priorities in national, regional R&I strategies is a little less needed than other respondents. Public authorities, however,



value the responsiveness towards societal needs and priorities in national, regional R&I strategies more than others.

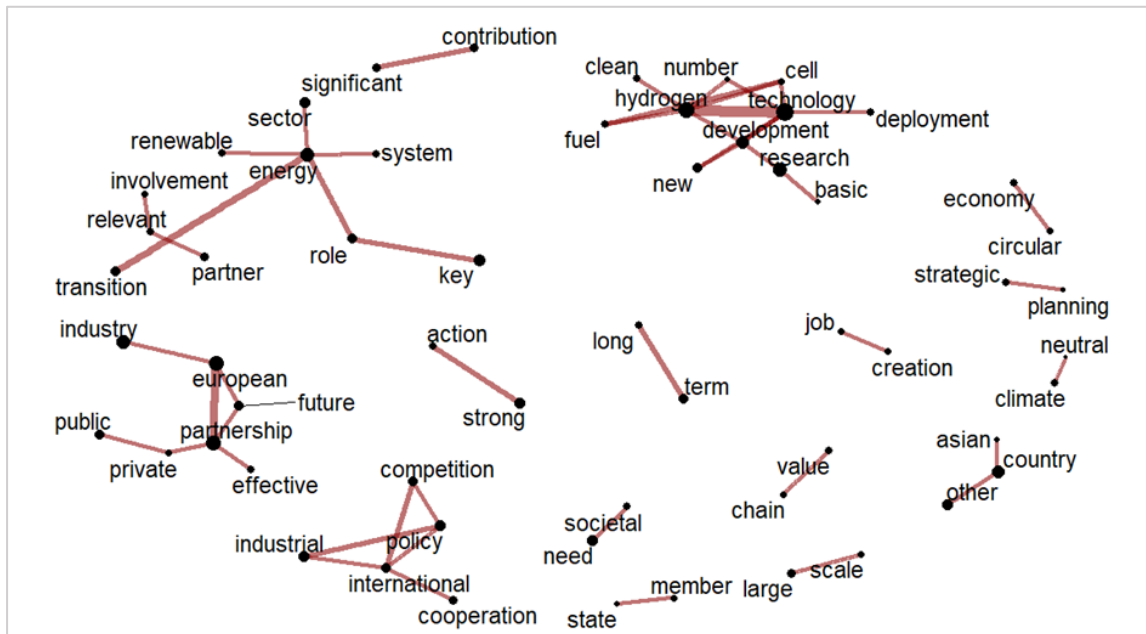
Figure 15: Needs assessment (N=1363)



Notes: Question: "To what extent do you think that the future European Partnerships under Horizon Europe need to ..."; Non-campaign replies; Aggregation of responses of all candidate initiatives

The analysis of the open answers provided to explain the "Other" field show that many respondents included the set-up of public-private European partnerships and the link between industrial policy and international competition and cooperation (see Figure 16). This is confirmed through qualitative analysis of answers, many of which mention the importance of collaboration and integration of relevant stakeholders to tackle main societal challenges and to contribute to policy goals. Against this backdrop, 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 deemed as priorities. Next to that, many respondents provided answers related to the fields of hydrogen and the energy transition, which corresponds to the high number of respondents that provided answers to the candidate European Partnership specific questions related to these topics.

Figure 16: Needs assessment, open answers to "Other" field (N=734)



Notes: Question: "To what extent do you think that the future European Partnerships under Horizon Europe need to ..."; 50 most common co-occurring keywords; Non-campaign replies; Aggregation of responses of all candidate initiatives

Many of the respondents that are classified as campaigns took the opportunity of the "Other" field to underline their key messages. The main aspects mentioned were:

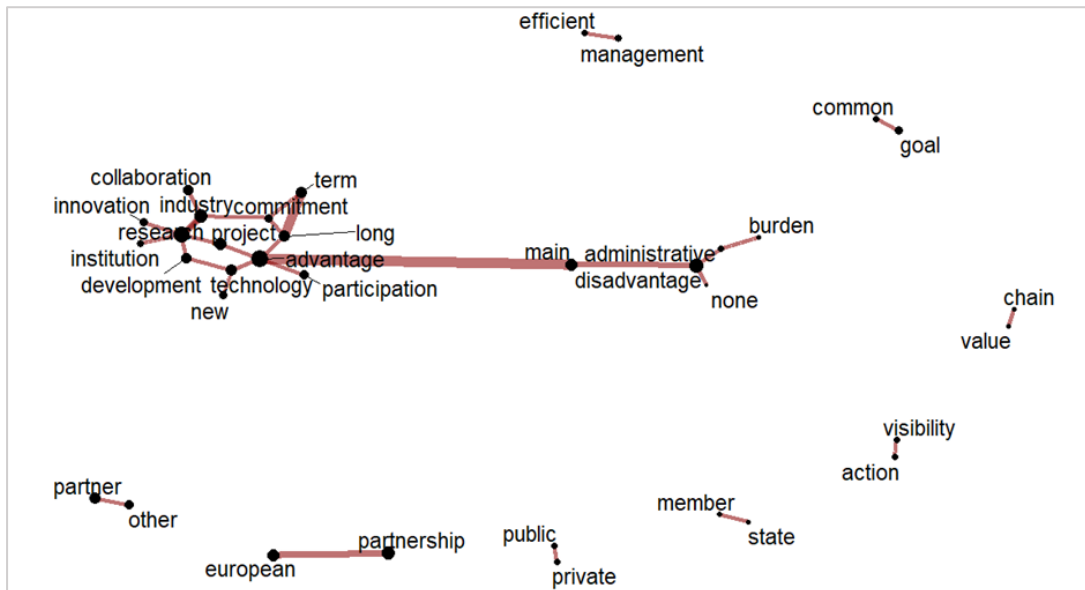
- The global positioning of Europe: outlining the role of global competition (including the role of technology), the importance of autonomy for Europe and the ability of Europe to act as a key player at the global level.
- The balance between policy objectives and private sector interests: Partnerships are regarded as an instrument to secure industry commitments due to the stability required for investments that serve policy goals.
- The importance of the transition between research and innovation (implementing research results in the market).
- The importance of multidisciplinary, and specifically cross-sectoral/cross-partnership collaboration.
- The importance of the long term commitment of a wide range of relevant stakeholders.

Next to that many respondents as part of campaigns stressed the importance of the energy transition, hydrogen and the environment, which corresponds to the high number of respondents that provided answers to the candidate European Partnership specific questions related to these topics.

### Main advantages and disadvantages of Institutionalised European Partnerships

In the next question, respondents were asked to outline the main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe. This was an open question for which a keyword analysis was used (see the main results in Figure 17). As can be observed, 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.

Figure 17: Main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) (N=1551)



Notes: Question: "What would you see as main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe?"; 30 most common co-occurring keywords; Non-campaign replies; Aggregation of responses of all candidate initiatives

When asked about the main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe, the following points were mentioned by respondents that are classified as campaigns:

**Advantages:**

- 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:**

- 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

### Relevance of EU level efforts to address problems in selected areas of Partnerships

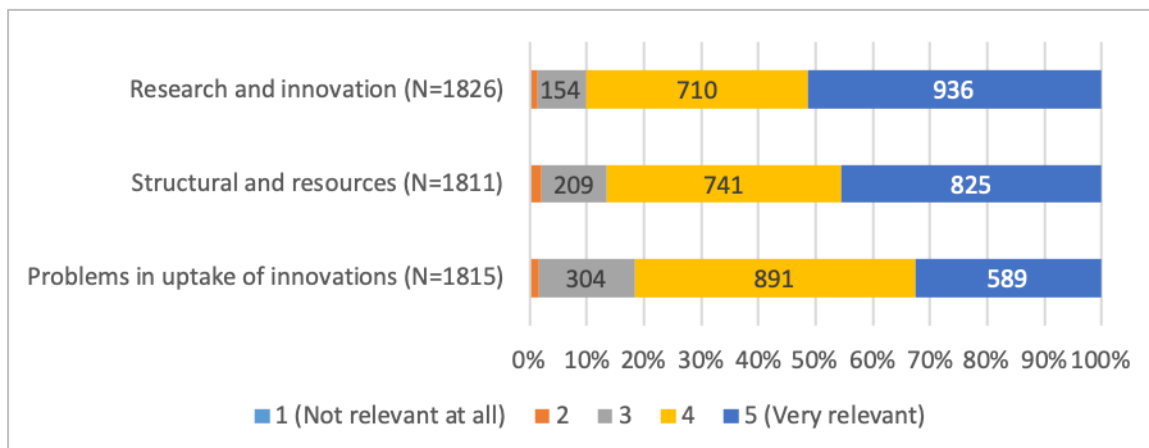
Per candidate European Partnership respondents were asked to rate the relevance of partnership specific problems in three main areas: Research and innovation problems, Structural and resource problems and Problems in the uptake of innovations. To aggregate results the average of the responses on partnership specific problems were calculated.

As presented in Figure 18, research and innovation related problems were rated as most relevant by the respondents 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 the main stakeholder categories of respondents. 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 it slightly more relevant to address problems in uptake of innovation than other respondents.

The views of citizens, both EU and non-EU citizens, are the same as other respondents (no significant differences). Respondents that are/were directly involved in a current/preceding partnership (Horizon 2020 or Framework Programme 7) find, however, the uptake of innovation problems slightly more relevant than other respondents.

Figure 18: Relevant problems to address



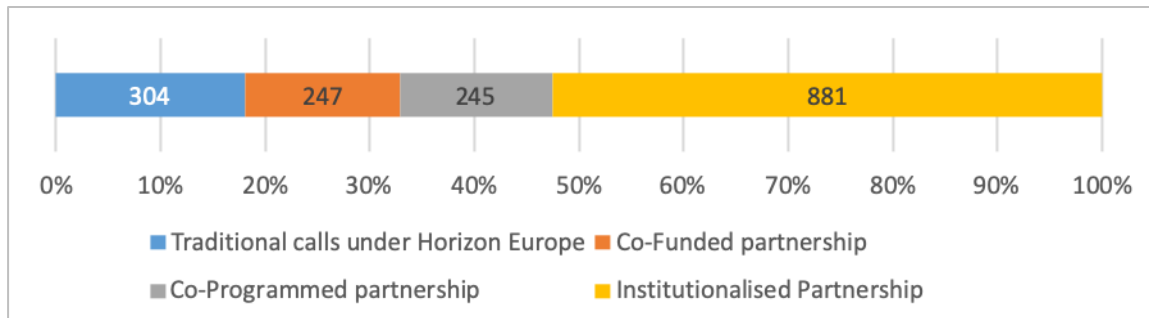
Notes: Question: "To what extent do you think it is relevant for research and innovation efforts at EU level to address the following problems in relation to the candidate partnership in question?"; Non-campaign replies; Aggregation of responses of all candidate initiatives

### Horizon Europe mode of intervention to address problems

After providing their views on the relevance of problems, respondents were asked to indicate how these challenges could be addressed through Horizon Europe intervention. As shown in Figure 19, just over 50% of all respondents indicated that institutionalised partnerships were the best fitting intervention, however, relatively strong differences between stakeholder categories were found. The intervention of institutionalised partnerships 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, compared to other respondents, indicated slightly less often that institutionalised partnerships were the best fitting intervention. Respondents that are/were directly involved in a current/preceding partnership, however, selected the institutionalised partnership intervention in far higher numbers (nearly 70%).

Figure 19: Options to address challenges



Notes: Question: "In your view, how should the specific challenges described above be addressed through Horizon Europe intervention?"; Non-campaign replies; Aggregation of responses of all candidate initiatives

When asked to reflect on their answers, respondents that pointed to the need for using the "institutionalised partnership" intervention 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. Respondents that referred to possible approaches, sometimes gave examples of good experiences in with other 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, evenly distributed across companies (25 of them), 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).

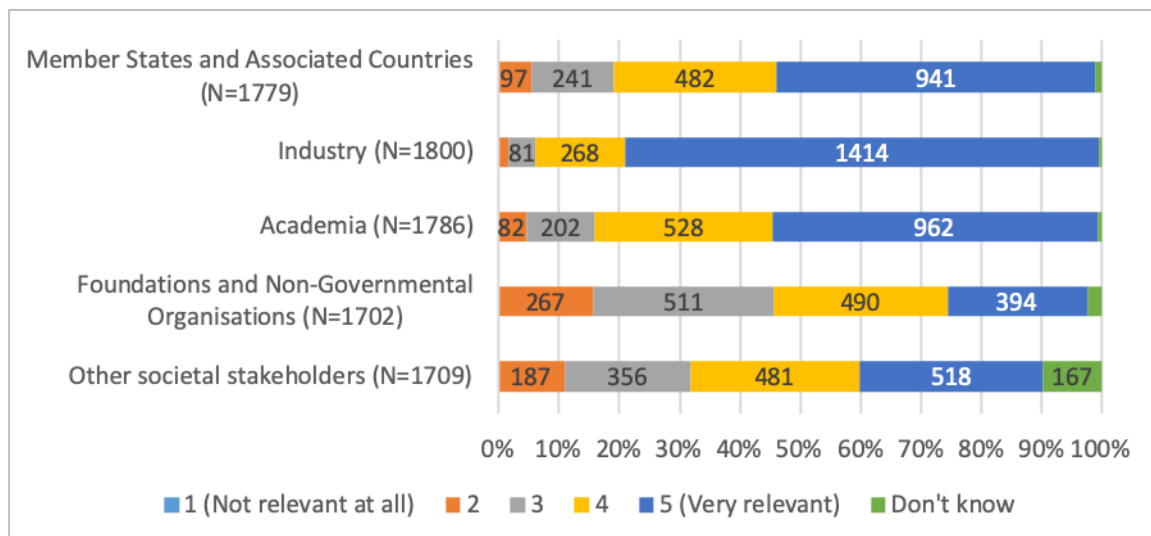
## Relevance of a set of elements and activities to ensure that the proposed European Partnership would meet its objectives

### 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. As presented in Figure 20, collectively all 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 were, however, still found to be (very) relevant by more than 50% of the respondents.

When looking at the differences between the answers of the main stakeholder categories only minor differences could be found. Overall, it could be observed that most respondents indicated the stakeholder group they belong to themselves or that represent them as relevant to involve. Academic/research institutions find it more relevant to involve academia and less relevant to involve industry when compared to other respondents. The other way around large companies, SMEs and business associations find it more relevant to involve industry and less relevant to involve academia, Member States and Associated Countries and NGOs. The involvement of Member States and Associated Countries was found more relevant by academic/research institutions and public authorities. NGOs also values their own involvement and those of other societal stakeholders more than other respondents. views of citizens also show a slightly higher relevance for foundations and NGOs. This is less so the case for respondents that are/were directly involved in a current/preceding partnership (most predominantly companies and academia).

Figure 20: Stakeholders to involve in setting joint long-term agenda's



Notes: Question: "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; Aggregation of responses of all candidate initiatives

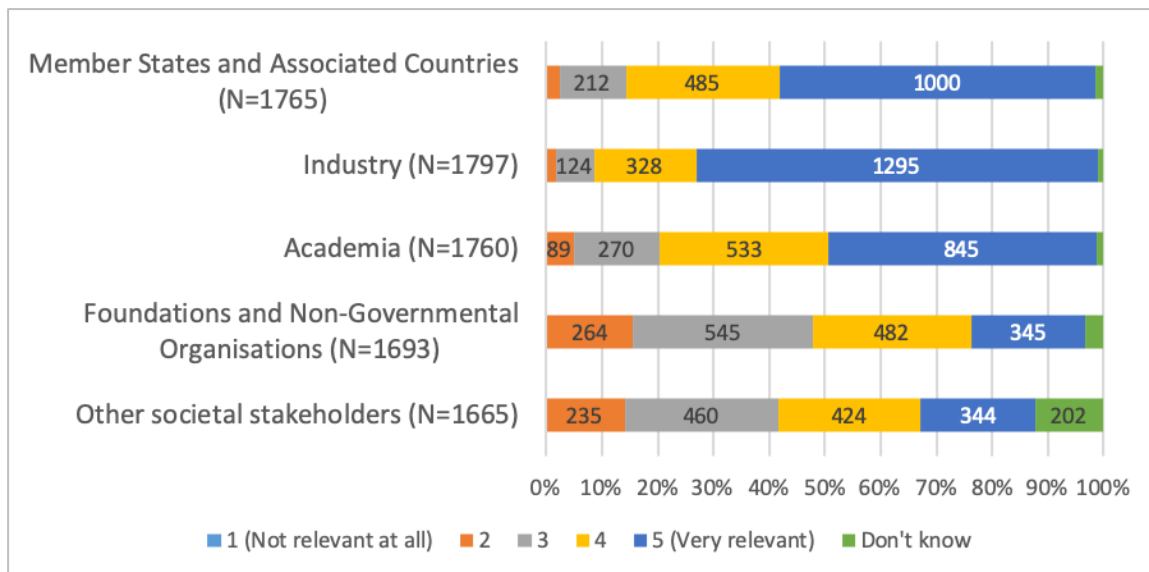
### Pooling and leveraging resources through coordination, alignment and integration with stakeholders

Respondents were also 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. As shown in Figure 21-similarly as for the previous questions-, respondents also 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. As such, academic/research institutions see the relevance of academia higher, while large companies, SMEs and business association indicated a lower relevance of academia than other respondents. Similarly, these private sector stakeholders valued the relevance of industry higher than others while valuing the relevance of NGOs and other societal stakeholders less. NGOs value themselves and other societal stakeholders however higher than other respondents, and also public authorities indicated a higher relevance for

Member States and Associated Countries then other respondents. Citizens mainly put more emphasis on the role of NGOs and other societal stakeholders then other respondents.

