S4D4C

USING SCIENCE FOR/IN DIPLOMACY
FOR ADDRESSING GLOBAL CHALLENGES

S4D4C
Policy Report

Calling for a Systemic Change

Towards a European Union Science Diplomacy for Addressing Global Challenges

Version 1.0

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Contributors

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Executive Summary

At the time of this report's publication, a novel coronavirus, SARS-CoV-2, had emerged in Wuhan (China) in late 2019 causing the Corona Virus Disease 19 (COVID-19), has expanded worldwide, and is evolving as the most striking pandemic and global health challenge in the last 100 years. COVID-19 has brought to the limit health, social, economic, and labour systems and provoked huge turbulence in regional, international and multilateral relations. At the same time, science and its ability to inform policies for better response has become a crucial dimension of the answer to the crisis. COVID-19 is testing the ability of countries and regions to collaborate and respond in a united way.

In this context, more than ever, **science diplomacy**, understood as a series of structured practices at the intersection of science, technology and foreign policy, **can become a fundamental dimension to the European Union (EU) and its Member States (MS). EU science diplomacy can contribute to address this current crisis as well as other global challenges, promoting both sustainable development and just and socially fair approaches**. This would also help EU position itself as a global role model in integrative leadership and multilateral responses.

From our understanding of science diplomacy to become effective, European stakeholders need to develop a basis of common understanding of i) what EU science diplomacy vision, mission, and principles should be for addressing global challenges, ii) the current EU science diplomacy state of the art and its stoppers, warnings and drivers and iii) a strategy on how to achieve that vision. **The project "Using Science for/in Diplomacy for Addressing Global Challenges - S4D4C" works to support these aims and this report is a contribution in this direction**.

This report is a summary of a series of co-creation networking meetings of the European and global scientific, diplomatic and science diplomacy communities, of key outputs from the S4D4C project and input from researchers and key opinion leaders in the field as well as from our own practice in science diplomacy over the last years.

This is our proposal for EU science diplomacy to support the EU wider policy objectives for addressing global challenges:

I) Where do we want to be? The EU science diplomacy vision, mission and principles, which emanate from the Madrid Declaration on Science Diplomacy (S4D4C 2019), for addressing global challenges:

In our vision, the **EU places global challenges at the core of its policy objectives and acknowledges the role of science in addressing these challenges as an important dimension of EU foreign policy and diplomacy**. As for the EU science diplomacy mission, we propose it demonstrates how evidence-informed foreign policies help address global challenges, strengthening links between countries to address them, positions the EU as a global role model, becomes key to better co-design mission-oriented European science, and contributes to the coordination of the EU and MS foreign policies.

II) Where are we? Main stoppers, warnings and drivers for addressing global challenges within each of the systems of science, diplomacy, and science diplomacy are identified and summarised below.

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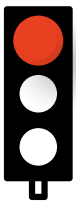
STOPPERS, WARNINGS AND DRIVERS FOR ADDRESSING GLOBAL CHALLENGES



SCIENCE	DIPLOMACY	SCIENCE DIPLOMACY
• Scientific and research misconduct • Insufficient European research workforce • Lack of structured policy engagement in scientific institutions • The Ivory Tower culture	• Nationalisms, protectionisms and populisms • Socio-political fractures in the EU • Political decisions outweigh scientific evidence • The tragedy of the commons	• Growing mistrust in democracy, institutions and experts • Discoordination between government departments • Limited or no funding schemes • Need for strengthening institutions
• Specialised and fragmented scientific knowledge • Bureaucracy and resistance to recognise interface professionals • Science advice mechanisms are complex • Lack of diplomatic training in the research community	• Globalisation, new actors and cooperation goals • Adaptation to digitalisation and information technologies • Common Foreign and Security Policy, a work in progress • Lack of scientific training in the diplomatic community	• Different understandings about science diplomacy • Different mind sets, cultures, and rules to bridge • Competitive versus collaborative approach • Weak political leadership for science diplomacy
• Science and collaboration as core European values • Good examples of science advice mechanisms • The public value of science • Wider policy impact of research and innovation	• The EU: global leader in multilateralism and science • Good examples of development cooperation frameworks • Knowledge-based economic diplomacy • Science as a driver for diplomacy	• The EU shows leadership in SDGs and climate emergency • Global and regional charters for win-win actions • Demand for training from both communities • Trust, empathy, political will, and timeframes

A list of 12 items is displayed per category: **stoppers** in red lights, **warnings** in amber lights, and **drivers** in green lights. Columns represent the nature of the system of said item: the first column addresses items related to science (as well as technology and innovation), the second column comprises items related to diplomacy, and third column involves items related to the science diplomacy system as such.

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III) How will we get there? The systemic change towards EU science diplomacy for addressing global challenges

We believe that EU science diplomacy would benefit from a systemic change triggered within **science, diplomacy and science diplomacy** to align and maximise the impact of everyone's efforts **towards addressing global challenges**.

We argue that more could be done to address global challenges with a stronger connection between science, technology and innovation, and diplomacy. We propose that **three transversal processes are required to happen in five key specific spheres (knowledge, governance with no silos, alliances, institutions and people)** to foster this systemic change:

1. a reinforced EU **learning system**, in place through a wide array of science advice mechanisms and their input into the evidence-informed foreign policy making process. This learning system needs to be embedded into and supported by all the spheres of the systemic change. It will require permanent and specially dynamic science advice mechanisms for knowledge to feed the policy-making process, a governance system able to ask for, absorb and react to this knowledge, alliances in place to integrate different stakeholders into the learning system, institutions acknowledging their role in the creation of the system and dedicated and trained people in every single sphere to make the learning system happen.

2. an **integrative leadership**: being able to foster the required changes in every single sphere of this holistic approach. This leadership will need to find ways to better generate and integrate knowledge so that it is fully exploited for addressing global challenges and to find ways to break the existing governance silos currently hampering transversal approaches to global challenges. Moreover, it will need to foster creative ways of establishing alliances, lead deep institutional cultural changes and even creating hybrid or boundary institutions more flexible and adaptive to sudden changes. Finally, an integrative leadership will be needed to inspire professionals addressing global challenges and to support the development of the necessary skills, competences and career options.

3. a **change of culture**, fostering agile, adaptive, effective and permeable environments for professionals of all kinds to collaborate to address global challenges. Scientific and foreign affairs institutions as well as government departments need better interactive spaces. New alliances require including all relevant stakeholders in the process and building new networks that do not rely on the existing bureaucratic structures. These networks link people of similar roles across existing organisational lines. For that to happen, institutions should promote awareness and a new culture for collaboration between scientists, diplomats, policy-makers, and other professionals. Lastly, new professionals in the science-policy-diplomacy interface must be trained to bring all worlds together and catalyse more interactions.

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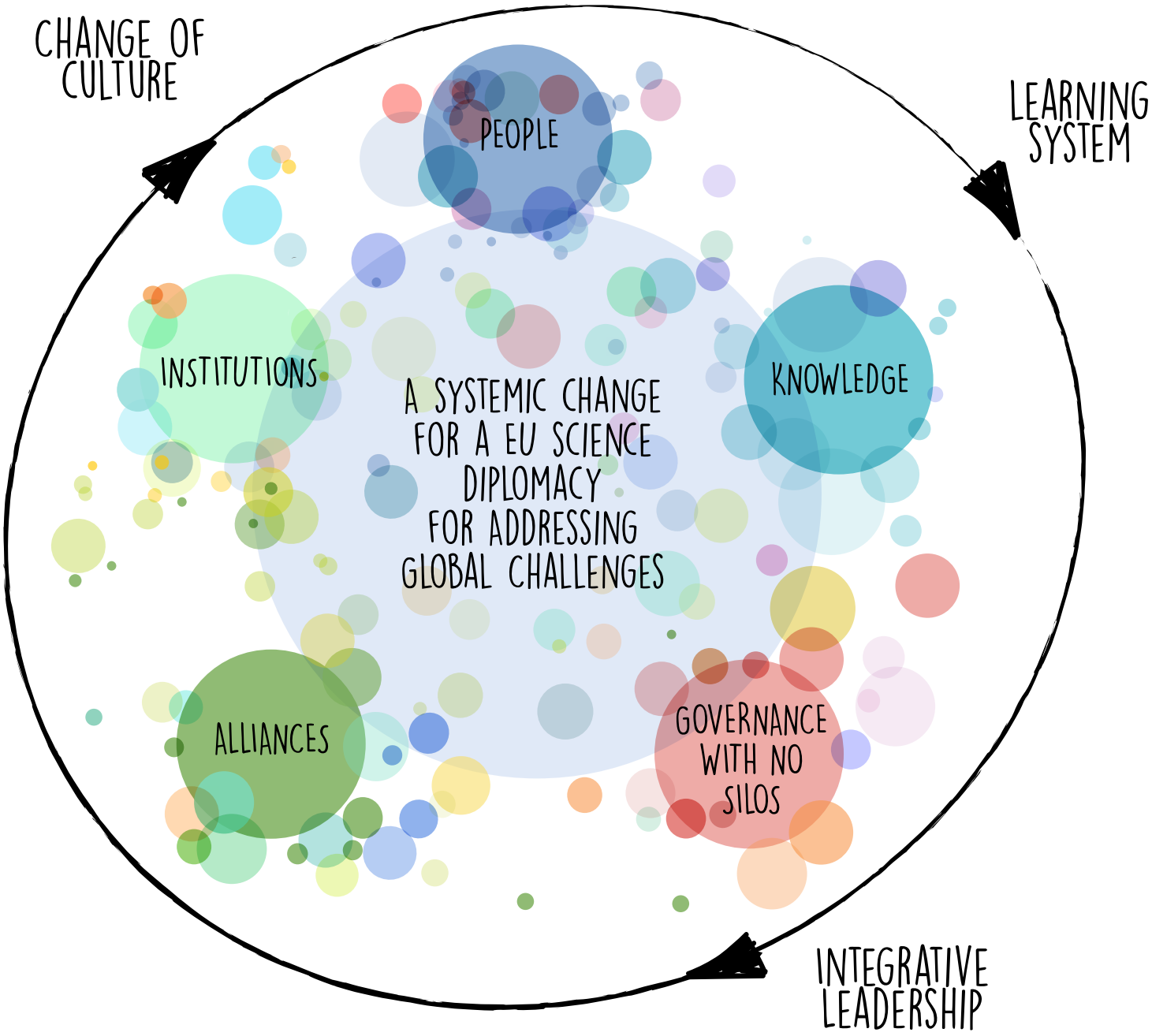

The systemic change towards a EU science diplomacy for addressing global challenges.

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As part of this systemic change, **this report proposes a set of policy recommendations focused on an integrative transformation** that takes into account these three transversal processes in the five specific spheres (knowledge, governance with no silos, alliances, institutions and people). These shifts will have to happen from the **very local level up to the MS and EU level and beyond** and will require efforts and long-term actions and resources from all stakeholders involved.

Knowledge for addressing global challenges

Scientific and technical knowledge has a role in addressing global challenges through the use of scientific evidence in policy making by governments and diplomats.

Recommendation 1: Reinforce Responsible Research and Innovation, Citizen Science, Open Science and Science Advice as European science core assets that need to be promoted in the EU global strategy and MS foreign policies.

Recommendation 2: Foster more interdisciplinary research around SDGs through specific calls and mission-oriented funding, ensuring a Social Sciences and Humanities (SSH) perspective is also included.

Recommendation 3: Share best practices for knowledge exchange in science diplomacy and science for policy for early-career and established researchers and diplomats.

Governance with no silos for addressing global challenges

Global challenges are wicked problems, complex and dynamic; a new way of collaboration is thus needed in order to solve the pressing problems we face globally. There is a need for better policy-alignments to tackle the challenges we face as a society in a coordinated effort.

Recommendation 4: Create and strengthen hybrid institutions bridging the scientific and the diplomatic communities.

Recommendation 5: Improve EU integration and cooperation between MS around scientific priority topics and geopolitical interests.

Recommendation 6: Improve coordination between EC and EEAS on global and multilateral challenges.

Alliances for addressing global challenges

A new way of collaboration is required where international, national, including regional, R&I systems, diplomatic corps, and policymakers are mobilised to use knowledge, fostering transnational and transregional cooperation through networks and alliances for global challenges.

Building networks that study, pilot, and support the new vision of the system is essential for establishing a lasting systemic change. These networks typically do not rely on the existing bureaucratic structure. They link people of similar roles across existing organisational lines reinforcing a change of culture in the community.

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Recommendation 7: Foster alliances through the allocation and reallocation of research funds for global and regional priority areas.

Recommendation 8: Involve researchers' networks.

Recommendation 9: Involve citizens.

Institutions for addressing global challenges

The design and implementation of a new model must be done in close interaction with all the relevant stakeholders in both the scientific and the diplomatic community. The barriers we are addressing have deep roots which can only be overcome through institutional changes. We advocate for an institutional cultural change leading to more agile, flexible, permeable, and adaptive institutions—in particular, research organisations, universities, and foreign affairs institutions—to better address global challenges.

Recommendation 10: Raise awareness of using science for global challenges and public policy in early-career and established researchers and diplomats.

Recommendation 11: Build knowledge-exchange interfaces

Recommendation 12: Foster strategic partnerships for capacity building and science diplomacy training with other institutions.

People for addressing global challenges

Global challenges require a paradigmatic cultural shift in the way many professions are framed and evolved. In the 21st century, scientists and diplomats need to be prepared to work in a more collaborative and interdisciplinary way. Both communities, scientists and diplomats, should be trained for a cultural change to better address global challenges, in particular SDGs.

Recommendation 13: Empower and train scientists and diplomats to work together to address SDGs.

Recommendation 14: Diversify career paths for scientists and diplomats to include professionals in knowledge brokerage.

Recommendation 15: Launch of a fellowship scheme for scientists to work in EC, EEAS or MS government institutions.

