



Study on 'Research and Innovation international cooperation in the field of renewable energy technologies'

Final Report

Written by Ecorys, ICE France and WIP Renewable Energies
August 2020

Research and
Innovation

Study on 'Research and Innovation international cooperation in the field of renewable energy technologies'

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Manuscript completed in August 2020.

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PDF	ISBN: 978-92-76-20010-9	doi: 10.2777/474916	Catalogue number: KI-02-20-480-EN-N
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Luxembourg: Publications Office of the European Union, 2020

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edited by



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Acknowledgements

This study was implemented between July 2019 and June 2020 by Ecorys, WIP Renewable Energies and ICE France (formerly RaL). The main authors were Stephen Miller (Ecorys), Amélie Girard (Ecorys), Jan Maarten de Vet (Ecorys), Laura Heidecke (Ecorys), Nga Nguyen (Ecorys), Jean-Paul Delattre (ICE France), and Rainer Janssen (WIP Renewable Energies).

The study team would like to thank all those who contributed to the study by sharing their valuable insights:

Adelphi Consult GmbH
Agence De l'Environnement et la Maitrise de l'Energie (ADEME)
AiF Projekt GmbH, Croatian Ministry of Environment and Energy
Croatian Ministry of Science and Education
Danish Ministry of Science Innovation and Higher Education
Direction des affaires européennes et Internationales (DAEI)
Energy & Water Agency of Malta
Federal Ministry Republic of Austria, Transport, Innovation and Technology
French Ministry of Economy, Finance and Industry
German Aerospace Centre (DLR)
German Agency for International Cooperation (GIZ)
German Federal Ministry of Economics and Technology
Innovation Fund Denmark
Institut National de l'Energie solaire
Agence Francaise de Developpement (AFD)
Italian Ministry of Economic Development
Italian Ministry of University and Research
Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA),
Latvian Central Finance and Contracting Agency
Lithuanian Energy Institute (LEI)
Management Agency on behalf of Germany's Federal Ministry for Economic Affairs and Energy (BMW)
Ministère de la transition écologique et solidaire (MTES)
Ministry of Economic Affairs and Employment of Finland
National Centre for Research and Development in Poland
Navigant
Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO)
Netherlands Enterprise Agency (RVO)
Polish Ministry of Science and Higher Education
Portuguese Centre for Power and Energy Systems (CPES)
Public Service of Wallonia, Department of Energy and Sustainable Building
Research and Innovation Department of the Swedish Energy Agency
Ricerca sul Sistema Energetico - RSE S.p.A
Science Foundation Ireland
Business Finland
Spanish Centre for the Development of Industrial Technology (CDTI)
Sustainable Energy Authority of Ireland (SEAI)
Technology Centre CAS (Czech Republic),
Swedish Energy Agency
UK Department for Business, Energy and Industrial Strategy (BEIS),
University of Lleida (Catalonia)
Vinnova.

List of abbreviations

ADEME	Agence de la transition écologique / French Agency for Environment and Energy Management
AEEP	Africa-EU Energy Partnership
AFiF	African Investment Facility
BMBF	German Ministry of Education and Research
BMWi	Ministry for Economic Affairs and Energy
CA	Cooperation Agreement
CDTI	Centre for the Development of Industrial Technology
CEM	Clean Energy Ministerial
CPLP	Comunidade dos Países de Língua Portuguesa
CSP	Concentrated solar power
DG ENER	Directorate-General for Energy
DG GROW	Directorate-General Internal Market, Industry, Entrepreneurship and SMEs
DG RTD	Directorate-General for Research and Innovation
DG	Directorate-General
DLR	German Aerospace Centre
ERA	European Research Area
ERAC	European Research Area and Innovation Committee
ERC	European Research Council
EU-AITF	EU-Africa Infrastructure Trust Fund
EUEI PDF	EU Energy Initiative Partnership Dialogue Facility
EU-ETIPs	European Union Energy Technology and Innovation Partnerships
FCT	Foundation for Science and Technology
GDP	Gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit / German Corporation for International Cooperation
ICT	Information and communications technology
IEA DSM	International Energy Agency Demand Side Management
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
MAECI	Italian Ministry of Foreign Affairs and International Cooperation
MISE	Italian Ministry of Economic Development
MIUR	Italian Ministry of Education, University and Research
MoU	memoranda of understanding
MSCA	Marie Skłodowska-Curie actions
NCBR	National Centre for Research & Development
NCN	National Science Centre
NECP	National Energy and Climate Plan
NWO	Dutch Research Council / Nederlandse Organisatie voor Wetenschappelijk Onderzoek
OECD	Organisation for Economic Co-operation and Development
PtJ	Project Management Jülich
PV	Photovoltaic
R&D	Research and development
R&I	Research and innovation
RD&D	Research, Development and Demonstration
RECP	Renewable Energy Cooperation Programme
RET	Renewable energy technologies
RVO	Netherlands Enterprise Agency
S&T	Science and technology
S&T	Science and Technology
SDGs	Sustainable Development Goals
SEAI	Sustainable Energy Authority of Ireland
SEforALL	Sustainable Energy for All
SET Plan	Strategic Energy Technology Plan
SET Plan	Strategic Energy Technology Plan
SETIS	Strategic Energy Technologies Information System

SFI	Science Foundation Ireland
SFIC	Strategic Forum for international S&T cooperation
STEM	science, technology, engineering, and mathematics
STI	Science, technology and innovation
SWOT	strengths, weaknesses, opportunities, and threats
TCP	Technology Collaboration Programme
TRL	technology readiness level
WTZ	German Scientific Technological Cooperation

Abstract

The main aim of the study is to analyse how the international cooperation efforts of Member States complement EU initiatives and efforts in the field of energy research collaboration, and to assess which actions at EU level would improve synergies and additionally between the EU and Member States. The research methods employed through this study included documentary collection and analysis, interviews with Member State representatives, and a final expert workshop. First, current cooperation mechanisms are examined, with regard to bilateral Cooperation Agreements and multilateral frameworks, in order to profile and understand current strategic approaches to international research and innovation in renewable energy technology. Second, the specific focus turns to funding entities (national agencies or organisations that are mandated by their governments to manage the funding of projects) in order to profile implementation approaches. Third, the Horizon 2020 and Horizon Europe perspective is incorporated through a review of relevant Horizon 2020 actions. Finally, five strategic recommendations for future EU-led action are proposed in two groups; recommendations to further improve EU R&I international cooperation in the field of renewable energy technologies, and recommendations for Horizon Europe.

Résumé

L'objectif principal de l'étude est d'analyser comment les efforts de coopération internationale des États membres complètent les initiatives et les efforts de l'UE dans le domaine de la collaboration internationale en matière de recherche énergétique, et d'évaluer quelles actions au niveau de l'UE amélioreraient les synergies et la complémentarité entre l'UE et les États membres. Les méthodes de recherche utilisées dans le cadre de cette étude comprennent la collecte et l'analyse de documents, des entretiens avec des représentants des États membres et un atelier d'experts. Dans un premier temps, les mécanismes de coopération actuels (les accords de coopération bilatéraux et les cadres multilatéraux), sont examinés afin de profiler et de comprendre les approches stratégiques en matière de recherche et d'innovation internationales dans le domaine des technologies liées aux énergies renouvelables. Dans un second temps, les entités de financement (agences ou organisations nationales qui sont mandatées par leur gouvernement pour gérer le financement des projets) sont analysées afin de définir les approches de mise en œuvre. Ensuite, l'étude examine les programmes de recherche Horizon 2020 et Horizon Europe et identifie les actions pertinentes d'Horizon 2020. Enfin, cinq recommandations stratégiques pour les futures actions menées par l'UE sont proposées en deux groupes: des recommandations pour améliorer la coopération internationale de l'UE en matière de R&I dans le domaine des technologies des énergies renouvelables, et des recommandations pour Horizon Europe.

Executive summary

The characteristics and role of Cooperation Agreements

Bilateral Cooperation Agreements (CAs) are agreements between EU Member States and third countries under international law. In practice, this means that they are signed between central government ministries or between their immediate proxies; governmental research and/or energy agencies acting directly on behalf of their governments.

The 'ownership' of bilateral CAs covering renewable energy technologies (RET) is complex and fragmented. A range of interests tend to converge to define the content and text of agreement, from diplomatic and strategic geopolitical priorities, to the operationalisation of trade and energy targets. Member State signatories of bilateral CAs are most commonly either education or research ministries (38%) or foreign ministries (28%). Less frequently, energy ministries (23%) or industry/innovation ministries (11%). Specifically, bilateral CAs are shaped by 5 drivers: historical and linguistic ties; geopolitical interests, including the projection of national influence; trade and export interests – including industrial policy considerations; research strengths; and geographical proximity.

The evidence indicates that bilateral CAs can have value as a foundation for relations and a standing requirement to maintain communication/dialogue with third countries. However, they are not the most important driver of joint research and innovation (R&I) collaboration to develop RET with third countries. Many are very broad and insufficiently specific to RET to 'trigger' concrete cooperative actions: only 23% of those identified in this study have an energy focus.

Macro-level (multilateral) frameworks on R&I and renewable energy

In addition to bilateral CAs, Member States and the EU engage in various multilateral fora which support international cooperation in R&I in RET in various ways. The main multilateral fora are: Mission Innovation, the International Energy Agency Technology Collaboration Programmes (IEA TCPs), the European Strategic Energy Technology Plan (SET Plan), International Renewable Energy Agency (IRENA), and the Clean Energy Ministerial (CEM).

Multilateral frameworks provide a useful 'umbrella' for EU Member States; however, it is difficult to 'disentangle' them. Rather than each serving a discrete and well-defined function, they overlap and interlink with each other. Among the various frameworks, the SET Plan and the IEA TCPs are paramount for the majority of the EU Member States. Some frameworks such as the IEA and Mission Innovation also contribute to developing bilateral cooperation as they serve as fora for sharing and networking to develop potential future partnership. Furthermore, at the EU level, the SET Plan is considered to be a key mechanism for intra-EU cooperation.

The interwoven nature of multilateral fora also presents challenges. The large number of frameworks makes it difficult for smaller Member States to participate in all of them, and can lead to an asymmetry between EU Member States in terms of degree of participation. Furthermore, many multilateral initiatives do not translate into international research and development (R&D) because, '[in many cases] these initiatives require significant effort from institutions' and - importantly - do not come with domestic funding pools attached. Thus, the benefits of multilateral frameworks are generally 'soft' in terms of mobilising political commitment and aligning energy and R&I priorities, as opposed to offering a direct and clear pathway to international R&I in RET projects.

Funding approaches and R&I in RET actions between EU Member States and third countries

Within the framework of bilateral and multilateral agreements outlined above, each Member State adopts its own unique approach to supporting R&I in RET. Specific forms of research cooperation can be classified into five different R&I action types:

- Collaborative research projects, up to technology readiness level (TRL 5)
- Collaborative demonstration projects, from TRL 5 to 7
- Networking projects
- Market uptake measures projects
- Joint programme(s)

Based on an analysis of bilateral CAs, networking projects appear to be the most common form of R&I action type (71% of reviewed CAs), followed by joint programmes (64%) and collaborative research projects up to TRL 5 (44%). Market uptake measures projects (22%) and collaborative demonstration projects from TRL 5 to 7 (21%) are less common, likely because they are closer to the market and because the involvement of more mature technologies presents greater complexity in international collaboration.

Funding entities are national agencies or organisations that are mandated by their governments to manage the funding of projects. Each Member State has a unique mix of funding agencies which range from those which are primarily energy focused to those which are primarily focused on research through academia; there is little standardisation in terms of Member State approaches to supporting R&I in RET.

Within each country, research partners usually receive funding in the form of grants. Member State initiatives with third countries usually only provide funding for domestic research partners. Some Member States do however have funding mechanisms in place to directly fund parties in third countries, however these mechanisms are rarely used in practice. In Sweden, the Swedish Energy Agency has a national call for proposals without bilateral agreement.

The role of the EU in supporting R&I in RET by Member States

Overall, R&I international cooperation in the field of RET is considered a positive sum game in which all actors benefit by consolidating complementary resources in terms of fostering environmental sustainability and to some extent, security of supply and energy costs. However, there are multiple challenges such as asymmetry between Member States in terms of levels of commitment and engagement, and a fragmented approach (between Member States) towards engagement with developing countries.

Interviewed Member State representatives were not unanimously clear about how the EU should best act to support Member States in their R&I in RET cooperation with third countries. However, a clear conclusion of this study is that there is a degree of fragmentation in terms of the approaches taken by EU Member States to energy development cooperation with third countries, which might benefit from greater visibility of EU actions on international R&I in RET. Furthermore, the potential for synergies between bilateral and multilateral frameworks is underexploited

Where EU-led If such interventions are to take place, the research findings indicate that they should not be via structural reforms as few Member States are likely to eschew or delegate any element of what is considered to be national foreign policy to EU policy by consent through majority vote. However, tasking individual or groups of Member States with diplomatic and operational initiatives on behalf of the EU could potentially reduce this competition and foster a sense of sovereignty and increased capacity.¹

¹ Lehne Stefan, *Is There Hope for EU Foreign Policy?*, Carnegie Europe, 2017, <https://carnegieeurope.eu/2017/12/05/is-there-hope-for-eu-foreign-policy-pub-74909>.

Recommendations on measures to improve the effectiveness of EU international cooperation R&I actions in the field of RET

Recommendation 1: Provision of an information resource to help Member States understand and exploit the synergies between bilateral and multilateral R&I agreements.

A centralised information resource, owned by the European Commission and maintained by the European Commission with the support of the Member States, could be introduced to map existing cooperation agreements between Member States and third countries. This resource, if kept up to date, could be a helpful go-to resource for R&I stakeholders in the EU, Associated Countries, and third countries.

Recommendation 2: The European Commission should make use of an existing forum to specifically highlight and address international cooperation in RET development.

The challenge in this context is that there is no specific EU strategy with third countries for R&I in the field of RET nor a specific forum to discuss it between Member States. As this study has found, there is a perceived lack of strategic direction from the EU in terms of where and how Member States should direct their efforts. This recommendation could be implemented by either: 1) extending the duties of the SET Plan Steering Group to include R&I international cooperation; 2) establishing a new R&I in RET-focussed group through the Strategic Forum for international S&T cooperation (SFIC); or 3) taking forward R&I in RET conversations through dedicated meetings between the SET Plan Steering Group and the SFIC. In this option, the SET Plan Steering Group would lead the discussions and the SFIC would provide recommendations.

Recommendation 3: Horizon Europe should build in stronger contractual safeguards and provide guidance to EU applicants to ensure intellectual property protection.

Under Horizon 2020, rights and obligations regarding intellectual property are outlined in the Annotated Model Agreement. The current set of rules tends to focus on dissemination, exploitation and 'open access' – this is not well oriented towards meeting the challenges of international R&I in RET with third countries such as China and the USA. This recommendation is based on broadening and strengthening intellectual property support, possibly with the co-support of the European Intellectual Property Helpdesk. A possibility is to include detailed written guidance on intellectual property, patents and trademarks, and a more robust contractual framework.

Recommendation 4: Horizon Europe should include targeted and concentrated calls focussing on specific RETs, third countries, and specific R&I actions.

Issuing targeted calls through Horizon Europe towards specific third countries or regions would serve to encourage specific forms of R&I collaboration that Member States otherwise find difficult to implement. This recommendation represents a continuation of the Horizon 2020 approach. Research organisations in some 130 developing countries are already automatically eligible for funding. The challenge is to expand and better coordinate the various calls, whilst ensuring that funding amounts are sufficient to enable impactful knowledge and technology development.

Recommendation 5: Horizon Europe should exploit the potential for joint funded initiatives to bring together industry and researchers to address international RET challenges.

ERA-NETs are being phased out in Horizon Europe and, given their recognised value, it is logical to ensure that their effective features can be carried forward in another instrument. Over the past two years, the European Commission has been developing the structure of Horizon Europe through a broad consultation. One of the new characteristics of Horizon Europe will be the introduction of European Partnerships between Member States, the private sector, foundations and other stakeholders. This recommendation is, therefore, to design the new partnerships – within the parameters that have already been agreed upon through the Commission's consultation with Member States – so that they can effectively replicate the success of ERA-NETs in the field of R&I in RET.

Résumé exécutif

Les caractéristiques et le rôle des accords de coopération

Les accords de coopération bilatéraux (AC) sont des accords entre les États membres de l'UE et les pays tiers en vertu du droit international. En pratique, cela signifie qu'ils sont signés entre les ministères du gouvernement central ou entre leurs mandataires immédiats; les agences gouvernementales de recherche et/ou de l'énergie agissant directement au nom de leurs gouvernements.

La "propriété" des AC bilatéraux couvrant les technologies des énergies renouvelables est complexe et fragmentée. Une série d'intérêts tendent à converger pour définir le contenu et le texte de l'accord, des priorités diplomatiques et géopolitiques stratégiques à l'opérationnalisation des objectifs commerciaux et énergétiques. Les États membres signataires d'AC bilatéraux sont le plus souvent soit des ministères de l'éducation ou de la recherche (38 %), soit des ministères des affaires étrangères (28 %). Moins fréquemment, ce sont les ministères de l'énergie (23 %) ou les ministères de l'industrie/de l'innovation (11 %). Plus précisément, les AC bilatéraux sont façonnés par 5 facteurs : les liens historiques et linguistiques ; les intérêts géopolitiques, y compris la projection de l'influence nationale ; les intérêts commerciaux et d'exportation - y compris les considérations de politique industrielle ; les atouts en matière de recherche ; et la proximité géographique.

Les résultats indiquent que les AC bilatérales peuvent avoir une valeur en tant que fondement des relations entre pays et exigence permanente de maintenir la communication/le dialogue avec les pays tiers. Toutefois, ils ne sont pas le principal moteur de la collaboration en matière de recherche et d'innovation (R&I) pour développer les technologies des énergies renouvelables avec les pays tiers. Nombre d'entre elles sont très généraux et insuffisamment spécifiques aux technologies des énergies renouvelables pour "déclencher" des actions de coopération concrètes: seules 23 % des actions identifiées dans cette étude sont axées sur l'énergie.

Cadres multilatéraux au niveau global sur la R&I et les énergies renouvelables

En plus des AC bilatéraux, les États membres et l'UE participent à divers forums multilatéraux qui soutiennent la coopération internationale en matière de R&I dans le domaine des technologies des énergies renouvelables de diverses manières. Les principaux forums multilatéraux sont les suivants: Mission Innovation, les programmes de collaboration technologique de l'Agence internationale de l'énergie (PCT de l'AIE), le plan stratégique européen pour les technologies énergétiques (plan SET), l'Agence internationale pour les énergies renouvelables (IRENA) et la Conférence ministérielle sur l'énergie propre (CEM).

Les cadres multilatéraux constituent un " canevas " utile pour les États membres de l'UE, mais il est difficile de les "dissocier". Plutôt que de servir une fonction distincte et bien définie chacun, ils se chevauchent et s'imbriquent les uns dans les autres. Parmi les différents cadres, le plan SET et les PCT de l'AIE sont primordiaux pour la majorité des États membres de l'UE. Certains cadres tels que l'AIE et Mission Innovation contribuent également au développement de la coopération bilatérale car ils servent de plateforme de partage et de mise en réseau pour développer un futur partenariat potentiel. En outre, au niveau de l'UE, le plan SET est considéré comme un mécanisme clé pour la coopération intracommunautaire.

L'imbrication des forums multilatéraux présente également des défis. Le grand nombre de cadres rend difficile la participation des petits États membres à tous ces forums et peut entraîner une asymétrie entre les États membres de l'UE en termes de degré de participation. En outre, de nombreuses initiatives multilatérales ne se traduisent pas par des activités internationales de recherche et développement (R&D) car "[dans de nombreux cas] ces initiatives exigent des efforts importants de la part des institutions" et - ce qui est important - ne sont pas accompagnées de fonds de financement nationaux.

Ainsi, les avantages des cadres multilatéraux sont généralement " limités " en termes de mobilisation de l'engagement politique et d'alignement des priorités en matière d'énergie et de R&I, par opposition à l'offre d'une voie directe et claire vers la R&I internationale dans les projets couvrant des technologies des énergies renouvelables.

Approches de financement et de R&I dans les actions de technologies des énergies renouvelables entre les États membres de l'UE et les pays tiers

Dans le cadre des accords bilatéraux et multilatéraux décrits ci-dessus, chaque État membre adopte sa propre approche pour soutenir la R&I dans le domaine des technologies des énergies renouvelables. Les formes spécifiques de coopération en matière de recherche peuvent être classées en cinq types d'actions de R&I :

- Projets de recherche en collaboration, jusqu'au niveau de maturité technologique (TRL5)
- Projets de démonstration en collaboration, de TRL 5 à 7
- Projets de mise en réseau
- Projets de mesures d'assimilation par le marché
- Programme(s) conjoint(s)

L'analyse des AC bilatéraux montre que les projets de réseautage sont la forme la plus courante de type d'action de R&I (71 % des AC examinées), suivis par les programmes conjoints (64 %) et les projets de recherche collaborative jusqu'au TRL 5 (44 %). Les projets de mesures de pénétration de marché (22 %) et les projets de démonstration en collaboration de TRL 5 à 7 (21 %) sont moins courants, probablement parce qu'étant plus proches de la mise sur le marché, et parce que la participation de technologies plus matures présente une plus grande complexité dans la collaboration internationale.

Les entités de financement sont des agences ou des organisations nationales qui sont mandatées par leur gouvernement pour gérer le financement des projets. Chaque État membre dispose d'un ensemble unique d'organismes de financement, qui vont de ceux qui sont principalement axés sur l'énergie à ceux qui sont principalement axés sur la recherche universitaire ; il existe peu de normalisation en termes d'approches des États membres pour soutenir la R&I dans le domaine des technologies des énergies renouvelables.

Au sein de chaque pays, les partenaires de recherche reçoivent généralement un financement sous forme de subventions. Les initiatives des États membres avec les pays tiers ne prévoient généralement un financement que pour les partenaires de recherche nationaux. Certains États membres ont cependant mis en place des mécanismes de financement pour financer directement des parties dans des pays tiers, mais ces mécanismes sont rarement utilisés dans la pratique. Par exemple, En Suède, l'agence suédoise de l'énergie lancent un appel à propositions national sans accord bilatéral.

Le rôle de l'UE dans le soutien de la R&I en matière de technologies des énergies renouvelables par les États membres

Dans l'ensemble, la coopération internationale en matière de R&I dans le domaine des technologies des énergies renouvelables est considérée comme un jeu à somme positive dans lequel tous les acteurs tirent profit de la consolidation de ressources complémentaires en termes de promotion de la durabilité environnementale et, dans une certaine mesure, de sécurité d'approvisionnement et de coûts énergétiques. Toutefois, les défis sont multiples, comme l'asymétrie entre les États membres en termes de niveaux d'engagement et de participation, et une approche fragmentée (entre les États membres) en ce qui concerne l'engagement avec les pays en développement.

Les représentants des États membres interviewés n'ont pas été unanimes à dire comment l'UE devrait agir au mieux pour soutenir les États membres dans leur R&I en matière de coopération avec les pays tiers dans le domaine des technologies des énergies renouvelables. Toutefois, cette étude conclut clairement qu'il existe une certaine fragmentation des approches adoptées par les États membres de l'UE en matière de coopération pour le développement énergétique avec les pays tiers, qui pourraient

bénéficier d'une plus grande visibilité des actions de l'UE en matière de R&I internationale dans le domaine des technologies des énergies renouvelables. En outre, le potentiel de synergies entre les cadres bilatéraux et multilatéraux est sous-exploité

Si de telles interventions doivent avoir lieu, les résultats de la recherche indiquent qu'elles ne devraient pas se faire par le biais de réformes structurelles, car peu d'États membres sont susceptibles d'éviter ou de déléguer un élément de ce qui est considéré comme une politique étrangère nationale à la politique de l'UE par consentement à la majorité. Toutefois, confier à des individus ou à des groupes d'États membres des initiatives diplomatiques et opérationnelles au nom de l'UE pourrait potentiellement réduire cette concurrence et favoriser un sentiment de souveraineté et de capacité accrue.²

Recommandations sur les mesures visant à améliorer l'efficacité des actions de R&I de l'UE en matière de coopération internationale dans le domaine des technologies des énergies renouvelables

Recommandation 1: mise à disposition d'une banque d'informations pour aider les États membres à comprendre et à exploiter les synergies entre les accords bilatéraux et multilatéraux de R&I.

Une banque d'informations centralisée, appartenant à la Commission européenne et gérée par la Commission européenne avec le soutien des États membres, pourrait être mise en place pour recenser les accords de coopération existants entre les États membres et les pays tiers. Cette ressource, si elle est tenue à jour, pourrait être utile pour les acteurs de la R&I dans l'UE, les pays associés et les pays tiers.

Recommandation 2 : La Commission européenne devrait utiliser un forum existant pour mettre en évidence et aborder spécifiquement la coopération internationale dans le développement des technologies des énergies renouvelables.

Le défi dans ce contexte est qu'il n'existe pas de stratégie européenne spécifique avec les pays tiers pour la R&I dans le domaine des technologies des énergies renouvelables, ni de forum spécifique pour en discuter entre les États membres. Comme l'a révélé cette étude, il y a un manque d'orientation stratégique de la part de l'UE en ce qui concerne le lieu et la manière dont les États membres devraient orienter leurs efforts. Cette recommandation pourrait être mise en œuvre soit 1) en étendant les fonctions du comité de direction du plan SET pour y inclure la coopération internationale en matière de R&I, 2) en créant un nouveau groupe axé sur la R&I dans le domaine de la RET par l'intermédiaire du Forum stratégique pour la coopération scientifique et technologique internationale (SFIC), soit 3) en faisant progresser les discussions sur la R&I dans le domaine des RET à travers des réunions spécifiques entre le comité de direction du plan SET et le SFIC. Dans le cadre de cette option, le groupe de pilotage du plan SET dirigerait les discussions et le SFIC formulerait des recommandations.

Recommandation 3: Horizon Europe devrait prévoir des garanties contractuelles plus solides et fournir des conseils aux candidats de l'UE pour assurer la protection de la propriété intellectuelle.

Dans le cadre d'Horizon 2020, les droits et obligations en matière de propriété intellectuelle sont décrits dans la section 3 du modèle d'accord annoté. L'ensemble actuel de règles tend à se concentrer sur la diffusion, l'exploitation et l'"accès ouvert", ce qui n'est pas particulièrement ciblé pour relever les défis de la R&I internationale dans le domaine des technologies des énergies renouvelables avec des pays tiers tels que la Chine et les États-Unis. Cette recommandation est basée sur l'élargissement et le renforcement du soutien à la propriété intellectuelle dans le cadre d'Horizon Europe, éventuellement avec le soutien du Bureau d'assistance européen pour la propriété intellectuelle. Il est possible d'inclure des orientations écrites détaillées sur la propriété intellectuelle, les brevets et les marques, ainsi qu'un cadre contractuel plus solide grâce aux directives complémentaires d'Horizon Europe.

² Lehne Stefan, *Is There Hope for EU Foreign Policy?*, Carnegie Europe, 2017, <https://carnegieeurope.eu/2017/12/05/is-there-hope-for-eu-foreign-policy-pub-74909>.

Recommandation 4: Horizon Europe devrait inclure des appels ciblés et concentrés sur des technologies des énergies renouvelables spécifiques, des pays tiers et des actions de R&I spécifiques.

La publication d'appels ciblés à travers Horizon Europe vers des pays ou des régions tiers spécifiques servirait à encourager des formes précises de collaboration en matière de R&I que les États membres auraient autrement du mal à mettre en œuvre. Cette recommandation représente une continuation de l'approche Horizon 2020. Les organismes de recherche de quelque 130 pays en développement sont déjà automatiquement éligibles à un financement. Le défi consiste à élargir et à mieux coordonner les différents appels, tout en veillant à ce que les montants de financement accordés soient suffisants pour permettre un développement efficace des connaissances et des technologies.

Recommandation 5: Horizon Europe devrait exploiter le potentiel des initiatives financées conjointement pour réunir l'industrie et les chercheurs afin de relever les défis internationaux en matière de technologies des énergies renouvelables.

Les ERA-NET sont progressivement éliminés dans le cadre d'Horizon Europe et, compte tenu de leur valeur reconnue, il est logique de veiller à ce que leurs caractéristiques efficaces puissent être reprises dans un autre instrument. Au cours des deux dernières années, la Commission européenne a élaboré la structure d'Horizon Europe dans le cadre d'une vaste consultation. L'une des nouvelles caractéristiques d'Horizon Europe sera l'introduction de partenariats européens entre les États membres, le secteur privé, les fondations et d'autres parties prenantes. La présente recommandation vise donc à concevoir les nouveaux partenariats - dans le cadre des paramètres qui ont déjà été convenus lors de la consultation de la Commission avec les États membres - de manière à ce qu'ils puissent reproduire efficacement le succès des ERA-NET dans le domaine de la R&I en matière de technologies des énergies renouvelables.

1 Introduction

1.1 Background

Fostering international cooperation in research and innovation is a strategic priority for the European Union with the aim of:

- accessing the latest knowledge and the best talent worldwide;
- tackling global societal challenges more effectively;
- creating business opportunities in new and emerging markets; and
- using science diplomacy as an influential instrument of external policy.

Therefore, Horizon 2020, the EU's framework programme for R&I, is fully open to participants from across the world and it includes many topics specifically targeting international cooperation. Within Horizon 2020, international cooperation takes place in **research and innovation projects, networking between projects, joint or coordinated calls and specific joint initiatives**. Furthermore, for individual researchers, the European Research Council (ERC) and the Marie Skłodowska-Curie actions (MSCA) offer funding opportunities to work in Europe.

The current proposal from the European Commission for the upcoming EU framework programme for R&I for the period 2021-2027 (FP9 - 'Horizon Europe') includes energy related R&I under Pillar 2 – Global Challenges and Industrial Competitiveness. Within Pillar 2 the **Cluster 'Climate, Energy and Mobility'** aims at fighting climate change by better understanding its causes, evolution, risks, impacts and opportunities, and by making the energy and transport sectors more climate and environment-friendly, more efficient and competitive, smarter, safer and more resilient. Main areas of intervention related to energy include Energy supply, Energy systems and grids, Buildings and industrial facilities in energy transition, Communities and cities, Industrial competitiveness in transport, Clean transport and mobility, as well as Energy storage.

International cooperation under Horizon Europe will, as the European Commission has proposed, continue in much the same way under Horizon Europe as it has under Horizon 2020. For example, participation in the Framework Programme by any legal entity anywhere in the world is in principle permitted (with the eligibility for cost reimbursement subject to the same conditions in Horizon Europe as in Horizon 2020), joint calls with third countries may be arranged, and countries may associate themselves to the Framework Programme. It is anticipated that the links of R&I international cooperation in the field of renewable energy technologies (RET) with Mission Innovation and its Innovation Challenges will be strengthened.

However, the European Commission's proposals could be modified. The Council of Ministers has not reached, at the time of writing, an agreement internally on how countries may be associated to Horizon Europe, let alone reached an agreement with the European Parliament on this matter.

In its position paper from July 2018 on the European Commission proposal for Horizon Europe, the German Federal Government appreciates commitments towards international initiatives.³ The German position on Horizon thus underlines that close cooperation

³ "Germany welcomes the proposed orientation of Horizon Europe to the 2030 Agenda and its Sustainable Development Goals (SDGs) as well as to the Paris Agreement on climate change". With respect to international cooperation, it is stated: "We support the Commission's intention to make the Framework Programme more open to the participation of Third Countries. However, at the same time we must safeguard European interests. In particular, it should be possible in individual cases to exclude third party applicants from funding in order to prevent knowledge drain."

between the European Commission and Member States is needed with respect to strategic planning as well as the actual implementation of international cooperation R&I activities.

Furthermore, the European Commission is leading the way in many global (research) partnerships. Often research and innovation to tackle societal challenges in areas such as energy is best implemented through global multilateral initiatives where solutions can be developed and deployed more effectively.

1.2 Objectives of this study

The overall study provides a detailed analysis of the EU Member States strategies, policies and concrete actions in the area of R&I international cooperation in the field of RET. It also provides a detailed mapping of the main funding entities on Member States level implementing international cooperation R&I activities. Thereby, the main aim of the study is to **analyse how the identified international cooperation efforts of Member States complement EU initiatives and efforts in the field of energy research collaboration and to assess which actions at EU level would improve synergies and additionality between EU actions and Member States actions**. Based on these findings, the study develops recommendations on measures (i.e. strategic planning and concrete R&I actions) to improve the effectiveness and impact of the EU international cooperation actions within Horizon 2020 and the next research framework programme (Horizon Europe) fully exploiting and complementing existing Member States' strategies, policies and actions.

This study has two specific objectives:

- Objective 1: To establish the base of the EU Member States policies and their international commitments and their combination with current EU policies & commitments in the fields of RET.
- Objective 2: To provide recommendations on how to improve the effectiveness and impact of the EU international cooperation actions towards Horizon Europe in RET and innovation

The outcome of the study should feed in the strategy of Horizon Europe. The study provides the European Commission with a picture of the current and expected governmental policies on R&I in the field of RET in the Member States.

1.3 Methodological approach

1.3.1 Methodological approach for Chapter 2

Chapter 2 presents the outcomes of Task 1 of the research contract; 'State of Play – Survey of EU Member States strategy, actions and policy'. The study started with **a review of previous research and macro-level agreements**. The results of this review are incorporated in sections 2 and 3 of this report. The preliminary list of sources is provided in Annex 1. The consortium researchers undertook a programme of desk-based research, with some communication (requests for written/documentary information) to map all relevant Cooperation Agreements (CAs) with third countries. The result of this exercise is a collection of 28 country memos. As the UK was an EU Member State at the outset of the study, it remains so throughout. Given the limited relevance of historical Cooperation Agreements, a cut-off date of 1990 was selected for the analysis in this interim report.

The following countries were also excluded as they are Horizon 2020 Associated Countries. Legal entities from these countries are entitled to the same conditions of access to actions and funding from the EU framework programme as those accorded to legal entities from EU Member States. Therefore, they lie outside the focus of this study.

Table 1: Horizon 2020 Associated countries (outside the scope of this study)

Albania	Georgia	Montenegro	Switzerland
Armenia	Iceland	North Macedonia	Turkey
Bosnia & Herzegovina	Israel	Norway	Ukraine
Faroe Islands	Moldova	Serbia	

The research approach undertaken was designed to highlight RET-specific bilateral CAs.

To complete the desk research the research team conducted **interviews** with Member State representatives. The aim was to interview representatives from all 28 Member States. However, due to difficulties in obtaining responses from invited SET-Plan Steering Committee members and other stakeholders, interviews could only be carried out with representatives from the following 18 Member States: Austria, Belgium, Croatia, Czechia, Finland, France, Germany, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Poland, Portugal, Spain, Sweden, UK. The full list of questions asked is provided in Annex 2.

The following reasons have been identified for the non or limited response from some Member States:

- Limited information available as the Member State has only limited international engagement in this area or detailed information on existing CAs are not publicly available (e.g. for Austria and Germany).
- Limited information available to the national expert interviewed due to fragmentation of information. In fact, CAs may be based on different strategies and, therefore, followed by different persons from different ministries and institutions. It can therefore be difficult to fully identify the CAs themselves and understand if they are in effect.
- Limited information available to the national expert due to time expiring; many bilateral agreements go back in time (even though the cut-off chosen was 1990) and therefore institutional memory can be poor.
- Bilateral agreements are more often general, for instance, Science and Technology (S&T) memoranda of understanding (MoU) with limited objectives and targets; implementation monitoring procedures are often non-existent and therefore it is difficult to find out who is in charge.
- CAs often do not come with dedicated budgets and are more focused on networking and establishment of business contacts

Our analytical findings from Chapter 3 on the synergies between EU and Member State actions are presented in a **strengths, weaknesses, opportunities, and threats (SWOT) analysis** (see section 4). These findings will be an important building block for development of recommendations.

1.3.2 Methodological approach for Chapter 3

Chapter 3 presents the outcomes of Task 2 of the research contract 'Mapping of the major MS funding entities doing international collaborative R&I'. **The first step was to process and analyse data collected under Task 1 for systematic identification of funding entities.** Then, to focus the research and provide a more in-depth analysis of funding and implementation approaches, ten 'focus countries' were selected through a **scoping exercise**. Details on the scoping exercise are presented in Section 3.1 of this report. The ten focus countries which are very or moderately active in R&I international cooperation in RET are: Germany, France, the Netherlands, Denmark, Italy, Poland, Sweden, Spain, Finland, and Ireland.

For the focus countries in the scoping exercise, the research team carried out a **fact-finding exercise to populate a funding entity database**, provided in full in Annex 5. This database captures key characteristics of the R&I in RET funding landscape for the selected organisations, such as the funding approach(es) employed and their budget

where available. As part of this, the research team also identified R&I actions that have been taken by the implementing government agencies, by reporting the types of actions that were taken. The team followed the categorisation of five R&I action types as indicated in the tender specifications:

- Collaborative research projects, up to technology readiness level (TRL) 5.
- Collaborative demonstration projects, from TRL 5 to 7.
- Networking projects.
- Market uptake measures projects.
- Joint programme(s).
- Others.

Box 1: Definitions of R&I action types

- 1. Collaborative research projects**, up to technology readiness level (TRL) 5
Pre-commercialised projects or initiatives which are carried out by multiple individuals/research entities from various countries and encompass initial basic technology development up to the validated of RE technologies in relevant environments.
- 2. Collaborative demonstration projects**, from TRL 5 to 7
Projects or initiatives that are carried out by multiple individuals/research entities from various countries and focus on demonstrating/validating RET, i.e. system prototype demonstrations in operational environments.
- 3. Networking projects**
Projects or initiatives which seek to preserve or establish official relationships between individuals and/or research entities from EU Member States and third countries, for the purposes of strengthening cooperative linkages, stimulating dialogue and knowledge exchange.
- 4. Market uptake measures projects**
Projects or initiatives which aim to move pre-commercialised but technologically proven RET from the (late) development stage to commercial uptake.
- 5. Joint programme(s)**
Programmes which are jointly designed, funded and implemented and consist of R&I projects in the field of RET, resulting in a new product, process or service.