Figure 21: Relevance of actors for pooling and leveraging resources



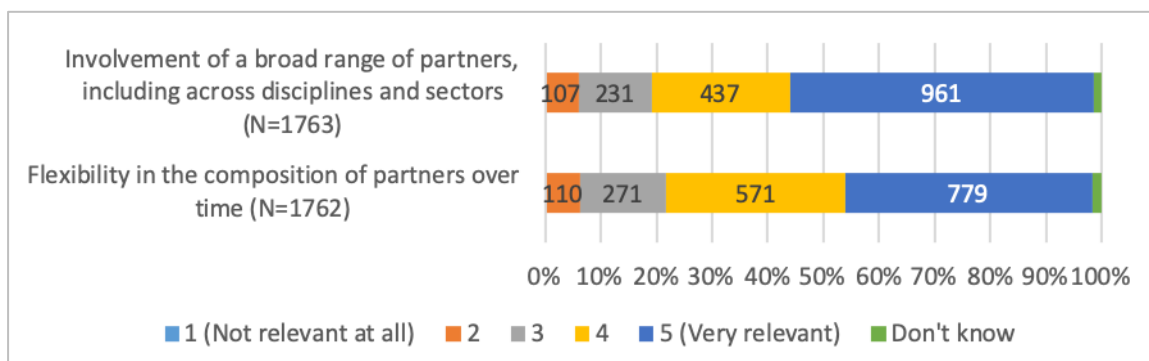
Notes: Question: "In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives – Pooling and leveraging resources (financial, infrastructure, in-kind expertise, etc.) through coordination, alignment and integration with:"; Non-campaign replies; Aggregation of responses of 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 22).

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 22: Assessment of the partnership composition





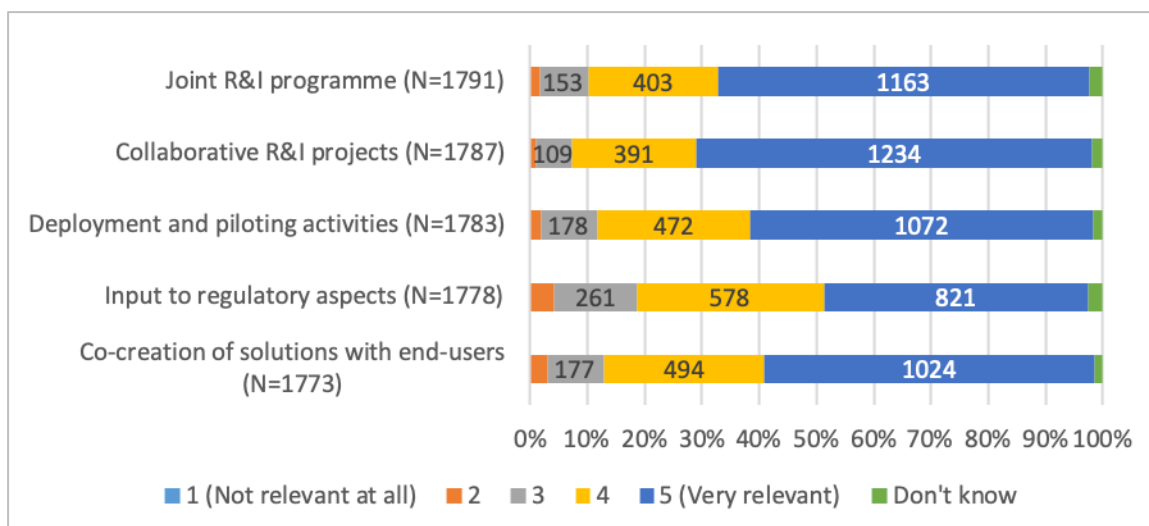
Notes: Question: "In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives – Partnership composition"; Non-campaign replies; Aggregation of responses of all candidate initiatives

### 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 (see Figure 23).

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 shown in Figure 23.

Figure 23: Relevance of activities to implement



Notes: Question: "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; Aggregation of responses of all candidate initiatives

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

Respondents were then asked to reflect on the relevance of setting up a legal structure (funding body) for achieving a set of improvements, as presented in Figure 24. In general, 70%-80% of respondents find a legal structure (very) relevant for these activities. The legal structure 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.

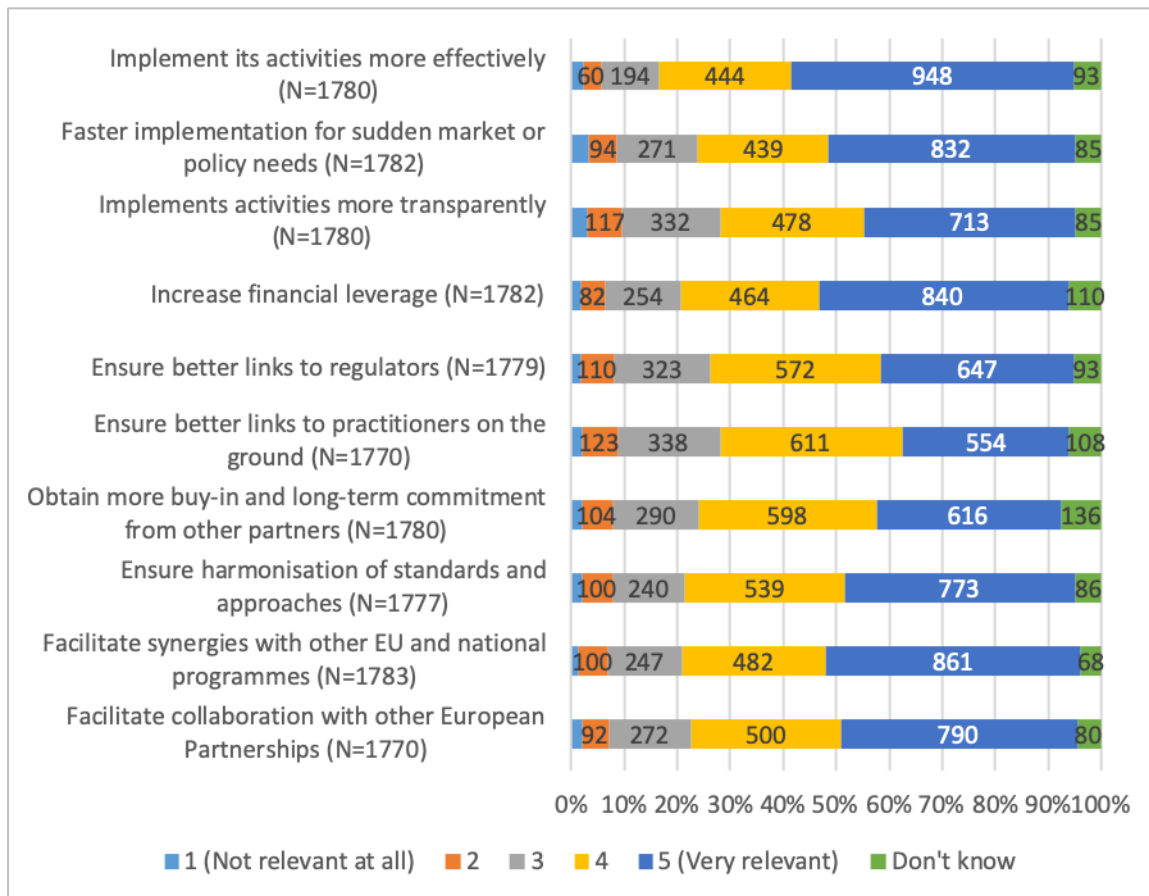
When comparing the main stakeholder categories we found minor differences. Academic/research institutions indicated a slightly lower relevance for transparency, better links to regulators as well as obtaining the buy-in and long-term commitment of other partners. SMEs also indicated a lower relevance 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 than other open consultation respondents. 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. Quite different results are shown for respondents that are/were directly involved in a current/preceding partnership when compared to respondents not involved in a current/preceding partnership, they indicated a higher relevance across all elements presented in Figure 24.

Figure 24: Relevance of setting up a legal structure (funding body)



Notes: Question: "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

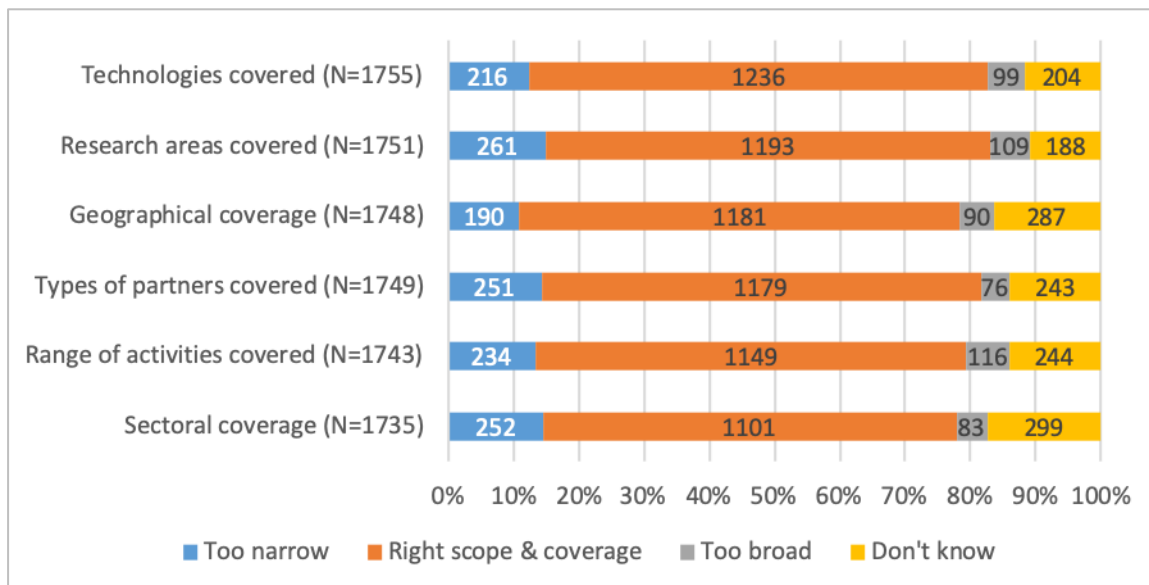
### Scope and coverage of the candidate European Partnerships based on their inception impact assessments

The response regarding the scope and coverage for the partnerships, based on inception impact assessments, shows that the large majority feels like the scope and coverage initially proposed in the inception impact assessments is correct. Figure 25 shows the results. 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". In the open answers respondents mostly reflected on specific aspects of the geographical and sectoral scope and coverage of the specific candidate European Partnerships, no overall lessons could be extracted.

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” than 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” when compared to other respondents. 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. Most notably, respondents that are/were directly involved in a current/preceding partnership, when compared to respondents not involved in a current/preceding partnership, more often indicated that the candidate institutionalised European Partnership have the “right scope & coverage”.

Figure 25: Assessment of the proposed scope and coverage of the candidate European Partnerships



Notes: Question: “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

### 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 62.15%), while over one third answered “No” (609, or 37.85%). Nearly no differences were found between the main 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.

In the open responses respondents often referred to specific similar/comparable and complementary initiatives discussing the link with a specific candidate European Partnership, no overall lessons could be extracted, but more detailed results can be found in the partnership specific result sections.

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

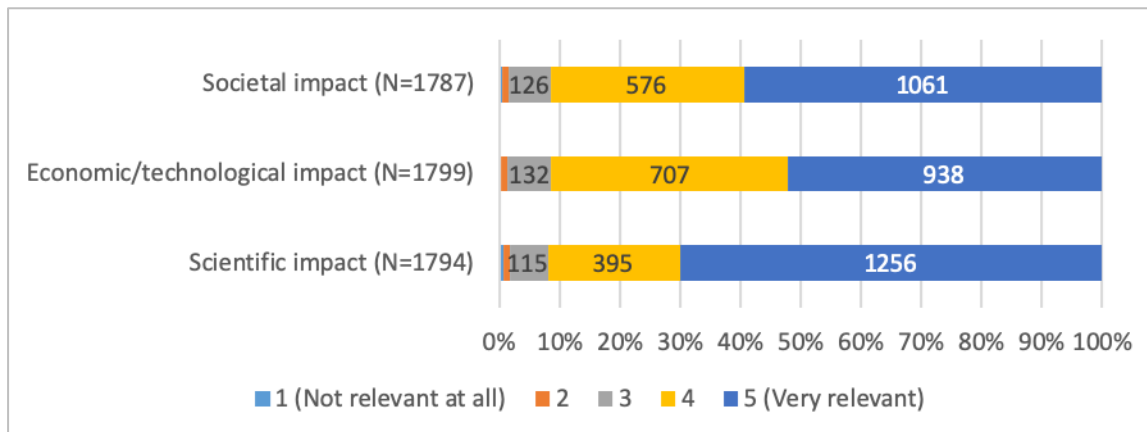
Finally, respondents were asked to rate the relevance of partnership specific impacts in three main areas: Societal impacts, Economic/technological impacts and Scientific impacts. To aggregate results the average of the responses on partnership specific impacts were calculated.

As presented in Figure 26, overall, 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 these impacts were (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, both EU and non-EU 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 26: Relevant impacts of future European Partnerships



Notes: Question: "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

## B.6 Responses to the open public consultation for the candidate partnership "European Metrology"

### B.6.1 Introduction

This section outlines the results of the Open Public Consultation for the candidate European Partnership on European Metrology. The section outlines the following:

- Results on general questions, segregated for this candidate European Partnership:
  - Views on the needs of the future European Partnerships under Horizon Europe
  - Views on the advantages and disadvantages of participation in an Institutionalised European Partnership
- Results on specific questions for this candidate European Partnership:
  - Relevance of research and innovation efforts at the EU level to address problems
  - Views on Horizon Europe interventions to address these problems
  - Views on the relevance of elements and activities in: setting a joint long-term agenda; pooling and leveraging resources; partnership composition; implementation of activities.

- Views on setting up a specific legal structure (funding body)
- Views on the proposed scope and coverage of this candidate European Partnership
- Views on the alignment of the European Partnership with other initiatives
- Relevance of this candidate European Partnership to deliver impacts

### *B.6.2 Characteristics of respondents*

There are 225 respondents who have answered (part of) the consultation for the European Metrology Partnership. Of these respondents, 36 (16.00%) were citizens. The largest group of respondents were from academic and research institutions with 112 (49.78%) respondents. There were 32 (14.22%) respondents from businesses and 3 from business associations (1.33%). Also, 28 respondents were from public authorities (12.44%). The remaining respondents were from NGO's (3, 1.33%) or selected other (11, 4.89%). Almost 75% of respondents, namely 168 (74.67%), have been involved in the on-going research and innovation framework programme, of which 124 respondents (73.81%) were directly involved in a partnership under Horizon 2020 or its predecessor Framework Programme 7.