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Call for action

It is time for **collective action;** it is time for a **committed EU integrative leadership in addressing global challenges using science diplomacy**.

We believe our recommendations are more relevant and necessary than ever. We trust this policy report is food for thought and fosters discussion to build a EU science diplomacy strategy for addressing global challenges. We advocate for the collaborative action of not only all Member States, but also all stakeholders and professional networks to make the proposed systemic change happen.

We want this report to be a live document so we are **calling for comments, contributions, and ideas on how to develop implementation plans** (with potential milestones and progress assessment) **of the fifteen recommendations for the EU and other important stakeholders of different nature**.

Please, send us your name, affiliation and comments to s4d4c@fecyt.es by **10th October 2020** and we will take them into consideration. Comments and contributions will help publish an improved version of the report by the end of 2020. Meaningful contributions will be acknowledged in the next version of the report.

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List of Abbreviations

AAAS	The American Association for the Advancement of Science
CFSP	Common Foreign and Security Policy
DAAD	The German Academic Exchange Service
DG RTD	The General Directorate for Research and Innovation
EC	The European Commission
EEAS	The European External Action Service
EU	The European Union
EUNIC	The European Union of National Institutes for Culture
EL-CSID	European Leadership in Cultural, Science and Innovation Diplomacy
H2020	Horizon 2020 Framework Programme
InsSciDe	Inventing a shared Science Diplomacy for Europe
MS	Member states
NGOs	Non-governmental organisations
OECD	Organisation for Economic Co-operation and Development
PRIMA	Partnership for Research and Innovation in the Mediterranean Area
RIA	Research and Innovation Action
SAM	The European Commission's Science Advice Mechanism
SD	Science Diplomacy
SDGs	Sustainable Developmental Goals
SFIC	The Strategic Forum for International S&T Cooperation
SSH	Social Sciences and Humanities
STI	Science, Technology and Innovation
S4D4C	Using Science for/in Diplomacy for addressing global Challenges
UK	The United Kingdom
US	The United States of America

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1

Nurturing a European Science Diplomacy Community

Science diplomacy (SD) has become an umbrella term for a wide array of activities falling in the intersection between research and scientific international collaboration and the diplomatic and foreign policy agenda (Rungius, Flink, and Degelsegger-Márquez 2018).

While SD emerged as an explicit concept in various European countries and the US in the mid-2000 years (Flink and Schreiterer 2009), it seized greater visibility by marketing campaigns of the US in the Obama Administration and learned societies such as the American Association for the Advancement of Science (AAAS) and the Royal Society of London (Royal Society and AAAS 2010).

Since 2015, the European Commission has made SD a main priority within its Open to the World policy (European Commission 2016). Part of its strategy was to support the establishment of a European SD cluster through the framework programme Horizon 2020 ("The European Science Diplomacy Cluster" n.d.), funding three consortia to carry out research around SD: EL-CSID, InsSciDe, and S4D4C.

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Box 1. Goals of the S4D4C consortium

S4D4C ("Using Science for/in Diplomacy for addressing global Challenges") is a H2020-funded consortium comprised of 10 European partner institutions that aims to support current and future European science diplomacy for the benefit of European capacities, EU foreign policy goals and especially the development of solutions for global challenges. S4D4C pursues the following specific objectives:

- Providing new insights and a better understanding of the contributions of science and science collaborations to foreign policy goals, especially in the context of European models and experiences.
- Facilitation of effective and efficient interfaces for European science diplomacy to take better advantage of European science and science cooperation.
- Provision of policy guidance on where and how EU and EU Member State (MS) science diplomacy can be active in the future.
- Better preparation, clearer mandate and stronger identity of European science diplomacy.
- Increased capacities and knowledge resources for EU and MS science diplomacy.
- Expanding global reach and visibility for EU science diplomacy.

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Among the S4D4C main goals (**Box 1**), there is a joint approach to nurture a European SD community where scientists, scholars, diplomats, policy-makers, and other practitioners have the opportunity to interact for the benefit of European science diplomacy. This community is key to provide policy guidance to the European Union (EU) and Member States (MS) about the impact and influence of the use of SD. Indeed, our S4D4C first policy brief already identified three main challenges for EU science diplomacy: (i) comprehending the variable geometry of SD, (ii) coordination between the EU Member States and the Commission (iii) recruiting, training and raising awareness (Flink and Rungius 2018).

1.1 EU Science Diplomacy beyond 2020 - The Madrid Declaration on Science Diplomacy

The 1st S4D4C Networking Meeting was held in Madrid in December 2018 with the title "EU Science Diplomacy beyond 2020"[1]. This conference had a global perspective and brought together international experts from across the world, not only from countries that are leading the trend in SD, but also from emerging and developing economies that are taking crucial steps towards establishing a coordinated SD effort.

As a result of this conference, the S4D4C consortium published the Madrid Declaration on Science Diplomacy[2], endorsed by over 125 experts in the field up to date. This declaration (i) defined science diplomacy "as a series of practices at the intersection of science, technology and foreign policy", (ii) identified the benefits and principles of good SD practice (**Box 2**), and (iii) emphasised that SD still remains an asset not fully leveraged by all governance levels, recommending to implement more comprehensive SD strategies to build bridges and tackle global challenges (S4D4C 2019).

1 Full information available on https://www.s4d4c.eu/s4d4c-1st-global-meeting/
2 Available for download on https://www.s4d4c.eu/s4d4c-1st-global-meeting/the-madrid-declaration-on-science-diplomacy/

Box 2. A Snapshot of The Madrid Declaration on Science Diplomacy

The "Madrid Declaration on Science Diplomacy" aims to foster agreement and raise awareness about the need to strenghten science diplomacy (SD) strategies and practices world-wide for the support of universal scientific and democratic values.

Benefits of science diplomacy

- Endeavours to address global challenges
- More productive and sustainable international relations
- Evidence-informed foreign policy
- Better conditions for scientific activities due to the contribution of foreign policy agendas
- Improved interfaces between science and public policies

Principles to foster science diplomacy worldwide

- Value for citizens
- Methodological diversity
- Demonstrable impact
- Evidence-informed
- Collaboration and inclusion
- Capacity building
- Independence of science

To endorse this declaration, please write to s4d4c@fecyt.es with your full name and affiliation.

The declaration has stirred public debate in the EU and MS, helping to raise awareness and deploy better public policies at the intersection between science, technology, innovation, and foreign policy; such as the Foreign Minister of Switzerland recognizing the value of this declaration (Cassis 2019).

1.2 Towards a European Science Diplomacy Roadmap

The 2nd S4D4C Networking Meeting held in Berlin in October 2019 with the title "Towards a European Science Diplomacy Roadmap"[3] focused on the European Union's approach to discuss the visions, achievements, challenges and principles of a European science diplomacy to tackle societal challenges (**Box 3**).

Box 3. Goals of the 2nd S4D4C Networking Meeting

1) Fostering networking between scientists, diplomats and practitioners to establish the pillars of a lively European science diplomacy community.

2) Identifying stoppers, warnings and drivers in science diplomacy actions based on the experiences of panellists and attending experts.

3) Delineating a European science diplomacy roadmap for addressing global challenges with policy recommendations to share with the European Commission, the European External Action Service (EEAS), national governmental departments, scientific institutions and international and multilateral organisations.

4) Sharing preliminary results about the S4D4C research case studies for feedback and collection of policy recommendations

Around a hundred of scientists, scholars, diplomats, policy-makers and other science diplomacy practitioners actively contributed to the debate with their ideas and insights.

3 Full information available on https://www.s4d4c.eu/berlin-networking-meeting/

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1.3 What Is This Policy Report About?

This series of S4D4C Networking Meetings resulted in the following outcomes:

- S4D4C is helping to build up a lively European science diplomacy community of scientists, diplomats, policy makers and other practitioners.

- Previous S4D4C conference outputs such as the Madrid Declaration on Science Diplomacy are stirring public and policy debates in the European Commission and Member states, as well as outside the EU.

- S4D4C is producing a series of academic studies and policy outputs that deepen the current understanding of SD and strive to achieve policy impact in the EU and its Member States.

This first version of this policy report comprises the main conclusions coming from these two conferences, from key outputs from the H2020-funded consortium S4D4C project and input from researchers and key opinion leaders in the field, as well as from our own practice in science diplomacy over the last years.

This policy report aims to stir public and policy debate among the European Commission, the EEAS and Member states as well as in both the scientific and diplomatic communities around a EU science diplomacy strategy to address global challenges.

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2

Where Do We Want to Be? The European Union Science Diplomacy Vision, Mission and Principles

Science diplomacy, understood as the set of practices at the intersection of science, technology and innovation and foreign policy (S4D4C 2019), keeps gaining momentum worldwide. We believe science diplomacy can become a fundamental dimension to the European Union (EU) and its Member States (MS).

We further believe that it is time for the EU to reflect on an agreed understanding of what the EU science diplomacy vision, mission and principles should be. EU science diplomacy can contribute to address global challenges, promoting both sustainable development and just and socially fair approaches. This would also help EU position itself as a global role model in integrative leadership and multilateral responses.

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Here it is our suggestion.

2.1 Vision of the European Union and European Union Science Diplomacy for Addressing Global Challenges

A Vision for the European Union for Addressing Global Challenges

• The EU is a global leader in addressing global challenges with a holistic approach that cherishes democratic values and scientific evidence-centred approach in a balanced way.

• The EU places global challenges at the core of its policy objectives and puts in place the necessary transformative changes to tackle them.

• The EU acknowledges science as an important dimension of its foreign policy because of its capacity to:

- address and solve global challenges,
- provide space for EU and MS to align foreign policy strategies towards common goals,
- bring closer non-EU countries that decide to become associated members to EU science, technology and innovation framework programmes,
- contribute to build the European identity, and
- carry the banner for European values worldwide

A Vision for EU Science Diplomacy for addressing Global Challenges

In order to achieve the proposed EU vision, we have to nurture the following vision of EU science diplomacy:

• EU science and EU diplomacy join forces in order to address global challenges and apply the necessary systemic changes for success.

• EU science diplomacy demonstrates how integrated and mission-oriented policies can better tackle global challenges.

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2.2 The Mission of EU Science Diplomacy to Address Global Challenges

EU science diplomacy for addressing global challenges incorporates:

- Showcasing how evidence-informed foreign policies help address global challenges.

- Strengthening links with countries all over the world in order to address global challenges together.
- Contributing to position the EU as a global leader in addressing common challenges and reinforcing cooperation in the European Neighbourhood.

- Raising awareness of large scale EU initiatives and their geopolitical impact.

- Becoming a key process to bring together all kinds of stakeholders for the co-design of mission-oriented EU science and innovation so that its outcomes better address global challenges.

- Being a driver of wider EU foreign policy goals.

- Contributing to the coordination and alignment of EU and MS foreign policies.

- Working for the convergence of interests from individuals, stakeholders, regions, nations, and international and supranational organisations towards addressing global challenges.

2.3 Principles of EU Science Diplomacy

EU science diplomacy acknowledges the principles presented in the Madrid Declaration on Science Diplomacy and applies them to the EU context:

- **Value for citizens:** it works to demonstrate its role in addressing global challenges to European citizens.

- **Methodological diversity:** it encompasses explicit and implicit science diplomacy forms. EU science diplomacy may be implicit sometimes due to strategic choices.

- **Demonstrable impact:** it works on the design of a methodology to measure its potential positive and, also, unintended or even negative effects.

- **Evidence-informed:** it builds on the integration of evidence, either content-related (e.g. scientific evidence on climate change, global inequality, cyber security), context-related (e.g. knowledge about a specific innovation system) or process-related (e.g. evaluative knowledge on the effects and the outcome of science diplomacy interventions).

- **Collaboration and inclusion:** it acknowledges its multi-actor effort in which diplomats, scientists and science managers as well as other non-state actors can have a role and can contribute to its deployment. In particular, European Science Diplomacy acknowledges the wealth that European Union diversity brings to addressing global challenges, whilst at the same time demanding new governance mechanisms.

- **Capacity building:** it builds on the benefit that exchange and capacity building activities will have on all stakeholders involved in science diplomacy.

- **Independence of science:** it acknowledges science as an extremely useful tool for addressing global challenges and for improving international relationships as long as it is not distorted by ideological goals.

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3

Where Are We? EU Science Diplomacy Stoppers, Warnings, and Drivers to Address Global Challenges

Using Science Diplomacy (SD) for addressing global challenges is a complex endeavour as it involves bringing together professionals with different backgrounds, nationalities, and interests to work together on common and collaborative joint initiatives.

The conceptual frameworks for SD are diverse: from the classical perspective of *science in diplomacy, science for diplomacy and diplomacy for science* (Royal Society and AAAS 2010), to the definition of actions pursuing further access to scientific and technological resources, promotion of national systems or influence through science in other countries (Flink and Schreiterer 2010). Another approach understands SD as an array of joint endeavours to address national, regional or global interests (Gluckman et al. 2017).

This heterogeneity of understandings promotes the idea of the need for a meta-governance framework for SD that can potentially bring together all government levels, and non-state actors in a variety of relations, networks, and processes (Aukes, Ordonez Matamoros, and Kuhlmann 2019). To be able to outline an effective SD, Aukes and colleagues suggested

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four premises: (i) grand societal challenges require both diplomatic efforts and science-based knowledge, (ii) science-based knowledge production is diverse and evolving, (iii) diplomacy means reconciling a variety of interests, and (iv) science diplomacy requires combined science and diplomacy literacy (Aukes et al. 2020).

In this context, understanding what processes may block, challenge, or drive any SD efforts is fundamental to pave the way for advancing a EU science diplomacy joint strategy for addressing societal and global challenges.

We have identified the following set of stoppers, warnings and drivers for EU science diplomacy focused on addressing global challenges (**Figure 3**).