The R&I implementation fact finding exercise was carried out through desk research and validated with interviews. Information on how governmental commitment is translated into actions is presented in Section 5.3.2.

The research team then performed an '**expert review of R&I implementation through interviews**' (27 semi-structured interviews, (see

Table 2)), with national funding agencies to assess how governmental commitment is translated into actions. The goal was to:

- Validate the factual information collected earlier, filling gaps in the desktop research.
 - Identify different approaches on how governmental commitments are operationalised by funding entities and discuss how R&I agreements are concretely implemented. This led to the development of R&I action typologies.
- Collect views of stakeholders on the relevance and effectiveness of the cooperation R&I actions, and possible measures to improve this. These views were fed into our analysis on complementarity and effectiveness of EU cooperation R&I actions and were stored in our interview grid.

Table 2: Overview of interviews conducted per Member State

Member State	Number of interviews conducted
Denmark	2
The Netherlands	2
Sweden	2
Germany	6
France	8
Italy	3
Ireland	1
Finland	1
Spain	1
Poland	1
Total	27

The aim was to conduct two interviews per Member State. It was not always possible to arrange two interviews, but at least one interview was conducted per focus country. For all Member States, multiple funding agencies and government ministries were contacted. Some contacts simply did not respond whereas others indicated that they and their organisation were not the right contact point to interview in this context. However, stakeholders in some countries were more eager to participate in an interview, hence the higher number of interviews in Germany, France, and Italy.

In order to prepare the interviewers for the discussions with funding entities, an interview note was created per country. This interview note included the list of questions, the definitions of R&I action types, as well as an overview table of the bilateral cooperation agreements and an overview table of the multilateral agreements for that country. Box 2 contains a list of questions for these interviews.

Box 2: Interview guidance note

Part 1 - Discussion on international cooperation in Research & Innovation in RET

1. Which are the third countries that [your country] has the strongest ties within research and innovation in renewable energy technologies (R&I in RET)?
2. Do these countries benefit from funded support?
3. If so, which cooperation agreements (both bilateral/multilateral in the provided document) are supported?

Part 2 - Funding and implementation of cooperation agreements

In light of the bilateral/multilateral agreements that you mentioned previously:

1. Who is responsible for implementing and monitoring these cooperation agreements in the field of R&I in RET in your country?
2. What types of R&I actions are you funding?
3. What is the funding approach (e.g. grants, co-financing, stipends, subsidies, tax benefits etc.?)
4. What are the corresponding allocated budgets?
5. How long are they running for?
6. How successful have they been?
7. What are the lessons learned in the implementation of these R&I actions?

Part 3 - Role of EU in R&I international cooperation in RET in the future

1. How and where could EU action support better linkages between MS and third country implementing and funding agencies?
2. What are the future international collaboration trends in RET?

As a next step, based on the mapping of funding entities, **the organisational set-up and funding approach to the R&I actions was reviewed**. As some of the R&I actions were implemented similarly, the research team developed three funding profiles (see Annex 6):

- Group 1: networking projects;
- Group 2: joint activities, including joint program, collaborative research projects and collaborative demonstration projects;
- Group 3: market uptake measures projects and others.

The following aspects were assessed for each funding profile:

- Organisational set-up: legal entity, tasks and responsibilities, delegation of authority, decision making process, linkages with other programmes;
- Funding approach: subsidies (direct or through calls for proposals), tax instruments, equity funding, improving framework conditions, risk guarantee funds;
- Objectives: international cooperation as main or secondary objective, R&I as main or secondary objective, role of industrialisation and energy security objectives;
- Scoping: how does the geographic and thematic scope influence the aspects above?
- Timeframe: is the action under consideration implemented annually or across multiple years?

The results of the mapping of the funding entities in the active Member States (Section 3.), the funding profiles (the funding profiles are in Annex 6 and the overview is in 3.3), as well as the **transversal implementation review** (Chapter 5) is presented in this report.

1.3.3 Methodological approach for Chapter 4 and 5 (section 5.4)

Chapter 4 and Chapter 5 (Section 5.4) present the outcomes of Task 3 of the study. The first step was the **inventory of most appropriate Horizon 2020 actions**. It includes the 'Global leadership in renewables' Actions, from LC-SC3-RES1 to RES28, and actions of particular importance, although we note that some relevant actions are sourced out with 'Global leadership in renewables' (e.g. LC-SC3-JA-5-2020 – International cooperation with Africa). The results of this review are incorporated in section 4.1 of this report. The list of actions is provided in Annex 7.

On the basis of information collected (including desk research and interviews carried out under Task 1 and 2 above), a brief scoping analysis was carried out on shortlisted H2020 actions (i.e. actions relevant to international cooperation in the field of renewable energy technologies) and placed within a matrix (see Annex 7). This includes:

- Code of the call;
- Third countries involved;
- RET field;
- Title;
- Scope;
- RET action;
- Financial support allocated;

The rationale behind putting this in a matrix is to clearly show common thematic trends, to highlight gaps in the previous ecosystem of Horizon 2020 actions and to identify the member States and third States particularly involved in Horizon 2020 international cooperation in the field of renewable energy technology actions.

The research team also identified **gaps and overlaps** comparing selected Horizon 2020 R&I actions in the field of RET through Horizon 2020 with Member States' implementation strategies and measures. Based on these data and building on the information collected in Task 2 (notably interviews), **draft recommendations** were prepared for Horizon Europe measures.

Finally, **an expert workshop** was organised, the purpose of which was to discuss and finalise the recommendations. This was held as a virtual half-day event due to the COVID-19 crisis. A total of 39 people registered in advance, with 23 attending. These individuals included influential stakeholders, members of the Strategic Energy Technology Plan (SET Plan) Steering Group, representatives of national governments, and a selection of European Commission staff. Several participants had previously contributed to this study as interviewees in Task 1 and/or Task 2. A discussion paper was shared with the participants prior to the meeting.

On the basis of the expert workshop, recommendations were further refined and elaborated. They were analysed following discussion and consideration of their justification, context and implementation options. Each option was assessed in terms of advantages and disadvantages (see Chapter 5, section 5.4).

1.4 How to read this report

The report aims to support the EU research policy development in the context of international cooperation in the fields of renewable energy technologies. Specific objectives are presented in the table below as well as the corresponding sections.

Objective	Section(s) in this report
To map EU Member States' international CA-based commitments to R&I in RET with third countries. This will be achieved by listing the existence and characteristics of relevant CAs with third countries, for all 28 Member States, through desk research and interviews	Section 2.1 – Member State bilateral cooperation
To understand existing macro-level agreements and frameworks influencing Member State RET R&I cooperation with third countries – such as Mission Innovation, EU bilateral S&T agreements with third countries, Sustainable Energy for All (SEforALL), and International Energy Agency (IEA) Technology Collaboration Programmes (TCPs)	Section 2.2 – Macro-level cooperation
To build an understanding of the strategic characteristics of CAs through interviews and a SWOT analysis, with a focus on common trends, gaps and the potential additionality from Horizon Europe.	Section 5.1 – SWOT analysis Section 5.2 – Emerging findings
To compile initial information about major Member State funding entities and mechanisms through which CAs are implemented, through desk research and interviews.	Section 3.1 – Funding approach to international cooperation in R&I actions
To identify in each of the EU Member States which organisation(s) is(are) implementing the bilateral and multilateral agreements taken by its government and their specific actions	Section 3.2 – Overview of implementing and funding entities
To review how EU Member States implement these international R&I agreements	Section 3.3 – Organisational setup and funding approach Section 5.3 – Emerging findings
To perform an assessment of the effectiveness of the EU international collaboration R&I actions in the field of RET through Horizon 2020 considering the overall Member States and EU policies.	Section 4.1 – Overview of relevant Horizon 2020 actions Section 4.2 – EU political commitment and their impact on R&I in the field of RET
To provide recommendations to further improve EU R&I international cooperation in the field of RET and make optimal use of Horizon Europe for this purpose.	Section 5.4 – Recommendation on measures to improve the effectiveness of the EU international cooperation R&I actions

The report includes five chapters (including this introduction) in line with the three tasks presented in Section 1.3:

- Task 1 - State of Play – Survey of EU Member States strategy, actions and policy;
- Task 2 - Mapping of the major MS funding entities doing international collaborative R&I;
- Task 3 - Recommendations on measures on how to improve the effectiveness of the EU international cooperation R&I actions.

The findings of Task 1 and 2 as well as the recommendations developed under Task 3 are presented in Chapter 5 'Conclusions'.

2 The state of play: Member States and EU R&I international cooperation in the field of RET

This chapter builds a clear picture of the situation across the EU and at Member State level, in terms of the scope of existing CAs activity, strategy, policy and actions. In other words, there is a need to understand 'what is out' there. This is a necessary first step upon which Chapters 3 and 4 will further build. Section 2.1 analyses EU Member States' international CA-based commitments to R&I in RET with third countries (see Annex 3). Section 2.2 aims to understand existing macro-level agreements and frameworks influencing Member State RET R&I cooperation with third countries. A mapping of the involvement of selected EU Member States in global fora is presented in Annex 4.

2.1 Member State bilateral cooperation

2.1.1 Overall state of play

Building on existing insights

Countries have for many years sought to establish their own bilateral frameworks via CAs. In this study, the following definition is used.

Box 3: What are Cooperation Agreements?

Cooperation Agreements (CAs) are agreements between EU Member States and third countries under international law. They are agreements between states. In practice, this means that they are signed between central government ministries or between their immediate proxies; governmental research and/or energy agencies acting directly on behalf of their governments.

Agreements between regional governments and third countries are not within the scope of this study. Similarly, agreements between research institutes, universities, think tanks etc. are not relevant and should not be covered.

Note that the term 'agreement' is very broad and covers all bilateral cooperation arrangements agreed between governments or their immediate proxies. CAs may also be referred to as treaties, protocols, covenants, conventions, pacts or memoranda of understanding, among other terms.

In recent decades, EU Member States have increasingly directed their attention to emerging economies in Asia. For example, EU RET cooperation with China is driven by a range of macro-level factors, such as over-reliance on energy imports from geopolitically unstable regions, national carbon reduction targets, environmental degradation and the need to find sustainable generation solutions, and market development (including export) interest.⁴ Indeed these factors are common to EU Member State cooperation with any third country, but their relative weight tends to vary. Previous research by the European Commission has highlighted a range of characteristics inherent to bilateral CAs focussed on Science, Technology and Innovation (STI). The 2014 study 'Basic Principles for Effective International Science, Technology and Innovation Agreements' made a distinction between two fundamentally different types of agreement; narrow (or knowledge-focussed) agreements, and broad agreements, noting that whilst the former are focussed on 'pure' research goals such as achieving research excellence, the latter extend to include diplomatic goals such as transforming a diplomatic relationship. Given the broad scope of many bilateral CAs, it was also noted in the 2014 report that there are a number of challenges inherent in assessing the effectiveness and impacts of bilateral CAs (Box 4).

⁴ Zhou Yunheng, Song Weiqing, *Sino-European Cooperation on Renewable Energy Development*, The International Spectator, 52:4, 145-156, 2017, <https://doi.org/10.1080/03932729.2017.1358432>.

Box 4: Challenges in quantifying the impacts of bilateral STI Cooperation Agreements

1. Very few countries have developed structural reviews of STI agreements;
2. Too little effort is made to identify causal relationships between the agreements and change in the system;
3. Discrepancies in the interpretation of 'impact';
4. Objectives are often set very broadly, which makes impacts hard to measure;
5. Low structural usage or performance indicators;
6. Narrow scoping of the reviews.

Source: European Commission (2014) Basic Principles for effective International Science, Technology and Innovation Agreements

Bilateral CAs covering RET – patterns, drivers, interests and responsibilities

The 'ownership' of bilateral CAs covering RET is complex and fragmented. A range of interests tend to converge to define the content and text of agreement, from diplomatic and strategic geopolitical priorities, to the operationalisation of trade and energy targets. Member State signatories of bilateral CAs are most commonly either education or research ministries (38%) or foreign ministries (28%). Less frequently, energy ministries (23%) or industry/innovation ministries (11%).

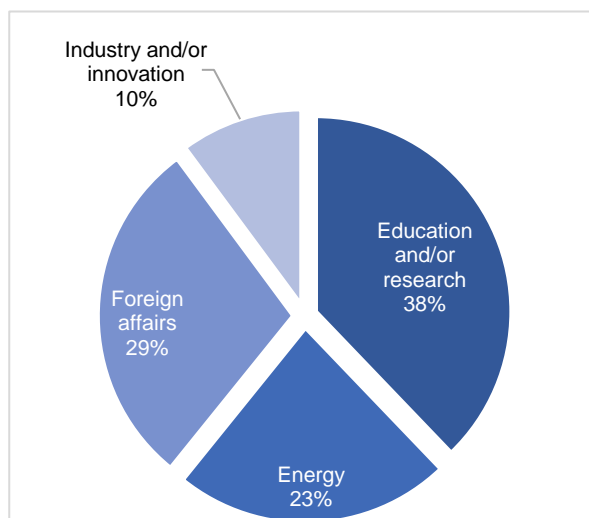


Figure 2: Member State CA signatories

* The majority of signatories are national ministries or ministerial representatives. Positively identified CAs signed on or since 1990. $n=164$

Despite the prevalence of education/research ministry signatories, it is clear from interview findings that diplomatic, trade and energy priorities are generally more influential than research priorities when it comes to establishing bilateral CAs. The signature of bilateral STI agreements is often somewhat opportunistic. They are often signed in the context of state visits and the central motivation is the symbolic establishment of ties. Furthermore, they may deliver the renewal of older agreements in the spirit of reinvigorated diplomatic and cooperative ties. To take one example of this, the 'Plan of Action on science, technology and innovation between the Governments of the Federative Republic of Brazil and of the United Kingdom' was signed in 2006 on the occasion of the state visit of the then-president of Brazil, Luiz

Inácio Lula da Silva, to the UK. This recognised the fact that a previous agreement on S&T cooperation had been signed between the two countries in 1997 and formed the original legal framework. It is highly questionable whether such a Plan of Action still has much value under the current Bolsonaro Presidency, highlighting the sensitivity of CAs to political relations. Each bilateral CA was analysed to assess its primary thematic focus, as follows:

Table 3: Definitions of bilateral CA focus used in this analysis

Category	Description/parameters	Example CAs
Energy focus	Reference to a specific focus on energy within the title of the CA (i.e. keyword 'energy'), <i>and/or</i> ; An EU Member State signatory with a main industry focus	Finland-Kazakhstan 'Memorandum of understanding on strategic partnership in energy and green economy', 2018 Austria-Vietnam 'Memorandum of Understanding between the Ministry of Industry and Trade of the Socialist Republic of Vietnam and the Federal Ministry Austria of Economy, Family and Youth on cooperation in Industry, Trade and Energy', 2012
General S&T agreement	An agreement which broadly covers research cooperation in science and technology in its title <i>and</i> encompasses RET without necessarily referencing RET specifically within the body the text	Croatia-Jordan 'Agreement between the Government of the Republic of Croatia and the Government of the Hashemite Kingdom of Jordan on cooperation in the fields of science and technology', 2006
Other	Reference to a specific field (e.g. environmental protection or biotechnology) in the title of the CA, <i>and</i> with renewable energy technology specified as being included within the scope of the agreement.	Spain-Morocco 'Agreement on cooperation in the field of environment', 2008 Estonia-India 'Memorandum of Understanding between The Department of Biotechnology, Ministry of Science and Technology Government of the Republic of India and The Ministry of Education and Research of the Republic of Estonia for Cooperation in the field of Biotechnology', 2014

Table 4: The focus of bilateral CAs covering RET*

Focus of bilateral CAs	Number identified	Percentage
General S&T (science and technology) agreement	220	74%
Energy focus	66	22%
Other	44	4%
Total	298	100%

* CAs signed on or since 1990
Source: Study findings

These trends are driven in part by the absence of formalised approaches to international R&I in RET. Overall, there is an overwhelming absence of such strategies at Member State level – with the exception of Germany and the UK. This is reflected in Table 4 above; some three quarters of bilateral CAs are not specific to RET (but encompass it) and only 22% focus on renewable energy development cooperation based on the definitions used in this study. The priorities of most Member States in terms of international R&I cooperation are driven by their domestic climate or energy policies (e.g. Netherlands, Sweden). In the absence of direct top-down strategy from central government, the responsibility for constructing a coherent approach to engaging third countries can fall to national research agencies. For example, in the Netherlands, the Dutch Climate Agreement is the major framework for NWO (Dutch Research Council) – and drives the focus of research in RET (energy generation) in the direction of wind power, solar (fuels), biofuels, geothermal and fusion power.

In terms of specific renewable energy generation technologies, wind power and solar photovoltaic (PV) are most commonly covered by bilateral CAs, with ocean energy systems less common. These trends broadly reflect the maturity of these technologies, and their applicability within the electricity generation mix of Member States (Figure 3). Given that many CAs are driven by trade and industry opportunities, the emphasis on developed generation technologies makes sense.

This renewable energy technology focuses is also strongly influenced by the general urgency that Member States have on reducing their carbon emissions (driven by EU-level policy incentives). As noted by one interviewee, “The only way for us to grow steadily and fast [in terms of the share of renewables in energy generation] is to use more conventional technologies” – and third country partnerships are shaped, in part, by this.

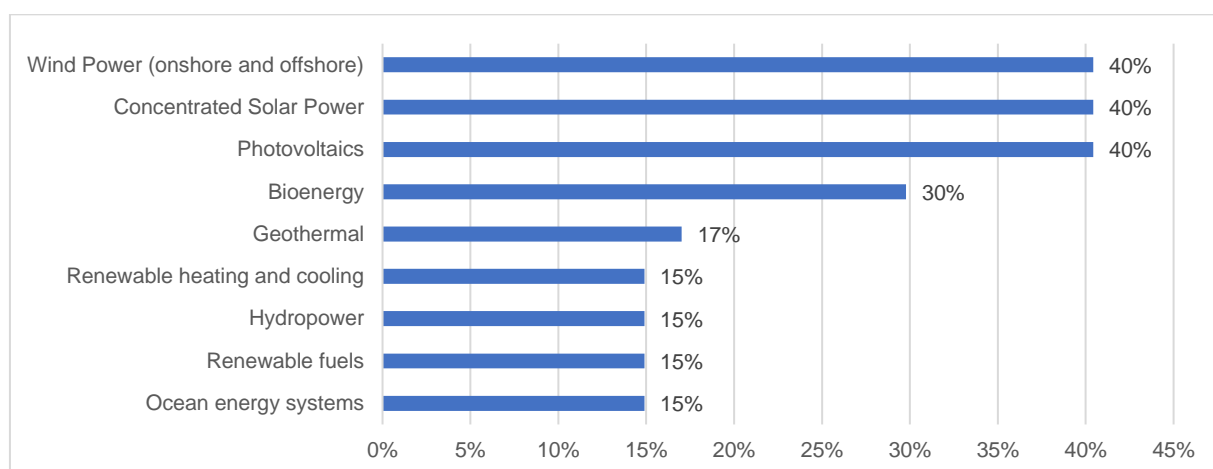


Figure 3: Specific RETs covered in energy-focussed bilateral CAs*

* 'Energy focus' CAs signed on or since 1990. $n=66$. Note that totals do not sum to 100% because each CA can cover multiple RETs.

Source: Study findings

Who, what, where? Trends in Member State interactions with third countries

When examining the content of bilateral CAs, it is notable that those which could be identified are not generally specific to renewable energy technologies but are more general science and technology agreements. For example, the 2007 'Agreement Between the United State of America and the Czech Republic' covers everything from HIV research to space and energy.⁵

All EU Member States have implemented bilateral CAs with third countries since 1990. As is expected, some are more actively engaged in others; Romania has the highest number, with 27 third country CAs (covering R&I in RET) signed since 1990. This is followed by Croatia (23 agreements), Poland and Denmark (21 each) and Spain (19) (Figure 4). There is no obvious east-west or north-south pattern in this trend. Poland is notable because it has 90 bilateral cooperation agreements in STI listed on the website of the Ministry of Foreign Affairs going back to 1957. However, many are older iterations of updated CAs, or are now clearly obsolete (in some cases because the third countries no longer exist).⁶

⁵ Agreement Between the UNITED STATES OF AMERICA and the CZECH REPUBLIC Signed at Prague September 6, 2007 with Annexes, Department of States, United States, <https://drive.google.com/file/d/0B5bWTd5-UI98cEVrNGZQVG5aWUk/view>.

⁶ Internetowa Baza Traktatowa, Polish Ministry of Foreign Affairs, <https://traktaty.msz.gov.pl/umowa-1>.

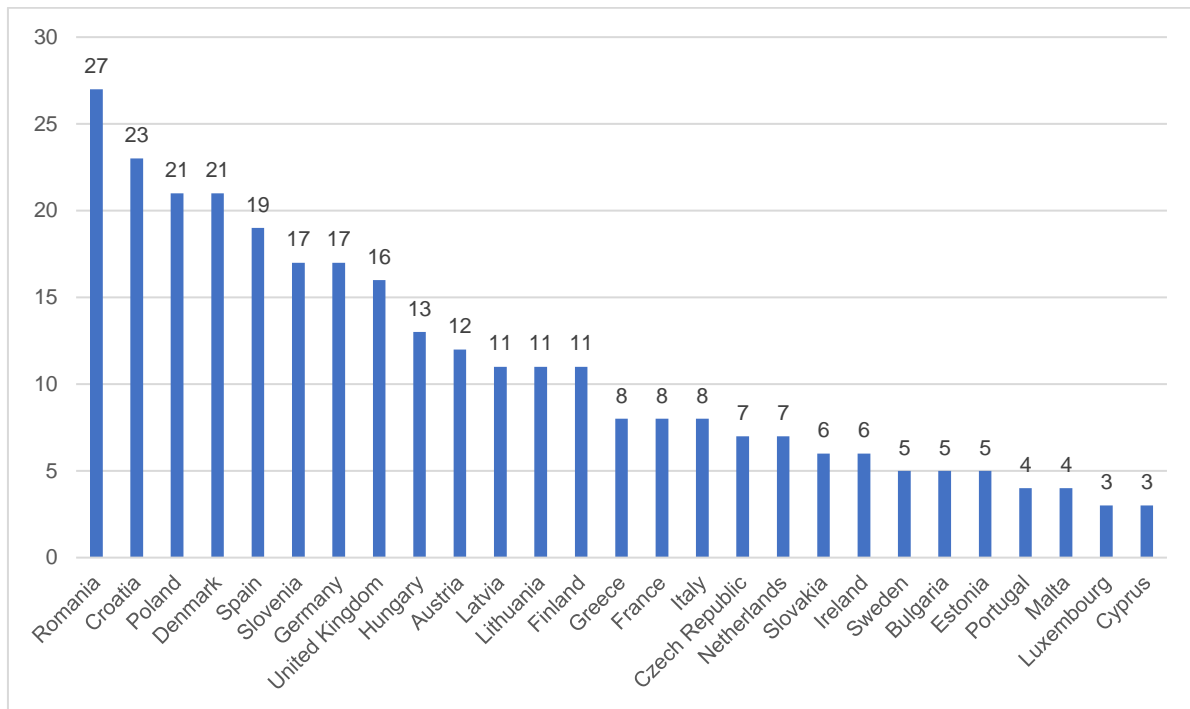


Figure 4: EU Member States' bilateral CAs encompassing RET*

* CAs signed on or since 1990. This chart covers all bilateral CAs identified (i.e. general S&T agreements as well as those with an energy focus and/or 'other' focus. $n=298$

Source: Study findings

China is the third country with which EU Member States most frequently sign bilateral CAs covering RET; 30 in total (Figure 5 and Figure 6). This number is not evenly distributed between Member States. Denmark, for example has 7 different agreements with China. After China, India and the USA are most commonly engaged third countries, followed by Brazil, Japan and Russia. There are some clear trends in terms of when CAs were signed. In the case of China, for example, CAs are quite recent: two thirds of CAs (20/30) were signed on or since 2010; a reflection of China's growing economic and geopolitical importance.

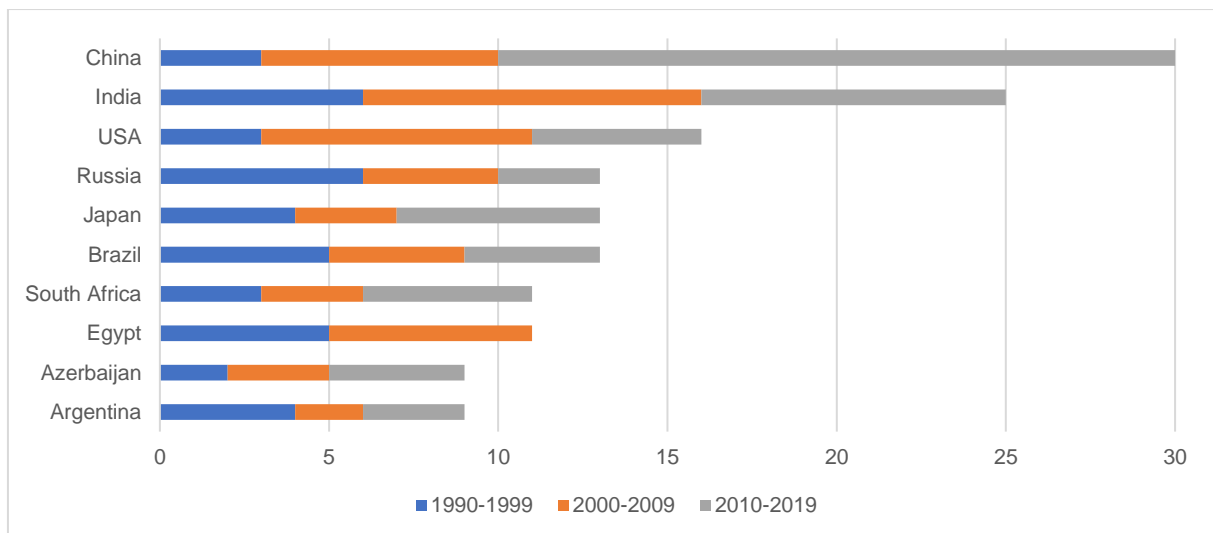


Figure 5: Most frequently engaged third countries through Member State bilateral CAs

Source: Study findings. $n=150$

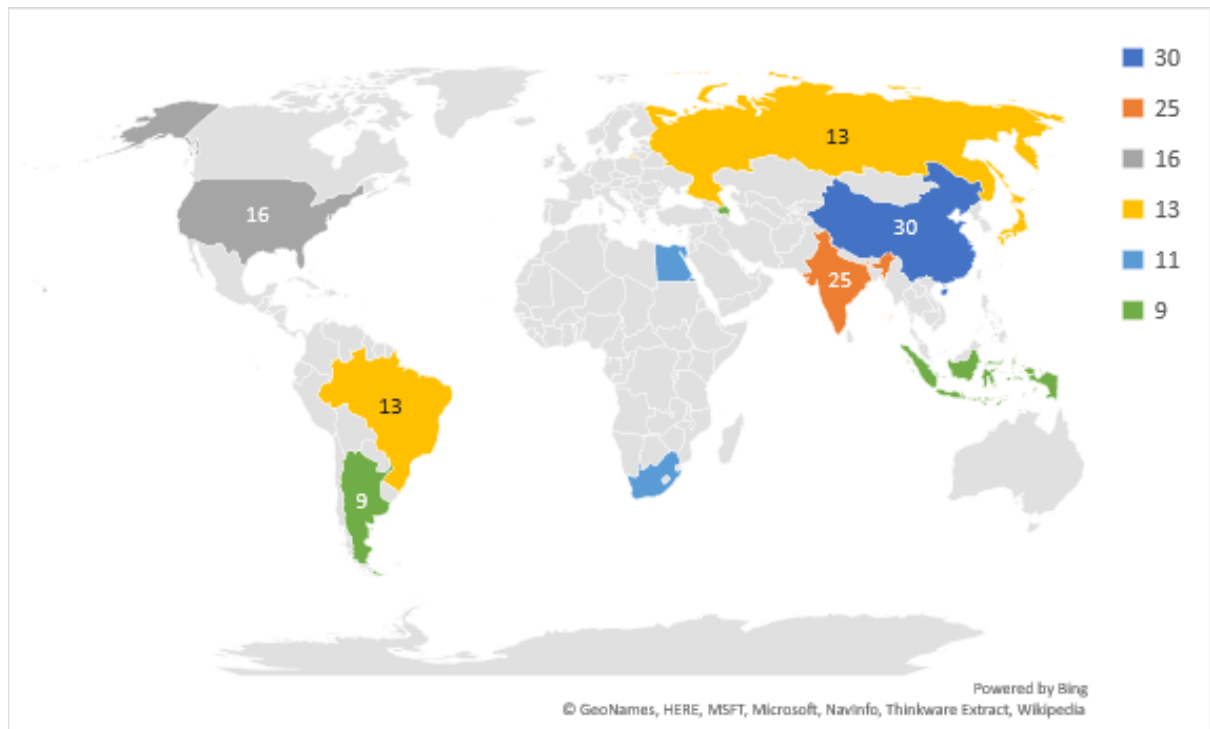


Figure 6: The top 10 third countries with EU MS bilateral Cooperation Agreements

Source: Study findings. Created with GeoNames.

Four out of ten (41%) of bilateral CAs signed across all third countries have taken place since 2010, with peaks in 2017 followed by 2008 (Figure 7). Although it is difficult to discern clear trends, the overall trend (as shown by the line of best fit) is towards an average increasing number of CAs per year since 1990.

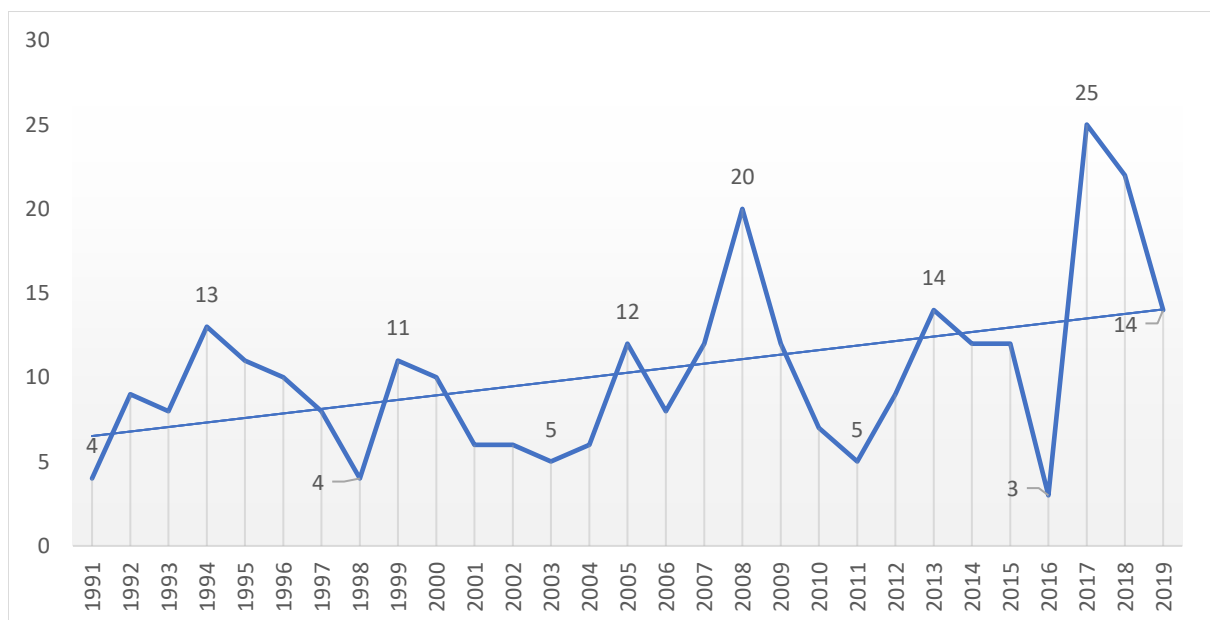


Figure 7: Years (since 1990) in which bilateral CAs were signed – all third countries

Source: Study findings. n=298. Selected data points quantified.

The interests of Member States in establishing collaborative relationships with third countries are driven by various factors including one or more of the following in combination.

Driver 1: Historical and linguistic ties

For example, Portuguese third country ties are strongly influenced by the CPLP (Comunidade dos Países de Língua Portuguesa) an association of Portuguese-speaking countries. As a consequence of these ties, Portugal has well-established research cooperation linkages with Brazil, Cape Verde, Angola and Mozambique.

Driver 2: Geopolitical interests; projection of national influence

This driver is strongly linked to trade and export (see below) but is more fundamentally connected to the global diplomatic 'standing' of Member States. The economic and political gravity of China, India and the USA are a strong pull factor for countries keen to maximise the weight of their influence. Bilateral CAs are often signed to cement this relationship. So-called 'science diplomacy' uses international cooperation in R&I as a mechanism to build soft power and is a mechanism for improving relations with key countries and regions. For example, the logic of R&I cooperation 'opening doors' is well recognised in Germany.

Driver 3: Trade and export interests – including industrial policy considerations

The potential for trade and exports is another strong driver. The role of industry is an important factor in driving the size and shape of bilateral CAs and cooperation activities. Denmark is a case in point. Danish wind turbine manufacturer Vestas (as well as Siemens Wind Power) ranked as the top companies least dependent on their domestic market.⁷ Denmark has signed 7 bilateral CAs with China and reciprocated visits from heads of state in 2012 and 2014. With Denmark's strengths in wind energy technology and China's state support for the uptake of renewable energy generation capacity, the two countries are continuing to build cooperation in fields like energy efficiency and wind energy technologies.⁸

Driver 4: Research strengths

The findings of this study indicate that the research focussed bilateral CAs are rare, with only 3% having a specific research focus (see Table 4). The 'narrow' research driven STI agreement paradigm (European Commission, 2014)⁹ is far less common, and most agreements between Member States and third countries fall under the 'broad' definition. This supports the 2014 finding, "that Member States, more than the EU and the USA, have a tendency to include non-STI objectives in their STI agreements". Interview findings indicate that the development of bilateral CAs based largely on complementary research strengths do take place, especially with larger third countries with world-leading knowledge and research facilities. But this may be a secondary or tertiary driver, ranking behind geopolitical interests and trade interests. Sweden, for example is interested in further strengthening research links with specific states in the USA; the Swedish Research Council recently supported a climate and environment researcher exchange programme with the USA, in collaboration with Formas (Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning) and the Swedish Energy Agency.¹⁰

⁷ The World's Most Global Wind Turbine Manufacturers Are Danish, State of Green 2014,

<https://stateofgreen.com/en/partners/state-of-green/news/the-worlds-most-global-wind-turbine-manufacturers-are-danish/>.

⁸ Deepening China-Denmark Comprehensive Strategic Partnership and Building a Model for China-Europe Cooperation, Ministry of Foreign Affairs of Denmark, 2015, <https://um.dk/en/about-us/the-ministers/speeches-and-articles-by-former-ministers/martin-lidegaard-speeches-and-articles/deepening-china-denmark-comprehensive-strategic-partnership/>.

⁹ European Commission (2014) Basic principles for effective international science, technology and innovation agreements.

Available at: <https://op.europa.eu/en/publication-detail/-/publication/652bf1ba-5a52-4b19-93ed-30e8498540a7/language-en>

¹⁰ Visiting researcher programme within climate and environment, Swedish Research Council, <https://www.vr.se/english/applying-for-funding/calls/2018-11-07-visiting-researcher-programme-within-climate-and-environment.html>.

Driver 5: Geographical proximity

With regard to third countries, this driver is obviously more relevant for peripheral EU countries. For example, Latvia has intermittent joint calls with Russia built on its proximity and its influence as a major energy (gas) supplier. Such calls support the exchange of researchers and research information, though in the example the cooperation is politically sensitive and sensitive to international (especially EU-Russia) relations.

2.1.2 The strategic priorities and interests of Member States

In terms of future priorities, it is important to note that EU Member States are primarily interested in **intra-EU cooperation** in RET. Driven by the Paris Agreement and EU carbon reduction targets, the policy drivers are (quite logically) geared towards cooperation with nearest neighbours.

With regard to areas of the world and/or specific third countries; few Member States have a strong vision when it comes to prioritisation of new partners with which to establish collaborative R&I in RET, preferring instead to focus on and consolidate existing links. In the words of one interviewee, "We're not at the stage where we can look at specific countries and say we want to collaborate with them".

Of those Member State interviewees who expressed future interest in specific third countries / world regions, the following stand out:

- Emerging and established economies in East and South East Asia; China, Taiwan, and Indonesia;
- South American countries – especially Brazil, and;
- North African countries, including Morocco.

Having said this, geographic and thematic interests differ markedly by country. For example, in Lithuania there is interest in collaboration with African countries on the biomass topic - agricultural by products/waste. Cooperation would be interesting also not only for research purposes but also for 'research to market' purposes in order to open new markets for our innovative ideas.

2.1.3 The importance of bilateral CAs in stimulating international R&I in RET

One of the findings which has emerged through interview research is that bilateral CAs can have value as a foundation for relations and a standing requirement to maintain communication/dialogue with third countries. For example, when actual cooperation activity takes place, it can be 'retrofitted' to existing CAs (as cited by one interviewee). However, the evidence indicates bilateral CAs are not the most important driver of joint R&I collaboration to develop RET with third countries. Many are very broad and insufficiently specific to RET to 'trigger' concrete cooperative actions: only 23% of those identified in this study have an energy focus (see Table 4). The status of the collaboration agreements is often unclear and not well monitored. Many bilateral CAs are, in contrast with the active everyday efforts of research institutions, static and of low visibility.