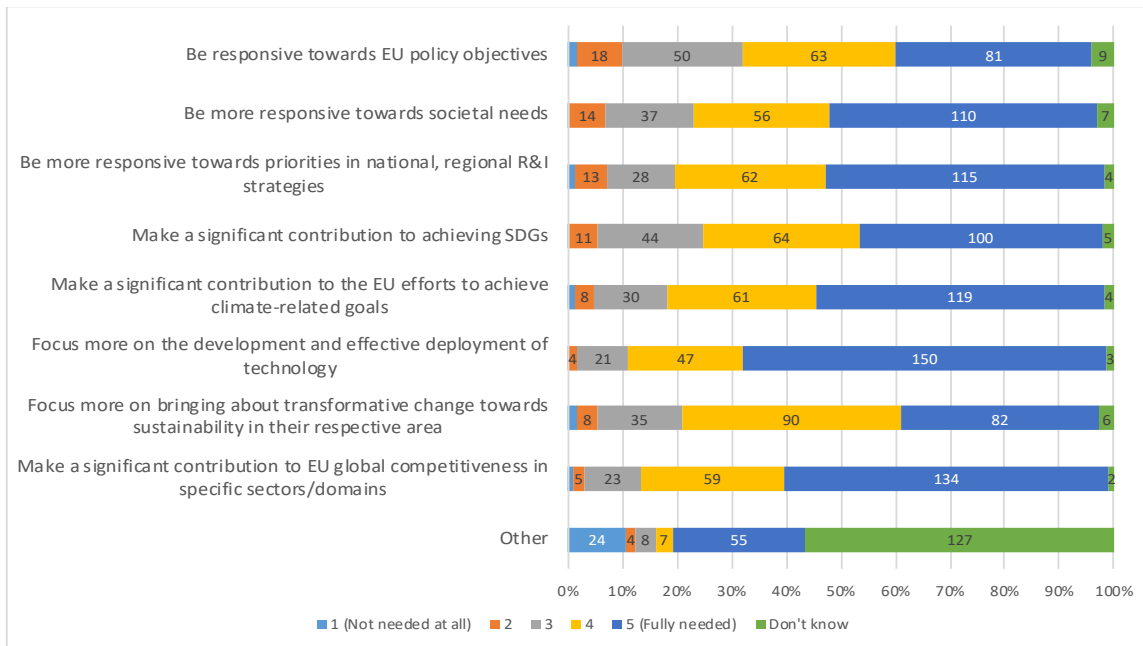
### *B.6.3 Characteristics of future candidate European Partnerships – as viewed by respondents to the European Metrology initiative*

At the beginning of the consultation, the respondents of this partnership were asked regarding their views of the needs of the future European Partnerships under Horizon Europe. All 225 respondents answered these questions. Overall, a large part of respondents indicated that many of the options presented needs were 'fully needed'. The needs where most respondents indicated this, was focusing more on the development and effective deployment of technology (150, 66.67%) and make a significant contribution to EU global competitiveness in specific sectors and/or domains (134, 59.56%). Industry respondents (large and small companies, and business associations) in particular were more likely to rank these needs as 'fully needed'.

Aside from 'other', the options where the least number of respondents indicated that improvements were fully needed, was making being more responsive towards EU policy objectives (81, 36.00%) and focusing more on bringing about transformative change towards sustainability in their respective area (82, 36.44%).

No statistical differences were found between the views of citizens and other respondents for most needs. However, citizens found the needs of being more responsive towards societal needs and to focus more on bringing about transformative change towards sustainability slightly less relevant.

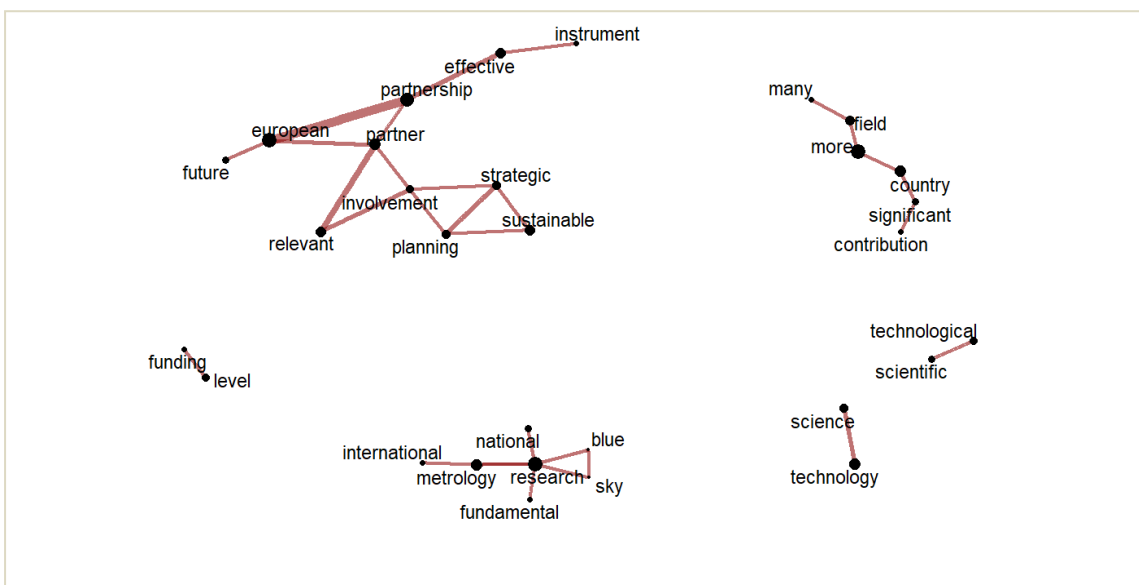
Figure 27: Needs assessment (N=225)



Notes: Question: "To what extent do you think that the future European Partnerships under Horizon Europe need to ..."

The respondents also had the option to indicate other needs. The results of the analysis resulted in the chart shown in Figure 28 showing the co-occurrences of keywords. The results show that respondents have indicated needs the involvement of relevant European partners, strategic and sustainable planning as well as significant country contributions. Responses also highlighted the need for long-term strategies and the involvement of relevant partners. Some respondents highlighted the need for the inclusion of industry partners, policy makers or regulators in particular. The need for the initiative to address societal needs was also highlighted many times, with stakeholders providing additional detail of particular societal needs to challenges that should be addressed, mostly health or environment/climate change related areas. By contrast, a small number of respondents also noted the need to support fundamental or 'blue skies' research.

Figure 28: Needs assessment, open answers to "Other" field (N=95)



Notes: Question: "To what extent do you think that the future European Partnerships under Horizon Europe need to ..."; 50 most common co-occurring keywords

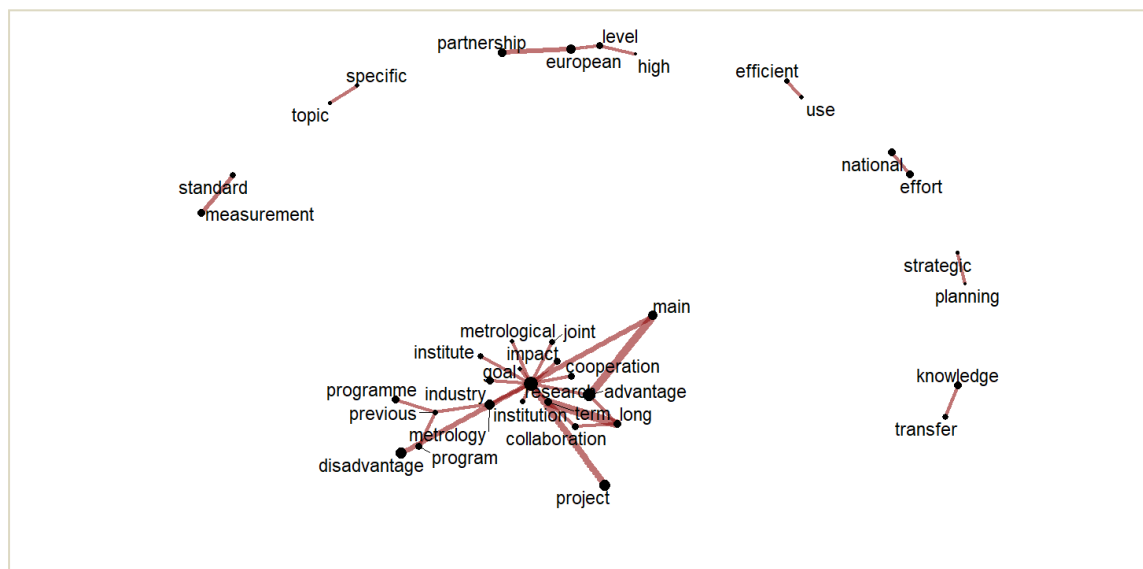
### B.6.4 Main advantages and disadvantages of Institutionalised European Partnerships

The respondents were asked what they perceived to be the main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe. The keyword analysis used for open questions resulted in the graph shown in Figure 29. This analysis showed the respondents viewed cooperation and collaboration as an advantage. Further analysis of the open answers showed that many respondents highlighting the value of pan-European nature of the partnerships. Most of these respondents highlighted the value of collaboration or coordination for improving the efficiency of research and resource use across Europe, or the contributions made to knowledge-sharing and access to expertise. Industry stakeholders in particular were more likely to frame the value of coordinated European metrology in terms of its economic impact and role in supporting EU competitiveness and industry leaderships, and to a lesser extent, the value of such programmes in supporting industry collaboration with research. Some respondents also highlighted the positive impacts of the previous EMPIR/EMRP programmes as indicators of potential future benefit. A small number of respondents also highlighted the value of having a coordinated/centralised European structure for facilitating international connections/ collaborations.

Many respondents also highlighted the long-term strategic nature of the partnership model as an advantage, either for supporting long-term collaborations, or for taking strategic views on the needs of metrology community and the industries it supports.

Though most respondents did not provide disadvantages of the partnerships, a small number of respondents noted bureaucracy and administrative burdens whilst others highlighted the complexity of the projects, referring in particular to the large size of the projects funded and/or the limited funding available to small teams /single organisation.

Figure 29: Main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) (N=199)

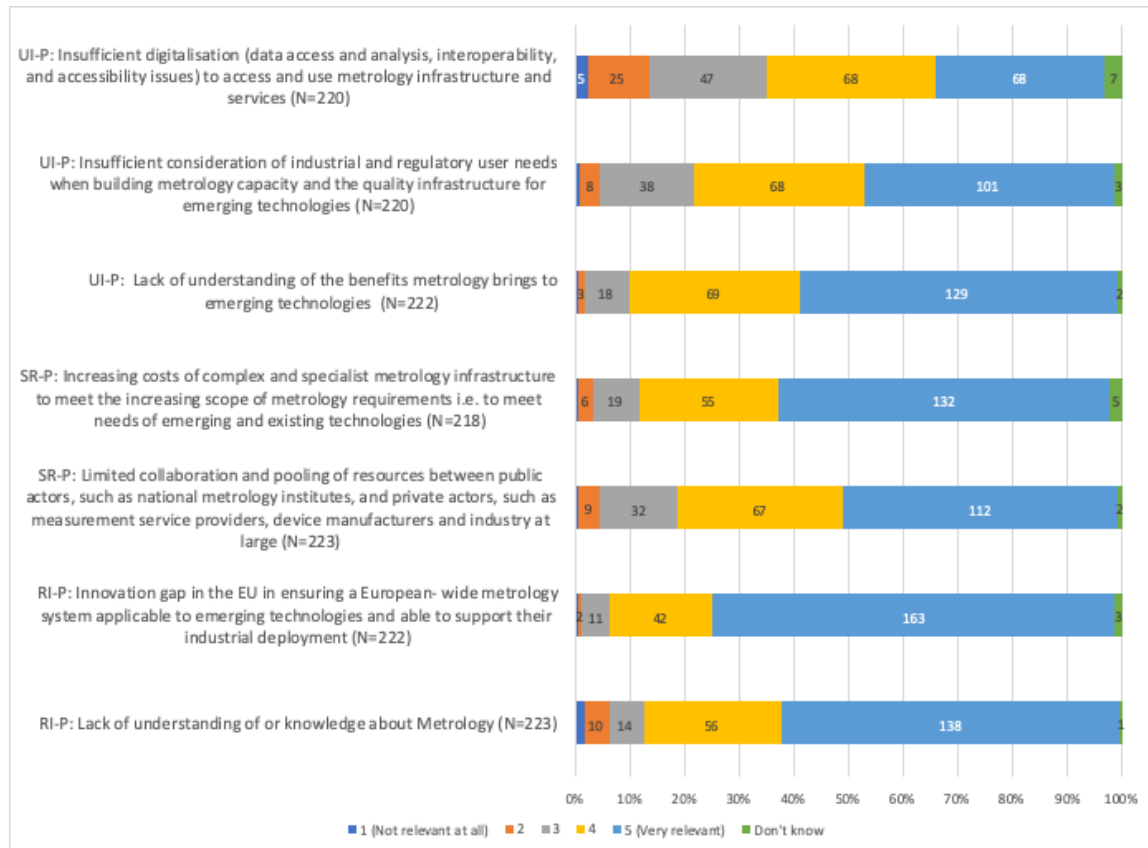


Notes: Question: "What would you see as main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe?"; 30 most common co-occurring keywords

### B.6.5 Relevance of EU level efforts to address problems in relation to the European Metrology field

In the consultation, respondents were asked to provide their view on the relevancy of research and innovation efforts at EU level to address the following problems in relation to metrology, specifically on three types of problems: problems in uptake of met (UI-P), structural and resource problems (SR-P) and research and innovations problems (RI-P). In Figure 30 the responses to these answers are presented.

Figure 30: Relevant problems to address in relation to metrology



Notes: Question: "To what extent do you think it is relevant for research and innovation efforts at EU level to address the following problems in relation to the candidate partnership in question?"

With regard to the uptake in innovation problems, 129 respondents have indicated that the research and innovation efforts at the EU level to address the issue of lack of understanding of the benefits metrology brings to emerging technologies is very relevant (58.10%). Notably, respondents from academic/research institutions and large companies though this was slightly more relevant than respondents from public authorities.

Of the two structural and resource problems that the respondents were asked to reflect on, increasing costs of complex and specialist metrology infrastructure to meet the increasing scope of metrology requirements i.e. to meet needs of emerging and existing technologies, is considered the more relevant problem to address at EU level. 132 respondents have indicated that this is a very relevant problem (132, 60.55%). This was stronger for industry respondents (75.76% of industry respondents) but much lower for EU citizens.

Finally, 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 ensuring a European wide metrology system applicable to emerging technologies and able

to support their industrial deployment is considered the most relevant with 163 respondents indicating it is very relevant (73.42%). This was noted as being particularly relevant by large companies (10, 90.00%).

Notably, with regard to the lack of understanding or knowledge about Metrology, respondents from industry, especially large companies, were less likely to note this need as being 'very relevant' (16, 47.06%). By contrast, respondents from academic/ research institutions were more likely to highlight the need as being very relevant (78, 69.64%).

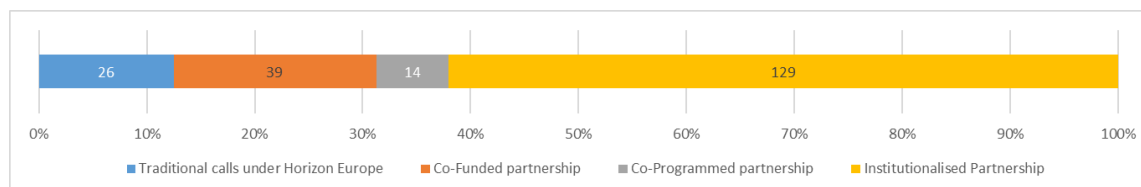
No statistical differences were found between the views of citizens and other respondents for most problems. However, citizens were less likely to indicate any problem as being 'very relevant', particularly the structural and resource problems.

#### B.6.6 Horizon Europe mode of intervention to address problems

After providing their views on the relevance of problems, respondents were asked to indicate how these challenges could be addressed through Horizon Europe intervention. As shown in Figure 31, 62.02% of respondents indicated that institutionalised partnerships were the best fitting intervention. This was slightly stronger for respondents from industry (22, 68.75%).

No statistical differences were found between the views of citizens and other respondents.

Figure 31: Options to address the challenges

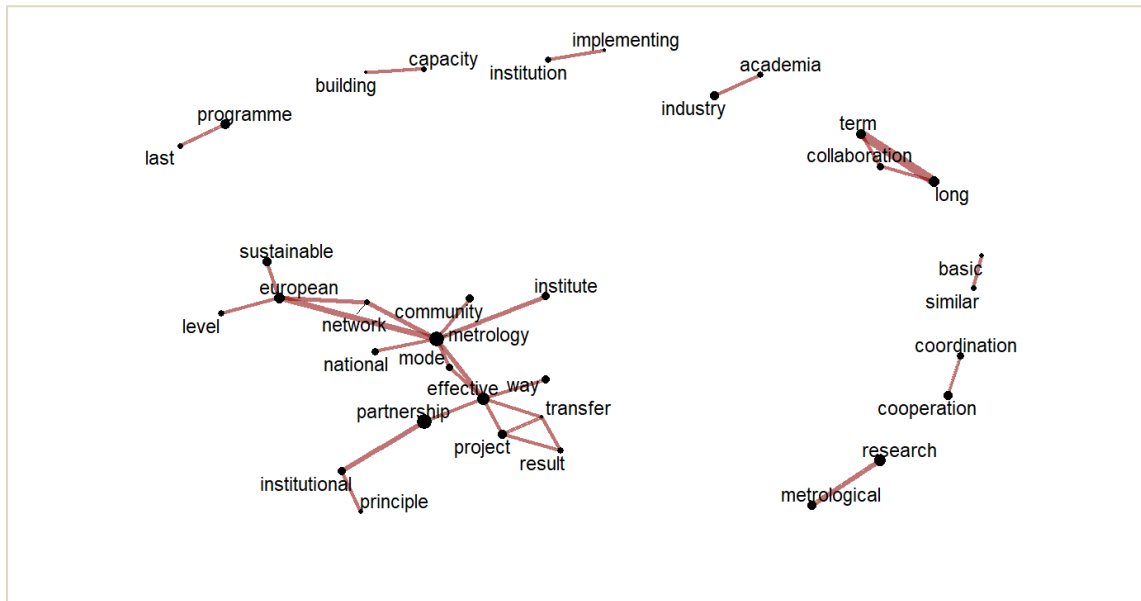


Notes: Question: "In your view, how should the specific challenges described above be addressed through Horizon Europe intervention?"