- **Stoppers** (red lights): elements or features that would hinder, stop, block or significantly frustrate or challenge the development of any action towards addressing global challenges. They embody current structural weaknesses in the SD ecosystem that are worth tackling

- **Warnings** (amber lights): elements or features that should be carefully considered when outlining any action towards addressing global challenges, because if not considered, they could turn into significant risks or stoppers

- **Drivers** (green lights): elements or features that contribute to addressing global challenges, ensuring current and future success and impact of any actions.

Additionally, these elements may be directly linked to the current scientific system (first column), the diplomatic system (second column) or the overarching SD system (third column).

In the following sections, each identified item is further explained using additional supporting references and contextual text.

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STOPPERS, WARNINGS AND DRIVERS FOR ADDRESSING GLOBAL CHALLENGES

Figure 1. Stoppers, warnings and drivers for addressing global challenges: stoppers in red lights, warnings in amber lights, and drivers in green lights. Columns represent the nature of the system of said item: the first column addresses items related to science (as well as technology and innovation), the second column comprises items related to diplomacy, and the third column involves items related to science diplomacy.

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3.1 Addressing Global Challenges Using Science

3.1.1 Stoppers for Addressing Global Challenges Using Science

Scientific and research misconduct

The usual SD rhetoric in public discourses and policy reports envisages science in a particular way, and often magnifies positive characteristics of science such as the cooperative attitude of the scientific community. Other less beneficial characteristics of science may be disregarding in this discourse, such as fierce competition, huge gaps in the possibilities of taking part in science between the North and South, arbitrariness in peer judgments, scientific misconduct, etc. (Flink and Rungius 2020).

Scientific or research misconduct can occur throughout the whole research cycle from the origin of the scientific idea or research question to the final output (paper, patent, product, process or scientific advice). Therefore it ranges from plagiarism to data falsification and failures to comply with ethical, legislative, and regulatory requirements, or to declare conflict of interests, among many other forms.
This lack of research integrity can affect people's trust in science and in public and private research institutions, reduce the impact of research investment from public and private funds, and also harm people and the environment if this unethical behaviour goes unnoticed. When addressing global challenges, this dark side of science has been noted in historical cases such as the case of leaded petrol (Rosner and Markowitz 1985) or the efforts from the tobacco industry to discredit scientific knowledge (Drope and Chapman 2001), but also in recent times with the unethical use of new genetic editing techniques (Cyranoski and Ledford 2018).

Another viewpoint on standards of good scientific practice relates to the question of how academic researchers act toward each other: in concrete situations of joint collaborations or competition, and in peer judgements. For example, editors of the journal Nature (2016) have criticised that researchers and especially reviewers would have increasingly devalued the works of "others" on the basis of national-cultural stereotypes, even in double-blinded peer review processes via speculative assumptions about the "national origins" of researchers who had sent in their drafts for reviewing—for an empirical confirmation, see also (Hesselmann 2019). In addition, the newly founded Global Research Council, an international network and dialogue forum for research funding agencies (including the French ANR, the German DFG, or the US-American NSF), supported the dissemination of two joint declarations that touch upon the same issue, though with more sensitive care: The Singapore Statement on Research Integrity (Resnik and Shamoo 2011) and the Montreal Statement on Cross-Boundary Research Collaborations (Kleinert and Anderson 2013) both address problems pertaining to international research collaborations. It is particularly the latter declaration that urges the "world science community" to acknowledge that "[…] international collaborations are challenging as they may involve substantial differences in regulatory and legal systems, organisational and funding structures, research cultures, and approaches to training. It is critically important, therefore, that researchers be aware of and able to address such differences […] that might arise in cross-boundary research collaborations." This call was further substantiated by the InterAcademy Council's (2013) global report on Responsible Conduct in the Global Research Enterprise.

Having said this, the European Commission and many research organisations have undertaken measures to manage research to the highest possible standards and provide guidance on the reporting and investigation of unacceptable research conduct.

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Insufficient European research workforce

An innovative EU capable of taking the global lead in addressing global challenges would require a bigger research workforce. Since millennium, the EU wants to achieve a target investment of 3% of EU GDP on Research & Development by 2020 to create up to 3.7 million jobs and increase annual GDP by €795 billion by 2025. To reach these numbers, Europe would require at least one million more researchers (European Commission 2010). According to Eurostat, the number of researchers in the EU has increased by one-third (35%) between 2007 and 2017, reaching from 1.46 to 1.97 million (Eurostat 2019). This growth, although promising, is still not enough to reach the target of one million more researchers by 2020.

Different factors explain this phenomenon. For instance, funding for R&D is quite unequal among MS and uneven efforts from MS to increase their national budgets hinder the overall EU efforts of investing a total 3% of EU GDP on R&D by 2020. Additionally, the academic career path is becoming more complicated and competitive than ever with declining percentages of PhD graduates in Sciences attaining academic positions (Langin 2019; Royal Society 2010; Eurostat 2019).

Science is a global enterprise where scientists are seeking to work with the best people, institutions and equipment which complement their research, wherever they may be (Royal Society 2011). In this regards, freedom of movement within the EU has also created unequal talent distribution across MS (Cavallini et al. 2018). Therefore, countries, regional and local authorities have to cope with the socio-economic effects caused by the loss of this talent, which may involve the development of specific policies to mitigate and/or prevent brain drain: for example, better promotion of scientific national job opportunities abroad or better engagement with the national scientific diaspora abroad (Cavallini et al. 2018; Burns 2013; Meyer and Brown 1999; Elorza Moreno et al. 2017).

The EU is fostering research mobility between MS through different Marie Sklodowska-Curie Actions and is able to attract and retain talent with the European Research Council Grants. However, EU funding, although welcomed, is not enough. Bigger efforts are still required at all government levels in MS: especially national governments, but also regional and local ones, to implement more ambitious brain gain and brain circulation policies, as well as to foster stronger ecosystems between academia and the private sector increasing researcher employability.

Lack of structured policy engagement in scientific institutions

Although the scientific endeavour also focuses on addressing global challenges, the very concept of SD for addressing global challenges needs to get more traction within the scientific community. There is a need to raise awareness in both public and private research and development institutions that these challenges are pressing and affect all of us, much more than it has been the case with respect to technology transfer, science communication, and other activities that interrelate science and societal matters.

For instance, institutions usually have units or representatives for international affairs, but they usually engage with equivalent scientific institutions abroad. Engaging with embassies and foreign-affairs government departments, as well as with international organisations, may channel new opportunities for scientific collaboration, funding streams, and scientific talent circulation. Additionally the active involvement of their scientific staff in foreign policy discussions (such as the climate change COP conference) is another opportunity for representing scientific institutions in the international and multilateral scene. Likewise professional teams of public and institutional affairs could ensure additional research outputs in the form of policy transfer and impact by establishing structured policy engagement practices and mechanisms.

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It is thus required to raise awareness, open new venues of collaboration, better staff the international units and policy units of research centres and universities, and provide training opportunities to research staff for their involvement in evidence-informed policy practices.

The Ivory Tower culture

The world is changing rapidly. Global challenges require a paradigmatic cultural shift in the way many professions are framed and evolved. In the 21st century, scientists are required to perform competitive research and publish their research outputs, to establish large research consortia through international collaborations, to fulfil their teaching commitments if any to the best of their abilities, to effectively communicate their findings to the general public, to ensure their research has a policy impact, among many other goals. This wide portfolio of activities is perhaps one of the reasons why scientists face many uncertainties and burnout rates among tenure-track researchers and early career scientists seem to be on the rise (Susi, Shalvi, and Srinivas 2019).

Even though recent decades and trends are breaking down the walls of the academic Ivory Tower (Bond and Paterson 2005)—or at least the oftentimes exaggerated image that such a tower was high and locked, the research profession should still reflect on at least three aspects. First, doctoral training should reach a minimum quality standard across the EU and be focused on nurturing soft and transferable skills, post-graduate research students should also be informed about academic and non-academic career opportunities (EURAXESS 2015). Second, the extent of professionalization of the scientific endeavour; researchers who transfer their knowledge to business, society or policy, should be supported by the best available professionals (tech transfer experts, science journalists or communicators, science policy officers, etc.) within their own institution or their closer ecosystem. Third, there should be career incentives rewarding those researchers who are committed to ensure their research has an impact on society.

The way these three aspects are addressed in academia across MS, and even within MS, is quite heterogeneous, but overall the research profession is adapting to the 21st century through more interconnectivity and international collaborations than ever.

3.1.2 Warnings for Addressing Global Challenges Using Science

Specialised and fragmented scientific knowledge

Science and technology have experienced vast specialisation for the last centuries, even decades, giving rise to new scientific concepts and disciplines that require highly-specialised professionals to lead research and innovation. This requirement involves at least three challenges when science explores having an impact on diplomacy and on addressing global challenges.

First, we need to find a way to provide the means to focus European research, innovation and investments on solving critical problems, while also spurring growth, jobs and resulting in positive spill overs across many sectors. In order to engage research and innovation in meeting such challenges, a clear direction must be given, while also enabling bottom-up solutions. This research and innovation policy cannot happen in a vacuum: a broader political commitment to align policy objectives at EU and MS level is needed. This goal needs to be achieved in Europe, which is more fragmented and diverse than other regions of the world – which creates a messier but also potentially more creative environment (Mazzucato 2018).

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Second, expert scientists who engage in these efforts in the science-policy-diplomacy interface need to have or develop communication skills in order to translate their complex scientific concepts into lay-language, being able to discriminate between useful and non-useful information for policy-makers and diplomats and to build lasting relationships with them to gain their trust. Lengthy explanations full of scientific facts will not have the expected results as opposed to the ability to create narratives and stories using specific scientific evidence for a real world audience.

Third, any expert scientist who engages in science advice (to policy or diplomacy) is not be presumed to have knowledge for all fields, so science advisers need to rely on their skills to collect a wide range of expertise from across the civil service, academia, and the private sector (Gluckman et al. 2017).

And fourth, when scientific institutions have a specific mandate for government science advice, such as the European Joint Research Centre (JRC) for the European Commission, or the Robert Koch Institutes, INSERM or *Instituto de Salud Carlos III* for biomedical issues in Germany, France and Spain, respectively; it is important that these organisations at the evidence-policy interface produce teams of people with different backgrounds, perspectives and complementary skills to ensure policy impact (Topp et al. 2018).

Bureaucracy and resistance to recognise interface professionals

Public administration tends to be a rigid environment where adaptive changes take time to be implemented because of administrative barriers and an excess of bureaucracy. Scientific public administration is not an exception to this rule, and even though there are policy tools and boundary organisations that help navigate this intricate context, there is still margin for improvement.

An example directly related to SD focuses on how countries deploy their science delegates abroad. The officers responsible for scientific affairs at an embassy greatly differ between countries. Science delegates may be appointed to Higher Education and Research offices, to Science and Innovation offices, to Business and Trade departments, or to Cultural departments (Flink and Schreiterer 2010; Ruffini 2017). Even though this diversity is a positive thing, the nature of the embassy office where these delegates are deployed will condition their portfolio of activities (more related to higher education or research, to trade, or to culture). The main issue, however, is when conceiving of new positions consider not only budgetary and/or administrative restrictions, but also allow space for political understanding and leadership to happen. Recognition of the strategic importance of these science counsellors or attachés must be ensured by their respective ambassadors and heads of units locally, as well as their ministerial coordinators in their national headquarters.

Likewise, scientific institutions and universities require a wider array of professionals in the scientific interface with society and policy (research managers and administrators, science communicators, policy officers, etc.) and this need may not be fully recognised.

Science advice mechanisms are complex

Even though the use of science advice committees is growing and can be considered as a driver for change (as can be seen later on), these science advice mechanisms need to become much institutionalised and formalised. This complex interface between science-policy-diplomacy relies on the power of networks and the appropriate coordination to make the most of them. Their institutional arrangements and effectiveness will depend on the subject matter, on the nature of the chief actors and their relationships, on the stage of the process, and on certain cross-cutting issues such as transparency, accountability, independence and approach to risk and uncertainty (SAPEA 2019).

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Individual experts can be appointed as science advisers to foreign affairs department, embassies, international and multilateral organisations, or other government departments. The type of collaboration/coordination across government departments as well as the kind of communication or administrative support in their host institutions will have a deep influence in the science adviser's role and impact (Gluckman et al. 2017). Depending on those institutional arrangements and contexts, science advisers can work either as an additional and effective piece in the machinery, ensuring science has some of impact on policy; or just as outsiders or free players that will get little traction in their host departments.

Scientific institutions committed primarily to research activity, but which also have a specific mandate for government science advice in their fields of expertise (JRC, the Robert Koch Institutes, INSERM, ISCIII, and others), usually have institutional arrangements in place for their advice to feed their related government departments as well as international agencies. However, information channels and formal links of these scientific institutions with their national Ministries of Foreign Affairs may not be properly established. Ministries of Foreign Affairs have in many fields lost their importance sometimes, as other ministries perform theme-specific foreign policies themselves. Close coordination between government departments, providing institutional settings for knowledge exchange, and harnessing the expertise of embassy counsellors, attachés and advisers (if any), among others, are just different possibilities to promote science advice mechanisms between these scientific institutions and the Ministries of Foreign Affairs.

Lack of diplomatic training in the research community

To address global challenges and make a policy impact in the international sphere, scientists will often be exposed to scenarios beyond their academic environment. Because of their highly-specialised training in their scientific field, usually involving only technical and scientific expertise, scientists often lack skills in international affairs and negotiation skills that would help them navigate the international policy system.

In fact, more than half of the SD practitioners that completed an S4D4C survey identified a need for further training on negotiation skills, knowledge on the interaction between science and foreign policy, better information about the international stakeholder landscape, the functioning and legal background of S&T agreements and collaboration between their home and host countries (Degelsegger-Márquez, Flink, and Rungius 2019). These skills are added up to those already identified for professionals in the science and policy interface (Joint Research Centre 2017).