Furthermore, bilateral CAs are not a prerequisite for research cooperation between Member States and third countries. As noted by one interviewee, the key challenge in bilateral cooperation is not to have a formal CA in place, but to find a partner at the right level of technology development who is willing to reciprocate interest (and commitment and availability in terms of funding).

2.2 Macro-level cooperation

2.2.1 Overall state of play - EU policy drivers and previous research findings

EU energy policy

The EU has implemented several directives which commit Member States to carbon reduction and green energy targets. Directive 2009/28/EC on promoting the use of energy from renewable sources acted to set individual binding targets for all Member States, and achieve a total renewable energy gross final consumption share of 20% across the EU. More recently, the Clean Energy Package negotiated in 2018 requires each Member State to produce a National Energy and Climate Plan (NECP). This was implemented through Directive 2018/2001, and implements a Union target of at least 32% renewable energy in gross final energy consumption by 2030.

The Energy Union is the key reference framework for the EU's energy policy, and encompasses five dimensions reflected in the EU member States energy policies:

- Energy security, solidarity and trust
- Fully integrated European energy market
- Energy efficiency contributing to moderation of demand
- Decarbonisation of the economy
- Research, innovation and competitiveness.¹¹

One of the most interesting features of the Energy Union initiative is the annual 'State of the Energy Union' report that it mandates. These reports provide key input on investment in R&I (both private and public sector) and output on trends in patents, the number of researchers active in the energy sector, technology development and systemic integration of new technologies. These are key elements to take into consideration when the EU and the Member States act at the international level through the various frameworks.¹²

EU R&I policy

Fostering international cooperation in R&I is a strategic priority for the EU with the aim to:

- access to the latest knowledge and the best talent worldwide;
- tackle global societal challenges more effectively;
- create business opportunities in new and emerging markets; and
- use science diplomacy as an influential instrument of external policy.

Horizon 2020 – and specifically its international dimension – is the vehicle through which the EU funds and support R&I actions that further the research goals of Union. Work on the international dimension stretches back some years. On 14 September 2012, the European Commission adopted a Communication entitled 'Enhancing and focusing EU international cooperation in research and innovation: a strategic approach' (COM(2012) 497). The 2018 report on the implementation of the strategy found that stronger EU-third country research connections are being pursued through a combination of high-level fora (e.g. Joint S&T Cooperation Committee meetings, regional policy dialogues) and Horizon 2020 mechanisms, notably through Flagship Initiatives (including Mission Innovation) and 'twinning' calls with third countries to engage their research institutions.¹³

¹¹ Ils Moorkens, Regulation on the Governance of the Energy Union and Climate Action, Flemish Institute for Technological Research (VITO) (Presentation), 2020, https://www.eera-set.eu/wp-content/uploads/Ils-MOORKENS_Regulation-on-the-governance-of-the-Energy-Union.pdf.

¹² The Future Shape of European Renewable Energy R&I, EUREC, <https://eurec.be/the-future-shape-of-european-renewable-energy-r-i/>.

¹³ 2018 Report on the Implementation of the Strategy for International Cooperation in Research and Innovation, European Commission, https://ec.europa.eu/research/iscp/pdf/policy/progress_report_oct-2018.pdf.

These EU-level activities are also reflected in international cooperation in R&I in the field of RETs, especially through the participation of the EU in fora, such as Mission Innovation, the IEA and REN21.¹⁴

2.2.2 Building on existing insights

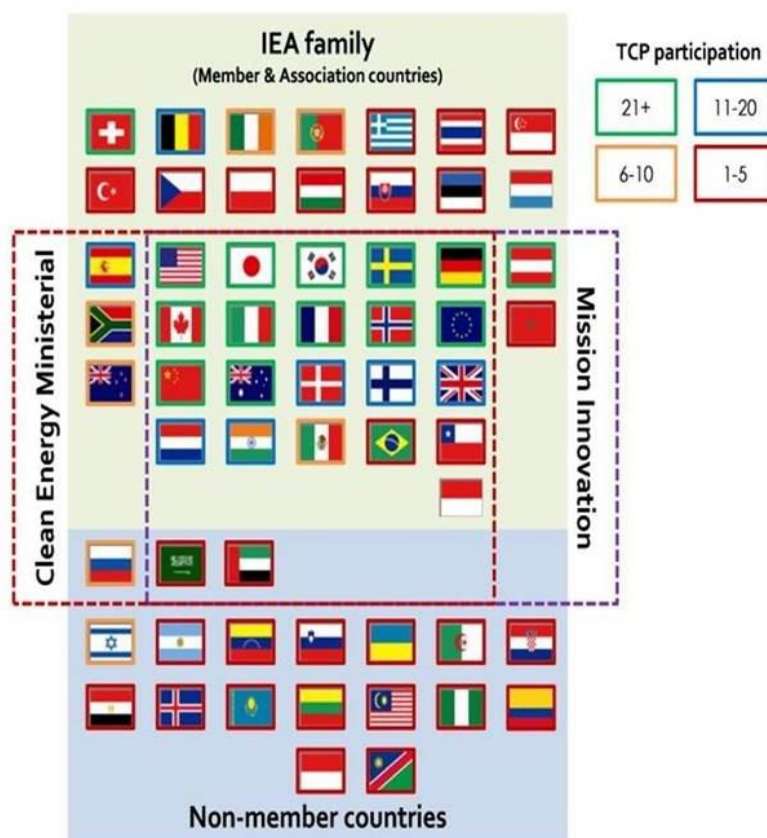


Figure 8: Overview of IEA family, Clean Energy Ministerial (CEM), Mission Innovation and TCP

Source: IEA (2019), Energy Technology Innovation Partnerships. All rights reserved

EU Member States involved in these fora appear to seek greater flexibility as legally binding agreements are increasingly perceived as burdensome. As collaborative mechanisms multiplied in the last decade to accelerate energy technology innovation, governments and/or public bodies have become active members in several initiatives, inducing complex membership overlaps across multilateral efforts.¹⁵

There is also an overlap in the sectoral / technology focus across collaborative mechanisms, i.e., macro-level frameworks. A 2014 study by the Organisation for Economic Co-operation and Development (OECD) and IEA noted that, although there was not an unacceptably high degree of duplication among the existing multilateral initiatives operating to support low carbon energy technologies, there is a balance to be found between the need to consolidating existing frameworks and prevent excessive numbers of initiatives from emerging, while capitalising on the complementarity that a range of initiatives can offer.¹⁶ However, this study did not focus primarily on R&D-focussed initiatives (unlike this study).

¹⁴ REN21 Members, REN21, <https://www.ren21.net/your-network/the-ren21-members/>.

¹⁵ Energy Technology Innovation Partnerships, IEA, <https://www.iea.org/reports/energy-technology-innovation-partnerships>.

¹⁶ OECD, IEA, Mapping Multilateral Collaboration on Low-Carbon Energy Technologies, 2014, <http://environmentportal.in/files/file/Mapping%20Multilateral%20Collaboration%20on%20Low-Carbon%20Energy%20Technologies.pdf>.

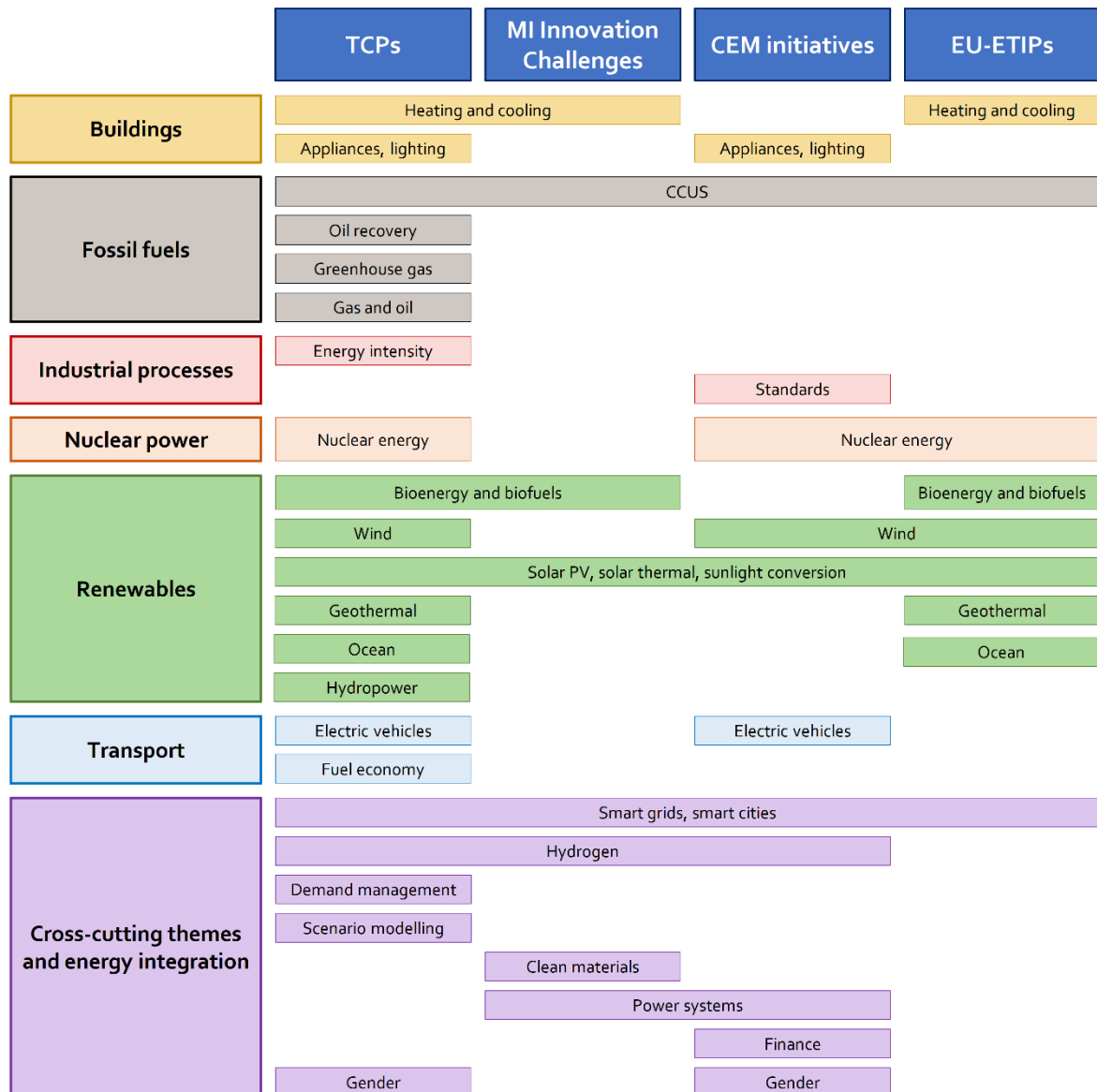


Figure 9: Sector and technology focus of the TCPs, Mission Innovation, CEM and EU Energy Technology and Innovation Partnerships (EU-ETIPs)

Source: IEA (2019), Energy Technology Innovation Partnerships. All rights reserved.

The four collaborative agreements presented in the figure above generally recognise the essential role of the private sector and seek further engagement; “But engaging with the private sector remains challenging, in part due to the private-public cultural differences but also due to diverging interests (private likely to engage with public bodies to seek funding but less likely to engage in information sharing activities given tendency towards confidentiality and competitiveness.”¹⁷

Preliminary studies suggest that these fora may benefit from identifying opportunities to collaborate, in order to establish strategic priorities, share knowledge and networks, pool resources and co- brand of activities. Furthermore, evaluation frameworks (although mostly internal reviews, and not always made publicly available) may be valuable tools for collaborative mechanisms to optimise resource use, set strategic priorities, and increase visibility. Summary of key findings; macro-level agreements

¹⁷ IEA, *Energy Technology Innovation Partnerships*, 2019, <https://webstore.iea.org/energy-technology-innovation-partnerships>.

2.2.3 Summary of key findings; macro-level agreements

Fragmented knowledge and division of responsibility in Member States

A first key message is that – mirroring the situation with bilateral CAs – the approach to engagement within Member States is often divided between multiple ministerial departments with different portfolios, and/or agencies with delegated authority. In the case of France, for example, a total of 7 ministries and agencies have involvement (Figure 9).

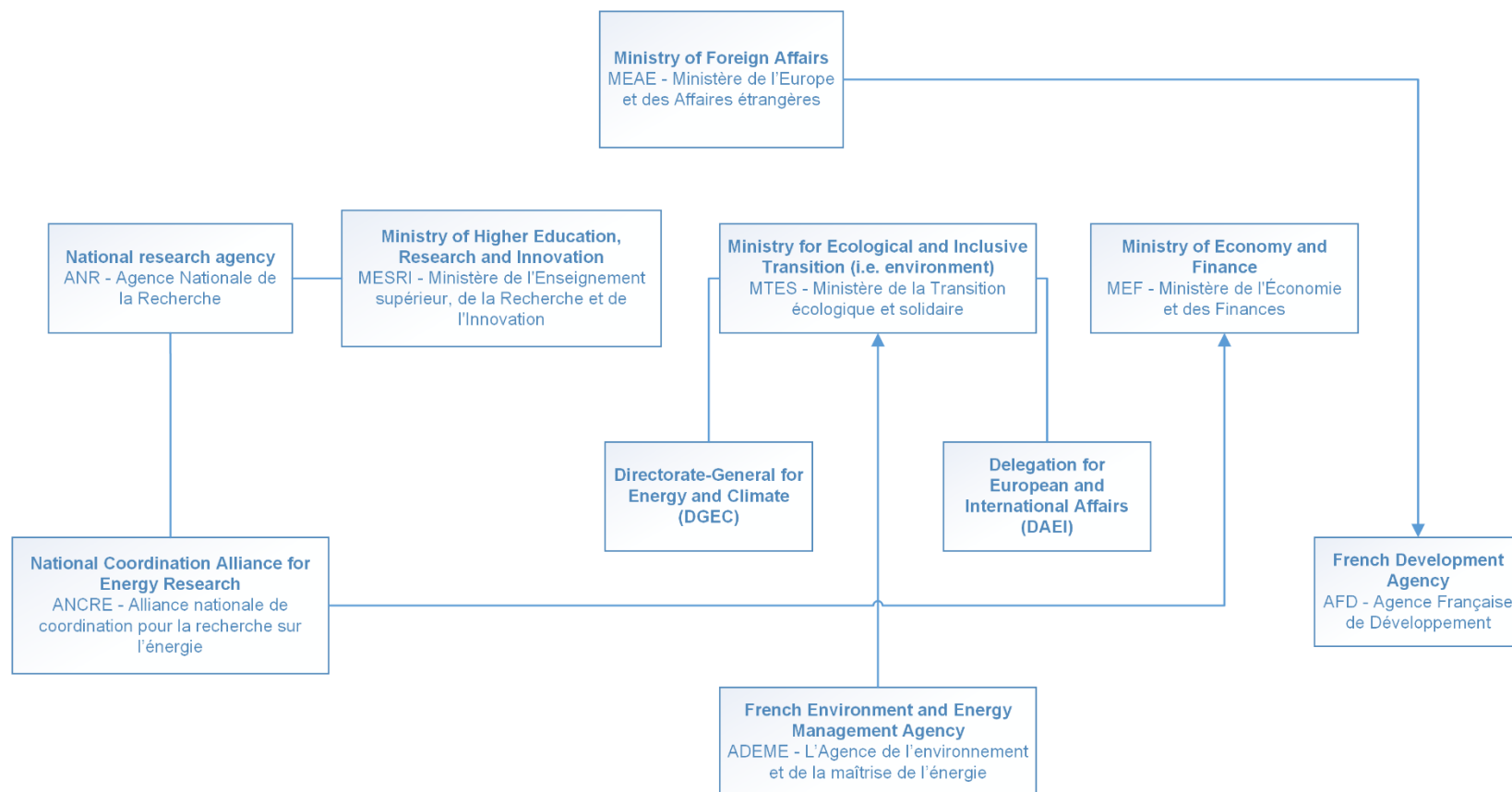


Figure 10: Ministries and agencies involved in bilateral and macro-level Cooperation Agreements in France

Source: Study findings

EU countries have well-established targets for energy generation, and all are currently developing NECPs, which should have been submitted to the European Commission by December 2019.¹⁸ Although targets for energy generation are well-coordinated, there is a less coordinated approach to research and development (R&D) spending targets (generally, and in the field of RET). There is no mechanism to drive international R&D cooperation interest in government. Hence, Member States may have very different approaches to R&D in RET.

Perceived value of partnerships, macro-level agreements and frameworks

Not all frameworks are judged to be of equal importance. They are seen and recognised as having various advantages and benefits for participating Member States. Several studies have shown that renewable energy partnerships differ in scope and strength at all levels as the partnership and / or the CA tag is used for ongoing and close relationships as well as for roundtables, repeat contracting and advising.¹⁹

Moreover, it is worth noting that previous research have found a significant discrepancy between the rhetoric and reality of cross-sector partnerships, with many partnerships (not all stemming from governmental initiatives) characterised by donor organisations' administrative demands instead of partnership values.²⁰

Varied levels of commitment to R&I with third countries

As noted in the previous section – but equally applicable to macro-level frameworks – some Member States (e.g. Poland, Germany) are generally more externally focussed when it comes to R&I activity. This is often linked to the size of the Member State in question, and by extension its resources and research budget. However, size is not the only determinant of commitment to R&I with third countries. France, for example, is strongly focussed on intra-EU cooperation through the SET-Plan, which includes all Member States, together with Iceland, Norway, Switzerland and Turkey.

¹⁸ *National energy and climate plans (NECPs)*, European Commission, https://ec.europa.eu/energy/topics/energy-strategy/national-energy-climate-plans_en.

¹⁹ *Reducing the cost of technology transfer through community partnerships*, in D.G. Ockwell, A. Mallett (Eds.), *Low-carbon Technology Transfer. From Rhetoric to Reality*, Routledge, London, 2012, pp. 340-353; M.M. van Huijstee, M. Francken, P. Leroy, *Partnerships for sustainable development: a review of current literature*, *Environ. Sci.*, 4 (2007), pp. 75-89

²⁰ Kruckenberg, Lena J., *Renewable energy partnerships in development cooperation: Towards a relational understanding of technical assistance*, *energy Policy*, 77 (2015), pp 11-20; D. Ashman, *Strengthening North-South partnerships for sustainable development*, *Nonprofit Volunt. Sect. Q.*, 30, 2001, pp. 74-98; W. Elbers, L. Knippenberg, L. Schulpen, *Trust or control? Private development cooperation at the crossroads*, *Public Admin. Dev.*, 34, 2014, pp. 1-13; Ellersiek, A., *Same Same but Different. Power in Partnerships: An Analysis of Origins, Effects and Governance*, Doctoral Thesis, Tilburg, 2011; A. Fowler, *Introduction beyond partnership: getting real about NGO relationships in the aid system*, *IDS Bull.*, 31, 2000, pp. 1-13.

Table 5: Participation of Member States in key multilateral frameworks

Member State	SET-Plan (EU-focussed)	IEA TCP – Renewable Energy	Mission Innovation	International Renewable Energy Agency (IRENA)	Clean Energy Ministerial (CEM)
Austria	x	x	x	x*	
Belgium	x	x		x	
Bulgaria	x			x	
Croatia	x	x		x	
Cyprus	x			x	
Czechia	x			x	
Denmark	x	x	x	x	x
Estonia	x	x		x	
Finland	x	x	x	x	x
France	x	x	x	x	x
Germany	x	x	x	x	x
Greece	x	x		x	
Hungary	x			x	
Ireland	x	x		x	
Italy	x	x	x	x	x
Latvia	x			x	
Lithuania	x	x		x	
Luxembourg	x			x	
Malta	x			x	
Netherlands	x	x	x	x	x
Poland	x			x	x**
Portugal	x	x		x	
Romania	x			x	
Slovakia	x	x		x	
Slovenia	x			x	
Spain	x	x		x	x
Sweden	x	x	x	x	x
United Kingdom	x	x	x	x	x
EU/EC	x	x	x	x	x

* In accession, based on the IRENA website (<https://www.irena.org/irenamembership>)

** Observer status

2.2.4 Key macro-level (multilateral) frameworks on R&I and renewable energy

International cooperation frameworks

Mission Innovation

Mission Innovation was announced on November 30, 2015, during COP21 as part of the ambitious efforts to combat climate change. Mission Innovation is a global initiative of 23 countries and the European Union to accelerate global clean energy innovation. As part of the initiative, participating countries committed to seek to double their governments' clean energy R&D investments over five years, while encouraging greater levels of private sector investment in transformative clean energy technologies. The following Member States are members of MI: Austria, Denmark, Finland, France, Germany, Italy, Netherlands, Sweden and United Kingdom.

The figure below provides an overview of the eight Mission Innovation - Innovation Challenges, each advanced by a voluntary coalition of participating Mission Innovation members, under the co-leadership of two to four countries. Interview evidence in this study indicates that Mission Innovation is generally recognised as an initiative that has value as a means of mobilising high-level political interest and commitment in low carbon technologies and the climate change agenda. Nine EU Member States take part.

Mission Innovation sees a strong involvement of both the European Commission and Member States and may thus contribute to improve synergies and additionality of R&I international cooperation in the field of RET. Specific European interests are indicated through co-leadership for the Innovation Challenges #1 Smart Grids (Italy), #2 Off-grid Access to Electricity (France), #3 Carbon Capture, Utilisation and Storage (UK), #5 Converting Sunlight (European Commission, Germany), #7 Affordable Heating and Cooling of Buildings (European Commission, UK), and #8 Hydrogen (European Commission, Germany).

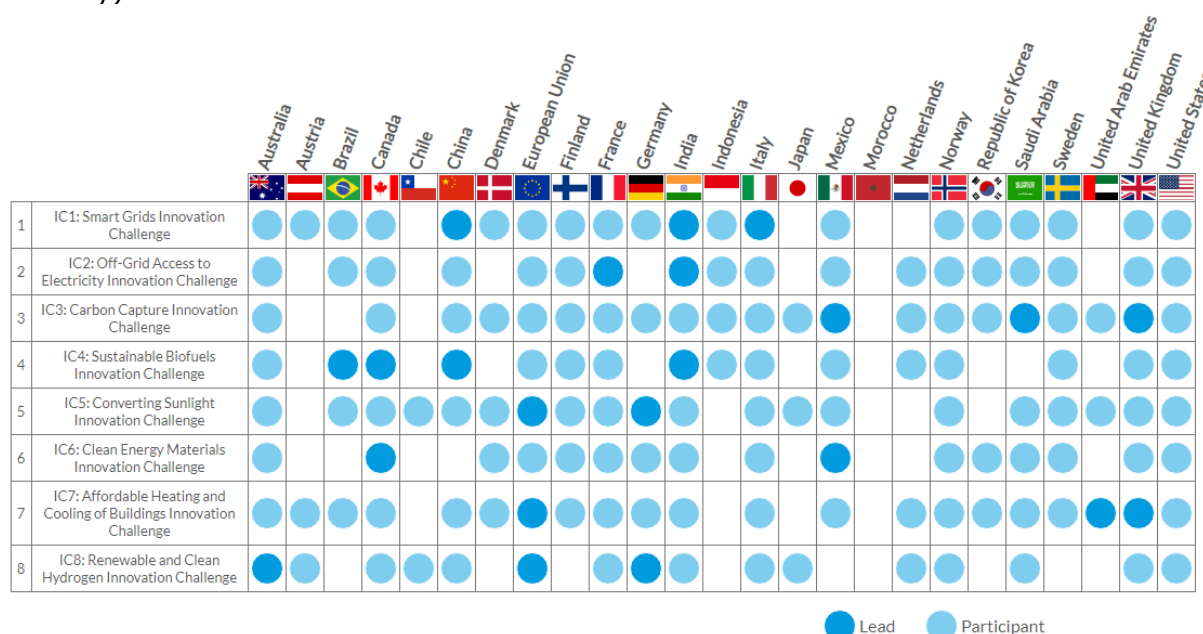


Figure 11: Mission Innovation – participating countries

Source: Mission Innovation (2017), Strategies, Progress, Plans and Funding Information Submitted by MI Members. All rights reserved.

Though the EU is a member of MI, other EU Member States are also participants but independently. For instance, the France is prominent members, considering this forum as key to identify new themes for cooperation with third countries, while Latvia is an observer considering that this initiative lacks implementation activities.

International Energy Agency (IEA)

Further international initiatives with participation of the European Commission as well as Member States are IEA TCPs in the field “Renewable Energy and Hydrogen”, namely:

- Bioenergy TCP: European Commission, Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Netherlands, Sweden, UK;
- Concentrated Solar Power (SolarPACES TCP): European Commission, Austria, Finland, France, Germany, Greece, Ireland, Italy, Spain;
- Geothermal TCP: European Commission, France, Germany, Italy, Spain, UK;
- Hydrogen TCP: European Commission, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Spain, Sweden, UK;
- Ocean Energy Systems (OES TCP): European Commission, Belgium, Denmark, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, UK;
- Photovoltaic Power Systems (PVPS TCP): European Commission, Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden;
- Solar Heating and Cooling (SHC TCP): European Commission, Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Portugal, Slovak Republic, Spain, Sweden, UK;

- Wind Energy Systems (Wind TCP): European Commission, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, UK.

The IEA is recognised by many of the Member States interviewed as a key forum for international cooperation in the field of RET. The IEA TCPs offer the opportunity of 'openness' to countries from all over the world. Furthermore, they are regarded as very useful agreements as they provide a clear (legal) framework concerning international cooperation and financing support. An advantage of the IEA TCPs is that, since they take Member States out of the 'closed loop' of the EU (in the words of one interview), they can broaden partner networks and lines of communication. The IEA TCPs are useful as a forum in which to meet counterparts. Their value lies in the way that they enable a better understanding of what is at the forefront of other countries' agendas. For instance, Sweden considers the IEA TCPs useful because they can help to support a focus on the final end-user groups in renewable energy initiatives. Ireland sometimes provides funding for representatives to go out to IEA TCP countries on bilateral visits. This can create linkages, which may lead to joint H2020 applications. In addition to networking activities, several TCPs are backed by (national) budget commitments for the implementation of projects (on joint agreed topics). Hence, some Member States are keen on financing IEA TCPs. Austria, for example, is very active in the IEA TCPs with annual spending of €2-2.5 million. However, this also demonstrates that participation in the IEA TCPs is expensive and that not all countries offer sufficient domestic funding support to researchers for participation, e.g. Spain. Hence, Spanish participation is generally more limited to exchanging and networking rather than directly creating funded R&D projects.

The IEA annual reports from the TCPs are also an enabler of international cooperation as they provide valuable information that feed into domestic energy policy dialogue. However, IEA TCPs have limits, for instance they do not have a technology innovation aim or mission. Furthermore, not all Member States participate in IEA TCPs under the renewable energy theme (e.g. Bulgaria, Czechia, Latvia, Romania).

International Renewable Energy Agency (IRENA)

IRENA is an intergovernmental organisation, which supports countries in their transition to renewable energy, serving as a forum for international cooperation and a repository of renewable energy policy, technology, resource and finance knowledge. IRENA encourages the widespread use of all sources of renewable energy, including solar, wind, bioenergy, geothermal, hydropower and ocean, for a fair and sustainable development, access to energy, energy security and low-carbon economic growth.²¹

IRENA is a key global forum in the field of RET. States, such as France, Malta, Sweden, and Portugal value this forum due to its global dimension. The findings of the study are that the value of IRENA lies more in information exchange and dialogue, rather than as an avenue for active R&I project-based cooperation. Moreover, the R&I dimension of IRENA is limited and, the results of the interviews suggest that IRENA's results could be better linked to other activities.

It is worth noting that IRENA and Mission Innovation cooperate to scale-up the deployment of RET through knowledge exchange on innovation, data, trends and priorities and cross-border collaboration. This initiative stresses the urgent need to accelerate clean energy innovation. Key areas for collaboration include:

- Tracking innovation progress: Working together in order to improve the quality of data and insights on progress in renewables and energy system technologies and better inform high-level decision-making processes related to clean-energy innovation.

²¹ *REthinking Energy 2017: Accelerating the global energy transformation*, IRENA, 2017, <https://www.irena.org/publications/2017/Jan/REthinking-Energy-2017-Accelerating-the-global-energy-transformation>.

- Strengthening cross-border collaboration on innovation: Identifying research priorities to support R&I in key technology areas, monitoring technological evolution, and identifying relevant innovation gaps.
- Sharing insights and knowledge on innovation policy priorities and strategies: Leveraging IRENA's data, tools and reports to inform Mission Innovation activities and priority areas.²²

The Clean Energy Ministerial (CEM)

CEM initiatives are global forums in which energy policies are discussed and best practices are shared to promote a smoother transition to clean energy. CEM initiatives are focused on improving energy efficiency as well as expanding clean energy access and supply.

In addition to the European Commission, the following Member States are members of CEM: Denmark, Finland, France, Germany, Italy, Netherlands, Poland (as an observer state), Spain and Sweden.

It is interesting to note that participating countries in Mission Innovation and CEM represent about 90% of investment in clean energy and 75 per cent of global greenhouse gas emissions. They are thus key global high-level fora for the EU, which aims to lead the clean energy transition.²³

The position of the EU Member States in these frameworks

Interviews with Member State representatives have highlighted differing approaches taken by larger and smaller EU countries with regard to these frameworks. Smaller Member States explained that due to budget constraints, participation in all major fora was challenging. Attending meetings of all of them requires a significant budget and resources that they might not have compared to "big" Member States. The interviewees from smaller Member States explained that they would welcome the support of the EU in such matters.

EU-level agreements

EU bilateral S&T Agreements

In line with the EU R&I policy goal to be 'Open to the World', knowledge and technology should circulate as freely as possible in a 'global research area'. In order to enable researchers to work together smoothly across borders, e.g. on large-scale common challenges, the European Commission is working to address obstacles to efficient international cooperation by ensuring fair and equitable framework conditions. This includes issues such as reciprocal access to programmes, mechanisms for co-funding, mutual access to resources and efficient and fair intellectual property rights systems. To do so, the European Union concluded 20 S&T agreements and maintains several policy dialogues with countries and regions across the globe. Currently, such S&T agreements exist with Algeria, Argentina, Australia, Brazil, Canada, Chile, China, Egypt, India, Japan, Jordan, Korea, Mexico, Morocco, New Zealand, Russia, South Africa, Tunisia, Ukraine and United States.

A specific bilateral arrangement, namely the EU-US Energy Council was created in 2009 and reports to the wider EU-US Summit. The Council meets annually and is chaired by the EU High Representative/Vice President, the EU Vice President for Energy Union, the EU Commissioner for Climate and Energy, the US Secretary of State and the US Secretary of Energy. The Council's discussions include global and regional energy security challenges,

²² IRENA and Mission Innovation to Work Together on Renewable Energy Innovation, IRENA, 2018, <https://irena.org/newsroom/pressreleases/2018/May/IRENA-and-Mission-Innovation-to-Work-Together-on-Renewable-Energy-Innovation>.

²³ Expanding clean energy is a global top priority: European Commission at Mission Innovation and Clean Energy Ministerial, European Commission, https://ec.europa.eu/info/news/expanding-clean-energy-global-top-priority-european-commission-mission-innovation-and-clean-energy-ministerial-2018-may-23_en.

mitigation of climate change, energy efficiency, renewable energy, offshore safety, as well as energy research and technologies.

In this study, interviewees were not aware or familiar with EU bilateral agreements with third countries, and awareness of them was generally low. A likely reason for this is that the overseas interests of individual countries, and their respective diplomatic and research connections, are driven by national interests to a very strong extent. Nevertheless, they informed the research team that they would be interested in knowing more about EU bilateral agreements.

Africa-EU Energy Partnership (AEEP)

Established in 2007 as one of the partnerships under the Joint Africa-EU Strategy, the AEEP is a long-term framework for strategic dialogue and structured co-operation between Africa and the EU. It is aimed at sharing knowledge, setting political priorities and developing joint programmes on the key energy issues and challenges in the 21st century, allowing Africa and Europe to develop a shared vision, common policy approaches and actions. The overall objective of the AEEP is to improve access to secure, affordable and sustainable energy for both continents, with a special focus on increasing investment in energy infrastructure in Africa. To achieve this, the AEEP Steering Group entrusted the EU Energy Initiative Partnership Dialogue Facility (EUEI PDF) with providing the AEEP Secretariat. The AEEP Secretariat works towards fostering strategic political dialogue and networking between Europe and Africa.

One of the interviewees emphasised the fact that the EU-Africa energy partnership may generate increasing interest to assist development in Africa, and thus may eventually serve to decrease migration flows.

Box 5: Portuguese engagement with Africa through a range of EU macro-frameworks

"At the multilateral level, Portugal has contributed to an alignment of agendas and actions of the main multilateral frameworks with the Sustainable Development Goals (SDGs), in particular in the framework of the United Nations and the European Union. On this last point, Portugal stressed its commitment to promote the revision of European priorities: i) on the next steps for a sustainable European future; ii) the revision of the European Consensus on Development; and iii) the renewed partnership with African, Caribbean and Pacific States, post-Cotonou Partnership Agreement, due to expire in 2020."²⁴

Through its Foundation for Science and Technology (FCT), Portugal ensures formal cooperation at bilateral and multilateral level through Memorandum of Understanding and collaboration Protocols. Besides, multilateral cooperation is primarily implemented through the membership of International Organisations worldwide.

Furthermore, Portugal / FCT participates in several multilateral EU instruments to implement the political EU-Africa dialogue:

CAAST-NET Plus: International Cooperation Network EU-Africa
ERAfrica: European Research Area Networks with Africa
RINEA: Research and Innovation Network for Europe and Africa
LEAP-AGRI: Long term EU-Africa R&I Partnership on Food and Nutrition Security and Sustainable Agriculture (FNSSA)

SET Plan

The EU's energy policies aim to ensure that European citizens can access secure, affordable and sustainable energy supplies. The SET Plan has been the R&I pillar of the EU's energy and climate policy since 2007. It was revised in 2015 to effectively line up with the EU's Energy Union R&I priorities. It coordinates low-carbon R&I activities in 32 European countries (EU Member States, Iceland, Norway, Switzerland and Turkey). The SET Plan is

²⁴ National report on the implementation of the 2030 Agenda for Sustainable Development Portugal, Portuguese Ministry of Foreign Affairs, 2017, https://sustainabledevelopment.un.org/content/documents/15766Portugal2017_EN_REV_FINAL_29_06_2017.pdf.

policy-focused forum and forms a platform to set up joint EU cooperation. The SET Plan helps to structure European and national research programmes and triggers substantial investments on common priorities in low carbon technologies. Ten key R&I actions of the integrated SET Plan have been identified which are fully aligned to the Energy Union's objectives.⁵ Following the consultative process launched in 2016 and after identifying key priorities and setting targets for each of the ten key actions, fourteen 'Implementation Plans' for the corresponding energy technologies (or energy sectors) with the greatest potential were elaborated. The implementation plans include specific R&I actions needed to achieve the set targets.

The figure below provides an overview of the Implementation Plans including the involvement of Member States in the corresponding energy technologies or sectors. Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden, and UK are specifically active Member States within the Implementation Plans ("Stars" in the figure below indicate the role of a Member State as Chair of the respective Implementation Working Groups).

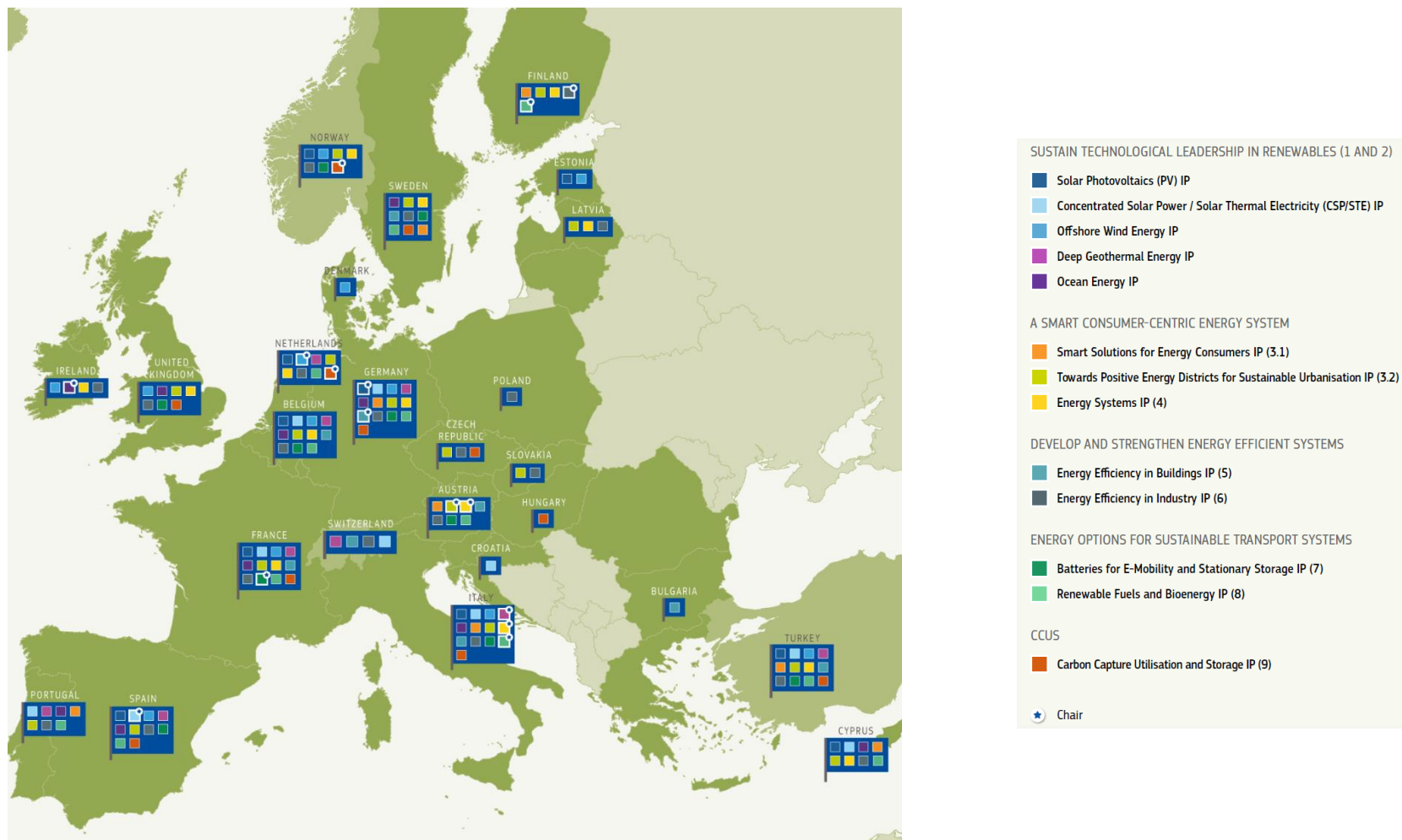


Figure 12: Overview of the implementation plans by country

Source: Implementation Plans/SETIS: https://setis.ec.europa.eu/sites/default/files/setis%20reports/brochure_set_plan-complete-v9-web-3_2.pdf#page=10;

Picture: <https://setis.ec.europa.eu/set-plan-delivering-results>.