The respondents were asked to briefly explain their answers to the question above. People who stated that an institutionalised partnership was the best fitting answer mentioned long term collaboration, coordination and cooperation as well as a sustainable European metrology network and effectiveness (Figure 32). Respondents who did not select institutionalised partnership as their preferred intervention (N=75) mentioned traditional calls, governmental financial support, long term sustainability and better tools for cooperation (not pictured).



Figure 32: Assessment of open answers to explain their choice institutionalised partnership in the assessment of the Horizon Europe intervention (N=110)



Notes: Question: "In your view, how should the specific challenges described above be addressed through Horizon Europe intervention?"

Respondents who selected the Article 185 partnership model, particularly those participating in previous partnerships, justified their selection based on the effectiveness and impact of previous metrology partnerships EMPIR/EMRP. Other reasons given for the A185 partnership included the breadth of participants involved and the ability for such a model to promote metrology research at the pan-European level.

#### B.6.7 Relevance of a set of elements and activities to ensure that the proposed European Partnership would meet its objectives

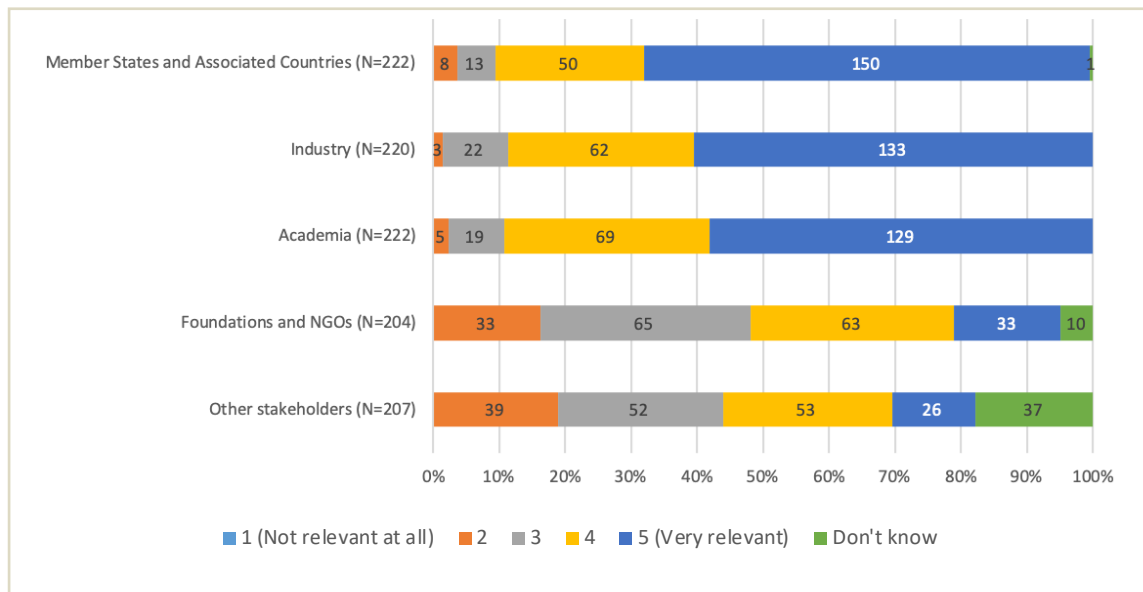
##### Setting joint long-term agendas

Respondents were asked how relevant the involvement of actors is in setting a joint long-term agenda to ensure that the proposed European Partnership would meet its objectives (Figure 33). The highest number of respondents indicated that the involvement of Member States and Associated Countries is very relevant (150 respondents or 67.57%), closely followed by Industry (133, 60.45%) and Academia (219, 58.11%). Respondents considered the involvement of foundations and NGO's and other stakeholders less relevant, with both options being seen as very relevant by just over 10% of respondents (16.17% and 12.56% respectively).

Respondents generally thought the involvement of their own stakeholder group as being more relevant for long-term agenda setting. Respondents from industry (business associations, large companies and small companies) thought the involvement of industry partners was more relevant than other respondent types (30, 88.24%). Respondents from academic/research institutions thought the involvement of academia was more relevant (73, 65.77%).

A slight statistical difference was found between the views of citizens and other respondents, citizens find other stakeholders less relevant.

Figure 33: Stakeholders to involve in setting joint long-term agenda's



Notes: Question: "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:"

### Relevance of elements and activities in pooling and leveraging resources

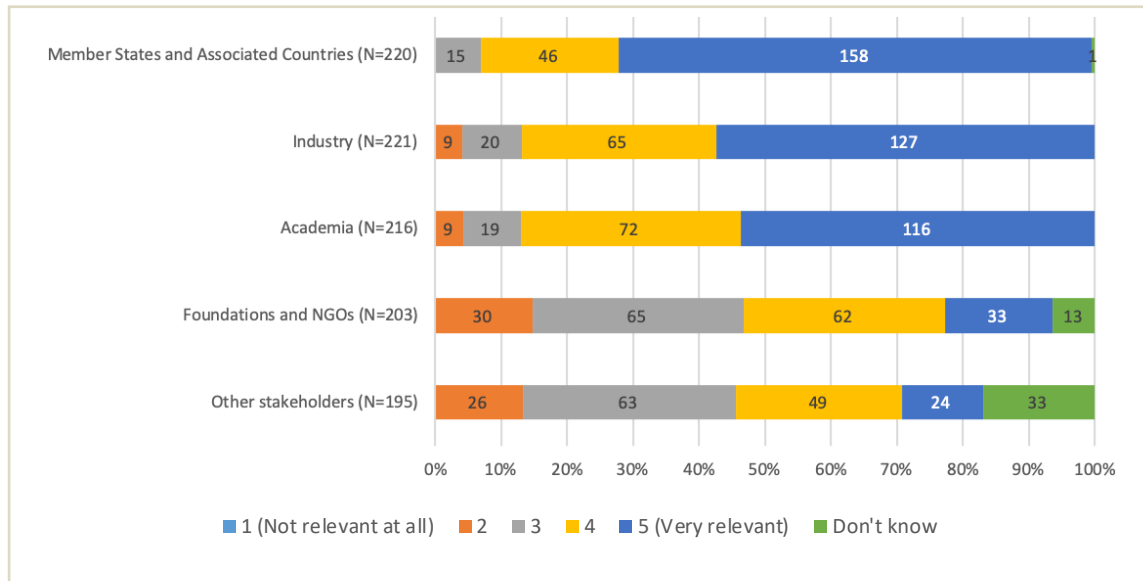
With respect to the relevance of actors in pooling and leveraging resources, such as financial, infrastructure, in-kind expertise etc.), to meet Partnership objectives, the patterns are similar. The highest number of respondents indicated that the involvement of Member States and Associated Countries is very relevant (158 respondents or 71.82%), closely followed by Industry (127, 57.73%) and Academia (116, 53.70%).

Similarly, respondents generally thought the involvement of their own stakeholder group as being more relevant for pooling and leveraging resources. Respondents from industry (business associations, large companies and small companies) thought the involvement of industry partners was more relevant (26, 76.47%). Respondents from academic/research institutions thought the involvement of academia was more relevant (67, 62.62%).

Foundations and other stakeholders were deemed less relevant, since only 33 (16.26%) and 24 (12.31%) respondents respectively indicated that these stakeholders were very relevant. No respondents indicated that any of the categories was Not relevant at all. See Figure 34.

No statistical differences were found between the views of citizens and other respondents.

Figure 34: Relevance of actors for pooling and leveraging resources



Notes: Question: "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:"

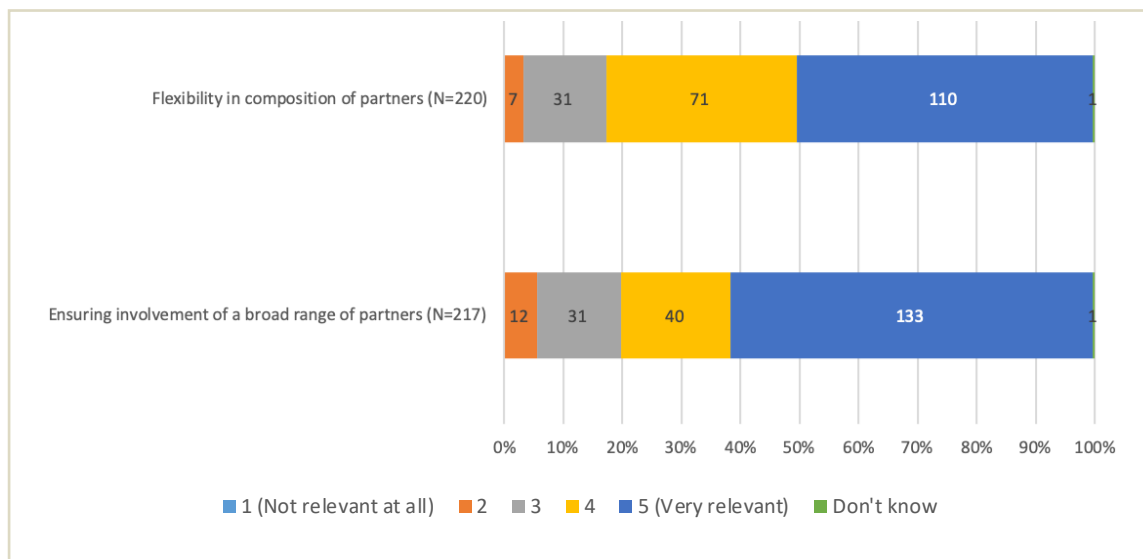
### Relevance of elements and activities for the partnership composition

Respondents were asked about the relevance of Partnership composition, such as flexibility in the composition of partners over time and involvement of a broad range of partners (including across disciplines and sectors), to reach Partnership objectives. As it is shown in Figure 35.

Ensuring involvement of a broad range of partners has slightly more 'very relevant' answers (133, 61.29%) than the flexibility in the composition of partners (110, 50.69%). Respondents from academic/research institutions and public authorities were more likely than industry to indicate that both of these characteristics were very relevant, particularly around the flexibility in the composition of partners.

A slight statistical difference was found between the views of citizens and other respondents, citizens find both the flexibility and the broad range of partners less relevant.

Figure 35: Relevant principles for the partnership composition



## Relevance of implementation of activities

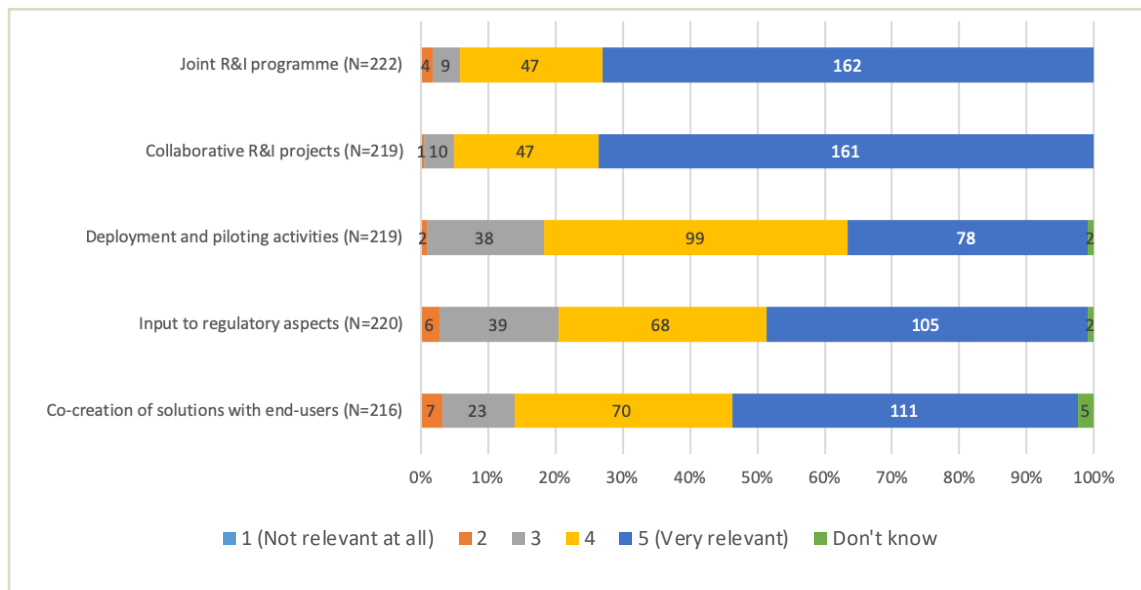
Respondents were asked to provide opinions on relevance of implementation of several activities for meeting objectives of the European Metrology Partnership. Among activities were listed – joint R&D programme, collaborative R&D projects, deployment and piloting activities, input to regulatory aspects and co-creation of solutions with end-users. Out of 222 respondents, 162 (72.97%) indicated that a joint R&I programme is very relevant to ensure that the Partnership would meet its objectives, collaborative R&I projects is also seen as very relevant, with 161 respondents (73.52%) choosing this answer.

Deployment and piloting activity have received the least 5 (very relevant) answers (78, 35.62%), however it has received the most 4 answers, which indicates that the respondents still find it to be relevant, although slightly less than the other options.

Though collaborative R&I project and a joint R&I programme were ranked by industry respondents as being most relevant, they also indicated a stronger preference than other stakeholders for input into regulatory activities, the co-creation of solutions with end-users and piloting activities, particularly respondents from large companies. Respondents from public authorities were also more likely than other stakeholder groups to indicate input into regulatory aspects as being more relevant.

No statistical differences were found between the views of citizens and other respondents for most activities. Citizens found the implementation of collaborative R&I project slightly less relevant. However, respondents that are/were involved in a current/preceding partnership (Horizon 2020 or Framework Programme 7) found the implementation of collaborative R&I project slightly more relevant.

Figure 36: Relevance of activities to implement



Notes: Question: "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"

### B.6.8 Relevance of setting up a legal structure (funding body) for the candidate European Partnerships to achieve improvements

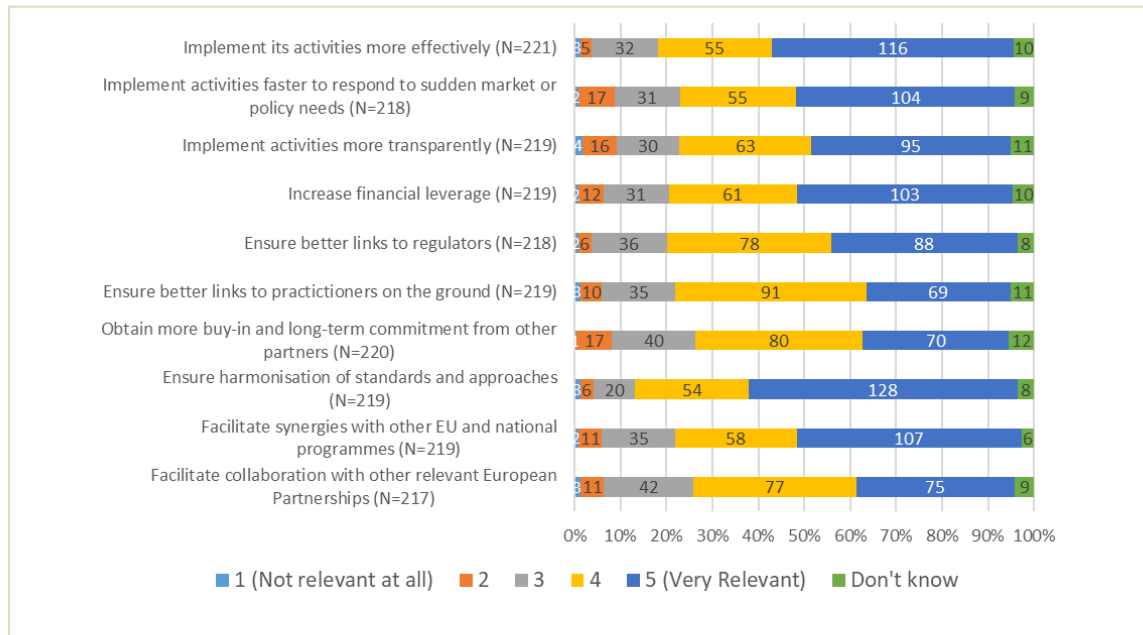
Respondents were also asked to assess the relevance of a specific legal structure (funding body) for the candidate European Partnership to achieve several activities. According to Figure 37, respondents specifically indicated that it was very relevant to set up a specific legal structure for the partnership to ensure harmonisation of standards and approaches (128, 58.45%). Respondents from industry and public authorities perceived this as being more relevant than other stakeholder groups.

Respondents from academic/research institutions found the legal structure to be most relevant for facilitating synergies with EU/national programmes.

Ensuring better links to practitioners on the ground has received the least 5 (very relevant) responses, however it has received the most 4's, which indicates that it is still seen as relevant by the respondents even if it is slightly less relevant than the other options.