Capacity building is therefore required in these areas for scientists who are or will participate in SD actions to address global challenges. These training opportunities could be provided by university and research institutions, national academies and also learned societies that could run professional workshops with a focus on SD alongside their annual meetings or conferences. Additionally, boundary scientific organisations and diplomatic academies could offer SD training workshops or alliances with the former institutions.

3.1.3 Drivers for Addressing Global Challenges Using Science

Science and collaboration as core European values

The EU values are an integral part of the European way of life and involves human dignity, freedom, democracy, equality, rule of law, human rights (European Union 2020), and as such they are part of the Charter of Fundamental Rights of the

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European Union (EU) and the Treaty of Lisbon. Humanistic thinking and rationality have been pillars on which these values have been established, and science and scientific cooperation have played a key role to shape this core set of European values. Against this narrative, the fact that EU science can take the lead in addressing global challenges seems like a natural development.

The recent push for a more integrated European Research Area may go in this line. This area fosters student and researcher mobility through different programmes, and embraces global science for a cause beyond its own borders, with the aim of being more openly and more strategically than ever before; making SD a natural extension of European values (Moedas 2016).

The relationship between science and the European values is bidirectional too. The set of EU values influences the way we establish the overarching science and technology governance framework and the way science is performed. The EU conforms to a human rights framework and culture that prioritises non-negotiable individual human rights over the common good, with considerable autonomy for MS to deploy independent policies to govern contested science and technology applications (Schroeder and Rerimassie 2015). Also, the EU commitment towards gender equality in research, open science, research integrity and, in general, responsible research and innovation frameworks, all prove this two way directionality.

Good examples of science advice mechanisms

Science advice committees are present in most international and multilateral organisations such as the Intergovernmental Panel for Climate Change (IPCC) in the United Nations, the Scientific Advice Mechanism (SAM) and Science Advice for Policy by European Academies (SAPEA) for the European Commission, or different permanent or temporal committees at the national level in MS, and have a key role in addressing global challenges (Aukes et al. 2020).

Evidence-informed decision making and public policy development are the hallmarks of good governance and responsible public administration. Science offers methodologies and approaches that produce the closest thing we have to proof and truth (Copeland 2015). Science has an important role to play in virtually every dimension of policy making at every level of government, from local to international. Thus, the practice of science advice involves different types of advice (technical, regulatory, deliberative, informal, and crisis) and must be based on a set of good principles (Gluckman 2014; 2016; SAPEA 2019; Mair et al. 2019).

Global challenges affect all levels and branches of government: from labour to migration, from health to economy and trade, from internal affairs to foreign policy. The use of science advice mechanisms in all these levels provides a great platform to drive policy responses for addressing those global challenges. Having said this, the COVID-19 crisis has underlined the importance of science advice structures, but also its current limitations for a global response (Gluckman 2020; Nature 2020).

The public value of science

From the classical science norms formulated by Robert Merton and commonly known by the acronym "CUDOS" (communalism, universal, disinterested, originality and scepticism) to the recent proposed addition to this set of "upstream public engagement" and "real-time technology assessment" (Merton 1942; Stilgoe, Wilsdon, and Wynne 2005), science is widely recognised as being well-intended and universal. Science is considered to be well-intended because of the assumption of it being naturally geared towards the betterment of humankind, which is a normative assessment

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again in itself. The apolitical nature of science stems from the normative and functional prerequisite of science crossing borders and dealing with problems of common interest. Last, scientific values of rationality, transparency and universality should be regarded unequivocally valid wherever in the world (Rungius, Flink, and Degelsegger-Márquez 2018).

It is clear that science (and scientific advice) themselves are not value-free, but scientific advice must not be driven by partisan interests and stealth issue advocacy (SAPEA 2019).

Altogether, these normative values can be considered scientific drivers for addressing global challenges because they provide a common place of understanding for different nations to collaborate in the international sphere.

Wider policy impact of research and innovation

The EC has been working on transforming the way scientific research has an impact beyond the academic setting. To ensure that research and innovation have a more comprehensive impact on society, the EC has been implementing a wide range of tools and mechanism.

For instance, the EC is putting an emphasis on the increasing role of science in society to reinforce the public value of science. Concepts such as Responsible Research and Innovation (RRI), Impact Evaluation, Citizen Science, Open Science, or even Science Diplomacy are in the policy discourse and strive to make sure that research and innovation have a wider policy impact beyond the classical boundaries of the science and technology framework. Moreover, the mission-oriented approach integrated in the next R&D&I framework programme, Horizon Europe, aims at spearheading public research and innovation investments in new strategic areas that have the possibility to bring together different actors (public, private and third sector) and spur collaboration across different sectors. This approach is inspired in the mission-oriented policies that can be defined as systemic public policies that draw on frontier knowledge to attain specific goals or "big science deployed to meet big problems" (Mazzucato 2018).

The EC is also tackling certain challenges in science such as boosting research careers (EURAXESS 2015) or promoting research integrity (ALLEA 2017), as well as better understanding the scientific advice processes to reinforce the principles of democracy and the rule of law (Mair et al. 2019; SAPEA 2019). Overall, there is a need for a better acknowledgement of the shared competence and responsibility of R&I policies and of the multi-level reality in Europe. A new ERA needs to ensure relevance, impact and visibility across Europe, and this should be achieved through tangible, larger and more impactful joint actions (ERAC 2019).

3.2 Addressing Global Challenges Using Diplomacy

3.2.1 Stoppers for Addressing Global Challenges Using Diplomacy

Nationalisms, protectionisms, and populisms

The EU has suffered a wave of different crises over the last decade. The economic and euro crisis, the Brexit crisis, the migration crisis, the rise of Euroscepticism, and currently the COVID-19 pandemic, have altogether altered the EU integration process and rule-based multilateralism. This process may have shifted instead towards a more cooperative and flexible approach between MS that implements a de-facto multi-speed Europe rather than an ever closer Union. For instance, the political and socioeconomic impact of Brexit on the EU is still to be determined, and the EU has to choose among different pathways to continue its institutional steps in the years to come (European Commission 2017; Oliver 2016).

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These crises have strengthened or even driven the disruption of nationalisms, protectionisms, and populisms across Europe. Even though the EU's Common Foreign and Security Policy (CFSP) was established in 1993 and has since been reinforced by subsequent treaties, the current context may delay further progress in the alignment of external policies, cooperative arrangements, and the design of a joint strategy to tackle global challenges. Permanent Structured Cooperation (PESCO) projects are instruments for MS to cooperate in Common Security and Defence Policy (PESCO 2019a; 2019b) but the degree in which they address global challenges through the use of science diplomacy is yet to be analysed.

Additionally, the rise of populism runs in parallel with the rise of innovation-averse feelings among society (Leijten 2019), and so this negative perception of science and technology progress across society may prevent its impact on diplomacy or cause a negative effect in the way diplomacy approaches these topics.

Socio-political fractures in the EU

Although the results from the Eurobarometer Spring 2019 shows an overall increase in trust and optimism in the EU project, there are still big differences when comparing MS (Eurobarometer 2019). Trust in their own democratic governments has also been more affected in those countries in which the economic crisis had big impact on their welfare states (Pennings 2017; Armingeon and Guthmann 2014).

Overall these public opinion surveys as well as opposing MS' interests point out current socio-political fractures in the EU between the North-South and the East-West (Alonso 2013; VoteWatch 2020), which are also supported by the easy flow of capital, companies and highly-skilled professionals towards the richest and most competitive MS or regions within the EU.

The EU has funding mechanisms in place to alleviate these differences and to build-up capacities through their European Structural and Investment Funds but, altogether these current socio-political fractures may be a handicap when the EU strives to act as a single global actor in addressing global challenges. Progress on the European Research Area (ERA) has slowed down in recent years and there are still major R&D disparities between countries and regions, some of which are even diverging rather than converging (Directorate-General for Research and Innovation 2019).

Deprived MS or regions may be more reluctant to cooperate as they face specific challenges that are not being fully resolved. These complex contexts should be considered when outlining any EU global challenge strategy through SD to prevent more inequality between MS and collaboration reluctance from deprived MS or regions.

Political decisions outweigh scientific evidence

The main responsibility of a science adviser is to present a rigorous analysis of what is known and not known about a specific issue to policy-makers, who then choose between options with different trade-offs (Gluckman 2014). During the policy-making process, science and scientific evidence is one source of information, albeit a credible one, but it is not the only one, as policy makers have to weigh other interests (social, economic, ideological, cultural, religious, etc.); thus, there is more to policy than scientific evidence (Tyler 2013; Mair et al. 2019). In foreign policy, the process gets another level of complexity through additional elements: the international order system, geopolitical strategic allegiances, power balances, historical and other relationships among countries, cooperation frameworks, etc. It is important to understand the whole picture to place science and scientific evidence within it.

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A clearer line between where science advice ends and political decisions begins is required. Sometimes this line gets blurred due to politicians or diplomats using experts as shields for their policies or to experts overstepping their responsibilities and complaining when their advice is not followed. Decision-making is not the domain of a science adviser. Both science advisers and science diplomats need to be aware of these facts and processes to better deal with their frustration whenever their advice is not followed by policy-makers and/or diplomats. Instead these scientists should focus their energy in improving their communication and persuasion skills and nurturing long-term relationships to build trust and empathy (Oliver and Cairney 2019; Cairney and Kwiatkowski 2017). Additionally, public perceptions about advice sources as well as notions of independency will likely differ by country (Grimes, Maxton, and Williams 2017).

The tragedy of the commons

Solving global challenges such as climate change or water sustainability always suffer from the Tragedy of the Commons and the logic of collective action failure (Hardin 1968; Olson 1965). Global goods or shared-resource systems, be it air quality, water availability, global temperature, etc., have the problem that individual users act independently following their own self-interest overexploiting or depleting the shared good without considering the common good. One major gridlock for global cooperation and collective action is the vast number of countries, communities and stakeholders (including private industry) involved, with differing and competing interests, and reaching consensus becomes very difficult and time-consuming (Held 2016).

The rise of global governance systems such as the United Nations and international organisations that foster cooperation among specific issues such as UNESCO or the World Health Organisation, or G20 is addressing this challenge somewhat. However, these systems also suffer from their trade-offs: slow decision-making processes in some cases, power over-representation from Western countries in others, or the fluctuating support to their resolutions from the global superpowers (US, UK, China, Russia, etc.).

3.2.2 Warnings for Addressing Global Challenges Using Diplomacy

Globalisation, new actors and cooperation goals

Globalisation has had a big impact on traditional diplomacy for various reasons but we can highlight here at least two: (i) the rise of new superpowers specially in East Asia alters the global power balance that has been dominant from the end of the Cold War; and (ii) nation states are no longer the only stakeholders that matter in the field of international relationships: from the growing role of regions and cities, to the role of international and multilateral organisations, transnational corporations, non-governmental organisations (NGOs), and civil society (Kehoane and Nye 2000; Held 2016), there has been a diversification of stakeholders in public diplomacy. For instance, in SD, the public administration pertaining to science and technology policy, scientific organisations, i.e. research centres, universities, and learned societies, and even individual scientists all play a role in shaping the different realms of international affairs.

The diplomatic civil service is central for the foreign policy affairs of any nation state and is catching up in how to cope with public diplomacy that is no longer under their strict control and their formal protocol. Diplomats face the challenge of implementing a coherent foreign policy strategy, adapting it to this new multi-stakeholder framework, keeping up with the use of digital and social media, and getting used to new ways to influence other actors. Diplomats need to recognise stakeholders' increased agency and learn how to collaborate with them creating a more open and transparent diplomatic process than before.

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Additionally, the dynamics of international cooperation and development cooperation has been in constant evolution since its origins after the Second World War. Nowadays the need to analyse the development process from a broader perspective and to redefine international cooperation for development strategies is underscored by multiple factors. For example, the United Nations Agenda for Sustainable Development (2015-2030), a successor of its Millennium Development Goals (2000-2015) demands international cooperation for development in areas such as climate change, security, migration, technology and innovation. Also, many middle- or high-income countries still have to tackle problems of poverty, inequality, low productivity and poor institutional development; this is the case for many Latin American and Caribbean countries. This leads to the questioning of traditional modes of cooperation and lends support to a more universal paradigm for cooperation that considers the fluid nature of these challenges and addresses them in many dimensions. As well as the traditional financial assistance, cooperation must evolve to include new instruments such as knowledge-exchange, multilateral policy dialogue, capacity-building, technology transfers, blended finance and resource mobilization (Economic Commission for Latin America and the Caribbean (ECLAC) and Organisation for Economic Cooperation and Development (OECD) 2018).

Adaptation to digitalisation and information technologies

Digitalisation is also causing a major disruption in traditional diplomacy. Digitalisation is a long-term process in which the values, norms, working procedures and goals of public diplomacy are challenged and re-defined (Manor 2019). This digital disruption of diplomacy stems from the global proliferation of Information and Communication Technologies (ICTs), the mass adoption of social media, the use of big data, new threats to security (cybersecurity), the emergence of the technology industry with powerful global actors, among many others. These factors go alongside the diplomatic pressure to manage crises in near real time and shape a nation's image, pushing for more open and transparent forms of diplomacy (Manor 2019; Copeland 2009). Diplomats face the challenge of acquiring better digital literacy, exploring new ways to engage with foreign populations, establishing virtual embassies, and the difficulties of framing issues in the era of social media, fake news and mis- or disinformation.

Challenges and opportunities lie ahead in this global transformation and, as a result, different countries are at different stages of the digitalisation process. Indeed, technological development and innovation impact in the sphere of foreign policy is part of the diplomatic toolbox, as has been the case in South Korea (Melissen and de Keulenaar 2017) or Slovenia (Republic of Slovenia 2019). Exploring with new roles and forms of diplomacy is also an asset, such as Denmark deploying the world's first ambassador to the tech industry (Satariano 2019; Klynge, Ekman, and Waedegaard 2020).