The SET plan has been identified as an important vehicle for strategy-making by the member States interviewed. It is considered a key forum for the future in terms of meeting EU targets and the NECPs. However, some countries such as Poland would advocate better integration of SET Plan objectives into national energy policy. As explained by the interviewed Spanish representative, the SET-Plan is a policy-focused platform (i.e. not strongly research-focussed) and policy stakeholders take part, but "they try to identify which topics need research" - and this can then feed in to national funding decisions. "The SET Plan is like a roadmap that you can follow to get funding". In Spain, the SET Plan representation strongly reflects the interests of industry and focus on domestic strengths.

It is also the main platform to set up joint EU cooperation. However, there is no joint EU strategy for international cooperation in the field of RET as of now. The SET Plan does not foster international R&I with third countries. Instead it is inward-looking, helping Member States to set domestic energy priorities.

Although the SET Plan does not include an international dimension, it would be appropriate to explore its usage for future strategy development concerning collaboration with 3rd countries, considering the difference between developed and developing countries.

ERA-NET

The ERA-NET scheme, launched in the FP6, aims to develop and enhance the coordination of public research programmes at national or regional level by launching joint calls, along with other things. It offers a network structure and exposes national or regional research programmes to one another, resulting in practical collaboration such as designing and implementing joint projects or activities. The ERA-NET mechanism is intended to minimise the heterogeneity of the European Research Area (ERA) by improving the coherence and coordination of regional and national research programmes in the EU Member States or associated countries.²⁵ In this study, interviewees pointed out that ERA-NET is helpful for securing joint funding commitments. Under Horizon 2020, the ERA-NET Cofund merges the former ERA-NET and ERA-NET Plus into a single scheme with the core and mandatory component of adopting a significant call with top-up funding from the Commission. Energy is one of the key sectors covered by ERA-NET and 106 ERA-NET Cofund calls closed by the end of 2018 (since 2015), with 16% of Cofund calls related to 'Secure, Clean and Efficient Energy'.²⁶ The ERA-NET Cofunds also promotes the broadening of EU Member States or Associated States' participation in calls for projects and support international cooperation, for instance, CO-REACH, the ERA-NET Coordinated Action dedicated to developing research programme co-operation between Europe and China.²⁷ It is important to acknowledge though the temporary nature of ERA-NETs (in the context of Horizon 2020).

Box 6: The definition of ERA-NET in Horizon 2020 (Article 26)

Public-public partnerships may be supported either within, or across, the priorities set out in Article 5(2), in particular through:

- (a) an ERA-NET instrument using grants to support public-public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities, as well as Union topping-up of no more than one joint call a year, and of actions of a transnational nature;
- (b) [...] For the purposes of point (a), top-up funding shall be conditional on the demonstration of added value of the action at Union level and on prior indicative financial commitments in cash or in kind of the participating entities to the joint calls and actions. The ERA-NET instrument may include, where possible, an objective to harmonise rules and implementation modalities of the joint calls and actions. It may also be used in order to prepare for an initiative pursuant to Article 185 TFEU.

ERA-NET is accessible to the EU Member States, which make financial contributions to it. As such, one interviewee pointed out that ERA-NET lacks a strong element supported solidarity across all Member States. ERA-NET is an important forum considered as useful and efficient by the countries participating in it. Though it is a strong partnership vehicle,

²⁵ EU Funding beyond H2020, C-Energy 2020, <http://www.c-energy2020.eu/eu-funding/eu-funding-beyond-h2020/>

²⁶ Thematic areas, ERALEARN, <https://www.era-learn.eu/partnerships-in-a-nutshell/facts-figures/thematic-areas>.

²⁷ 7th Framework programme, European Commission, https://ec.europa.eu/research/fp7/index_en.cfm?pg=eranet-projects&mode=search#projects; see also, *Made for China*, ERA-NET, https://ec.europa.eu/research/fp7/pdf/era-net/fact_sheets/fp6/co-reach_en.pdf#view=fit&pagemode=none.

the international cooperation component is limited. There are two initiatives with a specific targeted international dimension:

- ERA-NET RUS, a cooperation between the EU and Russia, which supports projects for innovation and science and technology;
- ERA-NET LAC, which provide a network with Latin America and the Caribbean countries on joint innovation and research activities.

Hence, ERA-NET currently provides a good framework for joint R&I project with third countries from Latin America, Caribbean and Russia, as acknowledged by interviewees. This international dimension could potentially be extended to other regions of the world.

3 Funding entities in international collaborative R&I actions in the field of RET

Chapter 3 maps how and how well governments' commitments under bilateral and multilateral CAs - identified in Chapter 2 - are translated into actions in EU Member States. More specifically it identifies the funding entities, mechanisms, and specific actions that are used to implement the bilateral and multilateral agreements identified in Chapter 2. Sections 3.1 and 3.2 identify the organisation(s) in Members States which are responsible for implementing bilateral and multilateral agreements, and their specific actions. Section 3.3 reviews how EU Member States implement these international R&I agreements.

3.1 International cooperation in R&I actions in the focus countries

3.1.1 Findings from country memos and interviews

The research team investigated how government commitment has been translated into actions. The review of the country memos, prepared in the context of this study as a tool to support this research, provides an overview of the frequency of each of the R&I actions types (see table below), the definitions of the various R&I actions types are available in Box 1 (Section 1.3.2). Networking projects and joint programme(s) are the most common R&I action types with 71% and 64%, respectively. They are followed by collaborative research projects (44%), market uptake measures (22%), and collaborative demonstration projects (21%).

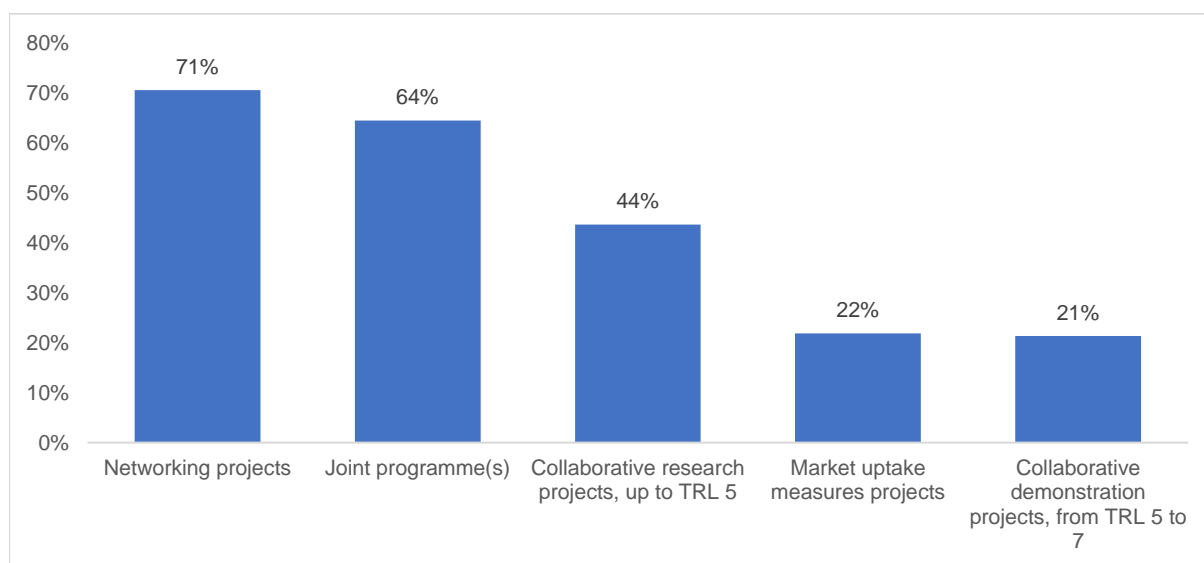


Figure 13: Frequency of R&I action types in bilateral CAs (since 1990)

Source: Study findings. n = 298. Note that, in analysis of the CAs, the definition of 'Joint programme(s)' was based on the identification of commitment to 'joint' or 'shared' activities grouped around a common goal over the medium-long term. This was fully in line with the definition in Box 1 (Section 1.3.1.) but in practice resulted in many CAs being identified, because many include paragraphs with such commitments. This accounts for the relatively large proportion (approximately two thirds) of CAs that encompass joint programmes in this figure.

Other findings resulting from the country memos and interviews include:

- Most CAs do not specify the funding mechanism attached to it as often these agreements are made at a high level and do not provide a detailed description of how they will be implemented.
- For those CAs in which the funding or implementation entities of the individual CAs are known, the implementation approach is often specific to each CA and there is no centralised funding mechanism for R&I in RET. Examples include those in Belgium, Sweden and the Netherlands.

- There is no single funding agency or mechanism that funds and/or implements all bilateral agreements in a Member State. The bilateral agreements can be funded through research/grant agencies or through the Ministry itself.
- The involvement of the funding agencies varies from Member State to Member State. For example in Croatia it seems that the funding agencies are involved only after the Ministry negotiates the CAs and sets aside a budget which the funding agency will then administer; whereas in the Netherlands the funding agencies are more directly involved in setting up the specific CAs as well as administering the funds.
- In some cases, a joint working group or a high level joint agreement is set up (e.g. France: Joint Working Group was set up for the CA on administrative arrangement in the field of renewable energies between the French and Indian Ministries of environment; Ireland: China-Ireland Joint Commission on Economic, Industrial, Scientific and Technological Cooperation). However, it is not always clear whether these joint working groups were set up and how they were organised.

3.1.2 Selection of the focus countries

To focus the research and provide a more in-depth analysis of the funding and implementation approaches, focus countries were selected through a scoping exercise. The scoping exercise is based mainly on the RET cooperation expenditure data from the IEA²⁸ and the level of participation in multilateral frameworks. The rationale for choosing the above 2 criteria is that (i) the more active a country is in international cooperation, the more likely that they support activities under the CAs in the form of funding and (ii) the more active a country is in international cooperation, the more likely it is to be participating in multilateral fora.

Although the RET cooperation expenditure data suffers from some methodological constraints, this has only limited impact on reliability in terms of volume of expenditures.²⁹

The table below provides an overview of the RET cooperation expenditure data, along with a number of other indicators to help contextualise the focus countries. The ten selected focus countries are shared in blue. The ten focus countries which are very or moderately active in R&I international cooperation in RET include Germany, France, the Netherlands, Denmark, Italy, Poland, Sweden, Spain, Finland, and Ireland.

As seen in the table below, the ten focus countries are the countries with the largest Research, Development and Demonstration (RD&D) budgets in RET, except for Ireland and Poland. Poland is included to ensure geographical diversity. Ireland is included as it is a small country and thus ensures a diversity of Member State size. Furthermore, Ireland has some interesting characteristics, such as a strong EU policy commitment, peripheral EU location, strong natural resource base to capitalise on renewable energy generation potential and strong historical ties with the USA. The table below shows the RD&D budget in RET as well as some other information collected through the country memos to help contextualise the focus countries compared to the other Member States.

²⁸ Energy Technology RD&D Budget Database, IEA, <https://www.iea.org/subscribe-to-data-services/energy-technology-rdd>.

²⁹ Fiorini Alessandro, et al, *Monitoring R&I in Low-Carbon Energy Technologies*, Publications Office of the European Union, 2017, <https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/monitoring-ri-low-carbon-energy-technologies>.

Table 6: Overview of selected focus countries (shaded in blue)

Country	Overall RET RD&D budget in million Euro (2018)	No. of CAs	Formalised cooperation strategy	No. of specific agencies in charge of implementation	Preferred third country partner for RET cooperation
Germany	207.55	17	No	9	n/a
France	134.05	8	no	6	n/a
Netherlands	96.69	7	yes	4	n/a
Italy	88.43	8	yes	2	n/a
United Kingdom	85.99	16	yes	2	India, USA
Denmark	42.45	21	no	8	n/a
Finland	36.16	11	yes	1	Indonesia, India, Kazakhstan, China, South Korea and Myanmar
Sweden	30.55	5	no	4	Brazil, India, China, USA, Canada
Spain	26.59	19	yes	8	n/a
Austria	22.39	12	yes	3	n/a
Poland	21.09	21	no	1	n/a
Belgium	16.51	4	no	1	n/a
Ireland	8.94	6	no	3	Japan
Portugal	4.66 (2015)	4	yes	1	Cape Verde, Mozambique, East Timor
Czech Republic	4.42	8	No	3	n/a
Luxembourg	4.27 (2012)	3	yes	1	n/a
Hungary	3.37	13	no	2	n/a
Estonia	2.96	5	no	3	n/a
Greece	2.06 (2011)	8	yes	4	Cyprus, Albania, Bulgaria
Slovakia	0.91	6	no	1	n/a
Romania	No data in EAA data base	27	yes	3	n/a
Croatia	No data in EAA data base	23	yes	2	n/a
Slovenia	No data in EAA data base	17	No	5	Socialist Federative Republic of Yugoslavia (valid by succession)
Latvia	No data in EAA data base	11	no	1	n/a
Lithuania	No data in EAA data base	11	No	1	n/a
Bulgaria	No data in EAA data base	5	no	3	n/a
Malta	No data in EAA data base	4	Yes	2	China
Cyprus	No data in EAA data base	3	no	2	Greece, Jordan, Iceland, Liechtenstein and Norway

Along with the overall RET RD&D budget, the participation of Member States in key multilateral frameworks (SET-Plan, IEA TCPs, Mission Innovation, and CEM) was also used to select the focus countries (see Table 7). In this study, a Member State has been classified as 'very' or 'moderately' active in R&I international cooperation if it participates in at least three out of four key multilateral frameworks. Using this additional criterion, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain and Sweden fit the profile of active countries. Ireland and Poland are the exceptions, with each participating in two out of four. However, as discussed previously, Ireland and Poland have been selected as focus countries to ensure diversity in terms of size and geography.

Table 7: Participation of Member States in key multilateral frameworks

Member State	SET-Plan	IEA TCP – Renewable Energy	Mission Innovation	CEM
Austria	x	x	x	
Belgium	x	x		
Bulgaria	x			
Croatia	x	x		
Cyprus	x			
Czechia	x			
Denmark	x	x	x	x
Estonia	x	x		
Finland	x	x	x	x
France	x	x	x	x
Germany	x	x	x	x
Greece	x	x		
Hungary	x			
Ireland	x	x		
Italy	x	x	x	x
Latvia	x			
Lithuania	x	x		
Luxembourg	x			
Malta	x			
Netherlands	x	x	x	x
Poland	x			x**
Portugal	x	x		
Romania	x			
Slovakia	x	x		
Slovenia	x			
Spain	x	x		x
Sweden	x	x	x	x
United Kingdom	x	x	x	x
EU/EC	x	x	x	x

* In accession, based on the IRENA website (<https://www.irena.org/irenmembership>)

** Observer status

3.2 Overview of implementing and funding entities

3.2.1 Identification of funding entities per Member State

Funding entities are national agencies or organisations that are mandated by their governments to manage the funding of projects. The funding entity database (Annex 5) includes a complete overview of the agencies, organisations, and parts of the governments (i.e. ministries) which are involved in the funding and implementation of R&I action in RET. Table 8 provides an overview of the number of funding and implementing bodies per Member State.

Table 8: Overview of the number of funding entities per Member State

Member State	Number of funding and implementation bodies
Denmark	8
Finland	8
Ireland	5
Italy	5
Germany	9
Spain	7
Poland	3
Sweden	4
France	4
Netherlands	6

Source: Desk research and stakeholder interviews

Based on our interviews we have identified the most active bodies in R&I action for each of the selected Member States in Table 9. This is mainly based on whether representatives from those bodies responded to our interview requests as well as which body is funding/implementing the identified CAs (see Annex 3); thus, this is not a complete overview. Furthermore, it is difficult to draw EU wide conclusions on any trends as it is only a selection of ten focus countries. Nonetheless as these countries were identified as the most active, a few conclusions can be made. The size of the country does not determine the number of funding or implementing bodies. The largest countries do not necessarily have the largest number of funding bodies. Some Member States use a mix of both private and public organisations to implement and fund R&I in RET.

Table 9: Overview of the most active funding entities in R&I in RET

Member State	Main funding entities in R&I in RET
Denmark	Innovation Fund Denmark
	Danish Agency for Science and Higher Education
	Danish Energy Agency
	Energy Technology Development Demonstration Programme
Germany	International Buero
Finland	Forschungszentrum Jülich
	The Academy of Finland
Sweden	Business Finland (formerly known as Tekes)
	Vinnova
	Swedish Energy Agency
Netherlands	Swedish Research Council
	Netherlands Enterprise Agency (RVO)
Ireland	NWO
	The Irish Research Council
	Science Foundation Ireland (SFI)
Spain	Enterprise Ireland
	Centre for the Development of Industrial Technology (CDTI)
Poland	National Centre for Research & Development (NCBR)
	National Science Centre (NCN)
Italy	No funding agency; ministries are responsible for funding
France	The Agency for Environment and Energy Management (ADEME)

Source: Stakeholder interviews, funding entity database

3.2.1 Overview of how bilateral and multilateral agreements are funded and implemented in the 10 focus countries

The following section provides an overview of how the bilateral and multilateral agreements are funded across the 10 focus countries. The majority of these findings are based on stakeholder interviews.

There are heterogenous implementation approaches between funding entities

There is no single funding agency or mechanism that funds and/or implements all bilateral agreements in a Member State. The bilateral agreements can be funded through research/grant agencies or through the Ministry itself. Furthermore, there is not a complete overview of which entities are responsible for funding each CA or R&I actions in the field of RET.

For example, in France there is not a defined strategy of cooperation with third countries in this field (R&I in RET) and responsibility for the CA's implementation is spread among several Ministries, agencies and services. In Sweden, the R&I implementation landscape is also very fragmented, but some funding agencies coordinate among themselves despite being under different ministries.

However, coordination really depends on the topic and there is no secretariat that would have the overview of all international cooperation in Sweden. There is cooperation within all levels (i.e. ministries, programme officer, etc.) but not across all levels.

The text box below describes the fragmented and complex funding landscape of three Member States.

Box 7: R&I implementation landscape in Ireland, Denmark and Germany

Ireland

In the context of this research, four funding entities and/or implementing bodies are variously involved in R&I in RET in Ireland:

The Irish Research Council – which funds research in the form of grants and funding to individuals and project based in Irish universities and research institutions. The main focus is on basic, academic research.

Science Foundation Ireland (SFI) – the national foundation for investment in research in the areas of science, technology, engineering, and mathematics (STEM).

Enterprise Ireland – Ireland's enterprise development agency. Enterprise Ireland delivers a portfolio of funding initiatives that primarily target businesses.

The Sustainable Energy Authority of Ireland (SEAI) – which guides energy policy including renewable energy priorities. Individuals from SEAI also represent Ireland in SET Plan meetings, and the SEAI helps to ensure that Ireland remains on track to meet SET Plan targets.

Denmark

In Denmark, there are three main ministries involved in international cooperation in R&I in RET, including The Ministry of Higher Education and Science, the Ministry of Climate, Energy and Utilities, and the Ministry of Foreign Affairs. Under each ministry, there are several funding agencies as well as implementing bodies. Under the Ministry of Higher Education and Science there are two main funding agencies: The Danish Agency for Science and Higher Education and Innovation Fund Denmark. Denmark also has eight Innovation Centres Denmark which are located at the Embassies of Denmark which implement bilateral collaboration activities in the STI-areas. The Ministry of Climate, Energy and Utilities is responsible for Denmark's Energy policy and many aspects of international collaboration, including activities related to Directorate-General for Energy (DG ENER), the IEA, Mission Innovation etc. Under the ministry there are two main stakeholders: The Danish Energy Agency & The Energy Technology Development and Demonstration Program.

Germany

In Germany, there are two main ministries involved in international cooperation in R&I in RET, namely the Ministry for Economic Affairs and Energy (BMWi), Federal Ministry for Food and Agriculture (BMEL) and the Ministry of Education and Research (BMBF). Under each ministry, there are several funding agencies as well as implementing bodies. The Ministry for Economic Affairs and Energy is also responsible for energy policy in Germany. The R&I strategy is laid down in the 7th Energy Research Programme "Innovations for the Energy Transition" and also addresses aspects of international collaboration, including activities related to the SET-Plan, Mission Innovation, the Clean Energy Managerial, and IEA TCPs. Under the 7th Energy Research Programme project funding for research, development and innovation in the field of energy is a competence of the Ministries concerned (BMWi, BMEL, BMBF), which each publish funding guidelines within their fields of competence. The federal ministries receive support throughout implementation from project management agencies, namely Project Management Jülich (PtJ) for energy technology research including basic research and the Agency for Renewable Resources (Fachagentur Nachwachsende Rohstoffe e.V.) for bioenergy. Finally, since the 1970/80s Germany is engaged in a number of Agreements for Scientific Technological Cooperation (WTZ). In recent years R&I cooperation is less formalised (and binding) and based on MoUs. Such MoUs are usually general cooperation agreements and do not specify topics. Focus is placed on more fundamental research and renewable energy are not covered in such agreements. Implementing agency for these WTZ is the International Bureau of the German Aerospace Centre (DLR), on behalf of the BMBF.

The involvement of the funding agencies in developing the CAs varies from Member State to Member State

In some Member States, funding agencies are more directly involved in setting up CAs with third countries while in others, CAs are set up at the Ministry level and implementation and funding are done by various agencies under each Ministry.

In Sweden, the government is head responsible, but they appoint the actual implementation to agencies such as the Swedish Energy Agency or Vinnova.

In France, bilateral agreements on energy and RET are usually signed during French presidency or Ministries (Environment, Energy, Economy or Industry) visits. These agreements usually cover global objectives with few details of planned activities and no budgets.

In Italy, the Ministries involved in the implementation and funding of international cooperation actions in R&I in RET are the Ministry of Foreign Affairs and International Cooperation (MAECI), the Ministry of Economic Development (MISE) and the Ministry of Education, University and Research (MIUR). In Italy, there are no funding agencies, and this is generally perceived as a shortcoming. As a consequence, relevant ministries are often responsible for research funding in their specific fields.

In the Netherlands, Poland, and Spain, the funding agencies are more directly involved in setting up the specific CAs as well as administering the funds.

In Denmark, the Ministries often create partnerships with third countries which are often translated into various bilateral agreements with these third countries. The agencies such as Innovation Denmark then use these bilateral agreements to create bilateral agreements with the relevant funding/implementation agency in the third country.

In some cases, a joint working group or a high level joint agreement is set up to implement and fund CAs (e.g. France: Joint Working Group was set up for the CA between India and Administrative Arrangement in the field of Renewable Energies between the French and Indian Ministries of environment; Ireland: China-Ireland Joint Commission on Economic, Industrial, Scientific and Technological Cooperation). However, it is not always clear whether these joint working groups were set up and how they were organised.

Funding is not directly attached to the bilateral cooperation agreements

Based on the desk research and the stakeholders interviews, most of the funding of R&I actions is not specifically tied to the cooperation agreements, the table below provides an overview of the number of CAs that receive funding, specified by the type of funding. The table also illustrates the percentage of funding type used in the CAs. For most of the CAs it is not known whether there is funding attached to it.

Table 10: Percent of CAs funded in focus countries

Funding of bilateral CAs	Number identified	Percentages
Co-financing	2	2%
Funds	1	1%
Grants	13	10%
Other	4	3%
None	18	14%
Unknown	92	71%

Source: Desk research and interviews

One of the main reasons for the large unknown category is that the text of the CA itself does not specify the funding agency or the funding mechanism to be used. Interviews with stakeholders provided further insights on why it is unknown whether the majority of these agreements are not funded.

In Finland, the funding mechanisms for international R&D in RET operate with limited connection to bilateral CAs. It is clear that Finnish agencies often engage in research collaboration regardless of whether a high-level agreement is in place. Interview evidence indicates that not all are actively monitored or pursued, but nevertheless are considered valuable in terms of reinforcing Finland's positive relations and ties with global partners. Japan is a particularly important third country with which R&I is undertaken, even though Finland does not have a governmental level bilateral CA with Japan. There are however several cooperation agreements in place between Japanese and Finnish agencies and an active Japan-Finland Joint Committee on Cooperation in Science and Technology.

Most Danish project funding is indirectly linked to any bilateral agreements. The funding belongs to the funding agencies which are independent of political decisions in the ministries. The funding agencies do, however, make use of the bilateral agreements of the ministries to make their own agreements with third countries and under these agreements they create calls which have funding attached to it. For instance, Innovation Fund Denmark uses the bilateral agreements made between the Ministry of Science and Higher Education to create agreements underneath and under these they have calls for projects which are funded.

For those CAs in which the funding or implementation entities of the individual CAs are known, the implementation approach is often specific to each CA and there is no centralised funding mechanism for R&I in RET. Examples include those in Sweden and the Netherlands.

Member State initiatives with third countries usually only provide funding for domestic research partners

Calls launched by an EU Member State's funding agency with third countries are mostly co-financed, i.e. each country provides their own funding. In other words, each country in the agreement funds their own research partners. Within each of the Member States, research partners usually receive funding in the form of grants. This applies to most of the focus countries: Finland, Denmark, Sweden, the Netherlands, Spain, Poland, and Germany. The amount of the grant depends on the type of stakeholder as different stakeholders have different investment rates.

How the partners in the Member State are funded are usually determined by national legislation. For instance, in Germany, R&I grants (national funding) for German partners in joint projects are governed by national funding rules and implementation agencies (under the 7th Energy Research Programme).

Co-financing with third countries is most frequently used under bilateral cooperation agreements as it is a cooperation between both countries and thus each country should finance their own partners. In some cases, Member States do not provide any funding to third countries as there are national legislation that do not allow direct funding of third countries. For example, in Finland, as a rule – because it contravenes the organisation's legal remit and Finnish law governing the expenditure of taxpayers' money – Business Finland cannot allocate any funding directly to third country partners under these schemes.

Some Member States do however have funding mechanisms in place to directly fund parties in third countries, however these mechanisms are rarely used in practice. In Sweden, the Swedish Energy Agencies has a national call for proposals without bilateral agreement, there is not a legal limitation to have a third country to take part in the call. In very limited cases third countries could get funding. In Finland, there have been occasions in the past, where legal entities have been established which are jointly owned by Finnish and third country stakeholders, where funding has been allocated. In the Netherlands, NWO can fund research in third country research but this is a general instrument not for specific agreements.

There are few examples of active calls in R&I in RET under the CAs

The analysis of which RETS are covered under the CAs was undertaken again to analyse if the focus countries follow the previous findings. Moreover, during the interviews conducted for this Chapter, information about the CAs was added. The findings, however, are similar to those of the previous Chapter. Most of the CAs in the focus countries are not specifically focused on R&I in RET although the majority of the agreements are very broad and thus could encompass this field. Figure 14 provides an overview of which RETs are covered under CAs in the 10 focus Member States that are very and moderately active in R&I international cooperation in RET.

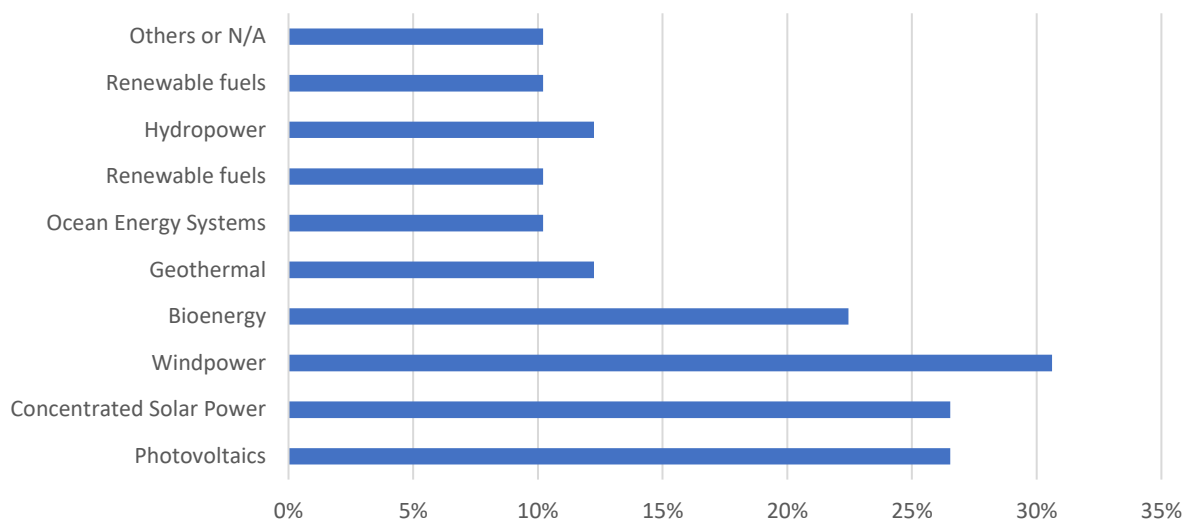


Figure 14: Specific RETs covered in energy-focused bilateral CAs in focus Member States

*'Energy focus' CAs signed on or since 1990. n=66. Note that totals do not sum to 100% because each CA can cover multiple RETs.

Source: Study findings

Even though the CAs are broad enough to encompass R&I in RET, few CAs per Member State are being used to facilitate active calls with third countries.

For instance, in Germany, BMWi in 2016 has launched contracts with three implementing agencies for a number of energy partnerships and energy dialogues with third countries. Thereby, energy partnerships are based on a MoU signed by ministries of the partner countries whereas energy dialogues are less formalised and initiated by the BMWi in order to (newly) establish collaboration contacts with third countries. However, up to date no focus is placed on R&I in these agreements.

In Denmark, Innovation Fund Denmark allocates about 2 million euros per call which are given to the Danish partners through grants. From 2017-2019 there were around 2 calls a year but spread over 3 different agreements in R&I in RET.

Multilateral agreements tend to be more structured and organised but funding approaches differ

This section details how the multilateral agreements are funded. The multilateral agreements that are the focus of this Chapter include:

- IEA TCP;
- Mission Innovation;
- AEEP;
- SET Plan; and
- CEM.

IEA TCPs

The IEA TCPs are open to IEA members as well as non-member countries. In addition to networking activities, several TCPs are backed by (national) budget commitments for the implementation of projects (on joint agreed topics); however, these projects are not limited to R&I projects. The IEA does not dispense grants or make loans.³⁰

³⁰ The IEA is an autonomous inter-governmental organisation within the OECD framework, headed by its Executive Director, IEA, 2020, <https://www.iea.org/about/structure>.

TCPs are self-financed by the participants, either through financial and/or in-kind contributions.³¹ Countries pay a membership fee to participate in a TCP. This membership fee differs for each TCP. The membership fee is higher for cost shared activities, and lower for task shared activities. In task shared projects, participating organisations arrange for their own experts to take part, while cost shared projects participants contribute funding.³² In some, TCPs such as the IEA GHG, funding is provided by the members, with individual contributions forming a common pool of research funds.

For example, the International Energy Agency Demand Side Management (IEA DSM), in which 12 countries participate, is a cost-shared approach with a membership fee of €20,000 for each country,³³ while the membership fee for the IEA Hydrogen is \$12,500.³⁴

Hence, some Member States are keen on financing IEA TCPs. Austria, for example, is very active in the IEA TCPs with annual spending of €2-2.5 million. However, this also demonstrates that participation in the IEA TCPs is expensive and that not all countries offer sufficient domestic funding support to researchers for participation, e.g. Spain. Hence, Spanish participation is generally more limited to exchanging and networking rather than directly creating funded R&D projects. Sweden is participating in around 22 TCP's, and funds Swedish actors who participate in these activities. Currently, Sweden pays kr6.5 million per year for those TCP membership fees, which are not limited to RET projects.

Mission Innovation

Mission Innovation is a political and strategic body which lacks an institutional framework as well as dedicated budget lines for project implementation.

As there are no dedicated budget lines, each country part of Mission Innovation contributes with funding for their activities within MI, based on their priorities (i.e. Italy's priorities include smart grids, hydrogen and advanced materials). Often Member States fund their activities through the form of grants that goes to research centres, universities, etc.

A minority of countries also set aside funding for open calls on topics of their choice. In Italy, the budget for 2019 and 2020 is respectively €16.8 million €39 million. In France, there is funded supported for at least one programme for the participation of France within MI, namely for 'Access to Energy in Africa' through Mission Innovation. France is also co-lead with India in the Mission Innovation 'Off grid electricity access to electricity'. In this framework, ADEME has launched two calls on this subject in 2017-2018 and 2019-2020, entitled 'Innovative solutions for off-grid access to energy'. In the first call, nine projects together received a grant subsidy of €1.8 million. In the second call, €2 million was evaluated for ten projects.

Other non-EU countries like China, India, Japan, USA are investing much more within MI, but Italy, France and the Netherland's contribution is approximately on the same level.

Africa-EU Energy Partnership (AEEP)

The AEEP framework is complemented by a European institution: the African Investment Facility (AFiF). This facility aims to increase European and African investment in infrastructure and provides support for these regional programmes. It is the successor of the EU-Africa Infrastructure Trust Fund (EU-AITF), which provided grants for energy infrastructure and projects which fell under the EU's guidelines for Sustainable Energy for All.

³¹ *The IEA works to ensure reliable, affordable and clean energy for its 30 member countries and beyond*, Sustainable Energy Authority of Ireland, <https://www.seai.ie/data-and-insights/seai-research/international-energy-agency/>.

³² *Joining the EBC Programme*, Energy in Buildings and Communities, https://www.iea-ebc.org/Data/Sites/1/media/docs/EBC/EBC_Joining_the_Programme.pdf.

³³ IEA DSM TCP Review, retrieved from Damuel Thomas, IEA DSM TCP Review, IEA DSM ExCo meeting, Bergen, 2018, http://www.ieadsm.org/wp/files/1.NEW%20ExCo%20File%20Library/ExCo%20meetings/2018%20Bergen/ExCo%20meeting%20presentations/20180412_IEA_DSM_TCP_review.pdf.

³⁴ *Membership in IEA Hydrogen*, IEA, <http://ieahydrogen.org/pdfs/Membership-in-IEA-Hydrogen.aspx>.

By 2016, the EU-AITF had allocated €438 million in grants to 67 energy projects. An example of a project which was supported by the AFIF in 2016 is the electrical network interconnection in Guinea and Mali, which received a grant of €18.86 million.³⁵

In September 2010, the Africa-EU Renewable Energy Cooperation Programme (RECP) was launched, which contributed to a further development of AAEP. The program was meant to promote to energy security through renewable energy in Africa.³⁶ In the beginning years, RECP received an initial financial contribution of €5 million from the European Commission. RECP provided “technical and financial assistance for project preparation and the facilitation of financing in order to close the gap between good ideas and bankable projects.”³⁷ Further, “innovative financing methods such as partial loan guarantees, insurance instruments or concessionary equity financing will be promoted in order to provide the necessary long-term finance and reduce risks for project developers.”³⁸ In 2019, GET.invest replaced RECP and extended its geographic focus to beyond the African continent, GET.invest delivers by mobilising the private sector and by building a pipeline of viable investment projects.³⁹ The programme works closely with a broad range of partners, including industry associations, private sector business and project developers, financiers and regulators in building sustainable energy in the space of international cooperation on decentralised renewable energy. GET.invest is hosted on the multi-donor platform GET.pro, implemented by GIZ, and supported by the European Union, Germany, Sweden, the Netherlands, and Austria.⁴⁰

SET Plan

The SET Plan is an EU framework, rather than a multilateral agreement, and as such it does not provide funding, but only strategic guidance. The SET Plan aims to support development of new technologies and bring down costs in the energy sector, by coordinating national research efforts and facilitating financing of projects in the energy sector.⁴¹ Through its forum, Member States take part, identify the topics that need research and as well receive guidance for national funding decisions.