Similar as for the previous question, citizens found the legal structure slightly less relevant for most objectives, while respondents that are/were involved in a current/preceding partnership found the legal structure slightly more relevant.

Figure 37: Relevance of setting up a legal structure (funding body)



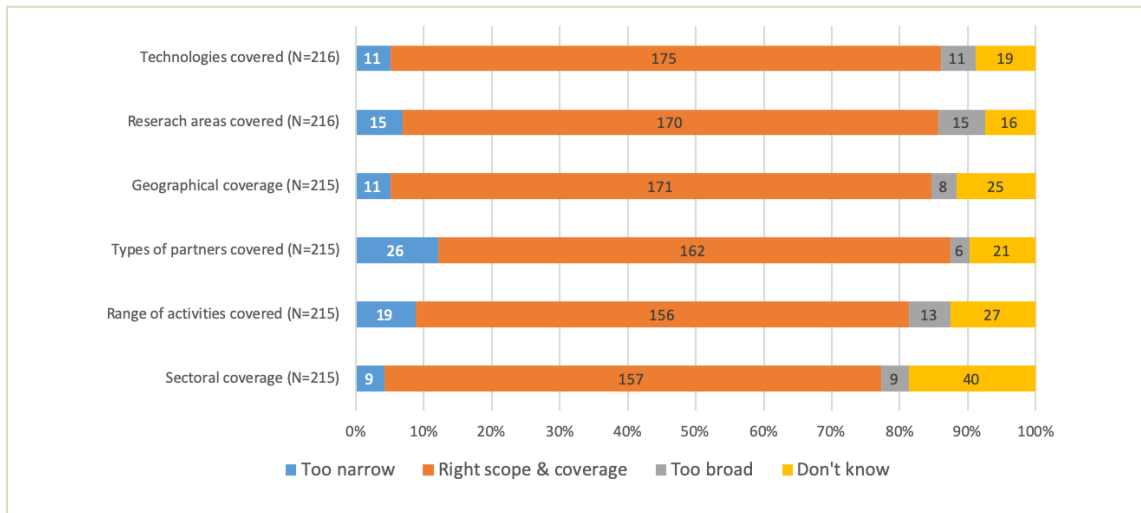
Notes: Question: "In your view, how relevant is to set up a specific legal structure (funding body) for the candidate European Partnership to achieve the following?"

### B.6.9 Scope and coverage of the candidate European Partnerships based on their inception impact assessments

Respondents were asked to assess the scope and coverage of the European Metrology Partnership, based on its inception impact assessment. The clear majority of the respondents have indicated that the partnership has the right scope and coverage across all areas. Across the different questions over 70% of the respondents have indicated that they think the scope and coverage are correct. The respondents have been the most positive with regard to the technologies covered, where 175 respondents (81.02%) have indicated the partnership has the right scope and coverage. There are no significant statistical differences between the different stakeholder types.

No statistical differences were found between the views of citizens and other respondents.

Figure 38: Scope and coverage proposed for the European Metrology Partnership

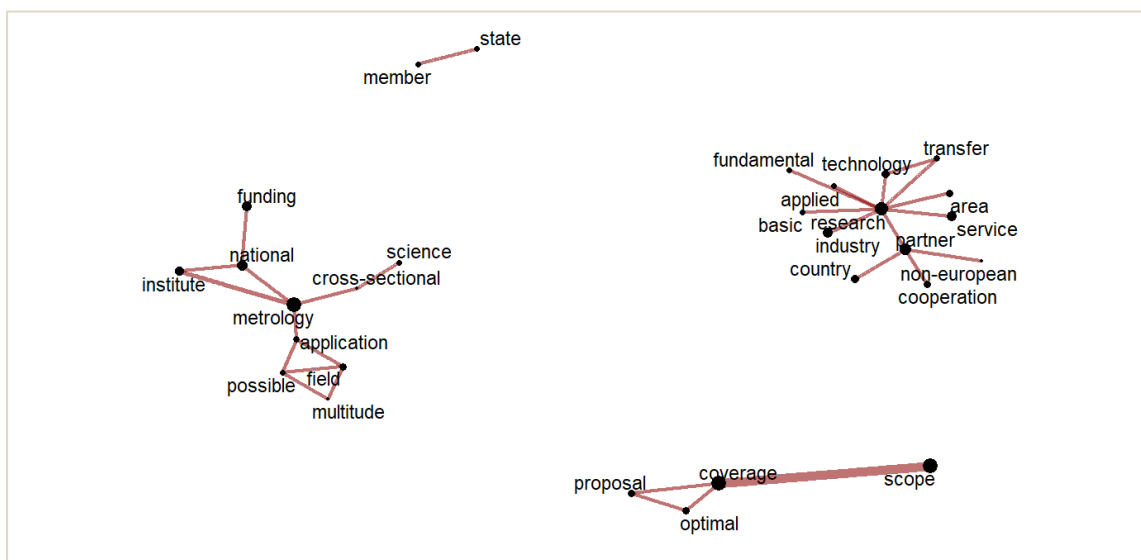


Notes: Question: "What is your view on the scope and coverage proposed for this candidate institutionalised European Partnership, based on its inception impact assessment?"

Aside from this multiple-choice question, the respondents were also asked to provide any comment that they may have on the proposed scope and coverage for this candidate Institutionalised Partnership. Respondents largely agreed that the proposed scope of the partnership was appropriate for the needs, highlighting again the need for the balance between fundamental and applied research, including a wide range of partner countries and that as metrology is such a transversal domain, it follows that the technologies and researcher areas covered are very broad. A small number of respondents also highlighted the need for the scope of the initiative to reflect the requirements of NMIs under the Metre Convention.

The keyword analysis used for open questions resulted in the graph shown in Figure 39:.. This analysis showed the respondents used this question to talk about the optimal and proposed scope and coverage as well as fundamental research, partner countries and non-European cooperation.

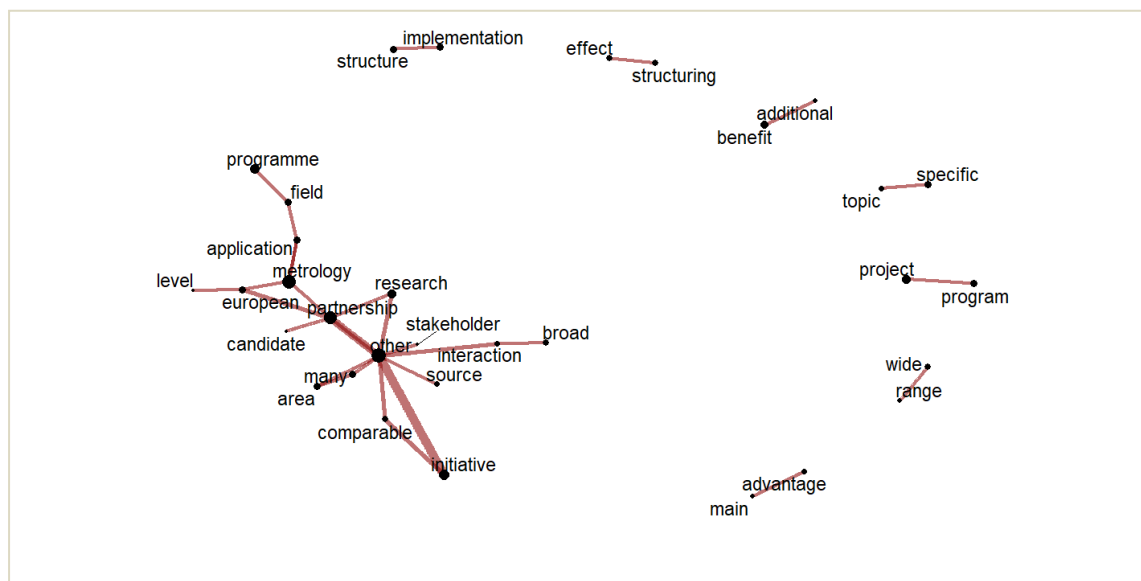
Figure 39: Scope and coverage proposed for this candidate Institutionalised Partnership (N=57)



Notes: 30 most common co-occurring keywords



Figure 41: Other comparable initiatives – open question (N=59)



Notes: Open question: "why other comparable initiatives are not suitable to be linked"; 30 most common co-occurring keywords

#### *B.6.11 Relevance of European Partnerships to deliver targeted scientific, economic/technological and societal impacts*

Respondents were asked to assess the relevance of the candidate European Institutionalised Partnership to deliver on listed impacts (Figure 42). Out of 220 respondents, 124 suggest that the Partnership would be 'very relevant' for contributing to reliable and trusted data exchange in health, environment, social protection and cultural heritage. This was strongest for research institutions, NGOs and Public Authorities.

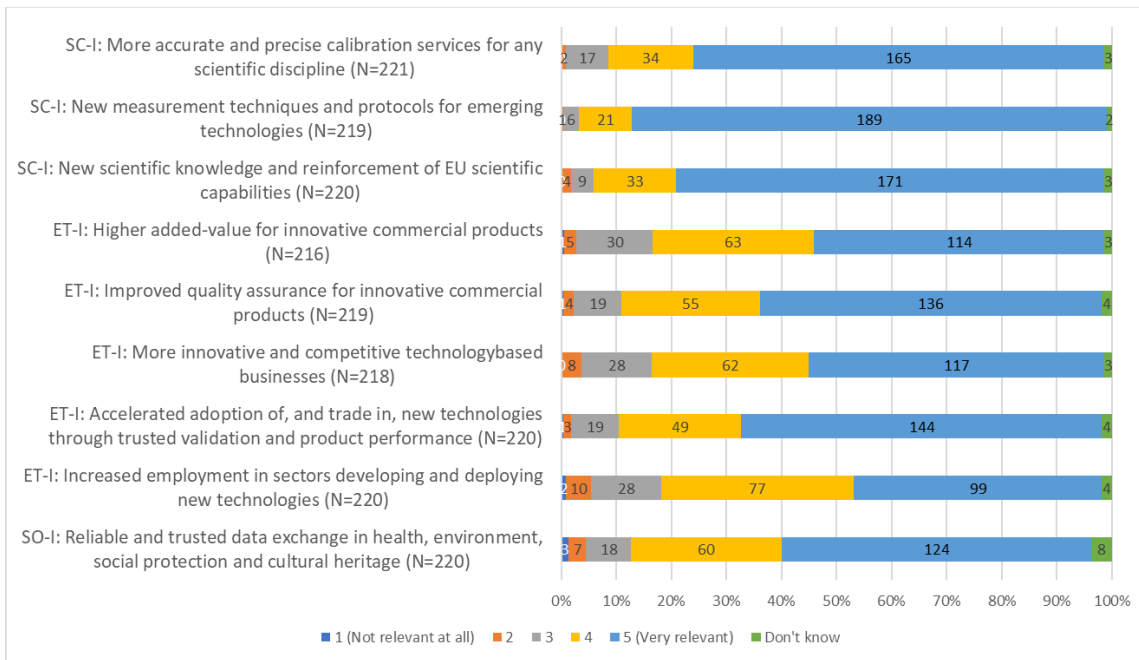
Among listed economic/technological impacts, a greater number of respondents, namely 144 out of 220 (65.45%), indicated that the Partnership is expected to be 'very relevant' for accelerating adoption of, and trade in, new technologies through trusted validation and product performance. The higher share of respondents suggest that the Partnership would have large impacts on science, in particular, on new measurement techniques and protocols for emerging technologies.

Respondents from industry were more likely to indicate higher relevance of economic impacts, particularly in the adoption and trade in new technologies. Academic/research institutes indicated the strongest impact for science impact, especially new measurement techniques and protocols for emerging technologies.

No statistical differences were found between the views of citizens and other respondents, except for the relevance of the economic/technological impacts regarding improved quality assurance for innovative commercial products and higher added value for innovative commercial products. Respondents that are/were involved in a current/preceding partnership (Horizon 2020 or Framework Programme 7) indicate a higher relevance of most listed impacts when compared to other respondents.



Figure 42: Relevance of the candidate European Institutionalised Partnership to various impacts



Notes: Question: "In your view, how relevant is it for the candidate European Institutionalised Partnership to deliver on the following impacts?"

**B.6.12 Summary of campaigns results for this specific initiative**

The candidate Metrology Partnership received 35 similar responses, which are treated as a campaign (campaign #3).

Table 25: Overview of responses of campaign participants (N=35)

Question category	Summary of responses
Research and innovation problems	Both categories are considered either 'very relevant' or 'relevant' (score 4).
Structural and resource problems	Both categories are considered either 'very relevant' or 'relevant' (score 4).
Problems in uptake of digital innovations	The categories "Lack of understanding of the benefits metrology brings to emerging technologies" and "Insufficient consideration of industrial and regulatory user needs when building metrology capacity and the quality infrastructure for emerging technologies" received a high score (either 4 or 5). The category "Insufficient digitalisation (data access and analysis, interoperability, and accessibility issues) to access and use metrology infrastructure and services" received mixed scores.
Preferred Horizon Europe intervention	Institutionalised Partnership was selected by all respondents. When respondents were asked to explain their choice, all of them used the following quote: "I believe that an Institutionalised Partnership is the most effective mode for metrology. This has been the mode of the last two programmes. It e.g. allows EURAMET to structure the community around shared institutional principles with ever deeper cooperation and coordination. Other modes would severely limit industrial and academia involvement as funded partners".
Relevance of actors for setting join long-term agenda	Involvement of Member States and Associated Countries, Industry and Academia is considered more relevant by

Question category	Summary of responses
	respondents, in contrast to involvement of foundations and NGOs, other societal stakeholders.
Relevance of actors for pooling and leveraging resources	Involvement of Member States and Associated Countries, Industry and Academia is considered more relevant by respondents, in contrast to involvement of foundations and NGOs, other societal stakeholders.
Partnership composition	Both answer categories ("Flexibility in the composition of partners over time" and "Involvement of a broad range of partners, including across disciplines and sectors") are considered 'relevant' and 'very relevant' by the majority of respondents.
Implementation of activities	All answer categories received a relatively high score (between 4 and 5, on average). However, deployment and piloting activities and co-creation of solutions with end-users has a slightly lower score.
Relevance of the legal structure	Across all categories, respondents indicated that the legal structure would be 'relevant' (on average, score 4). A slightly larger number of respondents consider that the legal structure would be particularly relevant (score 4 and 5) to implement activities of the Partnership more effectively, to ensure harmonisation of standards and approaches, and to facilitate synergies with other EU and national programmes.
Scope and coverage of the candidate Partnership	Almost all respondents considered that listed components of the candidate Partnership have right scope and coverage. Respondents were offered an opportunity to provide comments on the proposed scope and coverage of the Institutionalised Partnership. All of them included the following quote: <i>"The scope and coverage of the proposal is optimal. Member States fund their National Metrology Institutes to provide services and the associated research necessary to meet their obligations under the Metre Convention. It is part of this funding that they commit to the programmes and so the scope should match those responsibilities. If the scope were wider than the national funding would be restricted, if it were narrower than the opportunity for coordination would be limited"</i> .
Rationalisation of the candidate Partnership and linking to other initiatives	60% of respondents (21 respondents out of 35) consider that it would not be possible to rationalise the candidate Partnership and its activities, and/or to better link it with other comparable initiatives. Respondents were asked to explain their answer. Regardless of selection of answer options, all of them inserted a following quote: <i>"Metrology is a horizontal activity and the projects in the programme will interact with many of the other candidate partnerships and research funded from other sources, but the key benefits of the programme are the structuring effects from EURAMET being the Designated Implementation Structure. Not just running the programme processes but linking that to the wider responsibilities it has for metrology in Europe. Combined processes with other partnership areas would not provide this"</i> .
Societal impact	Majority of respondents considered that the candidate Partnership would be either 'very relevant' or 'relevant' to deliver on the listed societal impact.

Question category	Summary of responses
Economic/technological impact	Majority of respondents considered that the candidate Partnership would be either 'very relevant' or 'relevant' to deliver on the listed economic/technological impacts.
Scientific impact	Most respondents consider that the candidate Partnership is 'very relevant' for delivering on listed scientific impacts.

## Appendix C Methodological Annex

The Impact Assessment studies for all 13 candidate institutionalised European Partnerships 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. The Impact Assessment Study Teams went through grey and academic literature to identify the main challenges in the scientific and technologic fields and in the economic sectors relevant for their candidate partnerships. The review of official documentations, especially from the European Commission, additionally helped understand the main EU policy proprieties that the initiatives under assessment could contribute to achieve.

Almost no candidate institutionalised European Partnership is intended to emerge *ex nihilo*. Partnerships already existed under Horizon 2020 and will precede those proposed by the European Commission. In the assessment of the problems to address, the Impact Assessment Study Teams therefore considered the achievements of these ongoing partnerships, their challenges and the lessons that should be drawn for the future ones. For that purpose, they reviewed carefully the documents in relation to the preceding partnerships, especially their (midterm) evaluations conducted. The bibliography in Appendix A gives a comprehensive overview of the documents and literature reviewed for the present impact assessment study.