Common Foreign Security and Policy, a work in progress

The process of European integration involves different nation states *coming together* to build a federal or confederal environment (Stepan 1999), where they relinquish part of their own sovereignty to a supranational entity (the EU) in exchange for attaining better economic markets, greater security, and better alignment of other policies. This process is not exempt from continuous political bargaining to achieve a set of shared rules without losing too many self-rules (Elazar 1987). Over recent decades, in the process of European convergence, this continuous bargaining has been underpinned by a fluctuating political support from MS for more intergovernmental cooperation or supranational integration approaches. In particular, the area of foreign policy and security is still one where intergovernmental cooperation has been more predominant than an integrative approach.

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The origins of Common Foreign and Security Policy (CFSP) go back to 1970 when the European Political Cooperation (EPC) was established to provide an informal consultation process between MS on foreign policy issues, to promote a common approach. In 1993, the Maastricht Treaty established the European Union based on three pillars, one of which was the CFSP-pillar based on a strong intergovernmental approach. The Amsterdam Treaty in 1997 created the office of the High Representative for the CFSP in order to coordinate and represent the EU's foreign policy. Lastly, the Treaty of Lisbon in 2009 re-established the EU, ending with the "pillar" system, and created the role of the High Representative of the Union for Foreign Affairs and Security Policy. This position resulted from the merging of the High Representative for CFSP and the European Commissioner for External Relations and European Neighbourhood Policy, and was put in charge of the newly created European External Action Service (EEAS).

Launched in 2011, the diplomatic service of the EU can become a leading player in SD. The EEAS covers global and multilateral issues, such as human rights, democracy support, climate change, gender equality, humanitarian challenges, development or response to crises. However, the EEAS is still a relatively young institution that has yet to evolve, in the framework of the *Ever Closer Union* stated in the European ethos. The challenge is not only to build consensus between MS, but also to ensure coordination and policy coherence among EU Institutions, as well as taking into account the role of civil society and the private sector across Europe.

Lack of scientific training in the diplomatic community

Similar to scientists initially lacking any background training in international and global affairs, diplomats usually have educational backgrounds in Humanities and Social Sciences (such as Law, Political Sciences, International Relationships, etc.), which may condition their awareness of the latest scientific and technological developments.
Because they have not been trained as scholars or have been rarely exposed to the international and national science and technology systems and practices, they may not be that familiar with how research and innovation systems actually work (project grants, research publications, academic fellowships, etc.), or the different science policy frameworks present in the EU or in MS. When diplomats acquire a basic understanding of how both research and innovation operate, they are better prepared to engage with the scientific community at large.

This is of course not trivial. Research and innovation are having an increasing role in the international landscape; the development and exploitation of new technologies (AI, big data, cybersecurity, quantum technologies, geoengineering, pandemics, etc.) all have a geopolitical dimension of crucial interest for diplomats. As aforementioned, globalisation and digitalisation, are both driven by the economic impact of new products and technologies, the rise of social media and ICT, and so on. As a result, diplomats face the challenge of acquiring additional skills and knowledge to cope with this ever-changing scenario.

3.2.3 Drivers for Addressing Global Challenges Using Diplomacy

The EU: global example in integration and science

The EU is a unique global example in regional integration as well as a worldwide example of scientific research collaboration. First, the EU started its dynamics of regional integration in 1951 with six founding countries and has integrated up to 28 countries, now down to 27 after the UK leaving the EU. This integration dynamics has involved the establishment of supranational EU structures and the alignment of a wide array of policies among MS: economics, agriculture, energy, monetary, foreign policy and defence, and also in science, technology and innovation.

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Second, a more proactive Europe is filling a void in international scientific leadership thanks to the different framework programmes (FP6, FP7, Horizon 2020, and soon Horizon Europe) and other initiatives. This comes at a time when the United States is retreating from multilateralism under President Trump, China still struggles to move from research quantity to addressing thornier issues of scientific quality, ethics and integrity. And the United Kingdom's exit from Europe will condition its political and research systems in the years to come (Wilsdon and de Rijcke 2019).

Over 16 non-EU countries (including Iceland, Norway, Switzerland, Turkey or Israel among others) are formal associated members of Horizon 2020, which means they contribute with funds into the common EU funding pot and their researchers can compete for grants on equal terms with researchers based in EU countries. The opportunity for Third Countries to become Associated Members to the EU scientific framework programmes is a useful tool to strengthen relations. Indeed, the EU has initiated discussions with a handful of scientifically strong non-European countries for these to join Horizon Europe programme; these are Japan, Australia, South Africa, Brazil and Canada, and are already launching funding schemes for this purpose (Hudson 2020).

The soft-power of global EU leadership in multilateralism in general, but in international collaboration on science and technology in particular, is a significant driver for the EU to continue its efforts in fostering collaborative SD for addressing societal challenges worldwide, in total alignment and reinforcement of the very principles and values of EU integration.

Good examples of development cooperation frameworks

Development cooperation relates to the set of resources that developed countries allocate to developing countries for their economic and social progress. This aid must comply with four criteria: (1) it aims explicitly to support national or international development priorities, (2) it is not driven by profit, (3) it discriminates in favour of developing countries, and (4) it is based on cooperative relationships that seek to enhance developing country ownership (Alonso and Glennie 2015).

Multilateral organisations such as the UN or the Organisation for Economic Co-operation and Development (OECD) support development cooperation policies providing specific frameworks and instruments. For instance, with the Millennium Development Goals (MDGs) first and later the Sustainable Development Goals (SDGs), the international community has an acknowledged frame of reference for global objectives, which play a major role not least in development cooperation (Klingebiel 2014). Most SDGs have strong scientific components and the EU supports with its development aid funding national STI systems in certain countries and regions.

Certainly, EU institutions and countries are the world's leading donor of development assistance and cooperation. The EU proposes legislation and policies to promote good governance and human and economic development, such as fighting hunger and preserving natural resources (European Union 2019).

Altogether, these development cooperation frameworks are SD drivers for addressing global challenges as they provide excellent contexts for the deployment of strategies, instruments and actions together with third countries.

Knowledge-based economic diplomacy

The role of knowledge as a factor in economic prosperity of countries, the knowledge economy, is taking a predominant role in the relations between nations. The concept of knowledge has broadened from scientific knowledge to

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technology (ownership, products, services, patents) and to increase opportunities for innovation (social and economic value creation through new goods, services and systems) (Leijten 2017).

Global challenges also represent great opportunities for innovation and promotion of national strategies aligning interests in foreign affairs, trade, and science, technology, and innovation. With the aim of reinforcing their national economic competitiveness and explore business alliances worldwide, different countries are exploring innovative approaches with their foreign services. The UK Science and Innovation Network, the public-private partnership SwissNex, or the appointment of Science and Technology Ambassadors from Denmark or Bolivia to global hubs of innovation such as Silicon Valley rather than traditional administrative or political hubs, are just some examples of this global trend.

This knowledge-based economic diplomacy cultivates: (i) collaboration between at least three government departments: Foreign Affairs, STI Affairs, and International Trade, (ii) opportunities for direct economic impact, and (iii) an international framework for addressing global challenges via specific business partnerships.

Science as a driver for diplomacy

Science is often perceived as a universal language and as such can be a bridge between communities where political ties are weaker, but to develop relationships in these areas, scientists may require diplomatic assistance, whether in contract negotiations, intellectual property agreements or dealing with visa regulations (Royal Society and AAAS 2010). Successful examples with the involvement of the EU have taken place in recent years such as the scientific collaboration in the Middle East to build the particle accelerator SESAME in Jordan or the diplomatic collaboration for Arctic research.

To promote more collaboration and better institutional arrangements, *SD* could also benefit from recent European endeavours in other areas, such as cultural diplomacy, or what the key actors in the EC, EEAS and European Union National Institutes for Culture (EUNIC) prefer to call "international cultural relations". This coordinated cultural effort has made progress towards greater policy support by the Commission, the Parliament and the MS in the Council (EL-CSID 2019). Different milestones have been reached during this European support to international cultural relations or cultural diplomacy, as for instance the inclusion of cultural diplomacy as an instrument of policy in the 2016 Global Strategy (Higgott 2017). Recent trends in cultural diplomacy have fostered networking among different stakeholders, acknowledged the need for more multilateralism, created new public foundations or international organisations to push for strategic political goals through culture, supported values promotion instead of self-promotion, and focused on projects rather than events (Jora 2013). This previous successful experience in embedding international cultural relations in the core agenda of the Commission, Parliament and MS sets a precedent for a similar approach with a EU science diplomacy strategy (van Langenhoven 2017).

To highlight, scientific exchange, data and information sharing, early and open access to preprint publications and the joint study of genetic traceability of SARS-CoV2, among many other scientific actions are helping to tackle a universal response to COVID-19.

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3.3 Addressing Global Challenges Using Science Diplomacy

3.3.1 Stoppers for Addressing Global Challenges Using Science Diplomacy

Growing mistrust in democracy, institutions and experts

In a globalised world, national governments are confronted with complex challenges of maintaining sovereignty, transparency and democratic participation while advancing globalization and free markets (Rodrik 2011). The economic crisis in 2008 has put at risk the welfare state in many countries with growing citizen mistrust towards EU institutions, democracy and political representation (Armingeon and Guthmann 2014; Cordero and Simón 2016; Pennings 2017).

It is also often claimed that in modern democracies trust in scientific institutions and scientific experts is in decline, although how trustworthiness in science operates in different societies is a complex issue (ALLEA 2018; Eyal 2019). Indeed public trust in science depends on the scientific issue under discussion (climate change, energy issues, GM food, vaccines, etc.). Some science issues are strongly driven by politics and ideology, some are connected with religious beliefs, and others with gender (National Academies of Sciences Engineering and Medicine 2017). Certainly, this world-view value impregnation is inseparable in research studies in Social Sciences and Humanities, and also in research Life Sciences, which makes it crucial to foster critical societies able to understand research-based knowledge in the historical and social context in which is generated. Additionally, the rise of fake news is an emerging threat to ensure public trust in democracy and science.

It is important to consider how SD actions can better engage with citizens and civil society of a certain city, region, country, or continent. Framing these collaborations between scientists, diplomats and citizens in order to address global challenges that have regional or local impact, can be a mechanism to gain trust, but the current context is certainly a hurdle.

Discoordination between government departments

Addressing global challenges such as climate change, food and energy security, global health, among others, requires the close coordination of different governmental departments within and across all governance levels (supranational, national, regional, local), as well as close communication with other stakeholders involved. Sometimes joint governance models are put in place to implement actions. However, this is a complex decision-making scenario highly sensitive to political changes, discoordination or even mistrust for the exploitation of these policy competences.

For instance, those MS with a SD strategy in place have a different SD governance model. The governmental department in charge of outlining and implementing the SD strategy may be either the Foreign Affairs Department or the Science, Technology, Innovation, Higher Education and/or Trade Department with varying degrees of communication or coordination with the other national governmental department (van Langenhoven 2017; Flink and Schreiterer 2010; Flink and Rüffin 2019; Ruffini 2017) and certainly with limited engagement with the EU institutions.

Within the EU and the EC, there is no clear institutional linkage between the Directorate General for Research and Innovation (DG RTD) and the European External Action Service (EEAS), which obviously prevents leveraging the full potential of SD actions for addressing global challenges. The EEAS with its staff abroad has only slowly taken to explicit

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SD (Flink and Schreiterer 2010) and so it is recommended to build up a culture of SD within EEAS (van Langenhoven 2017), although S4D4C has noticed that such a culture is already in place in parts of the institution, which does not use the label as such (Degelsegger-Márquez, Flink, and Rungius 2019). Therefore it seems that the need for EU science diplomacy is rather articulated by actors in the field of EU science policy (Rungius, Flink, and Degelsegger-Márquez 2018).

In this light, a meta-governance framework for SD which enables cooperation among EU and MS science diplomacy actors while respecting and preserving each actors' specialisms and expertise is required (Aukes, Ordonez Matamoros, and Kuhlmann 2019).

Limited or no funding streams

The lack or the intermittent existence of public funding streams in the EU and MS for the research and/or development of SD actions tackling global challenges is a major stopper. Launching national or regional research funding schemes for international scientific collaboration is a SD operational tool used by countries, combining their scientific interests to promote more international collaborations with concrete foreign policy goals (van Langenhoven 2017).

Although actors involved in international science cooperation rarely see themselves as SD stakeholders, some MS have deployed specific funding schemes with a foreign policy perspective such as the UK with their Newton Fund or Germany with their DAAD education exchange programme (van Langenhoven 2017; Grimes and McNulty 2016).

The EC has instruments, policy initiatives and tools that provide adequate opportunities for the design and implementation of international scientific cooperation (ERA-Nets, Joint Programming Initiatives (JPI), Public Private Partnerships (PPP), etc.). For research on SD, the EU specifically launched the Research and Innovation Action (RIA) "Strengthening Europe's position in the global context: science diplomacy and intercultural relations" in 2016. But there still may be a missing opportunity to better engage DG RTD and EEAS and provide a funding stream for SD actions for addressing global challenges, uniting international scientific cooperation and EU foreign policy goals.

The UN has launched the Joint SDG Fund to fund transformative Joint Programmes and forge paths and partnerships that unlock public and private capital for the SDGs at scale.

Need for strengthening institutions

The exercise of SD relies heavily on people and their professional skills and networks. Diplomats and/or scientists in embassies, as well as civil servants in different government departments, all need time to develop their professional networks, build trust with international counterparts, and get familiar with SD projects and schemes. The rapid turnover that these officials have in these institutions is not negative but may represent a hindrance for the follow-up of any long-term plan of SD strategic action. To prevent it, sometimes embassies hire local staff that embody the "memory" of scientific networks providing a salutary counterweight to the rapid turnover of deployed officials (Ruffini 2017). The EU is not different to national governments in this regards, with EU officers having a relatively quick turnover too.