For some categories, the SET Plan 2018 states that funding should originate mainly from private and public sources at national level. However, when a project has a clearly demonstrated value at EU level, there is a possibility of EU funding.⁴² In more specific energy fields, such as in the Ocean Energy Implementation Plan, other options for financial support (such as an Investment Support Fund) are being investigated.⁴³

The SET plan voices the intent that in the majority of participating countries, beneficiaries should contribute co-finance national public research funding, especially innovation funds. A percentage of 30% (€225 million out of €750 million) should be paid by beneficiaries (depending on national funding rules).⁴⁴

The Clean Energy Ministerial (CEM)

CEM initiatives are focused on improving energy efficiency as well as expanding clean energy access and supply. CEM is funded on a project-specific basis. Funding for CEM

³⁵ AEEP, retrieved from Cross-border Information, Kenergy Renewables, *Ten Years of the Africa-EU Energy Partnership Status Report 2017-18 and future perspectives*, Africa-EU Energy Partnership (AEEP), c/o Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2017, http://www.euei-pdf.org/sites/default/files/field_publication_file/aEEP_status_report_2017-18_and_future_perspectives.pdf.

³⁶ 2020 *Targets of the Africa-EU Energy Partnership (AEEP)*, United Nations, <https://sustainabledevelopment.un.org/partnership/?p=737>.

³⁷ RECP, retrieved from *Africa-EU Renewable Energy Cooperation Programme (RECP) Creating Opportunities for Renewable Energy Strategy 2020*, Africa-EU Energy Partnership (AEEP), RECP, 2020, https://www.icafrica.org/fileadmin/documents/Knowledge/Energy/RECP-Strategy-2020_web_en.pdf, p.31.

³⁸ Idem, p.32.

³⁹ About GET.invest, GET.invest, <https://www.get-invest.eu/about-recp/>.

⁴⁰ Idem.

⁴¹ *SET Plan delivering results: The Implementation Plans Research & Innovation enabling the EU's energy transition*, European Commission, 2018, https://www.euneighbours.eu/sites/default/files/publications/2018-12/MJ0318372ENN_en_.pdf.

⁴² Idem, p.17;37.

⁴³ Idem, p.22.

⁴⁴ Idem, p.29.

activities is provided through national funding of Member States. Many initiatives are (also) supported by other actors, such as Power Africa.

While CEM initiatives are led by CEM members, participation in initiatives is open to any country. A noteworthy initiative is Global Leap, which is focused identifying and promoting energy-efficient off-grid appliances in commercial markets.⁴⁵ The Global Leap Awards provides incentives in the form of grants, prizes and results-based financing for procurement to winners and finalists of Challenges and Awards.⁴⁶ For example, in 2018-2020, the Global Leap Solar E-Waste Challenge made EUR1.6 million available in grant funding to “companies with innovative approaches to e-waste management in the off-grid solar sector in sub-Saharan Africa”.⁴⁷

3.3 R&I action organisational setup and funding approach

3.3.1 Overview

The additional desk review of CAs in Annex 3 as well as the interviews carried out provide an overview of the frequency of each of the R&I actions types in all 10 focus countries collectively (Figure 15).

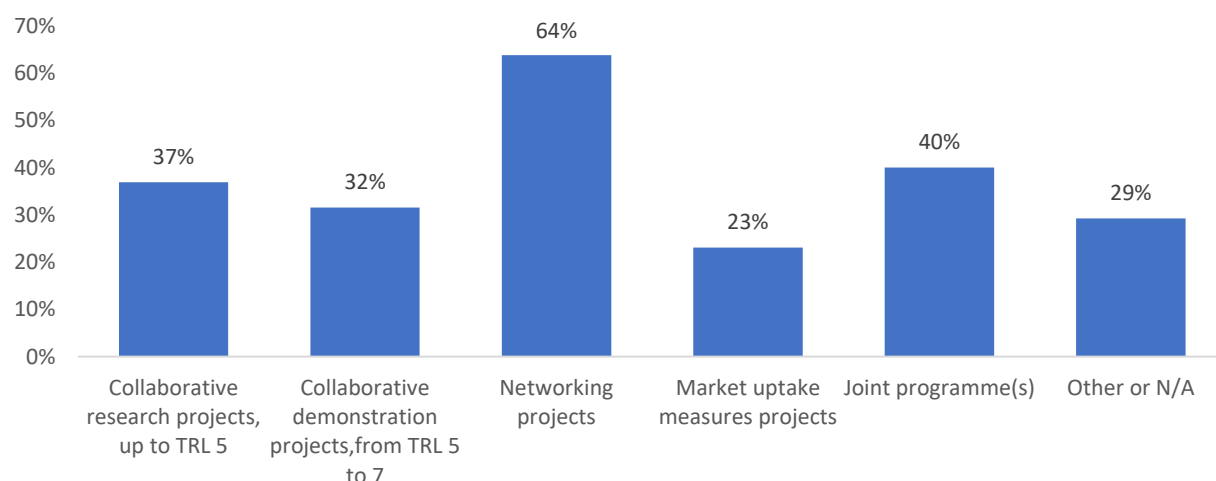


Figure 15: Frequency of R&I action types in bilateral CAs (since 1990) in focus Member States
Source: Study findings. n = 130.

Figure 14 illustrates that networking projects and joint programme(s) are the most common R&I action types with 64% and 40%, respectively. They are followed by collaborative research projects (37%), collaborative demonstration projects (32%) and market uptake measures (23%). 29% are classified as “Other or N/A.”

Figure 15 provides an overview of the frequency of each R&I action type in each of the focus countries. For example, the graph on networking projects illustrates that 35% of networking projects in all 10 focus countries are from Denmark. The graph attempts to provide an overview of which Member States are most active in which R&I action type.

⁴⁵ Incentives: Financing, grants & prizes, Global Leap Awards, <https://globalleapawards.org/incentives>.

⁴⁶ Idem.

⁴⁷ Global LEAP Solar E-waste challenge, GOGLA, <https://www.gogla.org/global-leap-solar-e-waste-challenge>

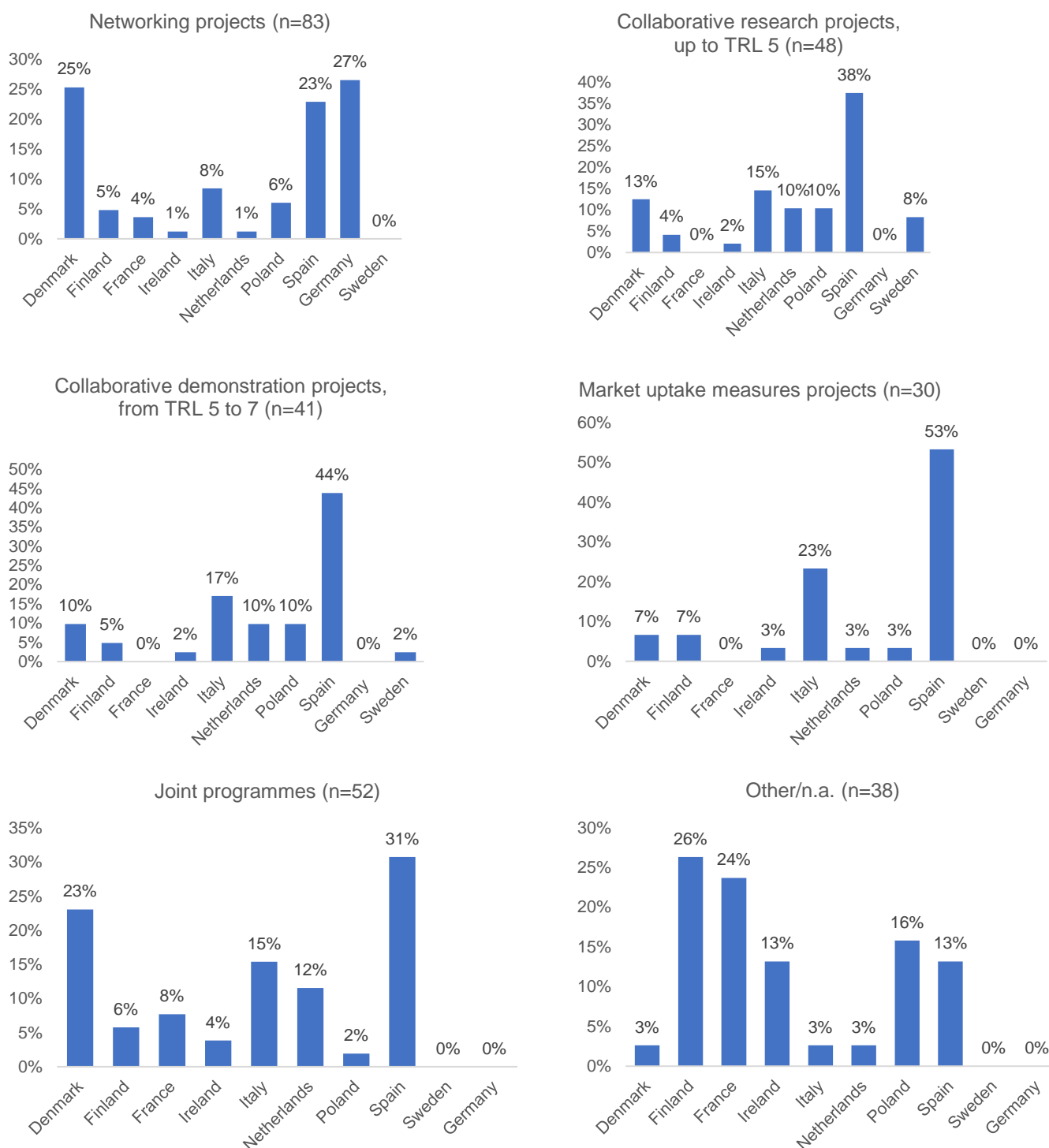


Figure 16: Frequency of Focus MS bilateral agreement by each R&I Action Type
Source: Study Findings.

Another example to understand Figure 15 is to focus on Germany. The figures for Germany can be interpreted in the following way: Germany is most active in Networking Projects compared to the other focus countries. In Germany, among the bi-lateral agreements, Energy Partnerships and Energy Dialogues funding is provided to organise dialogue formats such as conferences and study tours in Germany and the partner countries. No funding is provided for R&I and demonstration projects. Table 11 provides an overview of the R&I action types that are associated with the multilateral agreements.

Table 11: Overview of R&I actions per multilateral Cooperation Agreement

Multilateral Agreement	Most common R&I Action Type
AEEP	Other
CEM	Networking and joint programme
IEA TCP	Collaborative research, collaborative demonstration, market uptake
Mission Innovation	Others
SET Plan	Networking projects, collaborative research, and joint programme

Source: Study Findings

3.3.2 Organisational setup

Networking projects

Networking projects between EU Member States and a third country are mainly set-up by EU Member State ministries and their counterpart in the third country. In some Member States, the funding agencies are involved in setting up networking projects. However, typically as no funding is attached to the networking projects, the funding agencies do not play a large role. Nevertheless, if specific actions such as attending workshops/conferences are attached to the networking project, funding agencies can be involved. The ministries involved in each Member State varies but the most frequent ones are the research ministry, the energy ministry and the foreign affairs ministry.

The multilateral cooperation agreements that are used to facilitate networking projects include primarily the SET Plan, Mission Innovation and CEM. These three multilateral cooperation agreements are forums and are focused on providing strategic guidance and networking opportunities.

Joint activities

A variety of agencies are involved with the implementing and funding of joint activities including ministries, funding and implementation agencies. Even though ministries are often used to facilitating cooperation agreements, the funding agencies take a leading role in funding the actions under the agreements. However, for some joint activities, no cooperation agreements are needed and funding agencies directly cooperate with the agency in the third country.

CEM was the primary multilateral agreement engaged for joint programmes. For collaborative research projects and demonstration projects the main instrument were the IEA-TCPs. SET Plan was cited as being used by some countries.

Market uptake measures

The organisational set-up of market uptake measures is similar to that of the organisational set-up of joint activities. The funding agencies take a more leading role in these types of projects; however, the number of funding agencies involved in each Member State is smaller and the TRL level of these projects is higher and thus not funded by some agencies.

IEA TCPs was the primary multilateral agreement engaged for market uptake projects.

3.3.3 Funding approach

Networking projects

Networking projects typically do not have funding attached to it. If there is funding involved its usually Member States paying for their domestic partners' travel cost or attendance cost. For example, in Germany within the bilateral agreements Energy Partnerships and Energy Dialogues, funding is provided to organise dialogue formats such as conferences and study tours in Germany and the partner countries. In the Netherlands, the NWO very recently launched an instrument that aimed at fostering collaboration with some countries.

This instrument involves the funding of travel costs for participants to attend workshops. These workshops are not under a MoU but it might be used to setup a meeting to facilitate the creation of a new MoU.

Multilateral agreements (such as SET Plan, Mission Innovation and CEM) do not have specific budget lines, but Member States fund representatives to attend the forums.

Joint activities

Member States typically fund joint activities through grants for domestic partners. The size of the grant varies depending on the type of stakeholder involved. The partners in third countries typically do not receive funding from Member States.

Several IEA TCPs have (national) budget available for the implementation of projects (on joint agreed topics).

Market uptake measures

The funding approach for most market uptake measures is similar to that of joint activities in which each party (EU Member States as well as third countries) involved funds their domestic research partners through grants.

3.3.4 Summary

The organisational set-up for networking projects involves a variety of stakeholders including a number of ministries and funding agencies in each Member State. Networking projects are also implemented through multilateral agreements. The organisational set-ups for joint activities and market uptake measures are similar to one another and they mainly include the funding agencies of the Member States. However, in joint activities, a greater variety of funding agencies in the Member States (i.e. research agency, energy agency) take part while in market uptake measures, fewer agencies fund higher TRL projects.

Networking projects often do not have funding attached to it, aside from funding of domestic participants to take part in workshops or conferences. For calls under joint activities and market uptake projects, the funding approach is the same. Each country funds their research partners (i.e. co-financing) who receive funding in the form of grants.

4 EU international cooperation R&I actions: from Horizon 2020 to Horizon Europe

4.1 Review of relevant Horizon 2020 actions

4.1.1 Identification of relevant actions covering RET with an international cooperation component

Horizon 2020 played a primary role in the R&I in RET for delivering the solutions and system transformations necessary to ensure a transition towards climate neutrality by 2050. The programme also fostered international cooperation, contributing to positioning the EU as a frontrunner in renewables, leading the global clean energy transition. In fact, one of the key drivers of the research programme was, “ensuring a strategic approach to international cooperation, strengthen the EU's scientific excellence and its economic competitiveness, to jointly tackle global societal challenges and contribute to the EU's external policies.”⁴⁸ In point of fact, Horizon 2020 was the most important programme for the ocean energy industry over the period 2014-2019, granting over €180 million in grants to projects. Funding has been well tailored to tackle the most critical technological challenges of this sector.⁴⁹

The work programme ‘Secure, clean and efficient energy’ has been central to the development of RET in Europe and therefore is the main avenue to identifying relevant calls for this study. Through the review of the Horizon 2020 work programmes, the following key calls covering international cooperation in the field of RET were identified.

Under Horizon 2020 Work Programme 2014-2015,⁵⁰ several calls with an international dimension aimed to improve energy efficiency and progress in the clean energy transition. However, no calls were specially dedicated to R&I international cooperation in the field of RET. Nonetheless, the European Commission took the following actions:

- Contribution to Implementing Agreements of the IEA.
- Innovative financing for sustainable energy.
- Support to Research and Innovation Policy in the areas of Renewable Energy, Carbon Capture and Storage and Clean Coal. This public procurement action included:
- Research and innovation strategies of major international players, including inventory, impacts and best practices of the support put in place in leading countries.
- Contribution to the IRENA.

Under the Horizon 2020 Programme 2016-2017,⁵¹ two calls aimed to foster international cooperation in the area of renewable energy:

- LCE-22-2016: International Cooperation with Brazil on advanced lignocellulosic biofuels.
- LCE-23-2016: International Cooperation with Mexico on geothermal energy.

Additional actions included:

- Study on a comprehensive EU approach as regards international cooperation in the energy area – the R&I perspective.
- Contribution to Implementing Agreements of the IEA.
- Contribution to the IRENA.

⁴⁸ Horizon 2020 Work Programme 2014 – 2015 (European Commission Decision C (2014)4995 of 22 July 2014), European Commission, 2014, https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-intro_en.pdf, p. 7.

⁴⁹ ETIP Ocean, *Powering Homes Today, Powering Nations Tomorrow*, 2019; <https://www.oceanenergy-europe.eu/wp-content/uploads/2019/04/ETIP-Ocean-Integrated-Strategy-2019-LR.pdf>.

⁵⁰ Horizon 2020 Work Programme 2014 – 2015 (European Commission Decision C (2014)4995 of 22 July 2014), European Commission, 2014, https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-energy_en.pdf.

⁵¹ Horizon 2020 Work Programme 2016 – 2017: 10. ‘Secure, Clean and Efficient Energy’ (European Commission Decision C(2020)1862 of 25 March 2020), European Commission, 2020 https://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-energy_en.pdf.

- Contribution to the World Energy Outlook of the International Energy Agency.

Under Horizon 2020 Work Programme 2018-2020, four calls aimed to foster international cooperation in the area of renewable energy.⁵²

- LC-SC3-RES-3-2020: International Cooperation with USA and/or China on alternative renewable fuels from sunlight for energy, transport and chemical storage;
- LC-SC3-RES-25-2020: International cooperation with Japan for Research and Innovation on advanced biofuels and alternative renewable fuels;
- LC-SC3-RES-36-2020: International cooperation with Canada on advanced biofuels and bioenergy;
- LC-SC3-ES-13-2020: Integrated local energy systems (Energy islands): International cooperation with India.⁵³

Additionally, the European Commission subscribed to several international fora, ensuring as such the representation of the EU in the main RETs global fora:

- Annual subscription to the International Partnership for Energy Efficiency Cooperation/ Energy Efficiency Hub Secretariat hosted by the International Energy Agency.
- Contribution to TCPs of the IEA.
- Contribution to the IRENA.
- Contribution to the Secretariat of the Clean Energy Ministerial.

Under Horizon 2020, the call fostering international cooperation in the field of RET targeted specific technologies and countries. Other programmes such as ERA-NET, which is presented in section 3 of this report, contributed to cooperation between EU Member States with third countries.

4.1.2 The Horizon 2020 work programme

In order to bring the Horizon 2020 perspective more strongly into this analysis, and provide further context for final conclusions and recommendations, it is useful to examine the current SC3 work programme under Horizon 2020. Horizon 2020 has provided a boost for the EU Member States to enhance their R&I landscape in the energy field. The contribution of the EU has exceeded € 35 million for a few Member States. The table below highlights the 10 Member States having financially best benefitted from EU contribution under Horizon 2020 SC3 Clean, secure and efficient energy programme. Although the information is not specific to international cooperation; it allows to identify the most active Member States under Horizon 2020 and, later in this section, see if these same countries are using Horizon 2020 to implement their international cooperation strategy.

⁵² *Horizon 2020 Work Programme 2016 – 2017: 10. 'Secure, Clean and Efficient Energy' (European Commission Decision C(2020)1862 of 25 March 2020)*, European Commission, 2020
https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-energy_en.pdf.

⁵³ LC-SC3-ES-12-2020: Integrated local energy systems (Energy islands): International cooperation with India was cancelled and replaced by topic LC-SC3-ES-13-2020. Topic LC-SC3-ES-13-2020 is similar in terms of thematic scope, but has different requirements as regards the international cooperation aspects.

Table 12: Top ten Member States benefiting from EU contributions under the work programme SC3 (Clean, secure and efficient energy)

Member State	EU contribution in €
United Kingdom	45.190.135.202 €
Germany	42.189.157.212 €
Italy	38.098.901.748 €
Spain	37.933.427.651 €
France	34.757.213.380 €
Netherlands	24.002.972.391 €
Sweden	13.852.044.436 €
Belgium	13.662.959.937 €
Denmark	10.747.305.873 €
Finland	9.957.298.594 €
Austria	9.358.210.021 €

Source: CORDIS, 2020.

Note: The UK is included as it was an EU Member State during the operationalisation of Horizon 2020.

The use of Horizon 2020 by the Member States varied across, while some countries like France, Germany and Spain other countries make a limited use of Horizon 2020.

Box 8: Bulgaria - limited use of Horizon 2020 funds

This limited use of the Horizon 2020 programme funds can be better understood when considered in Bulgaria's national context. Due to the very limited public funding for research (R&D intensity in the country is 0.8%, compared to 2.1% for EU average), the country is a Modest Innovator, according to the European Innovation Scoreboard 2018. In its execution of the Europe2020 Strategy, the country has set a national government expenditure on research and development target of 1.5% of gross domestic product (GDP). Nevertheless, the country is very far from this target according to the latest calculations⁵⁴. This situation is due to a lack of strategic vision and stable financial policies in the sphere of research and innovation.

Although some EU countries have a limited number of Horizon 2020 projects including non-EU countries not associated to Horizon 2020, they make use of the programme to achieve their own targets. Indeed, some Member States have identified a clear complementarity between their national initiatives and the EU R&I actions in the field of RETs.

Box 9: Horizon 2020 to contribute achieving ambitious renewable energy targets

Given Sweden's ambitious targets related to renewable energy, an innovative pan-European research initiative to achieve a greater scientific understanding of the social and cultural influences on energy consumption is an important complementary feature of Horizon 2020 for Sweden's country actions. Aspects of the Horizon 2020 that are strongly aligned with Sweden's parallel country-level actions are:

- The development of innovative frameworks to evaluate renewable energy technologies across Europe;
- Research related to the establishment of a single, smart European electricity grid;
- Exchange of new knowledge and technologies;
- Market uptake of energy innovation.

⁵⁴ National Research Strategy 2012 – 2020.

Box 10: Complementarity of the national R&I landscape in the field of RETs with the EU actions

In Italy, the R&I in RET landscape complements some of the research areas under the priorities of the Energy Union, SET Plan strategy and Horizon 2020, as outlined in the National Energy Strategy and the Proposal for an Integrated National Plan for Energy and Climate. Although most of Italy's CAs with third countries remain quite broad, specific research areas under H2020 are also addressed, such as PVs, solar power, wind energy, geothermal energy, energy storage and biofuels. The intense work carried out by the Italian delegation in the framework of the working groups set up by the SET Plan has raised further awareness on the presence of research organisations, the industrial aspect and a significant system interest on a number of renewable sources, not only for the 2030 objectives but also in a longer-term perspective to 2050.⁵⁵

The CORDIS database facilitates identification of the EU countries which collaborated with third countries (i.e. excluding Associated Countries) under the work programme 'Secure, clean and efficient energy'. The options in terms of focus area available on the database did not allow for filtering the selection of data to renewable energy technology exclusively.

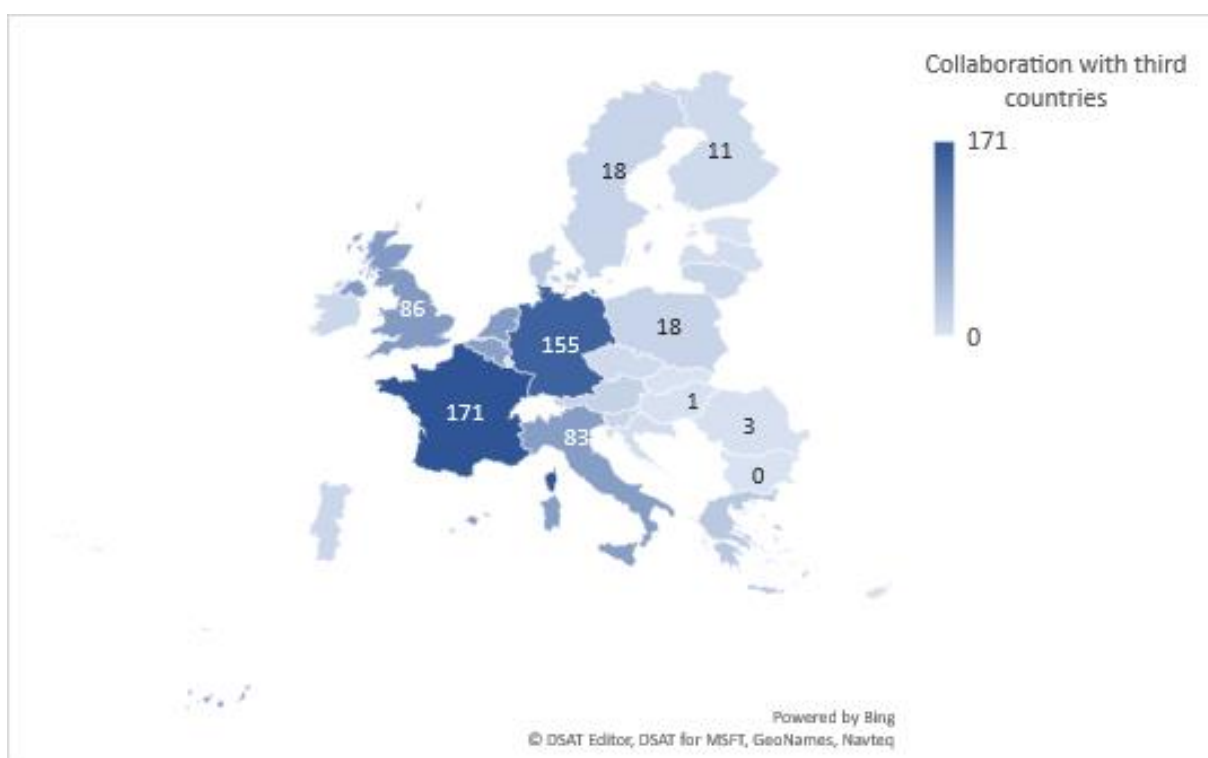


Figure 17: Member State collaboration with third countries under the under the topic 'Secure, clean and efficient energy'
Source: Elaboration for this study, based on CORDIS data (2020).

Note: The UK is included as it was an EU Member State during the operationalisation of Horizon 2020.

The following figure provides a comparison of collaboration with third countries, signed grants agreement, Horizon 2020 calls for the EU Member States.

⁵⁵ *Proposta Di Piano Nazionale Integrato Per L'energia E Il Clima*, Ministero dello Sviluppo Economico, Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Ministero delle Infrastrutture e dei Trasporti, 2018, https://www.mise.gov.it/images/stories/documenti/Proposta_di_Piano_Nazionale_Integrato_per_Energia_e_il_Clima_Italiano.pdf.

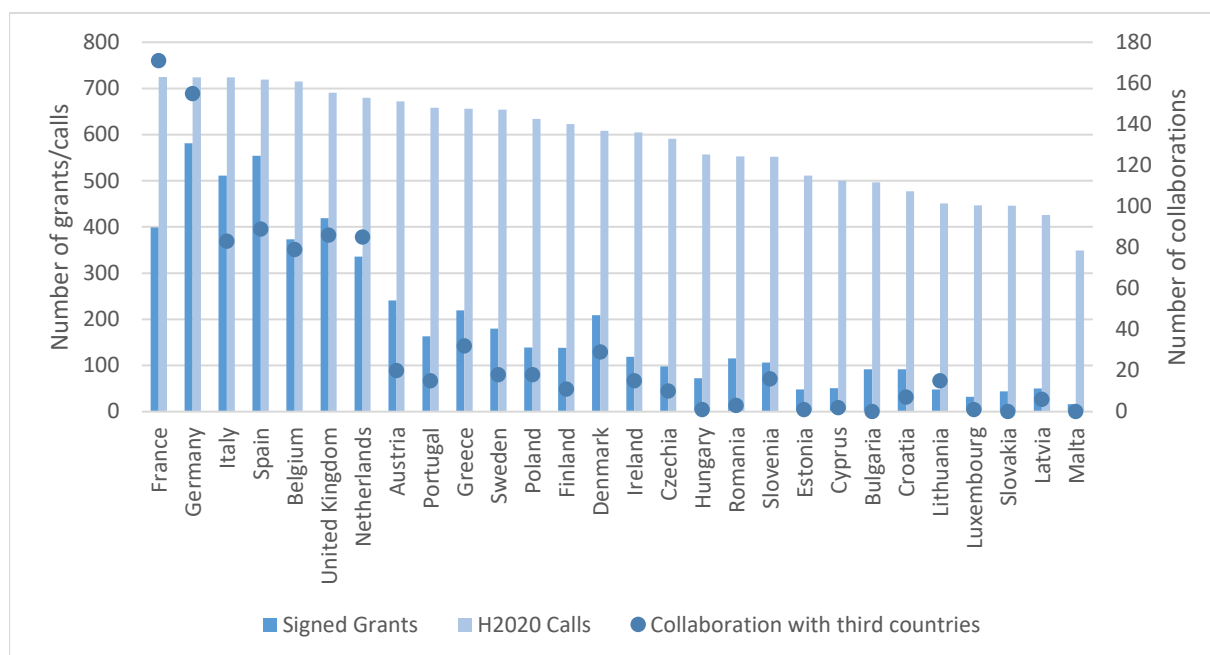


Figure 18: Comparison of collaboration with third countries, signed grant agreements, Horizon 2020 calls for the EU Member States

Source: Elaboration for this study, based on CORDIS data (2020).

Note: The UK is included as it was an EU Member State during the operationalisation of Horizon 2020.

Although France is the Member State that has collaborated the most with third countries under the work programme 'Secure, clean and efficient energy', Germany is the country that has signed the most grants under this programme (581). It appears that the top 6 Member States (United Kingdom, Germany, Italy, Spain, France and the Netherlands) benefiting from EU contributions under the work programme SC3 are also part of the top 10 countries collaborating with third countries confirming the use the Horizon 2020 for international collaboration by the most active countries.

The following map presents an overview of the Horizon 2020 retained proposal from third countries under the thematic priority 'low-carbon and climate resilient future', the nearest proxy match.

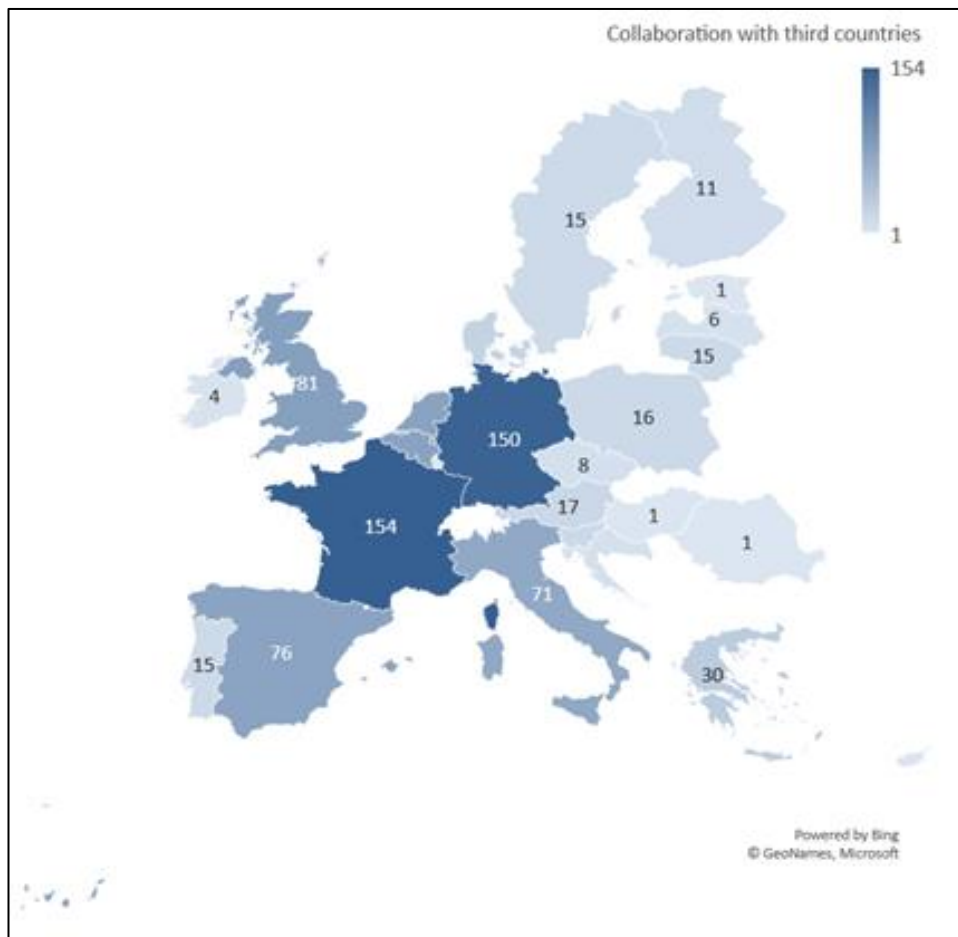


Figure 19: Member State collaboration with third countries under the under the topic 'low-carbon and climate resilient future'

Source: Elaboration for this study, based on CORDIS data (2020).

Note: The UK is included as it was an EU Member State during the operationalisation of Horizon 2020.

Similar to the results found for the programme SC3, France, Germany, the United Kingdom, Spain and Italy are the countries that use the most Horizon 2020 to implement their international cooperation strategy.

From the CORDIS database, the third countries which applied for EU contributions via the Horizon 2020 programme under the focus area 'low carbon and climate resilient future' were identified. The options in terms of focus area available on the database did not allow for filtering the data to focus exclusively on renewable energy technologies. The following map presents an overview of the Horizon 2020 retained proposals from third countries under the thematic priority 'low-carbon and climate resilient future', the nearest proxy match.

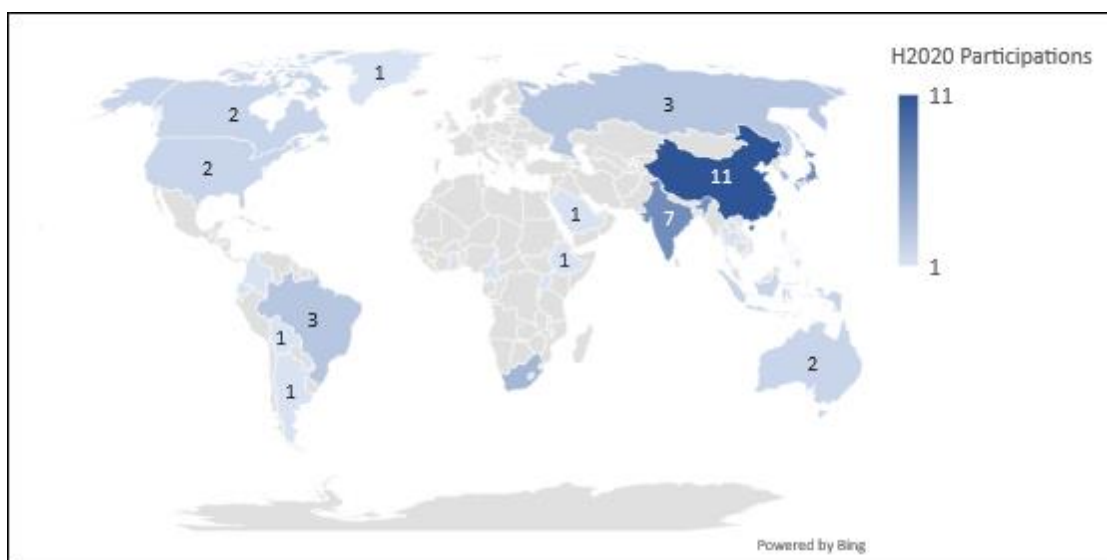


Figure 20: Horizon 2020 participation from third countries (not associated with Horizon 2020) under the topic 'low-carbon and climate resilient future'

Source: Elaboration for this study, based on CORDIS data (2020)

Note: The CORDIS dashboard does not specify the exact period covered by these figures, but all fall within Horizon 2020

The following table presents figures concerning the top 15 third countries with successful applications under this topic.

Table 13: Top 15 third countries with successful applications under the priority 'Low carbon and climate resilient future'

Country	Number of H2020 participating projects	H2020 net EU contribution	H2020 EU contribution	Number of SMEs participating in H2020 projects	H2020 SME net EU contribution	H2020 SME EU Contribution
China	11	€ 715.625	€ 715.625	0	€ 0	€ 0
South Africa	4	€ 629.250	€ 629.250	0	€ 0	€ 0
Brazil	3	€ 490.625	€ 490.625	0	€ 0	€ 0
Japan	7	€ 439.070	€ 439.070	1	€ 20.000	€ 20.000
India	7	€ 435.313	€ 435.313	0	€ 0	€ 0
Indonesia	2	€ 306.449	€ 306.449	0	€ 0	€ 0
Russian Federation	3	€ 178.125	€ 178.125	0	€ 0	€ 0
Colombia	1	€ 161.350	€ 161.350	0	€ 0	€ 0
Argentina	1	€ 157.265	€ 157.265	0	€ 0	€ 0
Cameroon	1	€ 144.271	€ 144.271	0	€ 0	€ 0
Ghana	1	€ 141.125	€ 141.125	0	€ 0	€ 0
Uganda	1	€ 138.066	€ 138.066	0	€ 0	€ 0
Thailand	1	€ 135.000	€ 135.000	0	€ 0	€ 0
Greenland	1	€ 133.744	€ 133.744	0	€ 0	€ 0
Vietnam	1	€ 117.500	€ 117.500	0	€ 0	€ 0

Source: CORDIS

Note: The CORDIS dashboard does not specify the exact period covered by these figures, but all fall within Horizon 2020

In line with the findings under Chapter 2, China is one of the most important countries when it comes to R&I international cooperation, from a Member State bilateral approach and through the EU research framework.

4.2 Presentation of the renewable energy component in Horizon Europe

4.2.1 Horizon Europe structure

Horizon Europe will be a key EU investment instrument to support the R&I effort. It is a key tool to implement part of the Green Deal. It will operate as a critical driver to support the shift to a low-carbon economy by investing 35% of its budget on innovative solutions that can support the Green Deal. Four 'Green Deal Missions' will be established for this purpose: healthy oceans, seas, coastal and inland waters, climate-neutral and smart cities, soil health and food and adaptation to climate change and societal transformation. The figure below presents the preliminary structure of Horizon Europe.