Finally, 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. The European Commission services and, where needed the ongoing Joint Undertakings or implementation bodies of the partnerships under Article 185 of the TFEU, provided data on the projects that they funded and their participants. These data 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 the countries (and groups of countries, such as EU, Associated Countries, EU13 or EU15) and to the industrial sectors, where relevant. The sectoral analysis required enriching the eCORDA data received from the European Commission services with sector information extracted from ORBIS. We used the NACE codification up to level 2. These data enabled identified the main and, where possible, emerging actors in the relevant systems, i.e. the organisations, countries and sectors that will need to be involved (further) in the future partnerships.

The horizontal teams also conducted a Social Network Analysis using the same data. It consisted in mapping the collaboration between the participants in the projects funded under the ongoing European 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 by the European Commission finally served a bibliometric analysis 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.

All together, these statistical analyses will complement the desk research for a comprehensive definition of the context in which the candidate institutionalised European Partnerships are intended to be implemented. The conclusions drawn on their basis will be 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 received in August 2019
- 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.

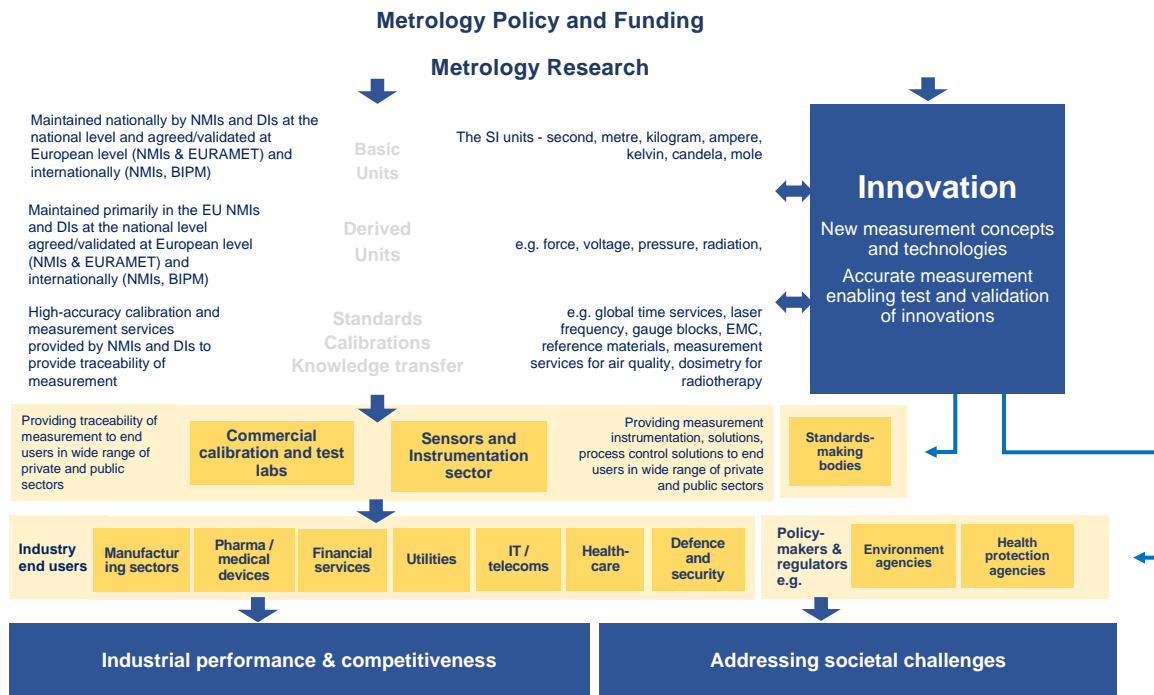
For instance, in all three exercises, the respondents were asked to reflect on the main challenges that the candidate institutionalised European Partnerships should address. In the open public consultations, they mainly reacted to proposals from the European Commission like when they were given to opportunity to give feedback to the inception impact assessment.

The views of stakeholders (and experts) were particularly important for determining the basic functionalities 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 Study Teams 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. Appendix B includes also the main outcomes of these three stakeholder consultation exercises.

The comparison of different options for European partnerships additionally relied on a cost-effectiveness analysis. When it comes to research and innovation programmes, the identification of costs and benefits should primarily be aimed at identifying the “value for money” of devoting resources from the EU (and Member States) budget to specific initiatives. Based on desk research and consultation with the European Commission services, the horizontal study team produced financial estimates for different types of costs (preparation and setup costs, running costs and winding down costs) and per partnership option. The costs were common to all candidate European Partnerships. The results of the cost model were displayed in a table, where each cost was translated on a scale using “+” in order to ease the comparison between the partnership options.

A scorecard analysis, which allocated each option a score between 1 and 3 against selected variables, was used to highlight those options that stand out as not being dominated by any of the other options in the group: such options are then retained as the preferential ones in the remainder of our analysis. It also allowed for easy visualisation of the pros and cons of alternative options.

## Appendix D Additional information related to the metrology value-chain



## Appendix E Additional information related to the problem definition

### E.1 Taxonomy of failures requiring policy intervention

Systemic failures	
<b>Capability And Infrastructure</b>	<p>Creating and maintaining a metrology capabilities and physical infrastructure has high fixed costs but has collective economic and societal benefits across a wide range of diverse measurement users that exceed the fixed costs.</p> <p>New and emerging technologies and new policy and regulation place additional demands on the metrology infrastructure while existing demands do not diminish. The fixed costs and on-going investment of ensuring fit-for-purpose national metrology systems in every European country to meet these demands is an inefficient solution to the metrology system to meet European needs for the future. Further coordination of national human, infrastructural and financial resources is needed. Furthermore, there is a risk of loss of European leadership in metrology infrastructure and capabilities if these demands are not met.</p>
<b>Network</b>	<p>As an infrastructure the metrology system has strong network effects that support arguments for public investment, in that the benefit to an individual user is greatest when as many others as possible also use the infrastructure.</p> <p>Where metrology research is concerned, there are on-going network failures in that there is insufficient exchange and collaboration between the metrology community and wider measurement users in industry, public services and policymakers/regulators that limit the benefits and impact of publicly funded metrology research (see also 'demand articulation' below).</p>
Transformational failures	
<b>Directionality Demand articulation Policy coordination</b>	<p>There is a continued need for a strategic approach to the provision of metrology capability and infrastructure at European level. The predecessor A185 programmes have successfully started a process of transformation of the metrology system in Europe. To date the greatest integration has been in metrology research at the project level but there is still a long way to go to reach sustained integrated coherent <b>research strategies and programmes</b> across Europe that are aligned with needs /demands.</p> <p>Furthermore, the future system needs to be more closely aligned than at present with demands in the industry and with policy-makers and regulators. Closer engagement with metrology users along the value-chain, in European businesses and among policy-makers, is required to capture needs, design a more integrated, coordinated and coherent metrology system and maximise its impact.</p>

Source: Technopolis Group (2018), Modified from Weber & Rohracher (2012)

## Appendix F Additional information related to the objectives definition

### F.1 General objectives for the initiative on Metrology aligned with the Horizon Europe objectives

Proposed initiative in Metrology	Alignment with Horizon Europe objectives
<b>Scientific objective</b>	
Establish, by 2030, a <b>sustainable coordinated world-class metrology system</b> based on high-quality science, open access and industrial and societal needs	To develop, promote and advance scientific excellence, support the creation and diffusion of high-quality new fundamental and applied knowledge, skills, technologies and solutions, training and mobility of researchers, attract talent at all levels and contribute to full engagement of Union's talent pool in actions supported under Horizon Europe
	<u>European Research Area objective:</u> Optimise programme delivery for strengthening and increasing the impact and <b>attractiveness of the European Research Area</b>
<b>Economic objective</b>	
Increase and accelerate the development and deployment of <b>innovation</b> in Europe through effective use of metrology capabilities	<b>Foster all forms of innovation</b> , facilitate technological development, demonstration and knowledge and technology transfer, strengthen deployment and exploitation of innovative solutions
<b>Societal objective</b>	
Increase the contribution of metrology to the design and implementation of <b>standards and regulation that underpin public policies addressing societal challenges</b>	<b>Strengthen the impact of research and innovation</b> in developing, supporting and implementing Union policies, and support the access to and uptake of innovative solutions in European industry, notably in SMEs, and society to address global challenges, including climate change and the Sustainable Development Goals

Metrology sits within the Digital, Industry and Space cluster of Pillar II in Horizon Europe but, as described throughout this document, the accurate and reliable measurements it enables, and the measurement knowledge it creates, is deployed throughout the economy and society and therefore will have impact in domains in other Pillars.



## Appendix G Outcomes and (expected) Impacts of Predecessor A185 Initiatives

### G.1 Predecessor partnership(s) / initiatives

The current A185 initiative in metrology, under Horizon 2020, is the **European Metrology Programme for Innovation and Research (EMPIR)** running from 2014 to 2023. This programme was preceded by European Metrology Research Programme (EMRP), under Framework Programme 7, that ran from 2009 to 2017 and a pilot ERA-NET plus programme (iMERA-plus) in 2005-2007.

#### G.1.1 Scope and objectives

The scope of the partnerships is *metrology - the science of measurement*. Metrology is fundamental to global trade and effective regulation. Often hidden from the public view, it is an important building block of our industrialised and increasingly globalised society and affects almost every aspect of modern life. Precision in industrial production and processes, the reliability of medical diagnosis, environmental monitoring, data quality for regulation and many more applications rely on correct and comparable measurements.

The comparability of measurements, i.e. measurements are the same wherever and whenever they are made, is achieved by ensuring all measurements are traceable to the International System of Units, referred to as the SI. Most countries invest in an infrastructure that holds and maintains national reference measurement standards (for the metre, kilogram, second, etc) that sit at the top of a 'traceability' chain that extends down to markets and public services. The National Metrology Institutes (NMIs)<sup>54</sup> responsible for national measurement standards work together to ensure measurement standards are consistent internationally. This combined national and international infrastructure ensures that measurements are the same worldwide so that everyone speaks the 'same measurement language'.

Both predecessor programmes focused on metrology and both supported, funded and coordinated research across Europe to address metrology needs related to societal grand challenges in health, environment, energy and challenges in innovation and industrial competitiveness while also supporting and developing the SI system of measurement units that forms the basis of metrology worldwide. Both programmes were implemented by EURAMET - the European Association of National Metrology Institutes.

The current European Metrology Programme for Innovation and Research (EMPIR) additionally supports: capacity-building projects that aim to bridge the gap between EU member states with emerging measurement systems and those with more developed capabilities; pre-normative research in partnership with the European standards-making bodies; and coordination and support actions, known as Support for Innovation Projects (SIPs), to further adapt and disseminate previous EMRP and EMPIR research project outputs to encourage and accelerate adoption by industry or other metrology users.

EMPIR was established in 2014 by 28 participating countries (23 Member States and 5 non-Member States)<sup>55</sup> with a total budget of €600M; €300M from national governments and €300M from the European Commission. The programme is implemented by EURAMET - the European Association of National Metrology Institutes. The core activity consists of funding multi-partner, multi-country joint research projects to advance metrology and its

<sup>54</sup> In some countries Designated Institutes (DI) share the national role with NMIs. Here NMI is used as shorthand to incorporate both NMIs and DIs

<sup>55</sup> Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Bosnia-Herzegovina, Serbia, Turkey, Norway, Switzerland

applications. Annual research calls will be made between 2014 and 2020, funding around 100-120 joint research projects for a maximum of 3 years.

*G.1.2 Stakeholder analysis*

Both EMPIR and EMRP coordinated significant proportions of national research budgets for metrology. As these budgets are typically allocated directly to the national metrology institutes and designated institutes (the core metrology community) they have been key participants in the partnerships in terms of governance and research participants. However the research programmes under both partnerships had mechanisms for, and encouraged, participation from the wider research base in academia and research institutes and measurement end-users in industry and the public sector. As Figure 43 shows the majority of the participations, just under half (48%), were from public entities and bodies (PUB) because this is the category into which the majority of national metrology institutes and designated institutes fall. There were also considerable participations from higher education (HES: 20%), the private sector (PRC: 16%) and public research organisations (REC: 11%).

Call themes covered metrology for health, environment, energy and industry in addition to research to develop the underpinning metrology system, and therefore the participants who were external to the metrology community came from a wide range of sectors and research disciplines.

88% of participations were from EU MS, 10% from Associated States and 2% from the wider international community (that were most commonly other national metrology institutes).

Figure 43: Composition analysis of EMPIR participant by organisation type

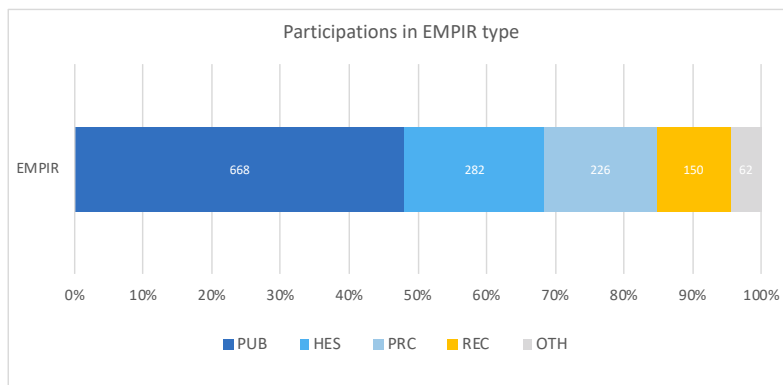
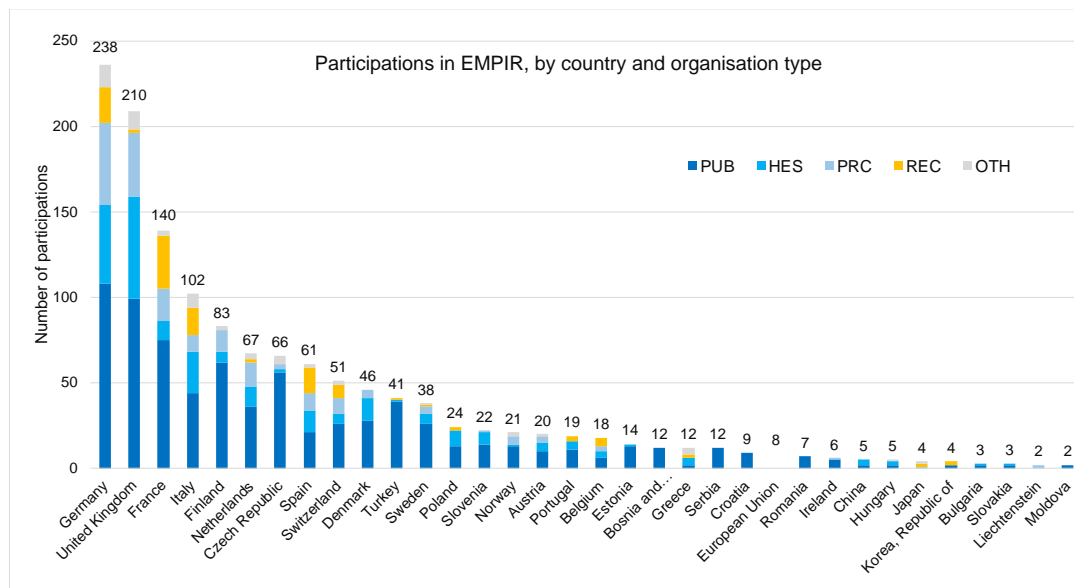


Figure 44: Composition analysis of EMPIR participant by country and by organisation type



## G.2 Outcomes and (expected) impacts

Two evaluations of EMRP and EMPIR have been conducted.<sup>56 57</sup>

These demonstrated that:

- Both programmes were well-managed and have achieved a relatively high degree of scientific, management and financial integration. EURAMET e.V. manages the programmes efficiently and can be trusted with the delegated authority of an Article 185 initiative
  - The research calls are run in full alignment with EU rules with this being demonstrated each year via an independent assessment
  - 28 countries were formal participants in EMPIR (including 23 EU MS) i.e. were signatories to the A185
  - The national commitments to the A185 partnership were exceeded in EMRP and on track to reach the target in EMPIR
  - It is estimated that around 50% of national metrology research budgets are aligned via EMPIR, an increase from an estimated of 5% of European metrology research conducted collaboratively before the first FP7 partnership (EMRP)
- Economic impact has been demonstrated (to date) as €420M in turnover of innovative products and services directly attributable to the programmes. This exceeds the target set for this metric in the EMPIR Impact Assessment. EURAMET continues to track economic impact and therefore this figure is expected to increase
- Social impact has been demonstrated in terms of large numbers of individual case studies detailing examples of the adoption of metrology research outputs for social benefit. The varied nature of these means that no form of aggregation of social impact is feasible

<sup>56</sup> Interim Evaluation of the European Metrology Research Programme (EMRP), Expert Panel Report, European Commission, 2012 [https://ec.europa.eu/research/evaluations/pdf/emrp-empir\\_expgrp\\_report\\_final.pdf](https://ec.europa.eu/research/evaluations/pdf/emrp-empir_expgrp_report_final.pdf)

<sup>57</sup> Final Evaluation of the European Metrology Research Programme (EMRP) and Interim Evaluation of the European Metrology Programme for Innovation and Research (EMPIR), Expert Group Report, European Commission, 2017 <https://publications.europa.eu/en/publication-detail/-/publication/eac61c51-ae2e-11e7-837e-01aa75ed71a1/language-en>

- In terms of scientific impact, collaborative European research under EMRP and EMPIR made a significant contribution to the international activity to overhaul the underpinning basis of the SI system of units in 2018.<sup>58</sup> In addition, bibliometric evidence demonstrates that the collaborative research conducted under EMRP<sup>59</sup> is above the world average in terms of citations and impact factors.