The need for strengthening institutions goes beyond governmental administration to also involve international organisations, scientific institutions (universities, research centres, learned societies, etc.), and diplomatic schools. If departments for SD or international collaborations exist at all in these institutions, they are usually under-staffed, composed with active researchers who are dedicated part-time, or without the awareness of the SD dimension in

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their affairs. Institutions that aim to have an impact in the evidence-policy interface require teams with people with different professional backgrounds and skills (Topp et al. 2018).

3.3.2 Warnings for Addressing Global Challenges Using Science Diplomacy

Different understandings about science diplomacy

It has become clear that different professionals and countries have different conceptions and understandings about SD (Flink and Rungius 2020). Many SD practices are framed under other names, and for most governments SD may still be a niche concept. Moving from a strict definition of SD as a rigid mechanism with clear-cut demarcations, it is worth considering SD as a fluid concept amended to individual cases entailing different goals, strategic intentions, target country or region. To facilitate these formal and informal approaches, the S4D4C consortium has published a first step towards a SD meta-governance framework depicting governance arrangements (top-down vs bottom-up, competitive vs collaborative), actors involved, and de facto practices (promotion or access to information, resources or markets, etc.) (Aukes, Ordonez Matamoros, and Kuhlmann 2019; Flink and Rungius 2018). Being aware of these variable understandings around SD will help to frame future roadmap or action.

Importantly, the use of science in international relations must consider the traditional boundaries between science and policy, in which scientific management and research should be free of any political or partisan intervention. SD can be thus framed as a "boundary problem" par excellence for the tension emerging between the interaction of the different social worlds of science and diplomacy (Kaltofen and Acuto 2018). Therefore, the implementation of any SD strategy or action must be free of any scientific misuse and be based on both strong scientific evidence and trusted networks of experts. Political manipulation of scientific evidence in the interest of ideological convictions has been common in democracy (Branscomb 2004), threatening the independence of science due to pure national interests and extreme political exploitation may entirely block any joint endeavour creating mistrust from the scientific community. As a conclusion, the scientific advisory role within government or foreign affairs ministries should be structured so as to protect its independence from both political interference and premature filtering in the policy process (Gluckman 2014). Framing SD strategies towards addressing global rather than national needs may provide a path to ensure the necessary research community support and engagement.

Note: During the 2nd S4D4C Networking Meeting "Towards an EU science diplomacy roadmap", attendees were asked what they understood for "**science diplomacy**" (Figure 2). Words such as cooperation, collaboration, understanding, knowledge, peace, bridge, and different variations of global challenges and SDGs were some of the top results.

Figure 2. The science diplomacy word cloud. More than half of attendees (51/87, 58,7%) entered up to three key words to define the term "science diplomacy".

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Different mindsets, cultures, and rules to bridge

Through the exercise of diplomacy in general and SD in particular, different mind-sets, cultures, and rules aim to coalesce around common interests and projects (Aukes et al. 2020). In this process, determining similarities among cultures should be secondary to the awareness of cultural differences as the logical starting point for the evaluation of intercultural commonalities and the design of joint projects around common goals (Bolewski 2008).

Specifically in SD, the main actors—scientists and diplomats—belong to two different systems or cultures with different rules, values and norms (Copeland 2009), and additionally these professionals have to engage with counterparts from other nationalities and continents, whose political, social, religious, economic and other values may differ. Examples of these dynamics can be noted in the design of Joint International Programmes, the establishment of large research infrastructures in developing countries or in war-conflict regions, in different sensitivities towards data governance for water management, among others (Young, Flink, and Dall 2020). Concerning providing science advice in a multicultural setting, science advisers have the challenge to be aware of culture peculiarities and norms to better provide their input (Grimes, Maxton, and Williams 2017). In general, having cultural sensitivity to understand these differences before or during an interaction will be crucial to build empathy and/or for troubleshooting.

Competitive vs collaborative approach

Strategies for cooperation and competition are based on different approaches and this holds true for both science and foreign policy, and surely for elements in SD. It is thus important to first establish the policy goal to frame the actions accordingly. The recent increase in sentiments of nationalism and protectionism across MS may push countries to outline more competitive strategies, hindering the development of the "Open to the World" policy and side-stepping joint approaches to address global challenges.

Having said this, the EU approach to SD combines cooperation (building neighbourhood capacity by sharing EU competence, or problem solving around joint actions on climate, health, etc.) with competition (improve EU scientific and industrial leaderships, positioning EU as global centre of excellence) (EL-CSID 2019).

The relationship between EU and MS to outline and implement an overarching SD strategy for addressing global challenges will be a complex one. To date, MS have deployed their SD strategies with little to no attention to the role of cooperation from the European Commission in SD-related issues beyond collaboration in established policy initiatives like the European Research Area (ERA). Interviews with different MS practitioners conclude that potential shifts in authority between the EC and MS mainly stems from providing complementary services and added value to national activities; whereas seizing the role of a coordinating actor could cause a shift in authority and subsequent changes in the SD governance, leading to a soft integration of agendas and actions at the European level (Rüffin 2020). Therefore, a joint EU science diplomacy strategy that already combines both approaches (competition/collaboration) should ensure it does not run against the interests of MS and these still have space for competition and collaboration among them.

Note: Considering that SD may be used as a cooperative or competitive or dominant asset for nation states (Rungius, Flink, and Degelsegger-Márquez 2018), according to the obtained word cloud in the 2nd S4D4C Networking Meeting in Berlin (Figure 2), the community attending this conference magnified the cooperative dimension rather than the competitive or dominant scopes.

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Weak political leadership for science diplomacy

Government SD strategies and actions do require political support in the higher government ranks to ensure its importance in the policy agenda and a smooth collaboration among different departments.

This political leadership by EU commissioners or national ministers/secretaries of state needs to be based on a basic understanding of the benefits and principles that SD may provide to the EU or their countries, respectively, for addressing societal challenges. It is also important to distinguish it from international scientific cooperation or international mobility, for instance. However, as stated above, the concept is still recent and has different understandings. Besides, political leadership across government departments should promote dialogue and collaboration among equals, be it ministers or secretaries of state. Any rank imbalance in this relation would weaken the negotiating or leading position of said department in SD.

The Strategic Forum for International S&T Cooperation (SFIC) composed by the European Commission, all MS and several non-EU countries as observers, has adopted an input paper on science diplomacy, entitled "Advancing the impact of Science Diplomacy at EU and Member States level through targeted support and improved coordination" to push forward this issue in the EC and MS' agendas (SFIC 2020).

3.3.3 Drivers for Addressing Global Challenges Using Science Diplomacy

The EU shows leadership in SDGs and climate emergency

The EU shows a strong willingness in addressing SDGs. In fact, the European Commission has committed to make Europe the world's first climate-neutral continent by 2050 with its European Green Deal (European Commission 2019). This is a package of measures presented in the form of an initial roadmap to enable European citizens and businesses to benefit from sustainable green transition that will cut emissions and invest in research and green technologies. This policy vision aims to provide a new EU growth strategy involving all kinds of stakeholders and, in doing so, ensuring that the transition will be just and socially fair, leaving no individual or region behind.

In parallel, in 2015, the European Commissioner for Research, Science and Innovation Carlos Moedas made SD a top priority in the Commission's agenda to position research and innovation at the centre of the EU global action to address global challenges, becoming central within the *Open to the World* policy framework to ensure the EU remained relevant and competitive at the global level (European Commission 2016). SD has been part of the Horizon 2020 programme and the Research, Innovation and Science Policy Experts (RISE) Group has valued this support recommending that it continues during the upcoming Horizon Europe framework programme (Gual Soler, Pavalkis, and Ritter 2019).

SD is present in the policy world as a policy tool, as a policy domain and as a fully-fledged strategic foreign policy discourse (Rungius, Flink, and Degelsegger-Márquez 2018). This fact together with the EU current leadership in the field both provide a favourable stage for MS to either revisit their national strategies on SD or open a public debate to craft a comprehensive strategy.

Global and regional charters for win-win actions

Global challenges require global solutions. Our complex international system is pushing to reinvent multilateralism and so provides excellent frameworks for global collaboration. The 2030 Agenda for Sustainable Development was adopted by all United Nations Member States in 2015 and sets the 17 SDGs, an urgent call for action by all countries, regardless of their income or development status, in a global partnership. Ending poverty and other deprivations must go hand-in-hand

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with strategies that improve health and education, reduce inequality, and spur economic growth—all while tackling climate change and working to preserve our oceans and forests (United Nations 2016). Other frameworks such as the EU Global Strategy or the deployment of regional missions such as the Partnership for Research and Innovation in the Mediterranean Area (PRIMA) initiative also provide these venues for global collaboration and win-win scenarios.

SD practice is embedded in these global and regional charters. Solutions to these global challenges may be provided by science, technology and innovation and will need to be implemented by diplomatic treaties and collaboration frameworks.

Demand for training from both communities

There is common agreement that SD requires science and diplomacy literacy and a unique set of skills (trust, empathy, communication skills, institutional language, analytical thinking, familiarity with S&T policies, etc.) (Degelsegger-Márquez, Flink, and Rungius 2019; Aukes et al. 2020). SD education and training comprise a wide array of subjects, from broad themes to specific topics, and specific training is indeed required.

The promotion of knowledge exchange scenarios, professional workshops and opportunities to training and capacity building in SD for scientists, diplomats, policy makers, civil servants, and citizens, would all drive SD actions and help design national and EU strategies (Turekian and Wang 2014; van Langenhoven 2017; S4D4C 2019; Holford and Nichols 2017). These training exercises not only provide capacity-building for participants, but specially allow them to increase their professional networks and nurture collaborative projects transcending national and professional boundaries.

Trust, empathy, political will and timeframes

The ability to build trust and show empathy is one of the top skills required in SD (Degelsegger-Márquez, Flink, and Rungius 2019). Science advice and diplomacy require that scientists, science advisers and science diplomats; policy-makers and diplomats, all build up long-lasting relationships to ensure mutual understanding, common trust, empathy, and influence to foster collaborative scenarios. All actors interested in SD should work on reflecting on each other's norms, values, goals etc. to find common ground in a constructive way (Aukes et al. 2020). However, it is also important that science advice is not perceived as advocacy, as trust in that advice and in the adviser would be undermined (Gluckman 2014). All in all, the identification of a wide array of practical skills tailored for professionals in the science and policy/diplomacy interface has already been undertaken (Joint Research Centre 2017; Mair et al. 2019; Degelsegger-Márquez, Flink, and Rungius 2019).

As mentioned above, political will from top government representatives provides a policy context ideal to stir up SD actions for addressing global challenges. This has been the case in the EC during the term of Commissioner Carlos Moedas, who has started to place SD as a priority item in the scientific agenda.

These strategies and actions will be better developed when established over a number of years, setting strategic milestones and goals along the roadmap. However, in doing so, it is important to understand that timescales in policy or diplomacy are much quicker and demanding (days or weeks) than in scientific research (months and years), and usually it will be science that adapts to the demands of policy/diplomacy.

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4

How Will We Get There? The Systemic Change towards EU Science Diplomacy to Address Global Challenges

An integrated EU science diplomacy strategy addressing societal and global challenges could be built on all its many achievements over decades. This strategy should work towards fulfiling a vision in which science diplomacy would contribute to a knowledge-based and innovation-led sustainable growth model able to provide solutions to societal and global challenges.

UN 2030 Agenda presents 17 SDGs, 169 targets and indicators to measure progress and was adopted by 193 countries in 2015. For Europe, and for the world, this agenda offers an opportunity for profound economic and societal transformation. There is a collective recognition of the need for a new approach in the face of the complexity that is affecting our world.

However, it is also true that the complexity of the issues that need to be tackled, together with the many different stakeholders and interests in place, the very many layers of governance and the slow pace at which institutions and people are adapting to the new paradigm may be hampering a timely, holistic response to these challenges.

A new approach is therefore needed.

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4.1 The Required Systemic Change

Many of the drivers identified by the different stakeholders put the EU in a unique position to lead a SD approach to address global challenges. Thus, the final recommendations proposed in this report aim at triggering a systemic change in the EU governance of science, diplomacy, and science diplomacy that aligns and maximizes the impact of everyone´s efforts towards addressing global challenges.

Mission-oriented innovation offers a fresh approach, rather than focusing on particular sectors—as in traditional industrial policy—mission-oriented policy focuses on problem-specific societal challenges, which many different sectors interact to solve (Mazzucato 2018). It is about an all-encompassing transformation implying changes throughout and across all disciplines. Furthermore, these shifts will have to happen from the very local level up to the European level and beyond and will require efforts and long-term actions from all stakeholders.

Considering that four premises have been established for effective SD practice by S4D4C experts: (1) Grand societal challenges require diplomatic efforts and science-based knowledge, (2) Science-based knowledge production is diverse and evolving, (3) Diplomacy means reconciling a variety of interests, and (4) Science Diplomacy requires science and diplomacy literacy (Aukes et al. 2020); we are proposing a systemic change towards addressing global challenges. Indeed global challenges are complex because they require a deep understanding of both the scientific dimension as well as the geopolitical dimension of the issue at hand. Neither the scientific community nor the diplomatic community can solve the challenges we currently face on their own; we recognise the need for both a "transformative science" and a "knowledge-based diplomacy" (Aukes, Ordonez Matamoros, and Kuhlmann 2019).