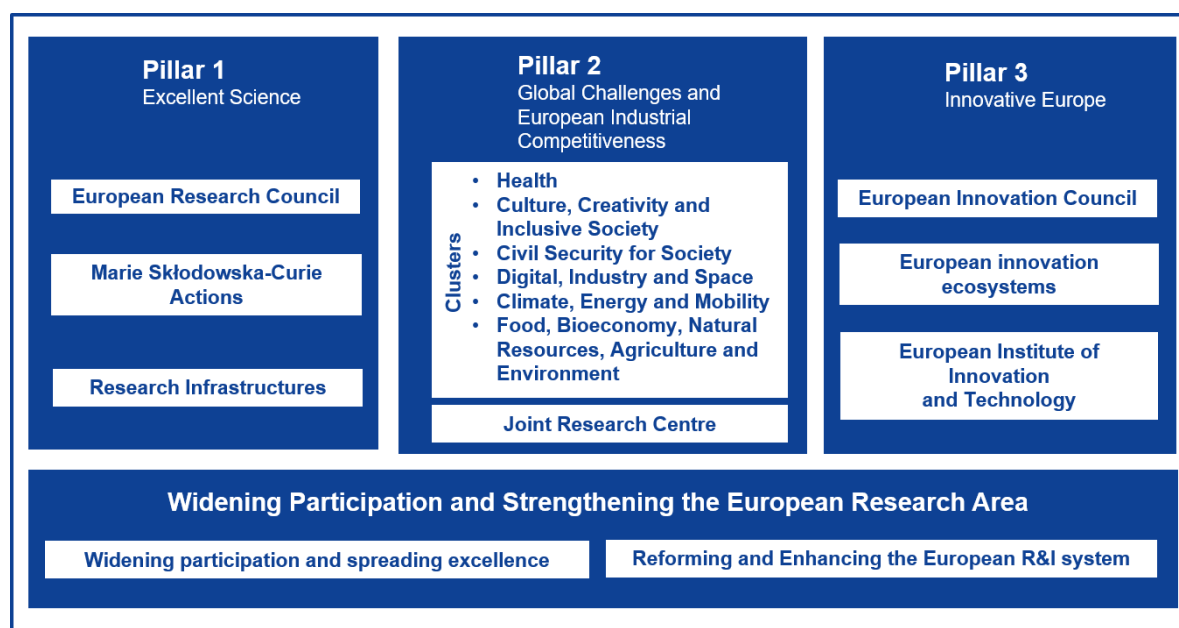


Figure 21: Preliminary structure of Horizon Europe
Source: European Commission website

Horizon Europe will be a key programme for the future of RET development. Therefore, it is important to make optimal use of the programme and fully integrate the international cooperation components within it. For this purpose, recommendations were drafted considering various options to implement appropriate measures and ensure synergies with MS actions, contribution to EU policies and visibility.

Under Horizon 2020, the EU particularly promotes participation and common efforts between organisations of EU Member States and associated countries on equal terms. However, associated countries are limited to countries in close EU proximity. For Horizon Europe, the European Commission suggests having a more flexible approach. Commissioner Mariya Gabriel (Innovation, Research, Culture, Education and Youth) suggested expanding association "to like-minded third countries with high Science, Technology and Innovation capacity also located beyond Europe's immediate geographic neighbourhood" while considering reciprocity and the safeguard of EU strategic interests.⁵⁶

4.2.2 The Clean Energy Transition Partnership

The European Partnership on Clean Energy Transition will encourage collaborative action between Horizon Europe and national funding programmes on common R&I priorities, building on – and advancing – the progress undertaken in the SET Plan. In this way, it can be seen as the effective successor to the ERA-NETs. It is related to the Pillar II 'Global Challenges and European Industrial Competitiveness' Cluster Climate, Energy and Mobility of Horizon Europe. The Directorate-Generals (DGs) directly involved in this partnership will

⁵⁶ Gabriel: 'Research and innovation is critical to tackle this global crisis', Science Business, 2020, <https://sciencebusiness.net/covid-19/news/gabriel-research-and-innovation-critical-tackle-global-crisis>.

be DG ENER and Directorate-General for Research and Innovation (DG RTD); "The partnership would build on existing ERANET-Cofund-based partnerships:

- Solar-ERA.NET 1 (11/2016 – 10/2021)
- Solar-ERA.NET 2 (6/2016 – 5/2023)
- DemoWind 1 (11/2015 – 12/2019)
- DemoWind 2 (1/2016 – 12/2020)
- GEOTHERMICA (1/2017 – 12/2021)
- OCEANERA-NET (1/2017 – 12/2021)
- Smart Cities: ENSCC (12/2014 – 11/2019)
- SmartGridPlus (SG9) (1/2015 – 1/2020)
- SGplusRegSys (1/2018 – 12/2022)
- BESTF 3 (1/2016 – 12/2020)
- ACT (2/2016 – 1/2021)

Three additional ERA-NET Cofund actions are expected to be supported under the Energy work programme 2018-2020 (one on concentrated solar power (CSP) in 2018 – already positively evaluated; one on energy systems in 2019 and one on smart districts in 2020)."

⁵⁷

The partnership will respond in a holistic way to the call for decarbonisation in the medium and long term, synthesise all fragmented actions to allow for greater integration of the relevant R&I areas and provide greater impact. The results of the structured consultation of Member States on Horizon Europe emphasised that 97% of respondents consider the Partnership on Clean Energy Transition 'very' or 'somewhat' relevant to their national policies and objectives, as well as to their research organisations, universities, and 83% to their industry.

The Partnership will primarily target national research programme managers in the Member States and Associated Countries. It intends to optimise national funding initiatives on the objectives and priorities decided together between the EU, Member States, Associated Countries, industry and the research community. Third countries are expected to be invited to participate to a more limited degree, fostering international cooperation. The international component was limited under ERA-NET; only ERA-NET LAC and ERA-NET Russia were dedicated primarily to international partnerships (though other ERA-NETs did issue calls that included third countries). In the context of this study, it is important that the new Partnership embeds the international dimension as it could also support the Member States in strengthening their RET industries.

The scope of the Partnership is not yet definitely fixed. Some Member States support, "focussing on system integration and technologies, [while] others favour a holistic system perspective to realise energy transition (e.g. by including non-technological aspects, smart and sustainable/livable cities and communities). Several delegations call for a clearer thematic focus / goal, the need to ensure better links with related partnerships, missions and initiatives (e.g. LIFE, SUNRISE (Solar Energy for Circular Economy) and Energy-X (Transformative Chemistry for a Sustainable Energy Future)), and to strengthen the local and regional dimension."

As explained above, the Clean Energy Transition Partnership will be a co-funded through the EU budget. This will allow participating Member States to adjust the call according to their priorities. The co-funded approach is anticipated to benefit industry, as a result of the higher budget for the objectives agreed at the EU level. Additionally, measures will be established to facilitate the uptake of project results. Having the project results commercially viable should be an important aspect of the project. This will not only contribute to the deployment of innovative technology but also support the competitiveness of the EU industry in this sector.

⁵⁷ General Information: Clean Energy Transition, ERA-LEARN, https://www.era-learn.eu/partnerships-in-a-nutshell/r-i-partnerships/european-partnerships-under-horizon-europe/partnerships-under-preparation/candidates-for-european-partnerships/26_cleanenergytransition.pdf.

4.3 Recent EU political commitment and their impact on R&I in the field of RET

4.3.1 European Green Deal

"New technologies, sustainable solutions and disruptive innovation are critical to achieve the objectives of the European Green Deal."⁵⁸ This statement from the Green Deal highlights the importance of R&I in RET for the next decade. Horizon 2020 and Horizon Europe are tools to implement the Green Deal and as such the European Commission used Horizon 2020 to reinforce the Green Deal-related R&I. Horizon 2020 will support R&I related to the Green Deal, with a call worth close to € 1 billion, in response to the urgency and ambition of the European Green Deal objectives.⁵⁹ The call, which contains 11 areas, supports:

- Pilot applications, demonstration projects and innovative products.
- Innovation for better governance of the green and digital transition.
- Social and value chain innovation.

One of the most relevant call for this study is the area 2 'Supplying clean, affordable, and secure energy', which includes two topics:

- Demonstration of innovative critical technologies to enable future large-scale deployment of offshore renewable energy technologies and their integration into the energy system.
- Develop and demonstrate a 100 MW electrolyser upscaling the link between renewables and industrial applications.

The call will be formally adopted as amendment to Horizon 2020 work programme 2018-2020, published and opened mid-September 2020.⁶⁰ Until then, the formulation of topics for the call is not final.

4.3.2 COVID-19 and the recovery package

On 27 May 2020, the European Commission has unveiled its plan for Europe's economic recovery from COVID-19, with its Communication 'Europe's moment: Repair and Prepare for the Next Generation'.⁶¹ The European Commission has placed R&I at the centre of its recovery plan, stating that policies need to be adjusted to ensure that R&I contributes to sustainability while at the same time improving EU competitiveness.

The Recovery Plan aims to drive Europe's recovery and move Europe towards a more resilient, sustainable and fair economy. It proposes the creation of a new recovery instrument: the Next Generation EU instrument. This recovery instrument will raise €750 billion. In addition, the European Commission proposed a revamped long-term EU budget amounting to €1,100 billion between 2021-2027. In order to recover from the crisis and prepare the next generation, the European Commission plan focuses on three policy fundamentals:

- EU Green Deal initiatives (the EU's growth strategy)
- A deeper and more digital single market
- A fair and inclusive recovery

⁵⁸ Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, *The European Green Deal*, COM(2019/640 final, https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf.

⁵⁹ *Research and innovation for the European Green Deal*, European Commission, https://ec.europa.eu/info/research-and-innovation/strategy/european-green-deal_en.

⁶⁰ *European Green Deal call*, European Commission; https://ec.europa.eu/info/research-and-innovation/strategy/european-green-deal/call_en#relatedlinks.

⁶¹ Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, *Europe's moment: Repair and Prepare for the Next Generation*, COM(2020) 456 final, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0456&from=EN>.

The report 'Science, research and innovation performance of the EU 2020: A fair, green and digital Europe'⁶² stresses that "R&I can directly contribute to a recovery that delivers on the European Green Deal." presents the EU post COVID-19 budget and recommendations for R&I. The recommendations cover three areas:

- R&I for a safe and just space for humanity.
- R&I for global leadership.
- R&I for economic and societal impact.

Under the second priority, the report recalls that the EU's R&I cooperation strategy with third countries should take full account of the need to safeguard EU strategic interests. This same strategy is a mean for science diplomacy to support EU's external actions to develop trust and common agendas with 3rd countries. The EU has often been opened to them to ease the exchange of knowledge and set up strategic partnerships with key partner countries. In this context, the European Commission aim to put "multilateralism and purposeful openness, while assertively negotiating a global level playing field at the heart of the EU's approach to international cooperation."⁶³

Additionally, the report stresses that digitalisation is transforming R&I. It highlights the importance of twinning green and digital strategies. For that purpose, R&I is key to move towards 'green Information and communications technology (ICT)'. The report presents the potential impact of ICT on greenhouse gas emissions and the role that renewable technologies can play, e.g. telecom operations powered by renewables, and by generating smart devices. Intelligence artificielle is also presented as a disruptive technology for the RET sector. Big data and advanced analytics can benefit the renewables sector. The optimisation of power grids via intelligence artificielle may justify demand-based energy supply. Digital solutions are a key part of the strategy along the value chain of wind and solar renewable energy generation, for which minimizing operating costs while optimising effectiveness is key.⁶⁴

⁶² *Science, Research and Innovation Performance of the EU 2020: A fair, green and digital Europe*, Publication Office of the European Union, 2020, https://ec.europa.eu/info/sites/info/files/srip/2020/ec_rtd_srip-2020-report.pdf.

⁶³ *Idem*.

⁶⁴ *Digital for Renewable Energy Companies*, BCG, <https://www.bcg.com/en-be/industries/energy/center-digital-transformation-power-utilities/digital-for-renewable-energy-companies.aspx>.

5 Conclusions

5.1 SWOT analysis of the current state of play

This section provides a 'SWOT assessment of the current state of play of the European Commission international collaboration energy research strategy taking into account Member State actions. The SWOT assessment is indicating if remedial actions at EU level would improve the synergies between EU actions and Member State actions.'

In the context of this research, we understand the European Commission's international collaboration to be considered as a framework of bilateral and multilateral actions and agreements, including those at international level (United Nations, Mission Innovation, IEA, etc.)

The SWOT analysis is laid out on the following page.

Table 14 - SWOT analysis of the current state of play

<p>Strengths</p> <p>A general willingness/openness in many Member States to engage in R&I RET with third countries, given favourable (pre-) conditions</p> <p>The openness of multilateral fora to new participants (i.e. fora are not exclusive)</p> <p>The SET Plan is seen as a useful strategic framework for energy policy between EU and Member States</p> <p>IEA TCPs are highly valued by Member States as fora to exchange views on possible cooperation with third countries</p> <p>Interlinkages and connections between the various initiatives – which allows for complementarities</p>	<p>Weaknesses</p> <p>Non-existent, weak or poorly implemented R&I in RET cooperation strategies at Member State level</p> <p>Insufficient capacity from smaller (or less well-resourced) individual Member States to engage</p> <p>Limited implementation actions from bilateral agreements</p> <p>Lack of pre-committed funds/financing for participants in macro-level frameworks (this can be a lack of funds set aside within the Member States and/or pools of funding held by the macro-level frameworks themselves)</p> <p>Low visibility & recognition (in Member States) of EU bilateral S&T agreements with third countries</p>
<p>Opportunities</p> <p>An opportunity lies in strengthening the visibility and effectiveness of the interlinkages and complementarity between multilateral frameworks – thus helping the EU to be/remain frontrunner in renewable energy</p> <p>There is scope for greater strategic coherence between Member States with regard to their engagement with third countries in R&I in RET. A more unified and aligned stance would help to maximise the influence that Member States can have over third countries (e.g. standards, access to EU market, etc.)</p>	<p>Threats</p> <p>Limited future engagement in macro-level frameworks from smaller (or less well-resourced) Member States</p> <p>Duplication of activity between macro-level frameworks – leading to underuse (non-realisation of potential) and a lack of complementarity</p> <p>The loose framework allows for questionable use of European technology/knowledge by competing third countries (technology leakage)</p> <p>In absence of a full renewable energy technologies strategy at the EU level, (advanced) third countries can play out EU Member States against each other.</p>

5.2 Findings on bilateral and multilateral cooperation agreements

5.2.1 Bilateral CAs with third countries are common, but often not visible/effective or translated into funded actions

The analysis of bilateral CAs points to various weaknesses in terms of effectiveness and efficiency – in terms of driving forward R&I cooperation in RET.

A first and overarching weakness seems to be that CAs often do not address R&I and that they are often not translated into any financial commitments. Hence, such CAs tend to be weak in terms of directing international R&I cooperation in the area of RET.

A second weakness is that many bilateral CAs tend to be not centrally coordinated at Member State level. There is commonly involvement from four ministries: foreign affairs, industry and innovation, environment/energy, and education/research. Below this level, funding and energy agencies play a role. In some cases (e.g. Sweden), the energy agency may directly sign international agreements on behalf of the government as a delegated authority.

Furthermore, bilateral CAs tend to be very broad – in terms of S&T focus. The R&I focus is often limited, and so is the focus on (renewable) energy technologies.

A fourth weakness – at least in terms of coordinating challenge – points to the wide variety of underlying drivers for establishing such CAs. They can be driven by history, geographic proximity, or by diplomatic considerations (R&I being a popular 'soft' diplomacy tool also from a geopolitical perspective). Industrial policy considerations (including market and export considerations) appear to be a driver at least as important as research priorities.

A fifth weakness lies in the fragmentation of geographic focus. A broad distinction can be made between a focus on advanced versus developing countries. Cooperation with advanced countries tends to focus more on basic research, whilst cooperation with less developed countries tends to have a more applied nature.

Table 15: Common factors underpinning R&I relationships with less developed/advanced third countries

	Less developed countries	Advanced countries
Basic research	Limited interest	Interested in specific countries with strong basic research funding ecosystems (e.g. Sweden-USA, Portugal-USA)
Applied (commercial) research and demonstration	Testing/validating new systems in different environments Export potential	Aligned commercial interests (e.g. UK-Japan ocean energy)

Source: Study findings

5.2.2 Multilateral frameworks provide a useful 'umbrella' for EU Member States

The overview of macro level agreements points to a broad scale of multilateral initiatives. Among the various frameworks, the SET Plan and the IEA are paramount for the majority of the EU Member States. Though the IEA does not dispense grants or make loans, the IEA TCPs encourage engagement from national energy agencies, which sit on the executive committees - implementation of the resulting actions is generally delivered by universities and researchers. As such, the IEA provides a forum for exchange among researchers and, potentially, for identifying possible cooperation projects. The SET Plan and Mission Innovation are political and strategic bodies, which lack an institutional framework as well as a dedicated budget line for project implementation. An exemption was the bilateral SET Plan initiative between Germany and Finland with a joint call for proposals. Given its

importance, the SET-Plan could be an appropriate forum for the EU member States to discuss together before acting on the international stage.

It is difficult to distinguish between macro-level frameworks and rank them in terms of importance. They can overlap and link with each other, which could be considered as a strength. Each forum fulfils a role and it is difficult to compare them side-by-side. Nevertheless, the duplication of efforts in different fora such as SET Plan, the Clean Energy Ministerial and Mission Innovation is a remaining weakness that should ideally be mitigated.

5.2.3 There is asymmetry between Member States in terms of levels of commitment and engagement

Some are more outwardly engaged and international. Others are (still) more focussed on conventional energy, intra-EU activities, or are constrained by a lack of capacity.

The large number of frameworks makes it difficult for smaller countries to participate in all of them and to attend their meetings - which leads to an asymmetry between EU Member states in terms of degree of participation. These macro level initiatives are recognised as useful, but in the words of one interviewee, 'the problem when you have a lot of programmes is the ability of institutions to focus'. These frameworks mobilise a lot of staff and human resources, a handicap for smaller countries. Many multilateral initiatives do not translate into international R&D because, '[in many cases] these initiatives require significant effort from institutions' and - importantly - do not come with domestic funding pools attached.⁶⁵ Moreover, there can be an element of short-termism from researchers, whom at the end of the day are the ones participating in renewable energy research consortia. They are not incentivised to think long-term; as research institutes put researchers' priorities on multilateral frameworks, which are the best funded and offer quicker wins, rather than fostering longer-term projects.

5.2.4 The potential for synergies between bilateral and multilateral frameworks is underexploited

Some frameworks such the IEA, Mission Innovation, ARENA and AEEP, contribute to develop bilateral cooperation as they serve as fora for sharing and networking to develop potential future partnerships. Furthermore, at the EU level, the SET Plan is considered as a key mechanism for intra-EU cooperation. Moreover, multilateral and bilateral partnerships together participate in the achievement of the SDGs and are often mentioned in the countries report on the implementation of the SDG. However, there are reasons so assume that the potential for synergies between bilateral and multilateral frameworks is underexploited.

5.2.5 A fragmented approach towards developing countries

The collaboration with developing countries is prominent and motivated by drivers such as development aid, support to just transition (e.g., development of green and smart cities), industrial policy, trade mission and diplomacy. Interviewees suggested that partnerships with these countries, especially African ones, could be further developed and include the private sector. Nevertheless, the EU can make a fragmented impression in developing countries as there appears to be a 'free for all'.

5.2.6 R&I international cooperation with advanced countries can pose several risks

It seems that there is some incoherence concerning the approach that Member States and the EU follow when engaging with developed and developing countries. Macro-level agreements and bilateral agreements seem to reflect this dual approach as the type of collaboration varied accordingly. Collaboration with advanced countries tends to focus on research and can be considered as a way to gather intelligence, but there are latent risks

⁶⁵ Interview with representative of the Portuguese Center for Power and Energy.

of leakage of intellectual property. Several interviewees pointed out leakage of intellectual property, and outputs of project development with these advanced countries. This also has for consequence the end of the developed product's production in the EU Member States as it is no longer competitive. This risk may be at an EU-wide scale, where research and technology has been built up with European funds (e.g. Horizon 2020), which are subsequently leaking to (competing) countries. This is an issue that deserves attention, particularly at the European level.

Moreover, these collaborations can be imbalanced, as highlighted by several interviewees. Even major EU countries, e.g. Austria and Germany, which have a strong industry that could provide strength against China, admit that there is an imbalance when cooperating with China. In light of the fragmented approach within the EU, advanced countries (e.g. China, US, Japan) are offered multiple entries into European research and technology. Although hard evidence could not be found yet, there is a clear risk that EU Member States are played out against each other by major global competitors.⁶⁶

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5.2.7 There is potential for greater visibility of EU actions on international R&I in RET

Due to the several EU initiatives in terms of international cooperation and transnational cooperation, there is a juxtaposition of frameworks and actions with limited transparency. The EU has a range of policy instruments and mechanisms to tackle the supply side of R&I (e.g., Horizon 2020) but lack of a specific and explicit policy plan to guide them. In addition, there is no coherent policy structure that places such instruments into perspective. The instrument-led approach of EU R&I policy and EU macro-level cooperation initiatives have hindered the effect of important investments made and the potential of some global R&I initiatives. A reason is that these international funding programs and EU international cooperation initiatives create the impression of being isolated from each other and from a wider policy purpose.⁶⁶

Given that there is no overall EU strategy with third countries for R&I in the field of RET, it is difficult for the EU Member States to have a clear overall picture of all the EU initiatives. This is reflected at the international stage as some countries participate individually in global initiative such as Mission Innovation.

5.3 Findings on R&I funding and implementation

5.3.1 Conclusions on funding entities and implementation bodies

A number of conclusions emerge from the research on funding entities and implementing bodies in Chapter 3:

- There is not a complete overview of which entities are responsible for funding and implementing the CAs. In the Member States that Chapter 3 focuses on, there are multiple Ministries and agencies responsible for implementing and funding various CAs.
- The involvement of the funding agencies in developing the CAs varies from Member State to Member State. In some Member States, funding agencies are more directly involved in setting up CAs with third countries while in others, CAs are set up at the Ministry level and implementation and funding are done by various agencies under each Ministry.

⁶⁶ Weber Matthias, Andrée Dan, Llerena Patrick: *A new role for EU Research and Innovation in the benefit of citizens: Towards an open and transformative R&I policy*, Publications Office of the European Union, 2015, https://ec.europa.eu/research/openvision/pdf/rise/weber-andree-llerena-new_rolo_research.pdf.

- Funding is not directly attached to the bilateral cooperation agreements. For the majority of bilateral agreements identified in this study, no funding source is clearly and explicitly attached.
- Calls launched by the funding agencies with third countries are mostly co-financed. In other words, each country in the agreement funds their own research partners. Within each country, research partners usually receive funding in the form of grants.
- Multilateral agreements tend to include more structured and organised actions but the funding approaches under these differ.
- Among the identified bilateral and multilateral CAs, networking projects and joint programme(s) are the most common R&I action types.

5.3.2 R&I implementation review

One of the main objectives of Chapter 3 is also to review how EU Member States implement these international R&I agreements. The main conclusions on this review are:

- Bilateral CAs are **not very effective in directly translating government commitment into R&I actions**. In some countries where CAs are implemented, **the impact is not always obvious**. This is also partly due to the fact that some actions are at an early stage so evaluating the impact will be forthcoming.
- There have been, however, evidence to show that CAs are helpful in creating partnership with third countries in the 10 focus Member States.
- In some cases, multilateral CAs are seen as a way to gain funding, not only from the government but also from the private sector.

During the interviews conducted, we collected the views of stakeholders on the relevance and effectiveness of the cooperation R&I actions in the 10 focus countries. A number of findings emerge, – many of which resonating with the one's derived from the earlier parts of the research, including:

- In some of the focus Member States, there is limited evidence to indicate that efforts are made to **translate government commitment in the form of bilateral CAs directly into R&I actions**. This applies to Finland and France. In Finland, for example, its approach to bilateral cooperation in R&I in RET with third countries is characterised by something of a disconnect between the governmental CAs – which have symbolic and diplomatic value – and the actual implementation of funding mechanisms in practice. High-level (government to government) bilateral CAs are not actively monitored and there is limited evidence to indicate that efforts are made to translate them directly into cooperative action. In France, it appears that many agreements may be active at the start. Whether an agreement is paid attention to depends on the presence of a Scientific Counsellor and/or the Ambassador's commitment.
- In Member States where R&I actions in RET have been implemented as a result of several bilateral agreements, **the impact is not always obvious**. In Ireland for example, although it has a number of bilateral CAs encompassing R&I in RET with third countries there is limited evidence to indicate that these agreements have an impact in practice.
- Many R&I actions such as recent calls for proposal are at an early stage so it is difficult to evaluate how successful these actions have been implemented. Examples include the MoU Netherlands – Indonesia to enforce research collaboration (2019) and the Science & Technology & Innovation MoU between the Netherlands and South Africa; several MoU between Denmark and Brazil and India; and an MoU between Sweden and India.
- In some Member States, regarding bilateral CAs with R&I actions that have been implemented for a number of years, there is some indication of success. A few examples include:
- In Germany, Energy Partnerships and Energy Dialogues have been successful when judged against their objectives and as a strategic instrument of the energy-political foreign policy of Germany. In some cases, these energy partnerships have contributed to energy sector reforms in partner countries. The overall objective of Energy Partnerships and Energy Dialogues is to promote the German 'Energiewende' and to exchange knowledge on energy transition topics with partner countries. Furthermore,

economic cooperation with German companies is promoted via these initiatives. Potential opportunities for R&I cooperation and the implementation of joint R&I projects are being investigated.

- In Denmark, CAs are seen as successful by stakeholders as they provide advancement in terms of research and thus societal impacts. It is worth noting, however, many CAs do not consider launching calls as their central aim. They rather have collaboration in terms of education or business as their main aim.
- In Sweden, the older CAs, once a project or a fixed call has been agreed, the cooperation tended to go well. However, it could be a challenge to get to the point of agreement because of difficulties in national budget, change in administration, change in priorities, different ways of working between different cultures in terms of deadlines and priorities.

A number of multilateral agreements are seen to be quite successful:

- Mission Innovation is an example of success. As the EU joined the multilateral agreement on the same level of a country, this allows for representation of the EU Member States that did not join the agreement. The EU in this context can act as a mediator within the Mission Innovation arena between EU Member States and third countries. However, it is too early to judge the success of specific R&I actions in Member States because in some Member States, the first funding were only made available in October 2019 and agreements with the research partners are still being finalised. Due to its success so far, Mission Innovation will continue onto the second phase, called Mission Innovation 2.0 after the expiration of the first phase in December 2020. International cooperation in R&D is key for the sector and has a bright future. Nevertheless, there is urgency to involve more the private sector (not only in terms of funding available, but also in terms of collaboration on identification of strategies and priorities), as this kind of multilateral agreements are only signed between governments.
- IEA TCPs are also seen to be successful, however, the level of success varies among the TCPs. For a Member State like Sweden, stakeholders suggest that it is more efficient and beneficial for them to participate in multilateral agreements as bilateral agreements require a lot more effort. Each Member State will evaluate annually how their participation in each TCP based on their priorities.
- The implementation of SET Plan is seen to be successful by several key actions. It is, however, worth noting that SET Plan is an EU framework, rather than a multilateral agreement, and as such it only provides strategic guidance. Currently, international cooperation is not integrated in the SET Plan but there might be potential to link it to future Horizon funding.

5.4 *Recommendations on measures to improve the effectiveness of EU international cooperation R&I actions*

This section provides recommendations on measures to improve the effectiveness of the EU international cooperation R&I actions considering the findings of Chapter 2, 3 and 4, i.e., the use of Horizon 2020, the overall Member f States and EU policies on R&I international cooperation in the field of RETs. The recommendations aim to make these policies more effective and increase additionality.

5.4.1 Recommendations to further improve EU R&I international cooperation in the field of renewable energy technologies

Recommendation 1: Provision of an information resource to help Member States understand and exploit the synergies between bilateral and multilateral R&I agreements

Justification: Member States often have bilateral CAs in place with individual third countries, which lay out governmental commitments to joint R&I. These CAs indicate that there is a general willingness/openness in many Member States to engage in R&I in RET with third countries, given favourable (pre) conditions. In parallel, the EU itself has bilateral

S&T Agreements⁶⁷ with 20 countries across the globe. In addition to these bilateral agreements Member States participate in numerous multilateral fora.

The challenge is that stakeholders find it challenging to understand the macro-level strategic picture and thus determine where they stand in relation to other Member States, the EU, and third countries. In Member States, the responsibility for R&I tends to be split between various ministries and funding agencies. Bilateral commitments at Member State, EU and multilateral commitments international level are not always effectively identified, communicated or exploited; in the words of one interviewee, 'the problem when you have a lot of programmes is the ability of institutions to focus'.

The objective: The objective is the provision of appropriate information and guidance to stakeholders to enable better understanding of where the various existing agreements with third countries can be used to reinforce and/or initiate R&I collaboration in RET.

The recommendation: A centralised information resource, owned by the European Commission and maintained by the European Commission with the support of the Member States, could be introduced to map existing cooperation agreements between Member States and third countries. Such a database should also include multilateral fora - namely the SET Plan, the IEA TCPs, Mission Innovation, IRENA and the Clean Energy Ministerial – and map the commitments made by individual Member States where they participate. This resource, if kept up to date, could be a helpful go-to resource for R&I stakeholders in the EU, Associated Countries, and third countries.

The following options are proposed under this recommendation:

- **Option 1:** An open access database published on the Community Research and Development Information Service (CORDIS). This would be maintained by a community of users, though would be curated by a single authority (e.g. DG RTD).
- **Options 2:** A semi-open database published on the Strategic Energy Technologies Information System (SETIS) and maintained by DG RTD and the SET Plan Steering Group. The list of Cooperation Agreements identified this study would be made publicly available. However, operational information concerning their state of implementation would remain private.
- **Option 3:** A closed access database published on SETIS, jointly owned by DG RTD and the SET Plan Steering Group. Access could be given to selected actors (e.g. Horizon Europe national contact points).

⁶⁷ *International Cooperation*, European Commission, <https://ec.europa.eu/research/iscp/index.cfm?pg=countries>.

Table 16 - Assessment of the options for Recommendation 1

Option	Advantages	Disadvantages
Option 1	Ensure ongoing visibility and impact by sharing the results of this study in a permanent information resource. Provide external actors (e.g. third countries government, research institutes, industry) with an overview of the various Cooperation Agreements in place. Support the ethos of openness in the European Research Area, and also EU relations with third countries via a concrete and visible shared resource.	Open access resources can suffer from a lack of engagement. The success of this database will rely on an active and engaged community of users. Some promotion by the European Commission would therefore be required (which is not in itself necessarily a disadvantage).
Option 2	Ensure ongoing visibility and impact by sharing the results of this study in a permanent information resource. Provide external actors (e.g. 3rd countries government, research institutes, industry) with an overview of the various cooperation in place Provide Member States with a secure platform through which to share information on the implementation of Cooperation Agreements. Equip Member States with the facility to share more strategic information.	Represents an additional demand on the limited time of SET Plan Steering Group members (however, responsibilities could be delegated) Demands more active involvement from Member State representatives to upload operational (state of play) information Member States might be reluctant to share sensitive information with other Member States
Option 3	Ensure ongoing visibility and impact by sharing the results of this study in a permanent information resource. Provide a greater degree of control over access to information (compared with Options 1 and 2). Provide Member States with a secure platform through which to share information on the implementation of Cooperation Agreements. Equip Member States with the facility to share more strategic information.	Represents an additional demand on the limited time of SET Plan Steering Group members (however, responsibilities could be delegated). Demands more active involvement from Member State representatives to upload operational (state of play) information. Member States might be reluctant to share potentially sensitive information.

Recommendation 2: The European Commission should make use of an existing forum to specifically highlight and address international cooperation in RET development

Justification: The Energy Union Strategy (2014-2019)⁶⁸ was a headline initiative of the Juncker Commission. More recently, the European Green Deal⁶⁹ has set out ambitious energy commitments to the year 2050. The importance of R&I in achieving these targets has been recognised. The 2016 communication Accelerating Clean Energy Innovation⁷⁰ acknowledged the need for Europe “to step up its investment in energy efficiency and renewable technologies”, and the European Green Deal plans to mobilise financial resources and instruments to realise the Commission’s ambition.

The challenge in this context is that there is no specific EU strategy with third countries for R&I in the field of RET nor a specific forum to discuss it between Member State. As this study has found, there is a perceived lack of strategic direction from the EU in terms of where and how Member States should direct their efforts. It is difficult for Member States to understand the overall stance of the EU towards R&I with specific third countries, in specific energy fields, through specific R&I actions.

⁶⁸ Energy union, European Commission, https://ec.europa.eu/energy/topics/energy-strategy/energy-union_en?redir=1.

⁶⁹ A European Green Deal: Striving to be the first climate-neutral continent, European Commission, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.

⁷⁰ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions, and the European Investment Bank Accelerating Clean Energy Innovation, COM/2016/0763 final, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583415762635&uri=CELEX:52016DC0763>.

Furthermore, the preliminary finding put forward the fragmentation of geographic focus of the EU and Member State actions in R&I international cooperation in RETs. A broad distinction can be made between a focus on advanced versus developing countries. Cooperation with advanced countries tends to focus more on basic research, whilst cooperation with less developed countries tends to have a more applied nature.

Table 17: Common factors underpinning R&I relationships with less developed/advanced third countries

	Less developed countries	Advanced countries
Basic research	Limited interest	Interested in specific countries with strong basic research funding ecosystems (e.g. Sweden-USA, Portugal-USA)
Applied (commercial) research and demonstration	Testing/validating new systems in different environments Export potential	Aligned commercial interests (e.g. UK-Japan ocean energy)

Source: Study findings

Although the collaboration with developing countries is prominent and motivated by drivers such as development aid, support to just transition (e.g., development of green and smart cities), industrial policy, trade mission and diplomacy. Interviewees suggested that partnerships with these countries (especially African ones), the EU can make a fragmented impression in developing countries as there appears to be a 'free for all'.

The objective: The objective in this context is to enable Member States to effectively communicate and coordinate, so that they can better understand how and where to direct their efforts in international R&I in RET, to better achieve their EU and national commitments. Moreover, a forum to highlight and address international cooperation in RET development in a more harmonised way could contribute to further developing and including the private sector in R&I international cooperation in the field of RET. The EU Integrated SET Plan encompasses the 27 Member States. It is – understandably – focussed on the actions and activities undertaken by the Member States, both nationally and in collaboration.

The recommendation: There are many multilateral initiatives/fora such the IEA TCPs, Mission Innovation, IRENA and the CEM. These fora can support Member States to develop bilateral cooperation but not all Member States take part; their representation and engagement is uneven. Furthermore, the benefits of engagement in some fora such as IRENA are perceived to lie more in information exchange and dialogue, rather than active R&I project-based cooperation.

The SET Plan Steering Group is a strategic body which focusses on alignment between R&I actions between EU and Member State level, and between national programmes, to avoid duplication. Given that it is already well established and highly visible, the Steering Group could be an appropriate forum for the EU Member States to discuss together before acting on the international stage. The SET Plan initiative appears to have relative advantages over other fora. Originating in 2006, it has operated for a long period and it provides the room for the European Commission (including DG ENER and DG RTD), Member State governments and relevant stakeholders to engage and align. The current shortcoming of the SET Plan initiative is that it does not cover international actions explicitly, whilst the coordination between the various actions could be strengthened.

The SET Plan Implementation Plans, established in 2017-2018, already stand as a robust and highly visible and well-regarded vehicles for defining and communicating the energy development priorities of the EU and Member States collectively. Many of the activities to which the Implementation Plans commit are technical (i.e. R&I related) in nature, and some Implementation Plans already include reference to international R&I efforts. But this emphasis varies greatly between plans. This recommendation is based on taking advantage

of the visibility of the Implementation Plans as a forum to encourage specific international cooperation in RET development more clearly.

Another adequate forum would be the Strategic Forum for international S&T cooperation (SFIC), a dedicated configuration of European Research Area and Innovation Committee (ERAC). The Forum "facilitates the further development, implementation and monitoring of the international dimension of ERA, with focus on the external dimension of the European Union and Member States' research and innovation activities, by the sharing of information and consultation between its members (Member States and the Commission) with a view to identifying common priorities which could lead to coordinated or joint initiatives, and coordinating activities and positions vis-à-vis third countries and within international fora."⁷¹ The SFIC is composed of the European Commission, all EU Member States and some non-EU countries as observers. Four SFIC plenary sessions are scheduled each year with their own a standing agenda item. If other thematic or strategic activities are initiated by one or more members of the plenary session and, given the sufficient interest of a great number of countries, working groups / ad-hoc groups or task forces are formed to address these matters further.

The working groups on Brazil, China, India, Russia and the USA, as well as an ad-hoc thematic group on gender in international STI cooperation and strategic working groups related to framework conditions and the toolbox for international cooperation, have been established. The current working groups work on benchmarking of international cooperation and science diplomacy.⁷² The renewal of the working groups about China and STI activities with Africa is under planning.⁷³ In addition, several SFIC members are involved in the Mutual Learning Exercise on "National Strategies and Roadmap for International Cooperation in Research and Innovation" which enable exchanges on R&I policy-making and help identify best approaches. However, there is no specific group to address RET and the focus of the SFIC is in general broad.

A range of options have been considered to operationalise this recommendation, namely:

- **Option 1:** Extending the duties of the SET Plan Steering Group to include R&I international cooperation, which relates as such to Horizon Europe, and international cooperation.
- **Option 2:** Establishing a new R&I in RET-focussed group through the Strategic Forum for international S&T cooperation (SFIC).
- **Option 3:** Taking forward R&I in RET conversations through specific meetings between the SET Plan Steering Group and the SFIC. The SET Plan Steering Group would lead the discussions and the SFIC would provide recommendations.

Furthermore, the research identified one more option, namely the creation of a new and specific Implementation Plan under the SET Plan or a cross cutting task force to run through the existing implementation plans, endorsed by the SET Plan Steering Group. This option has however been discarded as it is expected to bring too much complexity. This is noted here to acknowledge that such an option has been rejected before.