### Identified needs for action

The key needs for action are:<sup>60 61 62</sup>

- While the predecessor initiatives have gone a long way in establishing a coordinated metrology infrastructure, it is not yet firmly embedded or sustainable without support. Currently the initiatives are largely centred on the processes for developing and delivering joint research projects, this works well but when projects are complete the detailed cooperation fades and links to stakeholders revert to national concerns rather than the European level.
- While EMPIR was more open to wider participation beyond the core metrology community, more openness to industrial, academic and research partners would create a more integrated community that can better respond to society's emerging needs
- The impact of the metrology initiatives can be further improved through wider participation (as above) and through better alignment of activities with industrial and particularly to policy needs related to societal challenges
- There is more to be done to involve and develop the capacities of smaller metrology institutes
- Mechanisms need to be developed that will create more strategic, long term cooperation among a wider community of metrology experts and end users. Something that will last and operate independent from project funding
- In addition, the demands on the metrology system continue to increase to meet the needs of emerging technologies and societal challenges.

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<sup>58</sup> The SI system of units was redefined in its totality by international vote under the auspices of the International Committee for Weights and Measures (CIPM) in November 2018, with this change coming into effect in May 2019. This is was first time such a comprehensive change to the metrology system has taken place since the original Convention de Metre was signed in 1875. See for example an article in Nature <https://www.nature.com/articles/d41586-018-07424-8>

<sup>59</sup> It is too soon to conduct robust bibliometric analysis for EMPIR

<sup>60</sup> The two evaluations referenced in footnotes 13 and 14

<sup>61</sup> Input from the Expert Panel

<sup>62</sup> COM(2013) 497 final, SWD(2013) 250 final: Impact Assessment Accompanying the document Proposal for a Decision of the European parliament and of the Council on the participation of the Union in a European Metrology Programme for Innovation and Research jointly undertaken by several Member States

## Appendix H Detailed analysis of functionalities for each option

### H.1 Option 0: Baseline, Traditional calls under Horizon Europe

Functionalities required	Option 0: Horizon Europe calls
<b>Internal factor:</b> Type and composition of actors involved	
<ul style="list-style-type: none"> <li>• Ideally all European NMIs and DIs, but if not all, then majority of NMIs and DIs<sup>63</sup></li> <li>• Ideally all European Ministries responsible for metrology policy and funding</li> <li>• A wide range of industry from across the value-chain and key relevant sectors (such as aerospace, automotive, pharmaceuticals, process control equipment manufacturers, medical device manufacturers, ICT manufactures, telecommunication network providers, utilities, defence)</li> <li>• Regulators and standards-making bodies covering: climate, energy, environment and health, such as environment agencies, health protection and pharmaceutical and medical device regulators, CEN-Cenelec, ETSI</li> <li>• Academic / public sector researchers</li> </ul>	<ul style="list-style-type: none"> <li>• Metrology research distributed across the Horizon Europe programme dependent on which metrology priorities make it into the cluster thematic work programmes</li> <li>• Resulting in ad hoc participation in research projects by NMIs and DIs</li> <li>• No participation by Ministries</li> <li>• Where NMIs and DIs do participate this most likely to be the larger NMIs and DIs that are more experienced in bidding for FP funding (as was the case under traditional calls in previous Framework Programmes)</li> <li>• Bidding for funding under traditional calls is less attractive to NMIs and DIs due to costs of bidding compared to low success rate, resulting in lower overall quantity of metrology research lower</li> <li>• Industry can participate in joint research projects under Horizon Europe rules</li> <li>• Collaborations between NMIs / DIs and academics and industry would occur, with exact nature by sector and needs addressed dependent on which metrology priorities are in the cluster thematic work programmes</li> </ul>
<b>Internal factor:</b> Type and range of activities	
<ul style="list-style-type: none"> <li>• Centralised governance and management processes</li> <li>• Develop a long-term Strategic Research and Innovation Agenda (SRIA) for European Metrology that covers: changing the structures to coordinate metrology research and; the content of the research required to ensure European metrology remains world-class and meets economic and societal needs</li> <li>• Design the principles for European Metrology Networks, facilitate their creation in key domains identified in the SRIA, and ensure they involve key relevant actors along the value-chain</li> </ul>	<ul style="list-style-type: none"> <li>• The majority of activity would be collaborative R&amp;I projects</li> <li>• There would be no dedicated governance and management processes and no Strategic Research and Innovation Agenda, therefore no long-term strategy for metrology research</li> <li>• There would be no coordinating activities to drive long-term change to coordination structures for R&amp;I</li> <li>• EURAMET might try to build on the momentum created by previous A185</li> </ul>

<sup>63</sup> At least 70%, including NMI and DIs in the large European Countries in order to include the already world-leading NMI and DIs

Functionalities required	Option 0: Horizon Europe calls
<ul style="list-style-type: none"> <li>• Design and run calls for proposals driven by the SRIA for Joint Research Projects that support the development of the underpinning metrology system; innovation; and standardisation and regulation for EU policy with a focus on climate, environment and health</li> <li>• Support actions for capacity building in metrology in countries small and developing NMIS and Dis</li> </ul>	<p>initiatives but the coordination resource required and competition would make it difficult to maintain</p> <ul style="list-style-type: none"> <li>• The majority of activity would be collaborative R&amp;I projects but there would be underpinned by a collective European strategy for metrology</li> <li>• Limited capacity building activities. There might be coordination and support activities in this area, but projects would be selected on a competitive basis and so no guarantee of success</li> </ul>
<b>Internal factor:</b> Directionality required	
<ul style="list-style-type: none"> <li>• A high level of directionality and long-term commitment from NMIs, DIs, Ministries responsible for metrology policy and funding</li> <li>• Within NMIs and DIs - requires support from senior leaders and research staff</li> <li>• Strong central governance involving NMIs / DIs and their respective ministries</li> </ul>	<ul style="list-style-type: none"> <li>• Very limited directionality due to there being no SRIA, no involvement of Ministries and limited direct participation of NMI / DI senior leaders</li> <li>• No strategically driven coordinating activities to drive long-term change to coordination structures. Any networks established would be oriented towards mainstream metrology issues</li> <li>• No central governance would occur under traditional calls</li> </ul>
<b>External factors</b>	
<ul style="list-style-type: none"> <li>• International NMIs and DIs</li> <li>• Regulators and standards-making bodies covering: climate, energy, environment and health, such as environment agencies, health protection and pharmaceutical and medical device regulators, CEN-Cenelec, ETSI</li> </ul>	<ul style="list-style-type: none"> <li>• International partners (unfunded, unless international agreements in place) are eligible to participate in projects under Horizon Europe rules but this would be unlikely unless the specific calls encouraged international collaboration</li> <li>• Policy-makers, regulators and standards-making may participate in individual projects but would have no, or a very limited role in the process of designing calls and influencing R&amp;I direction.</li> </ul>

## H.2 Option 2: Co-Fund European Partnership

Functionalities required	Option 2: Co-fund European Partnership
<b>Internal factor:</b> Type and composition of actors involved	
<ul style="list-style-type: none"> <li>• Ideally all European NMIs and DIs, but if not all, then majority of NMIs and DIs<sup>64</sup></li> <li>• Ideally all European Ministries responsible for metrology policy and funding</li> <li>• A wide range of industry from across the value-chain and key relevant sectors (such as aerospace, automotive, pharmaceuticals, process control equipment manufacturers, medical device manufacturers, ICT manufactures, telecommunication network providers, utilities, defence)</li> <li>• Regulators and standards-making bodies covering: climate, energy, environment and health, such as environment agencies, health protection and pharmaceutical and medical device regulators, CEN-Cenelec, ETSI</li> <li>• Academic / public sector researchers</li> </ul>	<ul style="list-style-type: none"> <li>• Interested NMIs and DIs all agree to participate, and sign the co-fund grant agreement, on an individual basis</li> <li>• Partnership is 'owned' and run by the signatory NMIs and DIs</li> <li>• No Ministry participation</li> <li>• Number of participating NMIs and DIs expected to be reasonably high although somewhat lower than in an Institutionalised Partnership. There may a skew towards participation by larger institutes (and therefore their R&amp;I priorities), i.e. those NMIs more than DIs and those with experience of large complex grants. This limits ability to undertake capacity building</li> <li>• Participation limited to the NMIs and DIs that sign the grant agreement. Others can join during the partnership period by signing the grant agreement subject to an approved contract amendment), although the total budget remains the same so Horizon Europe funding levels for existing partners would need to be re-adjusted which may act as a disincentive.</li> <li>• Participation in R&amp;I projects limited almost exclusively to NMIs and DIs as the national funding for metrology is already allocated to them it cannot be allocated to other actors. It would be possible, in principle, to involve other actors (e.g. academia, industry, policy-makers, regulators and standards bodies) either on a self-funded basis and/or by using some of the EU co-funding budget to pay for subcontracted expertise but this would be subject to project-by-project decisions by the grant recipients</li> </ul>
<b>Internal factor:</b> Type and range of activities	
<ul style="list-style-type: none"> <li>• Centralised governance and management processes</li> <li>• Develop a long-term Strategic Research and Innovation Agenda (SRIA) for European Metrology that covers: changing the structures to coordinate metrology research and; the content of the research required to ensure European metrology remains world-</li> </ul>	<ul style="list-style-type: none"> <li>• Governance designed and driven via the grant agreement. If led by EURAMET, its governance structures can be re-purposed to govern the Co-funded Partnership. - or it would be led by a single NMI or DI</li> <li>• As partnership is signed by NMIs and DIs, then governance may be more complex as each NMI and DI will require 'a seat at the table' compared to an Insitutionalised</li> </ul>

<sup>64</sup> At least 70%, including NMI and DIs in the large European Countries in order to include the already world-leading NMI and DIs

Functionalities required	Option 2: Co-fund European Partnership
<p>class and meets economic and societal needs</p> <ul style="list-style-type: none"> <li>• Design the principles for European Metrology Networks, facilitate their creation in key domains identified in the SRIA, and conduct European joint research - ensuring they involve key relevant actors along the value-chain</li> <li>• Design and run calls for proposals driven by the SRIA for Joint Research Projects that support the development of the underpinning metrology system; innovation; and standardisation and regulation for EU policy with a focus on climate, environment and health</li> <li>• Support actions for capacity building in metrology in countries small and developing NMIS and DIs</li> </ul>	<p>Partnership (where it is one seat per Member State or Associated country)</p> <ul style="list-style-type: none"> <li>• Overall, the result is likely to be a governance process with moderate influence and authority</li> <li>• An agreed research agenda would be developed by and for participating NMIs and DIs for the duration of the grant agreement</li> <li>• Calls for proposals for collaborative research would be managed by the consortium lead under national rules. These would be 'internal' calls among NMIs/DIs competing on pre-defined priorities of the agreed research agenda.</li> <li>• There would be no centralised grant agreement per project, resulting in a weaker ability to monitor activities</li> <li>• Calls and/or agreed activities for greater coordination and the introduction of new structures of coordination (such as the European Metrology Networks) among the participating NMIs and DIs are, in principle, possible, with participation from a wider groups of stakeholders along the value-chain</li> <li>• Similarly calls and/or agreed activities for capacity building are possible, though dependent on how many smaller and developing NMIs/ DIS participate so creating a demand for such activities</li> </ul>
<b>Internal factor:</b> Directionality required	
<ul style="list-style-type: none"> <li>• A high level of directionality and long-term commitment from NMIs, DIs, Ministries responsible for metrology policy and funding</li> <li>• Within NMIs and DIs - requires support from senior leaders and research staff</li> <li>• Strong central governance involving NMIs / DIs and their respective ministries</li> </ul>	<ul style="list-style-type: none"> <li>• Senior level commitment would be required from the participating NMI/DIs but, depending on the degree of delegated authority, the involvement of national funding Ministries would not be necessary.</li> <li>• Governance structure could involve ministries but more likely to be senior representatives from NMI/DIs</li> <li>• Executive management structure would be committee based but could be centrally coordinated by EURAMET</li> </ul>
<b>External factors</b>	
<ul style="list-style-type: none"> <li>• International NMIs and DIs</li> <li>• Regulators and standards-making bodies covering: climate, energy, environment and health, such as environment agencies, health protection and pharmaceutical and medical device regulators, CEN-Cenelec, ETSI</li> </ul>	<ul style="list-style-type: none"> <li>• International partners (unfunded, unless international agreements in place) can participate unfunded alongside NMI/DI projects and activities, but without any formal agreement. They can also (in theory) be a member of the consortium although not eligible for EU grant funding.</li> <li>• Calls and/or agreed activities for greater coordination and the introduction of new</li> </ul>



Functionalities required	Option 2: Co-fund European Partnership
	structures of coordination (such as the European Metrology Networks) would bring together a wider range of relevant stakeholders from industry and policy-makers, regulators and standards bodies

**H.3 Option 3: A185 Institutionalised Partnership**

Functionalities required	Option 3: Institutionalised Partnership - Article 185 of TFEU
<b>Internal factor:</b> Type and composition of actors involved	
<ul style="list-style-type: none"> <li>• Ideally all European NMIs and DIs, but if not all, then majority of NMIs and DIs<sup>65</sup></li> <li>• Ideally all European Ministries responsible for metrology policy and funding</li> <li>• A wide range of industry from across the value-chain and key relevant sectors (such as aerospace, automotive, pharmaceuticals, process control equipment manufacturers, medical device manufacturers, ICT manufactures, telecommunication network providers, utilities, defence)</li> <li>• Academic / public sector researchers</li> </ul>	<ul style="list-style-type: none"> <li>• The partnership is 'owned' and run by Member States and Associated Countries via the Ministries responsible for metrology policy and funding participate in the partnership. As representatives of Member States and Associated Countries the Ministries are the signatories of the Co-decision by the European Parliament and Council</li> <li>• Participation at the level of Member States and Associated Countries, ensures that the NMIs and all DIs in each country can participate and benefit in the partnership</li> <li>• A high proportion of national Ministries expected to sign. Interest has already been expressed by 20 Member States and 4 Associated Countries. This is realistic based on a past initiative that had 28 participating countries (23 Member States and 5 thrd-countries)</li> <li>• Other Member States and Associated Countries can join at a later date but this requires amending the co-decision, a rather complicated process</li> <li>• The partnership runs calls for joint research projects under standard Horizon Europe rules, therefore industry and other eligible stakeholders can participate (and be funded) in joint research projects</li> <li>• International NMIs and DIs can participate in joint research projects as unfunded partners</li> <li>• Stakeholders from policy-makers, regulators and standards bodies can participate in joint research projects as unfunded partners and/or can participate in advisory roles on European Metrology Networks</li> <li>• The establishment of new structures for long-term cooperation in metrology research and provision of metrology capabilities in the form</li> </ul>

<sup>65</sup> At least 70%, including NMI and DIs in the large European Countries in order to include the already world-leading NMI and DIs

Functionalities required	Option 3: Institutionalised Partnership - Article 185 of TFEU
	<p>of European Metrology Networks (see 'type and range of activities' below) would bring together a wider range of relevant stakeholders from industry and policy-makers, regulators and standards bodies.</p> <ul style="list-style-type: none"> <li>• The partnership has flexibility to involve a wide range of stakeholders</li> </ul>
Internal factor: Type and range of activities	
<ul style="list-style-type: none"> <li>• Centralised governance and management processes</li> <li>• Develop a long-term Strategic Research and Innovation Agenda (SRIA) for European Metrology that covers: changing the structures to coordinate metrology research and; the content of the research required to ensure European metrology remains world-class and meets economic and societal needs</li> <li>• Design the principles for European Metrology Networks, facilitate their creation in key domains identified in the SRIA, and conduct European joint research - ensuring they involve key relevant actors along the value-chain</li> <li>• Design and run calls for proposals driven by the SRIA for Joint Research Projects that support the development of the underpinning metrology system; innovation; and standardisation and regulation for EU policy with a focus on climate, environment and health</li> <li>• Support actions for capacity building in metrology in countries small and developing NMIS and DIs</li> </ul>	<ul style="list-style-type: none"> <li>• The A185 co-decision would delegate authority to manage the partnership and manage Horizon Europe funding to a dedicated implementation body - in this case EURAMET</li> <li>• The proposed governance structure and processes under the auspices of EURAMET will be robust and supported /trusted by the community of NMIs, DIs and their respective ministries (as demonstrated by evaluations of past initiatives)</li> <li>• The Commission may participate in governance committees as an observer and full transparency of the partnership's strategies, decisions and activities</li> <li>• The governance structure would be supported by a professional management support function within EURAMET and funded by cash contributions the signatories to the co-decision (from Member States and Associated Countries.</li> <li>• The governance structure enables the development of a long-term Strategic Research and Innovation Agenda (SRIA) for European Metrology</li> <li>• The establishment of new structures for long-term cooperation in metrology research and provision of metrology capabilities in the form of European Metrology Networks - bringing together a wider range of relevant stakeholders from industry and policy-makers, regulators and standards bodies.</li> <li>• Joint research projects undertaken aligned with SRIA, run under Horizon Europe rules and fully transparent</li> <li>• The centralised implementation body undertakes the life cycle management of joint research projects from open calls for ideas from all stakeholders and calls for proposals, to peer review and selection, monitoring progress and supporting and capturing adoption of outputs</li> <li>• The centralised implementation body runs calls for coordination and support actions to</li> </ul>