For a systemic change to happen, this report proposes a set of policy recommendations focused on an integrative transformation that takes into account three transversal processes in five specific key spheres (knowledge, governance with no silos, alliances, institution, and people). (**Figure 3**):

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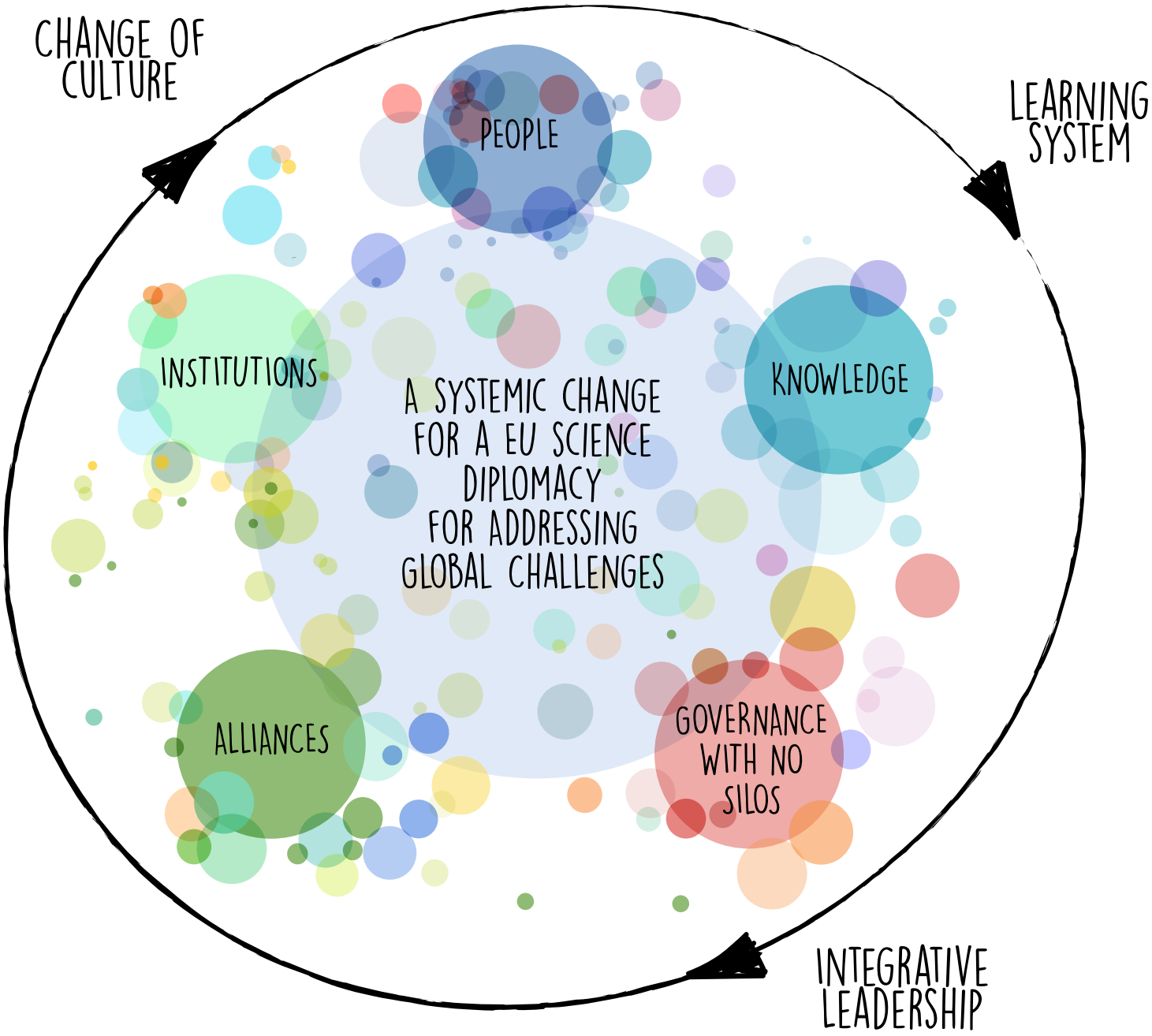

Figure 3. The S4D4C Systemic Change for Addressing Global Challenges via EU Science Diplomacy.

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Transversal processes required for a systemic change to address global challenges:

1. Learning system: through a wide array of science advice mechanisms and their input into the evidence-informed foreign policy making process. This learning system needs to be embedded into and supported by all the spheres of the systemic change. It will require permanent and specially dynamic science advice mechanisms for knowledge to feed the policy-making, a governance system able to ask for, absorb and react to this knowledge, alliances in place to integrate different stakeholders into the learning system, institutions acknowledging their role in the creation of the system and dedicated and trained people in every single sphere to make the learning system happen;

2. Integrative leadership: to foster the required changes in every single sphere of this holistic approach. This leadership will need to find ways to better generate and integrate knowledge so that it is fully exploited for addressing global challenges and to find ways to break the existing governance silos currently hampering transversal approaches to global challenges. Moreover, it will need to foster creative ways of establishing alliances, lead deep institutional cultural changes and even creating hybrid or boundary institutions more flexible and adaptive to sudden changes. Finally, an integrative leadership will be needed to inspire professionals addressing global challenges and to support the development of the necessary skills, competences and career options.

3. Change of culture: the collective endeavour to address global challenges requires agile, adaptive, effective, and permeable environments for professionals of all kinds to collaborate. Scientific and foreign affairs institutions as well as government departments need better interactive spaces. New alliances require including all relevant stakeholders in the process leaving no one behind. Building networks that study, pilot, and support the new vision of the system is essential in establishing lasting systemic change. These networks typically do not rely on the existing bureaucratic structures. They link people of similar roles across existing organisational lines. For that to happen, institutions should promote awareness and a new culture for collaboration between scientists, diplomats, policy-makers, and other professionals. Lastly, new professionals in the science-policy-diplomacy interface must be trained to bring all worlds together and catalyse more interactions and cycle spins.

4.2 Policy Recommendations to the EU and MS for Addressing Global Challenges via the Science Diplomacy Systemic Change

In a multi-stakeholder effort, S4D4C promoted networking and international dialogues in Madrid (2018) and Berlin (2019) between diplomats, scientists, policy-makers and science managers as well as other non-state actors. These events allowed thoughtful debates and insights around what policy recommendations can be drafted to the European Commission, the European External Action Service, international and multilateral organisations, national MS government departments, the scientific community (institutions, universities, research centres, learned societies, national academies, etc.), and other related non-state actors for using science in/for diplomacy for addressing global challenges.

This set of policy recommendations is focused on an integrative transformation implying changes throughout and across all spheres (Figure 3). Furthermore, these shifts will

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have to happen from the very local level up to MS and the European level and beyond and will require efforts and long-term actions and resources from all stakeholders.

Some items listed within these policy recommendations have already been proposed by other scholars and practitioners (Gual Soler, Pavalkis, and Ritter 2019; van Langenhoven 2017), some have been included in the SFIC input paper (SFIC 2020), and they may have already been implemented by the EC, the EEAS, or some MS. Having said this, this policy report aims at raising awareness about these spheres and their interaction to encourage all stakeholders to keep advancing in their use of knowledge in policy and drive citizen engagement to reach their goal to contribute effectively to global challenges.

4.2.1 Knowledge for Addressing Global Challenges

Scientific and technical knowledge has a role in addressing global challenges through the use of scientific evidence in policy making by governments and diplomats:

> Recommendation 1: Reinforce Responsible Research and Innovation, Citizen Science, Open Science and Science Advice as European science core assets that need to be promoted in the EU global strategy and MS foreign policies.

The EU has been at the vanguard of worldwide leadership in many scientific concepts, from conducting a research more aligned to society and innovation (Responsible Research and Innovation, RRI), to involving citizens in the scientific practice (Citizen Science) or making publicly available all scientific results funded by public grants (Open Access) as well as Science Advice, all of which is understood under the umbrella of Open Science. These scientific concepts are aligned with the set of European values of cooperation, integration, and social responsibility, and as such should be promoted as core European science assets in any EU global strategy designed by the EEAS and in any national MS strategy. Future results from the mission-oriented approach for Horizon Europe should be evaluated regarding its reinforced efforts to bring together different stakeholders and to put the EU at the forefront of many scientific endeavours with clear societal relevance.

> Recommendation 2: Foster more interdisciplinary research around SDGs through specific calls and mission-oriented funding, ensuring a Social Sciences and Humanities (SSH) perspective is also included.

For broad and complex scientific questions, it is necessary to set up multidisciplinary expert panels and encourage links between disciplines (SAPEA 2019). In the discussion to design Horizon Europe, it would be welcomed to articulate more interdisciplinary research targeting issues from the SDGs. The new Horizon Europe's Clusters and Missions schemes all have a SD dimension and could benefit from a transdisciplinary approach where the role of SSH is added increasing understanding of processes, governance frameworks, and solution-based approaches (SFIC 2020).

Solutions to all SDGs will be partly provided through STI efforts, and international scientific cooperation is a driving force of economic and social development. Even though it is difficult to establish a common understanding about the different meanings and practices of SD, it is recommended to keep expanding our knowledge and sharing good practices among stakeholders. By showcasing different initiatives and examples, practitioners will be more exposed and interested in improving their practices and building strategic alliances.

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Recommendation 3: Share best practices for knowledge exchange in science diplomacy and science for policy for early-career and established researchers and diplomats.

As a follow-up to the previous recommendation, scientists and academics who are science advisers or have been involved in SD or public policy-making, are all encouraged to actively share their knowledge and expertise with their peers and early-career researchers in scientific conferences, in their research institutions or in specialised training workshops. They are the best advocates before the scientific community and can help nurture the next generation of science advisers and science diplomats.

4.2.2 Governance with No Silos for Addressing Global Challenges

Global challenges are too complex problems and their evolution is uncertain, a new way of collaboration is needed in order to solve the pressing problems we face globally. Sustained political support and continuous commitment at all levels (global, European, national, regional, and local) are key to achieving global and societal challenges. Existing barriers at all levels cannot be overcome by R&D&I policy alone. There is a need for better policy-alignments to tackle the challenges we face as a society in a coordinated effort.

Recommendation 4: Create and strengthen hybrid institutions bridging the scientific and the diplomatic communities.

In the times of globalisation gridlocks produced by difficulties in reaching consensus and in altering dynamics of long-running institutions such as government departments, the role of hybrid and dynamic institutions that have flexibility to adapt to quick changes or to work on boundaries scenarios is fundamental (Held 2016). SD is an excellent example of a boundary practice that cannot be fully performed without the involvement of different professionals and government departments. Some countries, such as the UK or Switzerland, have created hybrid institutions or networks (SIN-UK or SwissNex) to implement their national SD strategies (van Langenhoven 2017; Ruffini 2017; Flink and Schreiterer 2010).

The **launch of a EU Hub or Observatory for Science Diplomacy** could be an example of a boundary institution in charge of fostering integration of SD practices in the EU, national MS, and global SD strategies; of building up capacity and SD skills; of performing different case studies; of running specific schemes to promote SD at the European and national level; and, lastly, supporting the EC and EEAS in whatever they require to fulfil their SD actions.

There must be monitoring mechanisms in place from the start to assess progress, identify gaps, impacts and successes, and to adapt to evolving demands and needs.

Recommendation 5: Improve EU integration and cooperation between MS around scientific priority topics and geopolitical interests.

The collaboration between the EU and MS will be better outlined when designed around societal priority topics and certain geopolitical interests that will bring together MS. Current success stories such as the collaboration with PRIMA, EULAC or the Arctic mission are examples to be followed. To achieve success stories different DGs or Services of European Commission are required for a joint approach.

The Strategic Forum for International Science and Technology Cooperation (SFIC), an advisory group to the Council and the

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European Commission in the field of International Cooperation in Science & Technology (SFIC n.d.), can be an important strategic stakeholder to promote joint actions between MS and to collaborate with the EU Hub/Observatory on Science Diplomacy in providing advice and guidance to the EC and EEAS in matters of SD, as well as in implementing certain actions.

The trend of MS pursuing their own national interests still sometimes hamper a EU approach to global challenges and, although some MS focus around projects of value for the EU, there is still much to be achieved. The United Nations and SDGs are a good example of how these policies of global interest can percolate among nations. Encouragement for lifting the focus from national to global interest is therefore imperative.

Recommendation 6: Improve coordination between EC and EEAS on global and multilateral challenges.

Different reports have stated that both EC and EEAS are involved in different SD projects and initiatives, but also that their communication and coordination could be further improved (Rüffin 2020; Rungius, Flink, and Degelsegger-Márquez 2018; van Langenhoven 2017). The establishment of a flexible coordination mechanism such as a joint committee that actively functions as a linkage between the EC and EEAS on matters related to international science cooperation, SD, and global policy goals could improve collaboration between both European institutions.

The EU network of S&T counsellors in EU delegations is a stepping stone in promoting this better coordination between EC and EEAS, and further knowledge exchange opportunities for these professionals would be welcomed.
To consolidate this coordination and also have a bigger impact of science and technology in global governance, a joint strategic policy could be designed with other relevant stakeholders to ensure STI ministerial fora alongside multilateral summits (G8, G20…).

4.2.3 Alliances for Addressing Global Challenges

A new way of collaboration is required where all international, national, including regional, R&I systems, diplomatic corps and policymakers are mobilised to use knowledge, fostering transnational and transregional cooperation through networks and alliances for global challenges.

The power imbalance between nations sometimes makes alliances driven only by one party. Establishing cofounding strategies may foster reciprocity, but also providing funds unilaterally as part of a joint decision process may build trust and capacities. When forming alliances, these aspects are important to address.

Building networks that study, pilot, and support the new vision of the system is essential for establishing a lasting systemic change. These networks typically do not rely on the existing bureaucratic structures, they link people of similar roles across existing organisational lines of different institutions.

Recommendation 7: Foster alliances through the allocation and reallocation of research funds for global and regional priority areas.