⁷¹ Outcome of Proceedings from General Secretariat of the Council to Delegations, No. prev. doc.: 6213/16 RECH 20, Subject: Revised mandate for SFIC, 2016, <https://data.consilium.europa.eu/doc/document/ST-7308-2016-INIT/en/pdf>.

⁷² Note from: SFIC Secretariat to SFIC delegations Subject: Input paper by the SFIC Science Diplomacy Task Force, ERAC-SFIC 1352/20, 2020, <https://data.consilium.europa.eu/doc/document/ST-1352-2020-INIT/en/pdf>.

⁷³ Strategic Forum for International S&T Cooperation, ERA Portal Austria, <https://era.gv.at/directory/35>.

Table 18 - Assessment of the options for Recommendation 2

Option	Advantages	Disadvantages
Option 1	<p>Easy to implement. The scope of SET Plan Steering Group's responsibilities already covers R&I in RET, so this option is in line with what is already established.</p> <p>All EU Member States are represented. This would help to cement direct inputs into Horizon Europe calls targeting international partners.</p> <p>Member State representatives (usually from a ministry) could liaise with their counterparts in other ministries and respective administrations to better understand the national position.</p> <p>Building coordination at EU level and then Member State level.</p>	<p>An additional demand on the time from This is potentially difficult to implement in a meaningful way.</p>
Option 2	<p>Organise policy dialogue with international partner countries. This would allow a dedicated focus on R&I in RET through an influential group.</p> <p>This option would circumvent significant further demands of the SET Plan Steering Group workload.</p>	<p>SFIC has no group working on RET, so this would require establishing one from scratch.</p> <p>Discussions might be considered superficial, given the broad scope of the SFIC remit.</p> <p>Member States might be reluctant to share information with international partner countries.</p> <p>SFIC would have to liaise with other EU initiative, such as the SET Plan, to share its finding and avoid working in silos</p>
Option 3	<p>Synergies between the SET Plan and SFIC (RETs and R&I).</p> <p>Creation of coordination at the EU level and then Member State level.</p> <p>Member State representatives (usually from a ministry) could liaise with their counterparts in other ministries and respective administrations to better understand the national position.</p> <p>All EU Member States are represented.</p> <p>Provide direct input in the call for Horizon Europe.</p> <p>Potential input from international partner countries.</p> <p>Specialists on RET R&I for Third Countries could formulate recommendations to the SET Plan Steering Group</p>	<p>Might require greater efforts to set up and coordinate the SET Plan Steering Group and the SFIC which are complex bodies.</p> <p>Risk of competition between the SET Plan and the SFIC.</p>

5.4.2 Recommendations for Horizon Europe

Recommendation 3: Horizon Europe should build in stronger contractual safeguards and provide guidance to EU applicants to ensure intellectual property protection

Justification: The New Industrial Strategy for Europe⁷⁴ was released on 10 March 2020. One of its drivers is the need for competitiveness on the global stage; acknowledging the need to uphold a global level playing field, in the context of today's geopolitical realities. In the context of industry development and R&I in RET, collaboration with third countries involves challenges in the protection and ownership of intellectual property. In comparison with intra-EU collaboration, third countries may have domestic intellectual property laws that do not align with those of the EU. This can represent a barrier to international R&I in RET. The Horizon 2020 Annotated Model Agreement indicate that only the partners contributing to the knowledge creation should have ownership of the partner(s) that

⁷⁴ European industrial strategy, European Commission, https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en.

generate(s) the results. Hence, Joint ownership by several beneficiaries if possible and the regime to manage this ownership must be established. However, it appears that some partners do not fully respect the clause of the contract and the ownership regime, leading to intellectual property leakage.

During this research, several interviewees pointed out that leakage of intellectual property can be a risk in collaboration, particularly with more economically advanced third countries – while the risk related to intellectual property leakage is not perceived as high during the pre-selection process. Where researchers/institutions or businesses fail to agree on the ownership of project IP (sometimes using intellectual property laws), they may lose financially through missed post-project commercialisation opportunities, and reputationally.

The intellectual property issue can essentially have an impact at two stages in the R&D project lifecycle. The first is in the run-up to a research funding application (e.g. under Horizon 2020 or Horizon Europe). Concerns about intellectual property can act as a barrier to engagement with research partners in third countries during project genesis. In this manner, IP concerns can act as a deterrent to international R&I in RET, preventing partnership before it has even started. The second stage concerns the (mis)use of outputs from projects which have already been set up without effective or sufficiently enforced rules regarding rights of use to intellectual property created.

The objective: It is important to support research project participants (whether individuals or organisations) in EU Member States with the appropriate legal tools to ensure intellectual property protection when in collaboration with third countries. By protecting research ideas through use of the laws governing intellectual property, research project participants (whether individuals or organisations) are better able to maintain control over the idea and influence its ultimate end use.

The recommendation: Under Horizon 2020, rights and obligations regarding intellectual property are outlined in section 3 of the Annotated Model Agreement.⁷⁵ The current set of rules tends to focus on dissemination, exploitation and 'open access' – this is not well oriented towards meeting the challenges of international R&I in RET with third countries such as China and the USA. This recommendation is based on broadening and strengthening intellectual property support under Horizon Europe; possibly with the co-support of the European Intellectual Property Helpdesk.⁷⁶ A possibility is to include detailed written guidance on intellectual property, patents and trademarks, and a more robust contractual framework through Horizon Europe supporting guidance.

The following options are proposed under this recommendation:

- **Option 1:** In section 3 of the Annotated Model Agreement,⁷⁷ include a subsection addressing cooperation with organisations from third countries.
- **Option 2:** Develop a dedicated guidance document/resource to be made available to Horizon Europe applicants as standard, to equip them with the knowledge and awareness to anticipate and mitigate future IPR problems at pre-application stage.
- **Option 3:** Provision of a guide and training on intellectual property management, to be offered via the European Intellectual Property Helpdesk, targeting applicants in the scope of R&I international cooperation under EU research programmes.
- **Option 4:** Provision of a dedicated assistance service through the European Intellectual Property Helpdesk to provide support to researchers facing intellectual property rights issues with third countries.

⁷⁵ *U Grants: H2020 AGA — Annotated Model Grant Agreement: V5.2 – 26.06.2019, Section 3 Rights and Obligations Related to Background and Results*, European Commission, https://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf#page=231.

⁷⁶ *About the European IP Helpdesk*, European Commission, <http://www.iprhelpdesk.eu/>.

⁷⁷ *U Grants: H2020 AGA — Annotated Model Grant Agreement: V5.2 – 26.06.2019, Section 3 Rights and Obligations Related to Background and Results*, European Commission, https://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf#page=231.

Table 19 - Assessment of the options for Recommendation 3

Option	Advantages	Disadvantages
Option 1	The provision of guidance to researchers at the consortium formation stage should help them to set up more robust consortium agreements from the start. Minimal cost to implement.	Preventative approach only (i.e. will be of limited help to researchers already in active Horizon-funded projects with third country partners). This demands significant effort from research applicants with limited tailored support, i.e. the 'light touch' option.
Option 2	The provision of guidance to researchers at the consortium formation stage should help them to set up more robust consortium agreements from the start. Moderate cost to implement.	Preventative approach only (i.e. will be of limited help to researchers already in active Horizon-funded projects with third country partners). This demands significant effort from research applicants with limited tailored support, i.e. the 'light touch' option.
Option 3	Target specifically the organisations needing help Preventive and partly mitigating approach Direct discussion with	Additional up-front cost and effort required. Coordination with DG Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) would be required (not necessarily a disadvantage, but a requirement).
Option 4	Direct advice tailored to the issue Mitigation measure	Significant up-front cost and effort required. Coordination with DG GROW would be required (not necessarily a disadvantage, but a requirement).

In this case, more than one option could be implemented, as they are not mutually exclusive.

Recommendation 4: Horizon Europe should include targeted and concentrated calls focussing on specific RETs, third countries, and specific R&I actions

Justification: Europe's green transition must be led not only by a clear strategic vision, but also by concrete funding instruments that can 'operationalise' research priorities, converting them into meaningful projects and contributing to critical mass in the European Research Area. The European Green Deal aims to mobilise investment of €1 trillion over 10 years.

However, despite the intentions of Member States, many do not have the institutional capacity nor the available public funding to operationalise such agreements in the form of concrete collaborative R&I projects. This is particularly the case for smaller Member States. While Horizon 2020 is well regarded, some research feedback has centred on the fact that the amounts attached to individual funding calls are not enough to support large projects.

Additionally, under Horizon 2020 calls with mandatory participation of 3rd countries, the national funding organisations of these 3rd country are involved. The modalities of their involvement and the budget made available by these countries have been unclear for applicants, although the information is relevant to the potential size of the project and the applicants. Horizon Europe call might follow the same logic and it is therefore important to improve transparency on this matter for all European R&I stakeholders.

The objective: Under its current remit, Horizon Europe is obliged to incentive and provide funding support to all Member States to undertake collaborative projects. Under the principle of additionality, some projects supported would otherwise be financially unfeasible. The objective is to build and expand upon the success of Horizon 2020, not only in implementing projects but increasing funding concentration in line with clear EU objectives.

Table 20 - Horizon 2020 calls under SC3 - RES – Secure, Clean and Efficient Energy - Global leadership in renewables

Total number of SC3-RES projects	90 projects
Total H2020 EU contribution for 2018-2020	€ 514.5 million
Average EU contribution per project	€ 5.72 million

Source: CORDIS⁷⁸

The recommendation: Issuing targeted calls through Horizon Europe to target specific third countries (or regions, such as the Middle East, Sub-Saharan Africa, etc.) would serve to encourage specific forms of R&I collaboration that Member States otherwise find difficult to implement. This recommendation represents a continuation and refinement of the Horizon 2020 approach. Research organisations in some 130 developing countries are already automatically eligible for funding. The challenge is to expand and better coordinate the various calls, whilst ensuring that the funding amounts attached are enough to enable impactful knowledge and technology development. These calls must be aligned with national R&I, energy, and industry development priorities to 'make sense' to national stakeholders. Finally, all targeted calls should be supported with details of third countries' funding modalities and amounts in a transparent way for all European R&I stakeholders.

The following options are proposed under this recommendation

- **Option 1:** Publish a call on R&I in the field of RET open to all third countries.
- **Option 2:** Publish a call on R&I in the field of RET open to specific third countries.
- **Option 3:** Publish a call on R&I targeting specific RET open to all third countries.
- **Option 4:** Publish a call on R&I targeting specific RET open to particular third countries.⁷⁹

These recommendations are not mutually exclusive over the time and could be applied as a strategy. The application of these options would also depend on the strategic orientation of the institutions and SET Plan Steering Group.

⁷⁸ CORDIS - EU research projects under Horizon 2020 (2014-2020), European Commission; <https://data.europa.eu/euodp/en/data/dataset/cordish2020projects>; Cordis Dashboard, <https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/erUXRa/state/analysis>.

⁷⁹ This option is the approach under Horizon 2020.

Table 21 - Assessment of the options for Recommendation 4

Option	Advantages	Disadvantages
Option 1	Allow for a lot of flexibility from the researcher and do not restrain the scope of the proposal	The focus can be too broad and hamper to focus on specific priorities and strategic international cooperation. Risk to receive a large amount of proposal targeting the same RET and / or region (i.e., 3 rd countries) Risk to have an even financial contribution from the 3 rd countries.
Option 2	The call can be link to an EU international cooperation strategy with a 3 rd country or region	Risk to receive a large amount of proposal targeting the same RET
Option 3	The call can be link to specific RETs that are less deployed and contribute to make them commercially viable. The call can be link to a strategic orientation of the SET Plan. The call could focus on developing the next generation of renewable energy technologies.	Risk to receive a large amount of proposal covering the same region (i.e., 3 rd countries)
Option 4	The specific challenge and scope can be more specific, reflecting both on the region and the appropriate technology. The call can be tailored to the need of the region and the priorities of the EU (RETs and international relations wise)	Risk to restrict the opportunities and side-line potential projects

Recommendation 5: Horizon Europe should exploit the potential for joint funded initiatives to bring together industry and researchers to address international RET challenges

Justification: The ERA⁸⁰ commits EU Member States and stakeholders to international cooperation, in the context of the European Semester integrating the SDGs.⁸¹ Under Horizon 2020, ERA-NET was a funding instrument based on a specific model (the so-called Berlin Model). Under this model, a limited number of Member States could agree on R&I activities of common interest and launch joint co-funded calls for proposals. Such calls could be supported by the European Commission with the provision of top-up funding. Thus, participation in an ERA-NET allowed individual Member States (or regions) to link their research programme to those of other Member States/countries and participate in joint activities, in particular the funding of transnational research projects with EU support.

The evidence brought together through this research study indicates that ERA-NET type arrangements for international R&I funding have been highly valued by many Member States. This is partly because they encourage alignment and synergies between the R&I RET priorities of Member States, and also because the co-funded approach enables more substantial funding amounts to be committed, that can help achieve critical mass in R&I. However, ERA-NETs are being phased out in Horizon 2020 and will not exist in Horizon Europe. They are replaced through Partnerships.

The objective: The objective in this context is to support Member States to participate in joint funded initiatives over the coming years, through a structure that can replicate the aspects of ERA-NETs that were well regarded, whilst also engaging third country partners in R&I in RET.

The recommendation: ERA-NETs are being phased out in Horizon Europe and, given their recognised value, it is logical to ensure that their effective features can be carried forward in another instrument. Over the past two years, the European Commission has been

⁸⁰ European research area (ERA), European Commission, https://ec.europa.eu/info/research-and-innovation/strategy/era_en.

⁸¹ Sustainable Development Goals, United Nations, <https://sustainabledevelopment.un.org/?menu=1300>.

developing the structure of Horizon Europe through a broad consultation. One of the new characteristics of Horizon Europe will be the introduction of European Partnerships⁸² between Member States, the private sector, foundations and other stakeholders. Co-funded European Partnerships using joint programme co-fund actions are planned. Partnerships represent a significant investment; approximately 25% of the Horizon Europe budget.

In May 2019, the Commission launched a consultation of Member States on possible candidates for European Partnerships as part of a strategic coordinating process.⁸³ Using a co-funded approach, the Partnerships will support collaborative actions between Horizon Europe and national funding programmes on common R&I priorities. One of the forthcoming European Partnerships will cover Clean Energy Transition; the report notes that “[This] partnership is perceived by countries as highly relevant and there is strong support for a partnership approach... There seems to be an emerging consensus on the use of a co-funded approach (48% are in favour), while half of the countries would need more information for informed decision”.

This recommendation is, therefore, to design the new partnerships – within the parameters that have already been agreed upon through the Commission’s consultation with Member States - so that they can effectively replicate the success of ERA-NETs in the field of R&I in RET. The international component was limited under ERA-NET, i.e. only ERA-NET LAC and ERA-NET Russia was dedicated to cooperation with specific non-EU countries. A few ERA-NET programs related Horizon 2020 work programme for ‘Secure, Clean and Efficient Energy’ (SC3) included non-EU countries (see Annex 8). The new Partnership approach has the potential to further embed the international dimension.

To include targeted and concentrated calls focussing on specific RETs, third countries, and specific R&I actions in Horizon Europe, the following options are considered:

- **Option 1:** Integrate international calls under the clean energy partnership;
- **Option 2:** Design a specific clean energy partnership for international cooperation.

Table 22 - Assessment of the options for Recommendation 5

Option	Advantages	Disadvantages
Option 1	Make optimal use of a (almost fully) designed Partnership. Start international cooperation via Horizon Europe from the beginning of the programme Use of joint funded initiatives to bring together industry and researchers. Allow an alignment between Member State funding bodies and allow on an EU strategic roadmap	The type of RETs are not yet defined and therefore, it might limit the collaboration targeting specific RETs It might be long to obtain an agreement from the national funding entities of non-EU countries
Option 2	Focus exclusively on international cooperation Tailored to the needs both in terms of RETs development and international, i.e., the international component will not be secondary. Use of joint funded initiatives to bring together industry and researchers.	This partnership can only be established for the next round of partnerships under Horizon Europe and therefore will not be part of the first four years of the programme

⁸² *European partnerships in Horizon Europe*, European Commission, https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme_en#european-partnerships-in-horizon-europe.

⁸³ *European Partnerships under Horizon Europe: results of the structured consultation of Member States*, European Commission, 2019, https://www.era-learn.eu/documents/results_structured_consultation_ms.

Annex 1: Sources reviewed for the state of play - Member States and EU R&I international cooperation in the field of RET

Reports / studies / projects and other relevant sources	Type	Year
Overview of EU and member states Research and Innovation cooperation with India (Delegation of the European Union to India and Bhutan)	Report	2016
Renewable energy partnerships in development cooperation: Towards a relational understanding of technical assistance.	Study	2016
Mapping Multilateral Collaboration on Low-Carbon Energy Technologies (IEA).	Study	2014
Mapping Global Energy Governance (Navroz K. Dubash, Ann Florini).	Study	2011
Energy Technology Initiatives: Implementation through Multilateral Co-operation	Study	2010
International Technology-Oriented Agreements to address climate change (H.C. de Coninck et al.)	Study	2008
International Standards to Develop and Promote Energy Efficiency and Renewable Energy Sources.	Study	2007
Monitoring R&I in Low-Carbon Energy Technologies - Methodology for the R&I indicators in the State of the Energy Union Report (EC - JRC, A. Fiorini, A. Georgakaki, F. Pasimeni, E. Tzimas).	Report	2016
Implementation of the strategy for international cooperation in research and innovation, COM(2016) 657 final (EC - EESC & Committee of the Regions).	Report	2016
Priorities for international cooperation in research and innovation, SWD(2016) 329 final (EC - EESC & Committee of the Regions).	SWD	2016
Review of EU-third Country Cooperation on Policies Falling within the ITRE Domain in Relation to the Brexit (European Parliament, study for the ITRE Committee).	Study	2017
SET Plan delivering results: The Implementation Plans, Research & Innovation enabling the EU's energy transition (EC DG ENER & JRC).	Report	2018
The Strategic Energy Technology (SET) Plan (DG RTD & JRC).	Report	2017
Data collection and analysis on R&I investments and patenting trends in support of the State of the Energy Union Report. (EC, JRC.C7 Knowledge for Energy Union).	Report	2018
RD&D Statistics: 2018 preliminary edition of the Energy technology RD&D budgets database (IEA).	Database	2018
Feature Dashboard (Finance Flows) - Renewable Energy (IRENA).	Dashboard	
Africa-Europe Research and Innovation Cooperation: Global Challenges, Bi-regional Responses (Andrew Cherry, James Haselip, Gerard Ralphs, Isabella E. Wagner).	Book	2018
The Role of Science, Technology and Innovation Policies to Foster the Implementation of the Sustainable Development Goals Report of the Expert Group "Follow-up to Rio+20, notably the SDGs" (EC - Enrico Giovannini, Ingeborg Niestroy, Måns Nilsson, Françoise Roure, Michael Spanos).	Report	2015
The Global Innovation Index 2016 - Winning with Global Innovation (Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO)).	Study	2016
Socio-economic regional microscope series - Regional performance in the Research, Innovation and Competitiveness Priorities of the Energy Union (EC - JRC, Aliki Georgakaki, Juan-Pablo Jimenez Navarro, Francesco Pasimeni, Alessandro Fiorini, Alain Marmier, José-Miguel Asensio).	Report	2018
Energy R&I financing and patenting trends in the EU (EC-JRC, A. Fiorini, A. Georgakaki, J.P. Jimenez Navarro, A. Marmier, F. Pasimeni, E. Tzimas).	Country dashboards	2017
Strategy for research and innovation cooperation with the EU: Horizon 2020 and ERA (Norway Ministry of Education and Research).	Strategy	2014
Energy Policies of IEA Countries	Series of country reports	2005-2018
Technology Collaboration Programmes: Highlights and Outcomes (IEA).	Study	2016

Patent-based estimation procedure of private R&D: the case of Climate Change and Mitigation Technologies in Europe (Francesco Pasimenia, Alessandro Fiorinia, Aliko Georgakaki).	Study	2018
Map of EU R&I Funds Distributions per Country	Interactive Map	
Energy to Innovation - Reinforcing cooperation with ENP countries on bridging the gap between energy research and energy innovation.	Project	End in 2016
STI International Cooperation Network for Eastern Partnership Countries.	Project	End in 2016

Annex 2: Interview question list

** Asterisks ** indicates that a question is critical to our report - please ensure that you ask all such questions specifically and capture the interviewee's response in the interview grid.

Part 1 – Bilateral cooperation activities

- 1) With regard to research activity in general, which renewable energy technologies are most important for your Member State?
- 2) ** Do you have an established international collaborative research strategy or policy in the field of RET? **
** If not, is there an overarching strategy for international cooperation in R&I more generally? **
- 3) A number of bilateral CAs affecting R&I in RET are listed in the country memo.
Which of these agreements are still operational?
Which are the most important, and how?
- 4) ** How are the bilateral R&I Cooperation Agreements implemented? **
** Which agencies or organisations are responsible for implementing them? **
- 5) Are you working to devise new R&I bilateral cooperation approaches to improve RET?
With which third countries?

Part 2 – International cooperation activities, Horizon 2020 and Horizon Europe

"EU cooperation with third countries covering RET is shaped mainly by EU participation in the IEA Technology Collaboration Programmes, Mission Innovation, EU science and technology agreements with 20 third countries, the EU-US Energy Council, and the EU-Africa energy partnership. There are also some wider frameworks in place established by organisations such as IRENA (the International Renewable Energy Agency)."

- 6) **Do you know in which macro-level frameworks – e.g. the SET Plan, the IEA Technology Collaboration Programme, IRENA etc. – your country participates? **
- 7) Does your country actively participate in them?
Which are the most important, and how?
- 8) Considering the above, how would you grade these macro-level CAs in terms of usefulness/relevance?

Is there any duplication with R&I **bilateral** cooperation actions conducted by your country?
- 9) Looking to the future - which of these frameworks should be extended, adapted, or terminated?
- 10) What is the national experience of the International Cooperation priority of Horizon 2020 (re. RET)? See the table.
- 11) How do you feel Horizon Europe could add value and bring better complementarity to Member States bilateral cooperation activities? In other words, how could we increase the synergy in the system?

- 12) ** Do you feel that in the upcoming Horizon Europe the European Commission should pursue the same policy with third countries or change it? **
- 13) In which direction do you suggest EU should focus its R&I cooperation activities in the next seven years in terms of regions/countries and RET?
- 14) ** Based on your country's activities and results – both in terms of bilateral and macro-level (multilateral) arrangements – which new topics, countries and/or RETs would you like to see in the Horizon Europe International Cooperation priority? **

Annex 3: Overview of bilateral Cooperation Agreements

EU MS	Cooperation agreement	Year	Third country
Austria	Energy Partnership with Belarus		Belarus
Austria	Memorandum of Understanding between the Federal Ministry for Sustainability and Tourism of the Republic of Austria and the Ministry of Mines and Energy of the Republic of Colombia on cooperation in the energy field	2018	Columbia
Austria	Memorandum of Understanding between the Federal Minister for Sustainability and Tourism of the Republic of Austria and the Ministry of Energy of the Islamic Republic of Iran to promote cooperation in the field of energy management, energy infrastructure, sustainability and renewable energies	2018	Iran
Austria	Memorandum of Understanding between the Federal Ministry of Science, Research and Economy of the Republic of Austria and the Ministry of Industries of the Republic of Cuba to promote cooperation in the field of Environmental and Renewable Energy Technologies	2015	Cuba
Austria	Memorandum of Understanding between the Government of the Republic of Austria represented by the Federal Minister of Economy, Family and Youth and the Tunisian Government on Energy Efficiency and Renewable Energies	2013	Tunisia
Austria	Memorandum of Understanding between the Ministry of Industry and Trade of the Socialist Republic of Vietnam and the Federal Ministry Austria of Economy, Family and Youth on cooperation in Industry, Trade and Energy	2012	Vietnam
Austria	Agreement between between the Austrian Federal Government and the Government of the Republic of India on bilateral economic relations and economic, industrial, technical and technological cooperation	2000	India
Austria	Agreement between the Government of the Republic of Austria and the Government of the Republic of India for scientific and technological cooperation	2008	India
Austria	Agreement between the Government of the Republic of Austria and the Government of the Russian Federation for scientific and technological cooperation	2012	Russia
Austria	Agreement between the Austrian Federal Government and the Government of the Republic of Kazakhstan on economic, agricultural, environmental, industrial, technical and technological cooperation	2004	Kazakhstan
Austria	Agreement on economic, industrial, technical and technological cooperation with Egypt	2000	Egypt
Austria	Agreement between the Austrian Federal Government and the Government of the People's Republic of Bangladesh on bilateral economic	2002	Bangladesh

EU MS	Cooperation agreement	Year	Third country
	relations and economic, industrial and technological cooperation		
Austria	Agreement between the Austrian Federal Government and the Government of the Kingdom of Saudi Arabia on economic, trade, industrial and technological cooperation	2005	Saudi Arabia
Bulgaria	Agreement between the Government of the Republic of Bulgaria and the Government of the United States of America on Scientific and Technological Cooperation	2008	USA
Bulgaria	Agreement for scientific and technological cooperation between the Republic of Bulgaria and the Republic of Argentina	2003	Argentina
Bulgaria	Programme for Cooperation in Science and Technology between the Ministry of Science and Technology of the Republic of India and the Ministry of Education and Science of the Republic of Bulgaria for the Period 2018-2021	2018	India
Bulgaria	Intergovernmental Agreement on Science and Technology Cooperation	2018	China
Bulgaria	Memoranda of Understanding between the Ministry of Education and Science of the Republic of Bulgaria and the National Council for Scientific and Technological Development of the Federative Republic of Brazil	2016	Brazil
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Republic of Azerbaijan on cooperation in the fields of science and technology - (Decree on the publication of the Agreement between the Government of the Republic of Croatia and the Government of the Republic of Azerbaijan on cooperation in the fields of science and technology, NN-MU 005/2013)	2013	Azerbaijan
Croatia	Agreement on scientific, technical and technological cooperation between the Government of the Republic of Croatia and the Government of the Republic of Chile - (Decree approving the Agreement on scientific, technical and technological cooperation between the Government of the Republic of Croatia and the Government of the Republic of Chile, NN-MU 006/1996)	1997	Chile
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Arab Republic of Egypt on Cultural, Educational, Scientific and Technological Cooperation - (Decree approving the Agreement between the Government of the Republic of Croatia and the Government of the Arab Republic of Egypt on Cultural, Educational, Scientific and Technological Cooperation, NN-MU 005/2001)	2001	Egypt
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Philippines on Scientific and Technological Cooperation - (Decree approving the Agreement	1996	Philippines

EU MS	Cooperation agreement	Year	Third country
	between the Government of the Republic of Croatia and the Government of the Republic of the Philippines on Scientific and Technological Cooperation, NN-MU 007/1996)		
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Republic of India on cooperation in the fields of culture, education, science, technology and sports	1999	India
Croatia	Agreement between the Government of the SFRY and the Government of Japan on Co-operation in the Field of Science and Technology - (Decision on the publication of bilateral international treaties to which the Republic of Croatia is a party on the basis of succession, NN-MU 004/1996)	1991	Japan
Croatia	Memorandum between the Ministry of Science, Education and Sports of the Republic of Croatia and the Ministry of Education, Culture, Sports, Science and Technology of Japan on cooperation in the field of education, sports, science and technology	2008	Japan
Croatia	Memorandum of Understanding on the Scientific Cooperation Program between the Ministry of Science, Education and Sports of the Republic of Croatia and the Japan Science and Technology Agency	2009	Japan
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Republic of South Africa on educational, artistic, cultural, scientific, technological and sport cooperation	1999	South Africa
Croatia	Memorandum of Understanding between the Ministry of Science, Education and Sports of the Republic of Croatia and the Ministry of Advanced Education and Technology of the Province of Alberta on cooperation in the fields of education, science and technology	2010	Canada
Croatia	Memorandum of Understanding between the Ministry of Science and Education of the Republic of Croatia and the Ministry of Education and Higher Education of the State of Qatar on cooperation in the fields of education, higher education and science	2018	Qatar
Croatia	Memorandum of Understanding between the Ministry of Science and Education of the Republic of Croatia and the Ministry of Education and Science of the Republic of Kazakhstan on cooperation in the fields of education and science	2019	Kazakhstan
Croatia	Memorandum of Understanding between the Ministry of Science and Education of the Republic of Croatia and the Ministry of Science and Technology of the People's Republic of China on joint financing of research and development projects	2019	China
Croatia	Agreement on scientific and technological cooperation between the Government of the	1997	China

EU MS	Cooperation agreement	Year	Third country
	Republic of Croatia and the Government of the People's Republic of China		
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Republic of Costa Rica on scientific and technological cooperation	1999	Costa Rica
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Republic of Cuba on scientific and technological cooperation	2008	Cuba
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Russian Federation on economic and scientific-technical cooperation	2014	Russia
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the United States of America on scientific and technological cooperation	2007	USA
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Democratic Socialist Republic of Sri Lanka on cooperation in the fields of culture, education, science, technology and sport	2008	Sri Lanka
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Argentine Republic on Scientific and Technological Cooperation - (Decree approving the Agreement between the Government of the Republic of Croatia and the Government of the Argentine Republic on Scientific and Technological Cooperation, NN-MU 004/1997)	1995	Argentina
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Republic of Indonesia on cultural and educational cooperation	2007	Indonesia
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Islamic Republic of Iran on Cultural, Educational and Scientific Cooperation	2002	Iran
Croatia	Agreement between the Government of the Republic of Croatia and the Government of the Hashemite Kingdom of Jordan on cooperation in the fields of science and technology	2006	Jordan
Cyprus	Memorandum of Understanding between Greece, Cyprus and Jordan on Renewable Energy Resources	2018	Jordan
Cyprus	Memorandum of Understanding On the implementation of the EEA Financial Mechanism 2004-2009 between The Republic Of Iceland, The Principality Of Liechtenstein, The Kingdom Of Norway, and the Republic of Cyprus	2005	Norway
Cyprus	Memorandum of Understanding On the implementation of the EEA Financial Mechanism 2009-2014 between The Republic Of Iceland, The	2014	Norway

EU MS	Cooperation agreement	Year	Third country
	Principality Of Liechtenstein, The Kingdom Of Norway, and the Republic of Cyprus		
Czech Republic	Memorandum of understanding on environmental cooperation between the Ministry of the Environment of the Czech Republic and State Environmental Protection Administration of the People's Republic of China	2004	China
Czech Republic	Memorandum on cooperation in the field of environmental protection between the Ministry of Environment of the Czech Republic and the Ministry of Environment, Living and Territory Development of Republic of Colombia	2008	Columbia
Czech Republic	Memorandum on Cooperation in the field of environmental protection between the Ministry of Environment of the Czech Republic and the Ministry of Environment and Natural Resources of United Mexican States	2006	Mexico
Czech Republic	Memorandum of understanding on co-operation in the field of environmental protection between the Ministry of the Environment of the Czech Republic and the Ministry of Natural Resources and Environment of Vietnam	2007	Vietnam
Czech Republic	Memorandum on cooperation in the field of environmental protection between the Ministry of the Environment of the Czech Republic and the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan	2008	Azerbaijan
Czech Republic	Agreement Between the UNITED STATES OF AMERICA and the CZECH REPUBLIC for Scientific and Technological cooperation	2008	USA
Czech Republic	Agreement on the main directions of the environmental cooperation between the Ministry of Environment of the Czech Republic and the Ministry of Nature and Environment of Mongolia	2001	Mongolia
Denmark	Implementing agreement between Ministry of Energy, Utilities and Climate of the Kingdom of Denmark and National Energy Administration of the People's Republic of China on Sino-Danish wind cooperation "Quality Offshore"	2018	China
Denmark	Memorandum of understanding between the Ministry of Science and Technology of the People's Republic of China and the Ministry of Climate, Energy and Building of the Kingdom of Denmark on cooperation in the area of energy research, development and demonstration	2012	China
Denmark	Memorandum of understanding between the Government of the Kingdom of Denmark and the Government of the Republic of South Africa on renewable energy and energy efficiency	2011	South Africa
Denmark	Memorandum of Understanding on Clean Energy and Energy Efficiency between the Indonesian Ministry of Energy and Mineral Resources and the Danish Ministry of Energy, Utilities and Climate	2015	Indonesia

EU MS	Cooperation agreement	Year	Third country
Denmark	Memorandum of Understanding on Indo-Denmark New and Renewable Energy Cooperation between the Ministry of New and Renewable Energy, Government of the Republic of India and the Ministry of Climate and Energy, Government of the Kingdom of Denmark	2008	India
Denmark	Memorandum of Understanding between the Danish Ministry of Science, Technology and Innovation, the Brazilian Ministry of Science and Technology and the Brazilian Ministry of Education on bilateral cooperation in science, technology, innovation and higher education	2011	Brazil
Denmark	Memorandum of Understanding between the government of the Kingdom of Denmark and the government of the Republic of South Africa on bilateral cooperation in science and technology	2017	South Africa
Denmark	Memorandum of Understanding between the Ministry of Science, Innovation and Higher Education of the Kingdom of Denmark and the Ministry of Education, Science and Technology of the Republic of Korea on bilateral co-operation in the fields of science, technology, innovation and higher education	2012	South Korea
Denmark	Memorandum of Understanding between the Ministry of Science, Innovation and Higher Education of the Kingdom of Denmark and the Ministry of Education, Science and Technology of the Republic of Korea on bilateral co-operation in the fields of science, technology, innovation and higher education	2013	South Korea
Denmark	Agreement between the Government of the Kingdom of Denmark and the Government of the United States of America for Scientific and Technological Cooperation	2009	USA
Denmark	Memorandum of Understanding between the government of the Kingdom of Denmark and the government of the People's Republic of China on bilateral cooperation in science and technology	2007	China
Denmark	Agreement between the government of the Republic of India and the government of the Kingdom of Denmark regarding the establishment of a joint commission for cooperation	2008	India
Denmark	MEMORANDUM OF UNDERSTANDING between National Energy Administration, the People's Republic of China and Ministry of Climate, Energy and Building, the Kingdom of Denmark establishing a CHINA-DENMARK RENEWABLE ENERGY PARTNERSHIP	2014	China
Denmark	Memorandum of Understanding between the National Development and Reform Commission of the People's Republic of China and the Royal Danish Ministry of Foreign Affairs on Cooperation in the Area of Climate Change and Energy Efficiency	2013	China
Denmark	Memorandum of understanding between the Ministry of Housing and Urban-Rural Development	2014	China

EU MS	Cooperation agreement	Year	Third country
	of the People's Republic of China and the Ministry of Climate, Energy and Building of the Kingdom of Denmark on cooperation in the area of energy efficiency in buildings		
Denmark	Memorandum of understanding between the Danish Energy Agency of the Kingdom of Denmark and the National Energy Conservation Center of China for cooperation in the field of energy efficiency	2014	China
Denmark	Memorandum of Understanding between the Government of the Kingdom of Denmark and the Government of the United States of America to strengthen cooperation on offshore wind energy	2016	USA
Denmark	Memorandum of Understanding between the Vietnamese Ministry of Industry and Trade and the Danish Ministry of Climate, Energy and Building	2015	Vietnam
Denmark	Memorandum of Cooperation between the Ministry of Education, Culture, Sports, Science and Technology of Japan and the Ministry of Higher Education and Science of Denmark on Science, Technology and Innovation	2018	Japan
Denmark	Memorandum of Understanding between the Innovation and Technology Commission of the government of the Hong Kong Special Administrative Region of the People's Republic of China and the Danish Agency for Science, Technology and Innovation, Ministry of Science, Technology and Innovation of the Kingdom of Denmark on science and technology cooperation	2009	China (Hong Kong)
Denmark	Memorandum of Understanding between the Department of Biotechnology, Ministry of Science and Technology Government of the Republic of India and the Ministry of Science, Technology and Innovation Government of the Kingdom of Denmark for Cooperation in the field of Biotechnology	2004	India
Estonia	Agreement for Scientific and Technological Cooperation between the Government of the Republic of Estonia and the Government of the United States of America	2009	USA
Estonia	Agreement on Scientific and Technological Cooperation between the Government of the Republic of Estonia and the Government of the Republic of India	1999	India
Estonia	Agreement on Economic, Technical and Scientific Cooperation between the Government of the Republic of Estonia and the Government of the Arab Republic of Egypt	1996	Egypt
Estonia	Memorandum of Understanding between The Department of Biotechnology, Ministry of Science and Technology Government of the Republic of India and The Ministry of Education and Research of the Republic of Estonia for Cooperation in the field of Biotechnology	2014	India

EU MS	Cooperation agreement	Year	Third country
Estonia	Economic, Scientific and Technical Cooperation Agreement between the Government of the Republic of Estonia and the Government of the Republic of Kazakhstan	2010	Kazakhstan
Finland	Memorandum of Understanding for cooperation in the field of Renewable Energy	2014	India
Finland	Implementing Arrangement between the Department of Energy of the United States of America and the Ministry of Trade and Industry of Finland for Cooperation in Energy Research and Development	1996	USA
Finland	Joint Declaration between the Republic of Finland and the People's Republic of China on Establishing and Promoting the future-oriented new-type cooperative partnership	2017	China
Finland	Memorandum of Understanding Between the Government of the Republic of Indonesia and the Government of the Republic of Finland on Science, Technology, Innovation and Higher Education Cooperation	2015	Indonesia
Finland	Memorandum of understanding on strategic partnership in energy and green economy	2018	Kazakhstan
Finland	Memorandum of Understanding on energy sector cooperation	2018	Myanmar
Finland	Joint Statement between Ministry of Energy and the Ministry of Employment and the Economy of Finland on Cooperation and Innovation in Energy	2013	Chile
Finland	Agreement for Cooperation in the Fields of Science & Technology	2008	India
Finland	Agreement Relating to Scientific and Technological Cooperation Between the Government of the United States of America and the Government of the Republic of Finland	1995	USA
Finland	Basic Agreement of Economic, Industrial and Technological Cooperation with Finland	1992	
Finland	Memorandum of Understanding	2017	China
France	Cooperation Agreement between the Government of the French Republic and the Government of the Kingdom of Morocco in the field of Renewable Energy	2015	Morocco
France	Declaration of Intent between the Government of the French Republic and the Government of the Republic of Tunisia for Further Enhanced Cooperation in the fields of Renewable Energy and Energy Efficiency	2013	Tunisia
France	Administrative Arrangement in the field of Renewable Energies between the French and Indian Ministries of environment	2015	India