Functionalities required	Option 3: Institutionalised Partnership - Article 185 of TFEU
	<p>support capacity building among smaller and developing NMIs and DIs. Actions that support collaboration and mentoring between experienced and less experienced NMIs and DIs</p>
Internal factor: Directionality required	
<ul style="list-style-type: none"> <li>• A high level of directionality and long-term commitment from NMIs, DIs, Ministries responsible for metrology policy and funding</li> <li>• Within NMIs and DIs - requires support from senior leaders and research staff</li> <li>• Strong central governance involving NMIs / DIs and their respective ministries</li> </ul>	<ul style="list-style-type: none"> <li>• Co-decision signed by Ministries on behalf of Member States and Associated Countries secures significant policy and financial commitment for the duration of the partnership and commitment to the long-term coordination objectives. Ministry participation also secures and drives NMI and DI buy-in to the to the long-term coordination objectives</li> <li>• A185 model allows for projects to be funded in last year of partnership budget allocation, meaning the partnership, its governance and activities run for another 3 years . Making the partnership lifetime 10 years in total, a sufficiently long duration to affect change and ensure coordination structures are in place beyond the partnership</li> <li>• Long-term commitment of Ministries enables strong governance structure and processes to be put in place to provide strategic direction and operational authority - enabling NMIs and DIs to commit to making structural changes such as the European Metrology Networks</li> <li>• Long-term financial commitment to (at least 50% of total partnership budget) is a strong influencer of change</li> <li>• The structural change in coordination, leaving a new structure in place (the European Metrology Networks) provides an exit strategy for the partnership</li> </ul>
External factors	
<ul style="list-style-type: none"> <li>• International NMIs and DIs</li> <li>• Regulators and standards-making bodies covering: climate, energy, environment and health, such as environment agencies, health protection and pharmaceutical and medical device regulators, CEN-Cenelec, ETSI</li> </ul>	<ul style="list-style-type: none"> <li>• International partners (unfunded, unless international agreements in place) are eligible to participate in projects under Horizon Europe rules</li> <li>• The establishment of new structures for long-term cooperation in metrology research and provision of metrology capabilities in the form of European Metrology Networks (see 'type and range of activities' below) would bring together a wider range of relevant stakeholders from industry and policy-makers, regulators and standards bodies</li> </ul>

**H.4 Summary of all three Options vs. functionalities**

Functionalities required	Option 0: Horizon Europe calls	Option 2: Co- funded Partnership	Option 3: Institutional Partnership (A185)
<b>INTERNAL FACTOR: Type and composition of actors involved</b>			
Ideally all European NMIs and DIs, but if not all, then majority of NMIs and DIs	<b>No</b>	<b>Possible</b>	<b>Yes</b>
Ideally all European Ministries responsible for metrology policy and funding	<b>No</b>	Indirectly as national funders	<b>Yes</b>
A wide range of industry from across the value-chain and key relevant sectors (such as aerospace, automotive, pharmaceuticals, process control equipment manufacturers, medical device manufacturers, ICT manufactures, telecommunication network providers, utilities, defence)	<b>Yes</b>	<b>Possible</b> If self-funded or sub-contractors	<b>Yes</b>
Regulators and standards-making bodies covering: climate, energy, environment and health, such as environment agencies, health protection and pharmaceutical and medical device regulators, CEN-Cenelec, ETSI	<b>Possibly</b>	<b>Possible</b> If self-funded or sub-contractors	<b>Yes</b>
Academic / public sector researchers	<b>Yes</b>	<b>Possible</b> If self-funded or sub-contractors	<b>Yes</b>
<b>INTERNAL FACTOR: Type and range of activities</b>			
Centralised governance and management processes	<b>No</b>	<b>Yes</b> moderate governance	<b>Yes</b> strong governance
Develop a long-term Strategic Research and Innovation Agenda (SRIA) for European Metrology that covers: changing the structures to coordinate metrology research and; the content of the research required to ensure European metrology remains world-class and meets economic and societal needs	<b>No</b>	<b>Yes</b> Likely to focus on duration of partnership	<b>Yes</b> With longer-term focus
Design the principles for European Metrology Networks, facilitate their creation in key domains identified in the SRIA, and conduct European joint research - ensuring they involve key relevant actors along the value-chain	<b>No</b>	<b>Possible</b>	<b>Yes</b>

Functionalities required	Option 0: Horizon Europe calls	Option 2: Co- funded Partnership	Option 3: Institutional Partnership (A185)
Design and run calls for proposals driven by the SRIA for Joint Research Projects that support the development of the underpinning metrology system; innovation; and standardisation and regulation for EU policy with a focus on climate, environment and health	<b>No</b>	<b>Yes</b> Likely to focus on duration of partnership	<b>Yes</b>
Support actions for capacity building in metrology in countries with small and developing NMIS and DIs	<b>Possible</b> via CSA or other HEU instruments	<b>Possible</b>	<b>Yes</b>
<b>INTERNAL FACTOR: Directionality required</b>			
A high level of directionality and long-term commitment from NMIs, DIs, Ministries responsible for metrology policy and funding	<b>No</b>	<b>Partly</b> Ministries involved indirectly	<b>Yes</b>
Within NMIs and DIs - requires support from senior leaders and research staff	<b>No</b>	<b>Yes</b>	<b>Yes</b>
Strong central governance involving NMIs / DIs and their respective ministries	<b>No</b>	<b>Yes</b> for NMI/DIs (indirect for ministries)	<b>Yes</b>
<b>EXTERNAL FACTORS</b>			
International NMIs and DIs	<b>Yes</b> Could participate in projects (self-funded)	<b>Yes</b> Could participate in projects (self-funded)	<b>Yes</b> Could participate in projects (self-funded)
Regulators and standards-making bodies covering: climate, energy, environment and health, such as environment agencies, health protection and pharmaceutical and medical device regulators, CEN-Cenelec, ETSI	<b>Possible:</b> Relevant DGs could lobby for metrology-related calls (but unlikely)	<b>Yes:</b> EMN engagement could increase policy impact of metrology	<b>Yes:</b> EMN engagement could increase policy impact of metrology
<b>COHERENCE</b>			
Internal coherence	<b>No</b>	<b>Yes</b>	<b>Yes</b>
External coherence	<b>Partly</b>	<b>Partly</b>	<b>Yes</b>

## Appendix I Additional information related to the policy options descriptions

### I.1 Degree of coverage of the different functionalities by policy option

Table 26: 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
<p><b>What is possible?</b> Any legal entity in a consortium 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)</p>	<p><b>What is possible?</b> Partners can include any national funding body or governmental research organisation, Possible to include also other type of actors, including foundations.</p>	<p><b>What is possible?</b> Partners can include MS and Associated Countries.</p>	<p><b>What is possible?</b> Suitable for all types of partners: private and/or public partners, including MS, regions, foundations. By default open to AC/ 3<sup>rd</sup> 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.</p>	<p><b>What is possible?</b> Suitable for all types of partners: private and/or public partners, including MS, foundations. By default open to legal entities from AC/ 3<sup>rd</sup> 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.</p>
<p><b>What is limited?</b> Systematic/ structured engagement with public authorities, MS, regulators, standard making bodies, foundations and NGOs.</p>	<p><b>What is limited?</b> Requires substantial national R&amp;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</p>	<p><b>What is limited?</b> Non-associated third countries can only be included as partners if foreseen in the basic act and subjected to conclusion of dedicated international agreements.</p>	<p><b>What is limited?</b> 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</p>	<p><b>What is limited?</b> 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.</p>

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
	<p>partnership, under national rules.</p>	<p>Needs good geographical coverage – participation of at least 40% of Member States is required</p> <p>Requires substantial national R&amp;I programmes (competitive or institutional) in the field.</p> <p>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.</p>		
<p><b>What is not possible?</b> To have a joint programme of R&amp;I activities between the EU and committed partners that is implemented based on a common vision.</p>	<p><b>What is not possible?</b> To have industry/ private sector as partners.</p>	<p><b>What is not possible?</b> To have industry/ private sector as partners.</p>	<p><b>What is not possible?</b></p>	<p><b>What is not possible?</b></p>

Table 27: Type and range of activities (including flexibility and level of integration)

**Appendix J Additional information related to the problem definition****J.1 Taxonomy of failures requiring policy intervention**

<b>Market failures</b>	
<b>Market power</b>	<p>Limited interest from private sector parties to invest in R&amp;D for the development of health technologies for PRNDs due to low potential for return on investment.</p> <p>Lack of universal health coverage means that individuals are often unable to cover the costs for treatments.</p>
<b>Externalities</b>	<p>There are weak and underfunded health systems in Africa.</p> <p>Capacity for conducting research in the region is similarly weak.</p>
<b>Information asymmetry</b>	<p>Pharmaceutical companies usually have a large extent of monopoly power, making it challenging for countries, in particular, LMICs, to negotiate affordable prices for health technologies.</p>
<b>Systemic failures</b>	
<b>Capability</b>	<p>Low capacity in Africa to conduct research and development locally</p>
<b>Network</b>	<p>Private sector parties have shown relatively limited interest in the development of suitable and affordable health technologies for PRNDs. Whereas public sector parties, including academic organisations, have shown greater interest in this, they usually lack the experience and resources to bring products through the clinical research and product development stages to bring a product to market. This calls for a partnership approach.</p> <p>Fragmentation in the research landscape should be reduced through stronger networking and a partnership approach.</p>
<b>Institutional</b>	<p>SSA countries require the development of a capacity to support the conduct of clinical trials in the region, including frameworks for regulatory oversight and medical ethics committees.</p>
<b>Infrastructural</b>	<p>Limited staff capacity for the conduct of clinical trials in the SSA region, as well as insufficient laboratory infrastructures (e.g. laboratory equipment, supply chain management systems, digital infrastructure to support data collection and analysis)</p>
<b>Transformational failures</b>	



<b>Directionality</b>	Need for a strong partnership to agree on shared objectives and development of global R&D roadmaps e.g. for TB vaccine development
<b>Demand articulation</b>	Equal voice and representation of SSA countries helps to ensure that supported activities are aligned with the local needs and demands for products of greatest relevance to the region
<b>Policy coordination</b>	There are many different stakeholders and initiatives in the global health field. A partnership approach allows ensuring proper coordination and alignment.
<b>Reflexivity</b>	EDCTP has developed a strong results-based management approach which supports is the ability to monitor its impacts and make necessary adjustments along the way. A strong partnership is able to more rapidly respond to emerging needs, as in the case of the 2014 West Africa Ebola outbreak.

Source: Weber and Rohracher (2012) adapted by Technopolis Group (2018)

## Appendix K Additional information related to the policy options descriptions

### K.1 Degree of coverage of the different functionalities by policy option

Table 28: 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
<p><b>What is possible?</b> Any legal entity in a consortium 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)</p>	<p><b>What is possible?</b> Partners can include any national funding body or governmental research organisation, Possible to include also other type of actors, including foundations.</p>	<p><b>What is possible?</b> Partners can include MS and Associated Countries.</p>	<p><b>What is possible?</b> Suitable for all types of partners: private and/or public partners, including MS, regions, foundations. By default open to AC/ 3<sup>rd</sup> 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.</p>	<p><b>What is possible?</b> Suitable for all types of partners: private and/or public partners, including MS, foundations. By default open to legal entities from AC/ 3<sup>rd</sup> 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.</p>
<p><b>What is limited?</b> Systematic/ structured engagement with public authorities, MS, regulators, standard making bodies, foundations and NGOs.</p>	<p><b>What is limited?</b> Requires substantial national R&amp;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</p>	<p><b>What is limited?</b> 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</p>	<p><b>What is limited?</b> 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</p>	<p><b>What is limited?</b> 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.</p>

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
	<p>partnership, under national rules.</p>	<p>Requires substantial national R&amp;I programmes (competitive or institutional) in the field.</p> <p>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.</p>		
<p><b>What is not possible?</b> To have a joint programme of R&amp;I activities between the EU and committed partners that is implemented based on a common vision.</p>	<p><b>What is not possible?</b> To have industry/ private sector as partners.</p>	<p><b>What is not possible?</b> To have industry/ private sector as partners.</p>		

Table 29: 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
<p><b>What is possible?</b></p> <p>Horizon Europe standard actions that allow <i>broad range of individual activities</i> from R&amp;I to TRL 7 or sometimes higher.</p> <p>Calls for proposals published in the Work Programmes of Horizon Europe (adopted via comitology).</p>	<p><b>What is possible?</b></p> <p>Activities may range from R&amp;I, pilot, deployment actions to training and mobility, dissemination and exploitation, but according to national programmes and rules.</p> <p>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.</p>	<p><b>What is possible?</b></p> <p>Horizon Europe standard actions that allow a broad range of coordinated activities from R&amp;I to uptake.</p> <p>In case of implementation based on national rules (subject to derogation) Activities according to national programmes and rules.</p> <p>Allows integrating national funding and Union funding into the joint funding of projects</p>	<p><b>What is possible?</b></p> <p><i>Horizon Europe standard actions</i> that allow a broad range of coordinated activities from R&amp;I to uptake.</p> <p>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</p> <p>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).</p> <p>Open and flexible form that is simple and easy to manage.</p>	<p><b>What is possible?</b></p> <p><i>HE standard actions</i> that allow to build a portfolio with broad range of activities from research to market uptake.</p> <p>The back-office allows dedicated staff to implement integrated portfolio of projects, allowing to build a “system” (e.g. <i>hydrogen</i>) 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.</p> <p>Procuring/purchasing jointly used equipment (e.g. HPC)</p> <p>Allows integrating national funding and Union funding into the joint funding of projects</p>
<p><b>What is limited?</b></p>	<p><b>What is limited?</b></p> <p>Scale and scope of the programme the resulting funded R&amp;I actions and depend on the participating programmes, typically</p>		<p><b>What is limited?</b></p> <p>Limited control over precise call definition, resulting projects and outcomes, as they are implemented by EC agencies.</p>	<p><b>What is limited?</b></p> <p>Limited flexibility because objectives, range of activities and partners are defined in the Regulation and negotiated in the Council (EP).</p>

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
	smaller in scale than FP projects			
<p><b>What is not possible?</b></p> <p>To design and implement in a systemic approach a portfolio of actions.</p> <p>To leverage additional activities and investments beyond the direct scope of the funded actions</p>				

Table 30: Directionality

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
<p><b>What is possible?</b> Strategic Plan (as implementing act), annual work programmes (via comitology). Possible also to base call topics on existing or to be developed SRIA/roadmap</p>	<p><b>What is possible?</b> Strategic R&amp;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.</p>	<p><b>What is possible?</b> Strategic R&amp;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&amp;I programmes).</p>	<p><b>What is possible?</b> Strategic R&amp;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</p>	<p><b>What is possible?</b> Strategic R&amp;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&amp;I programmes).</p>
<p><b>What is limited?</b> No continuity in support of priorities beyond the coverage of the strategic plan (4 years) and budget (2 years Annual work programme).</p>				
<p><b>What is not possible?</b> Coordinated implementation and funding linked to the concrete objectives/ roadmap, since part of overall project portfolio managed by agency</p>				

Table 31: 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
<p><b>What is possible?</b> Coherence between different parts of the Annual Work programme of the FP ensured by EC</p>	<p><b>What is possible?</b> 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</p>	<p><b>What is possible?</b> 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</p>	<p><b>What is possible?</b> 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</p>	<p><b>What is possible?</b> 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</p>
<p><b>What is limited?</b> Synergies with other programmes or industrial strategies</p>	<p><b>What is limited?</b> Synergies with other programmes or industrial strategies</p>	<p><b>What is limited?</b> Synergies with industrial strategies</p>	<p><b>What is limited?</b> Synergies with other programmes</p>	
<p><b>What is not possible?</b> Synergies with national/regional programmes and activities</p>				