SD is better appreciated when it is practiced around priority topics and areas. PRIMA is an excellent example that brings together international science cooperation, tackling SDGs for water management and food sustainability, and building strategic partnerships and collaborations between EU Member states and countries from the North of Africa.
This type of fund will trigger more STI capacity building projects in Third Countries. New development and

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cooperation strategies are required to reduce global inequality and advance social and economic global progress. The active involvement of the EU and MS in STI capacity building in Third Countries allows for an active positioning of the EU as global leader in cooperation and in scientific leadership. Projects related to the establishment of large research infrastructures such as SESAME or SKA, but also, those related with direct capacity building for scientific and project management, for water and global resources management, etc. are also excellent occasions to solidify strategic partnerships. For instance, the EU and the African Union have deployed joint thematic programmes (food security, sustainable agriculture and forestry, marine maritime and inland water research…) through two funding streams: (i) African Union Research Grants, supported by the EU Pan-African programme, funded by the EU, but managed directly by the African Union Commission, with a view to building a system of competitive research grants at Pan-African level; and (ii) Horizon 2020 projects, created in response to targeted calls to Africa, and allowing for synergies with emphasis on local multi-stakeholder action, among them, the ERA-NET co-fund LEAP-Agri (Ravinet, Cos, and Young 2020).

Including science diplomacy and SDGs in all STI bilateral agreements might also be a good strategy. STI bilateral agreements between countries are one of the most used operational tools in international scientific cooperation. For future agreements or the revision of current ones, both parties could benefit from adopting remits to tackle SDGs and to make more explicit their SD perspective. For example, thinking about how this international scientific cooperation could benefit other types of relationships between both countries (culture, trade, etc.) in order to articulate specific actions around it.

Lastly, setting more research funds to address grand challenges such as the United Nations Green Climate Fund, the Societal Challenges in Horizon 2020, the Global Challenges Research Fund in the UK, or the Global Grand Challenges in the Bill & Melinda Gates Foundation, are additional research venues where SD projects can thrive on.

Recommendation 8: Involve researchers' networks.

The power of scientific networks can be further harnessed by establishing closer alliances with national academies and all kind of learned societies to ensure a multi-stakeholder approach and sufficient opportunities for knowledge exchange. Considering these researchers' networks, the role of diaspora scientific organisations can be fundamental in bringing together their home countries with their destination countries, fostering scientific collaborations and academic exchange (Royal Society 2011; Meyer and Brown 1999; Burns 2013). Some MS governments have established certain policy instruments and channels of communications to reach their scientific diasporas abroad in order to (a) explore and implement joint collaborative projects with them, (b) get their insights to improving their national STI systems, and (c) strengthen scientific relationships with their destination countries (Elorza Moreno et al. 2017; Labrianidis, Sachini, and Karampekios 2019). So, MS that do not have an active policy to engage with their diaspora abroad are encouraged to develop it respecting their independency and building mutual trust and understanding.

The EU currently has some active networks such as the Marie Sklodowska-Curie Actions Alumni Network that could be further strengthened and empowered in SD around specific collaborative projects. The EC could promote its engagement with and the activity of national diaspora organisations through specific calls, maybe within the Coordination and Support Actions (CSA).

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Beyond EU and national governments, active engagement with alumni is also important at the regional and local level (SciTech DiploHub n.d.).

During the last few years, different European universities have established strategic alliances across Europe to harmonise their curricula and to exchange staff and students. These global and European university alliances can become active stakeholders in EU science diplomacy if they engage with other stakeholders in SDG projects, global EU policies, and "Open to the World" EC initiatives.

Recommendation 9: Involve citizens.

Launching new pilot actions to involve citizens and have broader societal engagement and responsiveness when rolling out SD projects on the ground may contribute to tackle societal challenges. The aim is to support active involvement of citizens for addressing global challenges, to ultimately ensure better results leaving no one behind.

Policy mechanisms and funding schemes to integrate refugee scientists and minorities should be explored. Countries such as the UK or Germany already have initiatives and funding schemes to integrate scientists and academics who have fled their home countries.

4.2.4 Institutions for Addressing Global Challenges

The design and implementation of a new model must be enacted in close interaction with all the relevant stakeholders in both the scientific and the diplomatic community. The institutions of both communities should promote awareness among their members on how to face societal challenges. The barriers we are addressing have deep roots which can only be removed through institutional changes.

Recommendation 10: Raise awareness of using science for global challenges and public policy in early-career and established researchers and diplomats.

Societal challenges need bigger involvement of scientists in diplomacy and public policy-making who, besides their research and teaching responsibilities, may engage with diplomats and policy-makers in the policy-making process to ensure better societal response to health emergencies, food security, cybersecurity, water droughts, nuclear emergencies, migration crisis, etc. Scientists need to be exposed to SD and evidence-informed policy-making, to understand the basics of these boundary disciplines and to acquire further skills (Aukes et al. 2020). Institutions should foster and raise awareness for both early-career researchers, this may even be framed as a career path option or as a stepping stone in their individual careers; and for established researchers, this provides opportunities to transfer their expertise and knowledge directly to society. It is thus recommended to organise SD and public policy initiatives, seminars, satellite symposia alongside international and national scientific conferences and/or be part of the research centre's or university's PhD training curricula. On the other hand, diplomatic and foreign affairs institutions should sensitise their diplomats and policy officers about the increased importance of S&T in external relations and geopolitics.

Recommendation 11: Build knowledge-exchange interfaces.

More interactive spaces for science diplomacy are needed. These interactive spaces where scientific knowledge, policy and diplomacy all meet allow to identify issues of common interest, to reflect jointly on joint responses for addressing global challenges, to access relevant science-based knowledge infrastructures and experts and to suggest forms

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of organising intended science diplomacy activities. Science diplomacy efforts should aim to create and institutionalise these spaces at all levels of government and accessible to a broad range of stakeholders.

Professionalization of international offices and policy units is required. Many research centres and universities rely on staff scientists, professors or lecturers to perform duties related to international affairs or policy affairs part-time or full-time. The set of skills and professional backgrounds required to engage with other international officers, diplomats, and policy makers differ from the set that researchers and lecturers usually have. To ensure bigger impact and a better knowledge transfer from the research institution, it would be beneficial to employ professional staff working in these international and/or public policy units with the right profiles. Previous success stories have been attained when employing journalists or tech transfer officers for science communication and patent/IP/regulation affairs, respectively.

Strengthening current SD units or opening new ones might be a good path. International and multilateral organisations such as UNESCO already have SD units, but there are others that still have not created or empowered a department to undertake SD initiatives. This does not mean these institutions do not do SD, but maybe they define their actions in other terms: international science cooperation, health cooperation, etc. International and multilateral organisations play a key role in influencing countries to develop specific public policies, and they can be strategic partners in capacity building and training in SD. As an example, some countries have Units of Science and Technology or Scientific advisers in the Ministries of Foreign Affairs (see the country members in the Foreign Ministries S&T Advice Network—FMSTAN).

Recommendation 12: Foster strategic partnerships for capacity building and science diplomacy training with other institutions.

This recommendation is particularly addressed at international and multilateral organisations that have SD units. These organisations prove themselves to be strategic partners for capacity-building and SD training based on their own programmes (for example, the TWAS-AAAS Science Diplomacy Annual Courses) and expertise (international organisations have to liaise daily with foreign policy affairs bringing together different countries). The UN, UNESCO, OECD, the World Health Organisation (WHO), the World Trade Organisation (WTO), TWAS, and many other international institutions can actively pursue these partnerships to help create dynamics and practices around SDGs.

4.2.5 People for Addressing Global Challenges

Global challenges require a paradigmatic cultural shift in the way many professions are framed and understood. In the 21st century, scientists and diplomats need to be prepared to work in a more collaborative and interdisciplinary way. New professionals are needed who master skills in understanding people, science and diplomacy communication, problem solving, decision making, and teamwork if we are to solve global challenges. If proper capacity building and training opportunities do not occur, all the other changes have little value. Both communities, researchers and diplomats, should be trained to better address global challenges, in particular SDGs.

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Recommendation 13: Empower and train scientists and diplomats to work together to address SDGs.

Scientists who are to engage in SD practices are recommended to receive some basic training in diplomacy and international relations in order to understand how to better fit their scientific expertise in this boundary and complex arena (Degelsegger-Márquez, Flink, and Rungius 2019; van Langenhoven 2017; Grimes, Maxton, and Williams 2017; Gual Soler, Robinson, and Wang 2017). Capacity training workshops, knowledge exchange programmes and seminars/symposia in their research centres and universities are all perfect venues for scientists to develop these skills and get engaged with the global SD community of practitioners.

Conversely, diplomats also need to acquire basic understanding in STI affairs to better perform their *SD* duties. Again, training workshops and inclusion of STI issues in their diplomatic academies are essential to nurture complete science diplomats.

Universities and research centres could align part of their scientific and teaching strategies and governance frameworks around SDGs as this can help them to stand out as active stakeholders in SDGs in the international landscape and to build up global partnerships. Early-career researchers and students who do research in SDG research centres or study Bachelor's and Master's Degree based on SDGs would benefit from a global and highly technical perspective. For example, the Sustainable Development Solutions Network (SDSN) France has been launched in 2018 and it is a network that mobilises scientists and experts from Kedge Business School, PSL University and the University of Cergy-Pontoise working on practical solutions to reach the SDGs. Likewise, SDG Bergen is a strategic initiative from the University of Bergen (Norway) to engage with international organisations via SD activities to make the most of their research efforts in SDGs. These examples show a path that can be further explored by other academic institutions.

Recommendation 14: Diversify career paths for scientists and diplomats to include professionals in knowledge brokerage.

Throughout this report an emphasis has been placed on modernising, revamping, and enriching the practice of scientists and diplomats, with the idea of addressing global challenges through a process that is sufficiently enriched with knowledge-exchange scenarios and science advice mechanisms. Basically, we propose a more open and collaborative approach for scientific and technological research and diplomatic practice. However, this systemic change requires the connection between scientific experts, diplomats, and by extension policy-makers, to be reinforced with a set of unique professionals able to understand all worlds and build bridges among experts from across all disciplines and professional backgrounds, and who would have the mission of catalysing new processes to ensure more learning exercises and evidence-informed policy-making processes.

These professionals (framed as science diplomats, science advisers, policy officers, etc.) would enrich not only the embassy staff, ministerial departments, science advice mechanisms; but also departments for international and public affairs from universities and research centres, learned societies and national academies, as well as SD units in international and multilateral organisations, providing support to the daily practice of research, policy-making, and diplomacy.

Knowledge-exchange scenarios and Science & Technology Policy Fellowship Schemes would provide opportunities for early career scientists to explore this science-policy-

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diplomacy nexus in practice with the result of either going back to their research labs with a different mind-set in place or pursuing it as a career option in public administration, scientific management, industry, NGOs, or think tanks afterwards.

Recommendation 15: Launch of a fellowship scheme for scientists to work in EC, EEAS or MS government institutions.

The challenges that society faces at the local, national, regional, and international levels are becoming increasingly complex. Governments around the world tackle multifaceted problems that STI contribute to or can help address, including challenges related to energy, water and food resources, healthcare, employment and economic stability, infrastructure and communications, environmental sustainability, and security. These governments can benefit from scientific expertise and scientific evidence to deploy evidence-informed policies that may better tackle these societal challenges (Aukes et al. 2020).

The EU and some MS have governmental research agencies and scientific institutions with specific government science advice mandates. In addition to these formal mechanisms, there are informal ones to connect scientists to policy, enthusing early career scientists for engaging in policy-making and diplomacy, and vice versa, for policy-makers and diplomats to see the value of research in their fields. The AAAS has grouped them in four categories: fellowships, internships, pairing schemes, and details and rotation (Gual Soler, Robinson, and Wang 2017).

These knowledge exchange schemes are grounds for capacity building, nurturing both science-policy interfaces and evidence-informed culture in policy-making. There are success stories in EU and MS: the European Parliament MEP-Scientist Pairing Scheme, the British Royal Society Pairing Scheme, or the Spanish "Ambassadors for Science" exchange programme between scientists and diplomats (van Langenhoven 2017; RISE Group 2018; Gual Soler, Robinson, and Wang 2017). S4D4C also launched a pilot programme called "Open Doors" for scientists to spend a few days in different MS scientific and foreign affairs institutions (ministries, embassies, research facilities, etc.).

We believe the EU and its MS could explore formulas of fellowship schemes similar to the AAAS Science & Technology Policy Fellowships in the United States, which has been enabling scientists to spend 1-2 years in different US government departments for decades. **The launch of a EU Science & Technology Policy Fellowship Scheme** could enable scientists to spend 1-2 years in different EC and EEAS departments, helping to link their policies to the scientific community and expertise. This scheme could be monitored and implemented by the EU Observatory on Science Diplomacy, making sure all fellows are trained and capacitated to have the biggest impact on their destination offices. Additionally this EU practice could permeate among MS replicating these schemes at the national, regional or local level.

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5

Call for Action

It is time for **collective action**; it is time for a **committed EU integrative leadership in addressing global challenges using science diplomacy**.

We believe our recommendations are more relevant and necessary than ever. We trust this policy report is food for thought and fosters discussion to build a EU science diplomacy strategy for addressing global challenges. We advocate for the collaborative action of not only all Member States, but also all stakeholders and professional networks to make the proposed systemic change happen.

We want this report to be a live document so we are **calling for comments, contributions, and ideas on how to develop implementation plans** (with potential milestones and progress assessment) **of the fifteen recommendations for the EU and other important stakeholders of different nature.**

Please, send us your name, affiliation and comments to **s4d4c@fecyt.es** by **10th October 2020** and we will take them into consideration. Comments and contributions will help publish an improved version of the report by the end of 2020. Meaningful contributions will be acknowledged in the next version of the report.

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S4D4C

USING SCIENCE FOR/IN DIPLOMACY FOR ADDRESSING GLOBAL CHALLENGES

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