EU MS	Cooperation agreement	Year	Third country
France	Cooperation Agreement between the Government of the French Republic and the Government of the Republic of Chile in the field of Renewable Energy	2009	Chile
France	Memorandum of Cooperation in the field of Energy Efficiency of Renewable Energies between the Ministry of Ecology, Energy, Sustainable Development and Spatial Planning of the French Republic and the Ministry of Energy of the Russian Federation	2008	Russia
France	Agreement between the Government of the French Republic and the Government of the State of Kuwait on Environment, Sustainable Development and Renewable Energy	2011	Kuwait
France	Declaration of Intent to Promote the African Clean Energy Corridor	2014	
France	Framework Agreement between the Government of the French Republic and the Government of the Bolivarian Republic of Venezuela for the Cooperation and the Establishment of a High Level Commission	2013	Venezuela
Germany	German-Algerian Energy Partnership	2015	Algeria
Germany	German-Australian Energy Partnership	2017	Australia
Germany	German-Brazilian Energy Partnership	2008	Brazil
Germany	Sino-German Energy Partnership	2007	China
Germany	Indo-German Energy Forum - Energy Partnership	2006	India
Germany	German-Moroccan Energy Partnership (PAREMA)	2012	Morocco
Germany	German-Mexican Energy Partnership	2016	Mexico
Germany	German-South African Energy Partnership	2013	South Africa
Germany	Turkish-German Energy Partnership	2012	Turkey
Germany	Emirati – German Energy Partnership	2017	UAE
Germany	German-Tunisian Energy Partnership	2012	Tunisia
Germany	German-Chilean Energy Partnership	2019	Chile
Germany	German-Nigerian Energy Partnership		Nigeria
Germany	German-Jordanian Energy Dialogue (in April 2018, the two countries agreed to upgrade the energy dialogue into an energy partnership in 2019) German-Jordanian Energy Partnership signed 09/04/2019	2019	Jordan
Germany	German-Russian Energy Dialogue	2010	Russia
Germany	German-South Korean Energy Dialogue		South Korea

EU MS	Cooperation agreement	Year	Third country
Germany	U.S.-German Energy Dialogue		USA
Germany	German-Iranian Energy Dialogue	2017	Iran
Germany	German-Japanese Energy Dialogue	2019	Japan
Germany	German-Kazakh Energy Dialogue	2012	Kazakhstan
Greece	Memorandum of Understanding between Greece, Cyprus and Jordan on Renewable Energy Resources	2018	Jordan
Greece	Memorandum of Understanding (MoU) to cooperate in the field of renewable energy between India and Greece.	2017	India
Greece	Memorandum of Understanding on Renewable Energy Sources and Energy Efficiency	2017	Azerbaijan
Greece	Memorandum of Understanding between Greece and UAE on Renewable Energy Resources	2017	UAE
Greece	EEA Financial Mechanism 2009-2014, Programme Agreement between the Financial Mechanism Committee established by Iceland, Liechtenstein and Norway and the Ministry of Development and Competitiveness representing the Hellenic Republic for the Financing of the Programme Renewable Energy.	2013	Norway
Greece	EEA Financial Mechanism 2014-2021 Programme Agreement between the Financial Mechanism Committee established by Iceland, Liechtenstein and Norway and Special Service of Planning, Coordination and Monitoring of the Implementation of Financial Mechanisms of the European Economic Area, of the General Secretariat for Public Investments & the NSRF, of the Ministry of Economy and Development representing the Hellenic Republic for the financing of the Programme "Renewable Energy, Energy Efficiency", (GR-Energy)	2017	Norway
Greece	2017-2019 Plan on Key Areas of Cooperation between China and Greece	2017	China
Greece	Memorandum of Understanding On the implementation of the EEA Financial Mechanism 2004-2009 between The Republic Of Iceland, The Principality Of Liechtenstein, The Kingdom Of Norway, and The Hellenic Republic	2007	Norway
Hungary	Agreement between the Government of the Republic of Hungary and the Government of the United States of America for Scientific and Technological Cooperation	2010	USA
Hungary	Agreement on Scientific and Technological Cooperation the Government of the Republic of Hungary and the Government of the Republic of Chile	2009	Chile
Hungary	Agreement on Scientific and Technological Cooperation the Government of the Republic of	1998	South Africa

EU MS	Cooperation agreement	Year	Third country
	Hungary and the Government of the Republic of South Africa		
Hungary	Technical-Scientific Cooperation Agreement between the Government of the Republic of Hungary and the Government of the Republic of Argentina	1999	Argentina
Hungary	Technical-Scientific Cooperation Agreement between the Government of the Republic of Hungary and the Government of the Federative Republic of Brazil	1992	Brazil
Hungary	Agreement on Scientific and Technological Cooperation the Government of the Republic of Hungary and the Government of the Arab Republic of Egypt	1996	Egypt
Hungary	Agreement on Scientific and Technological Cooperation the Government of the Republic of Hungary and the Government of the Republic of India	1993	India
Hungary	Agreement on Scientific and Technological Cooperation the Government of the Republic of Hungary and the Government of the People's Republic of China	2002	China
Hungary	Agreement on Scientific and Technological Cooperation	1997	Malaysia
Hungary	Agreement on Technical, Scientific and Technological Cooperation between the Government of the Republic of Hungary and the Government of the United Mexican States	1992	Mexico
Hungary	Agreement on scientific and technological cooperation	1999	Thailand
Hungary	Agreement on Cooperation in Science and Technology	2005	Vietnam
Hungary	Agreement on Cultural, Scientific and Educational Cooperation between the Government of the Republic of Hungary and the Government of the Russian Federation	1998	Russia
Ireland	Agreement on Scientific and Technological Co-operation between the Government of the Republic of India and the Government of Ireland	2008	India
Ireland	MoU between Conselho Nacional das Fundações Estaduais de Amparo à Pesquisa and Science Foundation Ireland	2015	Brazil
Ireland	US-Ireland R&D Partnership - Memorandum of Understanding	2014	United States of America
Ireland	MoU on China-Ireland STI cooperation	2019	China
Ireland	Agreement on Scientific and Technological Cooperation between the Government of the	2000	China

EU MS	Cooperation agreement	Year	Third country
	People's Republic of China and the Government of Ireland		
Ireland	Joint Declaration: A Partnership for Innovation and Growth	2013	Japan
Italy	Executive programme for scientific and technological cooperation between the Italian Republic and the Republic of South Africa	2018	South Africa
Italy	Executive programme for scientific and technological cooperation between the Italian Republic and the United States of Mexico for the years 2018-2020	2018	Mexico
Italy	Executive programme for scientific and technological cooperation between the Italian Republic and the Republic of Chile for the years 2018-2020	2018	Chile
Italy	Executive programme for scientific and technological cooperation between the Italian Republic and the Republic of Argentina for the years 2017-2019	2017	Argentina
Italy	Executive programme for scientific and technological cooperation between Italy and China for the years 2019-2021	2019	China
Italy	Executive programme for scientific and technological cooperation between the Italian Republic and the Republic of Korea for the years 2019-20210	2019	South Korea
Italy	Executive programme of cooperation in the field of science and technology between the Government of Italy and the Government of Japan for the years 2017-2019	2017	Japan
Italy	Executive programme for scientific and technological cooperation between the Italian Republic and the Republic of India for the years 2017-2019	2017	India
Latvia	Agreement between the Government of the Republic of Latvia and the Government of the Republic of Belarus on Economic, Scientific and Technical Co-operation	2004	Belarus
Latvia	Agreement between the Government of the Republic of Latvia and the Government of the Republic of Azerbaijan on Economic, Scientific, Technical and Cultural Cooperation	2006	Azerbaijan
Latvia	Agreement between the Government of the Republic of Latvia and the Government of the People's Republic of China on Cooperationa in the field of Science and Technology	2018	China
Latvia	Agreement on Co-operation in the Field of Education and Science between the Government of the Republic of Latvia and the Government of the Arab Republic of Egypt	2009	Egypt

EU MS	Cooperation agreement	Year	Third country
Latvia	Agreement between the Government of the Republic of Latvia and the Government of the Republic of India of the Intergovernmental Commission on Trade, Economic, Scientific, Technological and Cultural Cooperation	2001	India
Latvia	Agreement between the Government of the Republic of Latvia and the Government of the Republic of Kazakhstan on the Economic, Scientific and Technical Co-operation	2006	Kazakhstan
Latvia	Agreement between the Government of the Republic of Latvia and the Government of the State of Kuwait for the Economic and Technical Co-operation	2018	Kuwait
Latvia	Agreement between the Government of the Republic of Latvia and the Government of the Kyrgyz Republic on Economic, Industrial, Scientific and Technical Cooperation	2007	Kyrgyzstan
Latvia	Agreement between the Government of the Republic of Latvia and the Government of the Russian Federation on the Establishment of Intergovernmental Commission in the Field of Economic, Technical and Scientific, Humanitarian and Cultural Cooperation	2006	Russia
Latvia	Agreement between the Government of the Republic of Latvia and the Government of the Republic of Tajikistan on Economic, Industrial, Scientific and Technical Cooperation	2009	Tajikistan
Latvia	Agreement between the Government of the Republic of Latvia and the Government of Turkmenistan on Economic, Industrial, Scientific and Technical Cooperation	2009	Turkmenistan
Lithuania	Memorandum of Understanding between the Ministry of Energy of the Republic of Lithuania and the Ministry of Energy of the United Arab Emirates on Cooperation in Renewable Energy and Energy Saving	2017	United Arab Emirates
Lithuania	Memorandum of Understanding between the Ministry of Energy of the Republic of Lithuania and the Ministry of Energy and Minerals of The republic of Indonesia on Cooperation in Renewable Energy and Energy Saving	2017	Indonesia
Lithuania	Agreement between the Government of the Republic of Lithuania and the Government of the Republic of Azerbaijan on cooperation in the Fields of Economy, Industry and Energy	2008	Azerbaijan
Lithuania	Agreement between the Government of the Republic of Lithuania and the Government of the Republic of Belarus on Cooperation in the Field of Science and Technologies	2008	Belarus
Lithuania	Agreement on Economic, Technical and Scientific Cooperation between the Government of the Republic of Lithuania and the Government of the Arab Republic of Egypt	1997	Egypt

EU MS	Cooperation agreement	Year	Third country
Lithuania	Agreement between the Government of the Republic of Lithuania and the Government of the Republic of the Philippines on Cooperation in the Field of Science and Technology	2005	Philippines
Lithuania	Agreement between the Government of the Republic of Lithuania and the Government of the Republic of India on Co-operation in the Spheres of Culture, Science and Education	2005	India
Lithuania	Agreement between the Government of the Republic of Lithuania and the Government of the United States of America for Cooperation in Science, Technology and Innovation	2019	USA
Lithuania	Agreement between the Government of the Republic of Lithuania and the Government of the People's Republic of China on scientific-technological cooperation	1992	China
Lithuania	Agreement on Economic Cooperation between the Republic of Lithuania and the Argentine Republic	2019	Argentina
Lithuania	Agreement between the Government of the Republic of Lithuania and the Government of the United Arab Emirates on Economic and Technical Cooperation	2018	United Arab Emirates
Luxembourg	Memorandum of understanding between Luxembourg National Research Fund and RIKEN (JP)	2015	Japan
Luxembourg	Memorandum of understanding between Luxembourg National Research Fund and The National Research Foundation Singapore	2015	Singapore
Luxembourg	Memorandum of Understanding between the Luxembourg National Research Fund (FNR) and with the Fulbright Commission for Educational Exchange between Belgium, Luxembourg, and the United States of America	2017	USA
Luxembourg	Agreement between the Luxembourg National Research Fund (FNR) and NASA Ames Research Center (US)		USA
Malta	General Agreement on Economic, Trade, Scientific, Technical, Cultural, Youth and Sports Areas on Co-operation between the Government of Malta and the Government of the Kingdom of Saudi Arabia	2007	Saudi Arabia
Malta	Executive programme on scientific, technical and cultural cooperation between Malta and the Arab republic of Egypt for the years 1994 -1995 -1996	1994	Egypt
Malta	Agreement on Scientific and Technological co-operation between the Government of Malta and the Government of the People's Republic of China	2003	China
Malta	Executive programme for the cultural educational and scientific agreement between Malta and Kuwait for the years 2005-2007	2005	Kuwait

EU MS	Cooperation agreement	Year	Third country
Netherlands	MoU India - Netherlands on Renewable energy	2014	India
Netherlands	MoU Netherlands – Taiwan on Renewable Energy	2015	Taiwan
Netherlands	MoU Japan - Netherlands Cooperation in Science and Technology	1997	Japan
Netherlands	MoU UAE – Netherlands on innovation	2017	United Arab Emirates
Netherlands	MoU Indonesia - Netherlands to enforce research collaboration	2019	Indonesia
Netherlands	Renewal MoU Netherlands – China on Promotion of rural renewable energy (RRE) in Western China	2014	China
Netherlands	Science & Technology & Innovation MoU	2015	South Africa
Poland	MoU between the Ministry of Energy of the Republic of Poland and the Ministry of Energy of the Republic of Azerbaijan on cooperation in the field of energy	2017	Azerbaijan
Poland	Agreement between the Government of the Republic of Poland and the Government of the Republic of India on cooperation in the field of science and technology.	1993	India
Poland	Agreement between the Government of the Republic of Poland and the Government of the Republic of Korea on scientific and technical cooperation.	1994	Korea
Poland	Agreement on scientific and technical cooperation between the Government of the Republic of Poland and the Government of the People's Republic of China.	1995	China
Poland	Agreement between the Government of the Republic of Poland and the Government of the Kingdom of Thailand on scientific and technical cooperation.	1997	Thailand
Poland	Agreement on economic, scientific and technical cooperation between the Government of the Republic of Poland and the Government of Malaysia.	1996	Malaysia
Poland	Agreement between the Government of the Republic of Poland and the Government of the Federative Republic of Brazil on cooperation in the field of science and technology.	1998	Brazil
Poland	Agreement on cooperation in science and technology between the Government of the Republic of Poland and the Government of the United Mexican States	2000	Mexico
Poland	Agreement between the Government of the Republic of Poland and the Government of the Socialist Republic of Vietnam on cooperation in the field of science and technology.	1999	Vietnam

EU MS	Cooperation agreement	Year	Third country
Poland	Agreement between the Government of the Republic of Poland and the Government of South Africa on scientific and technical cooperation.	2000	South Africa
Poland	Agreement between the Government of the Republic of Poland and the Government of Mongolia on cooperation in the field of science and technology.	2001	Mongolia
Poland	Agreement between the Government of the Republic of Poland and the Government of Malaysia on cooperation in the field of science and technology.	2000	Malaysia
Poland	Agreement between the Government of the Republic of Poland and the Government of the Arab Republic of Egypt on cooperation in the field of science and technology.	2001	Egypt
Poland	Framework agreement between the Government of the Republic of Poland and the Government of the Kingdom of Saudi Arabia on cooperation in the fields of economy, trade, investment, technology, culture, tourism, youth and sport.	2004	Saudi Arabia
Poland	Agreement on cooperation in science and technology between the Minister of Science and Higher Education of the Republic of Poland and the State Commission for Scientific and Technological Research of the Republic of Chile	2007	Chile
Poland	Agreement between the Minister of Science and Higher Education of the Republic of Poland and the Secretariat of Science, Technology and Innovation of the Rep. Argentinean cooperation in the field of science and technology.	2007	Argentina
Poland	Agreement between the Government of the Republic of Poland and the Government of the State of Qatar on economic cooperation.	2017	Qatar
Poland	Agreement between the Government of the Republic of Poland and the Government of the People's Democratic Republic of Algeria establishing an Joint Intergovernmental Commission for economic, commercial, scientific and technical cooperation.	2018	Algeria
Poland	Agreement between the Government of the Republic of Poland and the Government of the United States of America on scientific and technical cooperation.	2018	USA
Poland	Agreement between the Government of the Republic of Poland and the Government of the Republic of Belarus on cooperation in the field of science and technology.	1992	Belarus
Poland	Agreement between the Government of the Republic of Poland and the Government of the Russian Federation on cooperation in the field of science and technology.	1993	Russia

EU MS	Cooperation agreement	Year	Third country
Portugal	Memorandum of understanding in the field of renewable energies	2017	Morocco
Portugal	Memorandum of understanding	2019	Mozambique
Portugal	Memorandum of understanding	2009	Cape Verde
Portugal	Memorandum of understanding on cooperation within China's modern Silk Road initiative	2018	China
Romania	Agreement between the Government of the United States of America and the Government of Romania on cooperation in science and technology	2000	USA
Romania	Agreement for scientific, technological and environmental cooperation between the Government of Romania and the Government of the Socialist Republic of Vietnam, amended by: Verbal Notes of 5 and 17 July 2002	2004	Vietnam
Romania	Agreement between the Government of Romania and the Government of the People's Republic of China on scientific and technological cooperation	2009	China
Romania	Agreement of economic, scientific and technical cooperation between the Government of Romania and the Government of the Republic of Korea Amended by: The Protocol between the Government of Romania and the Government of the Republic of Korea regarding the cooperation in the field of science, technological development and innovation.	2007	Korea
Romania	The Cooperation Protocol between the National Authority for Scientific Research and the Department of Science and Technology of South Africa Republic	2005	South Africa
Romania	Agreement of scientific and technological cooperation between the Ministry of Education, Research, Youth and Sport of Romania and the Ministry of Science, Technology and Innovation of the Republic of Argentina	2013	Argentina
Romania	Agreement between the Ministry of Research and Technology of Romania and the State Committee for Science and Technology of the Republic of Azerbaijan on scientific and technological cooperation	1996	Azerbaijan
Romania	Agreement on collaboration in the fields of science, education, culture, information, health, sport and tourism between the Government of Romania and the Government of the Republic of Belarus	1994	Belarus
Romania	Agreement of technical, scientific and technological cooperation between the Government of Romania and the Government of the Republic of Bolivia	1996	Bolivia
Romania	Agreement of technical, scientific and technological collaboration between the Government of Romania and the Government of the Republic of Chile	2005	Chile

EU MS	Cooperation agreement	Year	Third country
Romania	Agreement for technical, scientific and technological cooperation between the Government of Romania and the Government of the Republic of Colombia	1998	Columbia
Romania	Agreement for technical, scientific and technological cooperation between the Government of Romania and the Government of the Republic of Cuba	2002	Cuba
Romania	Agreement on scientific and technological cooperation between the Ministry of Research and Technology of Romania and the Ministry of Scientific Research of the Arab Republic of Egypt	1994	Egypt
Romania	Agreement between the Ministry of Research and Technology of Romania and the Ministry of Science and Technical Policy of the Russian Federation on scientific and technological cooperation	1995	Russia
Romania	Agreement between the Ministry of Research and Technology of Romania and the Department of Science and Technology of the Philippines on scientific and technological cooperation	1995	Philippines
Romania	Agreement for scientific and technological cooperation between the Government of Romania and the Government of the Republic of India	1994	India
Romania	Long-term economic, technical and scientific cooperation agreement between the Government of the Republic of Indonesia and the Government of the Socialist Republic of Romania, amended by: Protocol between the Government of Romania and the Government of the Republic of Indonesia amending the Agreement for scientific and technological cooperation, signed in Jakarta, 23.11.1982	2007	Indonesia
Romania	Memorandum of understanding in the field of research and technology between the Ministry of Research and Technology of Romania and the High Council for Science and Technology of the Hashemite Kingdom of Jordan	2000	Jordan
Romania	Memorandum of Understanding on the exchange of specialists between the Ministry of Research and Technology and the Japanese Society for the Promotion of Science	1994	Japan
Romania	Framework Convention for Technical and Scientific Cooperation between the Government of Romania and the Government of the United Mexican States	1995	Mexico
Romania	Agreement between the Government of Romania and the Government of the Republic of Uzbekistan on technical-scientific cooperation	1999	Uzbekistan
Romania	Common declaration for establishing a Strategic Economic Partnership between the Government of Romania and the Government of United Arab Emirates (17.10.2018)	2018	UAE

EU MS	Cooperation agreement	Year	Third country
Romania	Agreement between the Government of Romania and the Government of Mongolia on collaboration in the fields of education, culture, science, technology, health and sport	2005	Mongolia
Romania	Agreement on scientific and technological cooperation between the Ministry of Research and Technology of Romania and the Ministry of Science and Technology of the Islamic Republic of Pakistan	1997	Pakistan
Romania	Agreement between the Government of Romania and the Government of the Republic of Paraguay on collaboration in the fields of education, culture, science and sport	1995	Paraguay
Romania	Collaboration agreement in the fields of education, science and culture between the Government of Romania and the Government of Qatar	2003	Qatar
Romania	Agreement between the Government of Romania and the Government of Turkmenistan on cooperation in the fields of culture, science, education, information and sport	1996	Turkmenistan
Slovakia	Agreement between Slovak Republic and Russian Federation about the economic cooperation, and cooperation in technology and research	2005	Russia
Slovakia	Agreement between the Slovak Republic and the Kazakhstan Republic about the economic cooperation, and cooperation in technology and research	2013	Kazakhstan
Slovakia	FRAMEWORK AGREEMENT on comprehensive partnership and cooperation between the European Community and its Member States, of the one part, and the Republic of Indonesia, of the other part	2014	Indonesia
Slovakia	Agreement between the Czech and Slovak Federal Republic and the United States of America about the cooperation in research and technological development	1992	United States of America
Slovakia	Agreement between Slovak Republic and Russian Federation about the economic cooperation, and cooperation in technology and research	1993	Russia
Slovakia	Agreement between Ministry of Foreign and European Affairs of the Slovak Republic, and Government of the Belarusian Republic about the economic cooperation, and cooperation in technology and research.	2017	Belarus
Slovenia	Agreement between the Government of the United States of America and the Government of the Republic of Slovenia for Scientific and Technological Cooperation	1999	USA
Slovenia	Agreement on Scientific and Technological Cooperation between the Government of the Republic of Slovenia and the Government of the Republic of Argentina (OGRS - MP, 10/1999)	1999	Argentina

EU MS	Cooperation agreement	Year	Third country
Slovenia	Framework Agreement on Scientific and Technological Cooperation between the Government of the Republic of Slovenia and the Government of the Federative Republic of Brazil (OGRS - MP, 10/1999)	1999	Brazil
Slovenia	Agreement between the Ministry of higher education, science and technology (MHEST) of the Republic of Slovenia and the National council for scientific and technological development (CNPq) of the Federative Republic of Brazil	2019	Brazil
Slovenia	Memorandum of Understanding on Scientific and Technological Cooperation between the Ministry of Science and Technology of the Republic of Slovenia and the Secretariat of Science and Technology of the State of Minas Gerais, Federative Republic of Brazil	1997	Brazil
Slovenia	Agreement between the Government of Republic of Slovenia and the Government of the Arab Republic of Egypt on Economic, Industrial, Technological and Scientific Cooperation	2000	Egypt
Slovenia	Protocol on scientific and technological cooperation between the government of the Republic of Slovenia and the government of the Arab Republic of Egypt	2008	Egypt
Slovenia	Agreement between the Government of the Republic of Slovenia and the Government of the Republic of India on Scientific and Technological Cooperation (OGRS - MP, 4/1996)	1996	India
Slovenia	Agreement between the Government of the Republic of Slovenia and the Government of the Republic of the Philippines on Scientific and Technological Cooperation	2003	Philippines
Slovenia	Agreement between the government of the Republic of Slovenia and the government of the Republic of Indonesia on scientific and technological cooperation	2008	Indonesia
Slovenia	Agreement on Scientific and Technological Cooperation Between the Government on the Republic of Slovenia and of Republic of Korea	1995	Korea
Slovenia	Agreement between the Ministry of Science and Technology of the Republic of Slovenia and Ministry of Science and Technology policy of the Russian Federation for scientific and technological cooperation	1995	Russia
Slovenia	Memorandum of Understanding on Scientific Cooperation between The Ministry of Science, Education and Sport of the Republic of Slovenia and The Japan Society for the Promotion of Science	2001	Japan
Slovenia	Memorandum of Understanding between the Ministry of Education, Science and Sport of the Republic of Slovenia and the Ministry of Science and Technology of the Federative Republic of Brazil	2002	Brazil

EU MS	Cooperation agreement	Year	Third country
	Concerning a Joint Research and Development Cooperation Programme in Priority Areas		
Slovenia	Memorandum of Understanding between the Ministry of Education, Science and Sport of the Republic of Slovenia and the Ministry of Science and Technology of the People's Republic of China on joint financing of research and development projects	2019	China
Slovenia	Agreement on Economic, Scientific and Technological, and Cultural Cooperation between the Government of the Republic of Slovenia and the Government of the Belorussian Soviet Socialist Republic (OGRS - MP, 14/1992)	1992	Belarus
Slovenia	Agreement between the government of the Republic of Slovenia and the government of the Republic of Azerbaijan on cooperation in the fields of culture, education and science	2012	Azerbaijan
Spain	Framework Agreement on Scientific, Technical, Cultural And Educational Cooperation between the Kingdom of Spain and the Democratic and Popular Algeria Republic	1993	Algeria
Spain	Agreement on Cultural, Educational and Scientific Cooperation between the Kingdom of Spain and the Republic of Azerbaijan	2013	Azerbaijan
Spain	Agreement on Technical, Scientific and Technological Cooperation between the Kingdom of Spain and the Federative Republic of Brazil	1992	Brazil
Spain	Agreement on technical and scientific cooperation	2005	Haiti
Spain	General complementary agreement on technical and scientific cooperation	1992	Honduras
Spain	Agreement on scientific and technological cooperation	2011	Japan
Spain	Agreement on scientific and technological cooperation	2003	Russia
Spain	Agreement on technologic and scientific cooperation	2005	South Africa
Spain	Framework agreement on scientific and technical cooperation	1993	Tunisia
Spain	Agreement on cooperation in the field of environment	2008	Morocco
Spain	Special agreement on the development of solar radiation concentrator technology, within the framework of the General Agreement on Scientific and Technological Cooperation between the Argentine Republic and the Spanish State, made in Buenos Aires on April 16, 1986	1991	Argentina
Spain	Cooperation agreement in R&D	2013	China

EU MS	Cooperation agreement	Year	Third country
Spain	General cooperation agreement	2008	Saudi Arabia
Spain	General complementary agreement on cooperation of the basic scientific and technical cooperation agreement	1991	Guatemala
Spain	Framework agreement on cultural, scientific and technical cooperation	1994	Jordan
Spain	Agreement on cultural, educational and scientific cooperation between Spain and Australia	1991	Australia
Spain	Agreement on cultural, educational and scientific cooperation	1996	Georgia
Spain	Agreement on cultural, educational and scientific	2010	Kuwait
Spain	Agreement on cultural, educational and scientific cooperation	2011	Singapore
Sweden	Memorandum of Understanding on Swedish-Chinese Energy Cooperation	2017	China
Sweden	Memorandum of Understanding on Sweden-India Renewable Energy Cooperation	2010	India
Sweden	Memorandum of Understanding on Swedish-Brazilian Bioenergy Cooperation	2009	Brazil
Sweden	Agreement on Science and Technology Cooperation between the Government of the Kingdom of Sweden and the Government of the United States of America	2006	USA
Sweden	Memorandum of Understanding between the Government of the Kingdom of Sweden and the Government of Canada on Science and Technology Cooperation	2010	Canada
United Kingdom	Memorandum of Understanding between the Department of Energy of the United States of America and the Department of Energy of the United Kingdom of Great Britain and Northern Ireland on Collaboration in Energy Research and Development	2000	USA
United Kingdom	Statement of Intent (SOI) between NITI Aayog and the Department of Business, Energy and Industrial Strategy (BEIS), UK	2018	India
United Kingdom	Plan of Action on science, technology and innovation between the Governments of the Federative Republic of Brazil and of the United Kingdom of Great Britain and Northern Ireland	2006	Brazil
United Kingdom	Agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the Russian Federation on science and technology cooperation	1994	Russia
United Kingdom	Agreement on co-operation in science and technology	1994	Japan

EU MS	Cooperation agreement	Year	Third country
United Kingdom	Agreement on co-operation in science and technology	1995	South Africa
United Kingdom	Memorandum of Understanding (MoU) on science, technology, and innovation	2017	Canada
United Kingdom	Agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the Republic of Indonesia on co-operation in the fields of education, science and culture	2002	Indonesia
United Kingdom	Agreement on cooperation in the fields of education, science and culture	1995	Belarus
United Kingdom	Agreement on cooperation in the fields of education, science and culture	1994	Azerbaijan
United Kingdom	Agreement on cooperation in the fields of education, science and culture	1993	Georgia
United Kingdom	Agreement on cooperation in the fields of education, science and culture	1994	Kazakhstan
United Kingdom	Agreement on cooperation in the fields of education, science and culture	1994	Kyrgyzstan
United Kingdom	Agreement on cooperation in the fields of education, science and culture	1993	Uzbekistan
United Kingdom	Agreement on cooperation in the fields of education, science and culture	1994	Armenia
United Kingdom	UK-China Joint Strategy For Science, Technology and Innovation Cooperation	2017	China
Total	328		

Annex 4: Overview of Multilateral Cooperation Agreements

The table below provide an overview of the multilateral cooperation agreements in which the countries selected in Chapter 3 are involved.

EU MS	Multilateral agreement	Year	Third country	Responsible ministry	Funding mechanism	R&I Action Type
Denmark	AEEP	2007	Europe, Africa	Participation through the European Commission	Unknown	6
Finland	AEEP	2007	Europe, Africa	Participation through the EC	Unknown	6
France	AEEP	2007	Europe, Africa	Participation through the European Commission	Unknown	6
Germany	AEEP	2007	Europe, Africa	Participation through the EC	Unknown	6
Ireland	AEEP	2007	Europe, Africa	Participation through the EC	Unknown	6
Italy	AEEP	2007	Europe, Africa	Participation through the EC	Unknown	6
Netherlands	AEEP	2007	Europe, Africa	Participation through the EC	Unknown	6
Poland	AEEP	2007	Europe, Africa	Participation through the EC	Unknown	6
Spain	AEEP	2007	Europe, Africa	Participation through the EC	Unknown	6
Sweden	AEEP	2007	Europe, Africa	Participation through the EC	Unknown	6
Denmark	CEM		Worldwide	Ministry for Climate, Energy and Utilities	Project-specific	3,5
Finland	CEM		Worldwide	Ministry of Economic Affairs and Employment	Project-specific	3,5
France	CEM		Worldwide	Ministry for the Ecological and Inclusive Transition	Project-specific	3,5
Italy	CEM		Worldwide	Ministry of Economic Development	Project-specific	3,5
Netherlands	CEM		Worldwide	Ministry of Economic Affairs and Climate Policy	Project-specific	3,5
Poland	CEM		Worldwide	Ministry of Energy	Project-specific national funding	3,5
Spain	CEM		Worldwide	Ministry of Energy, Tourism and Digital Agenda	Project-specific	3,5
Sweden	CEM		Worldwide	Ministry of Infrastructure	Project-specific	3,5
Germany	CEM		Worldwide	Ministry for Economic Affairs and Energy	Personnel for networking activities; National funding	3

EU MS	Multilateral agreement	Year	Third country	Responsible ministry	Funding mechanism	R&I Action Type
Germany	ERA-NETs		Europe, Latin America, Russia (depending on ERA-NET)	Ministry for Economic Affairs and Energy	Grants, National funding, nat. funding rules and implement. agencies (under 7 th Energy Research Programme)	1,2
Denmark	IEA-TCP		Worldwide	Ministry for Climate, Energy and Utilities	Membership fee for participation	1,2, 4
Finland	IEA-TCP		Worldwide	Ministry of Economic Affairs and Employment	Membership fee for participation	1,2, 4
France	IEA-TCP		Worldwide	Ministry for the Ecological and Inclusive Transition	Membership fee for participation	1,2, 4
Ireland	IEA-TCP		Worldwide	Sustainable Energy Authority of Ireland (SEAI)	Membership fee for participation	1,2, 4
Netherlands	IEA-TCP		Worldwide	Ministry of Economic Affairs and Climate Policy	Membership fee for participation	1,2, 4
Spain	IEA-TCP		Worldwide	Ministry for the Ecological Transition and the Demographic challenge	Membership fee for participation	1,2, 4
Sweden	IEA-TCP		Worldwide	Ministry of Infrastructure, Swedish Energy Agency	Membership fee for participation, Funding for different actors to participate in TCP-activities	1,2, 4
Germany	IEA-TCP		Worldwide	Ministry for Economic Affairs and Energy	National funding, nat. funding rules and implement. agencies (under 7 th Energy Research Programme)	1,2
Germany	IRENA	2009	Worldwide	Ministry for Economic Affairs and Energy	Funding for Innovation and Technology Centre (IITC) in Bonn	3
Sweden	Mission Innovation	2015	Worldwide	Ministry of Infrastructure	National	1,2, 3
Germany	Mission Innovation	2015	Worldwide	Ministry for Economic Affairs and Energy	Personnel for networking activities	3
Denmark	Mission Innovation	2015	Worldwide	Ministry for Climate, Energy and Utilities	National	6
Finland	Mission Innovation	2015	Worldwide	Ministry of Economic Affairs and Employment	National	6
France	Mission Innovation	2015	Worldwide	Ministry for the Ecological and Inclusive Transition	National	6
Italy	Mission Innovation	2015	Worldwide	Ministry of Economic Development	National (grants with 100% funding rate)	6

EU MS	Multilateral agreement	Year	Third country	Responsible ministry	Funding mechanism	R&I Action Type
Netherlands	Mission Innovation	2015	Worldwide	Ministry of Economic Affairs and Climate Policy	National	6
Finland	SET		EU27, CH, IS, NO, TR	Ministry of Economic Affairs and Employment	Unknown	1,3,5
France	SET		EU27, CH, IS, NO, TR	Ministry for the Ecological and Inclusive Transition	Unknown	1,3,6
Ireland	SET		EU27, CH, IS, NO, TR	Sustainable Energy Authority of Ireland (SEAI)	Unknown	1,3,8
Italy	SET		EU27, CH, IS, NO, TR	Ministry of Economic Development, Ministry of University and Research	No funding, only strategic guidance	1,3,9
Germany	SET		EU27, CH, IS, NO, TR	Ministry for Economic Affairs and Energy	Personnel for networking activities, National funding	1,3

Annex 5: Funding entity database

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Denmark	Ministry of Foreign Affairs	The Danish Climate Envelope is a mechanism for channeling Danish dedicated climate funding to support mitigation and adaptation activities in developing countries. The Ministry for Foreign Affairs proposes and prepares activities for half of the Climate Envelope funds. In collaboration with the Ministry of Climate, Energy and Utilities, the Ministry of Foreign Affairs, Denmark, is funding many bilateral and multilateral activities. The ministry has recently appointed a climate ambassador of Denmark and selected 15 embassies as so-called front posts for Denmark's activities to combat climate change.	Grants	2016	2140	Emerging countries, Priority countries (Afghanistan, Burkina Faso, Mali, Niger, Palestine, Somalia, Bangladesh, Ethiopia, Kenya, Myanmar, Tanzania and Uganda)	Renewable Energy, Energy Planning, Energy Efficiency, Reform of Policy Frameworks, Climate-Friendly Technologies and Solutions	Collaborative demonstration projects, from TRL 5 to 7
Denmark	Ministry of Climate and Energy	The Ministry of Climate, Energy and Utilities is responsible for Denmark's Energy policy and many aspects of international collaboration, including activities related to DG-Energy, the IEA, Mission Innovation etc. The Ministry for Climate Change also proposes and prepares activities for half of the Climate Envelope funds (see 'Ministry of Foreign Affairs').	Grants			UAE, China, Germany, Vietnam, Indonesia, Mexico, Kenya, India, France, South Africa, South Korea, Japan, and the US		

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Denmark	Ministry of Higher Education and Science	The Ministry of Higher Education and Science has bilateral agreements with countries.	Grants			US, South Korea, Japan, Israel, Turkey, Vietnam, South Africa, India, Brazil, and China		
Denmark	The Energy Technology Development and Demonstration Program (EUDP-Energiteknologisk Udviklings- og Demonstrationsprogram)	Supports development and demonstration of energy technologies in the Danish national STI-system, which can contribute to fulfilling Denmark's goals in Energy and Climate. It is a public subsidy scheme. For instance, this funding agency supports research if it is part of development and demonstration projects. It can also support international projects. Sits under the The Ministry of Climate, Energy and Utilities.	Grants		33.5	Denmark	RET	
Denmark	The Danish Agency for Science and Higher Education	The Danish Agency for Science and Higher Education has responsibility for all tasks that require particular expertise within the areas of research and education. The agency lays the foundation for further development of high-quality Danish research and higher education, and works to promote good international interaction in both research and education areas.	Grants				Research and education	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Denmark	Innovation Centres Denmark	The Innovation Centres are the Government of Denmark's main instrument for implementation of bilateral collaboration activities in the STI-areas. The Innovation Centres Denmark are located at the Embassies of Denmark.	Grants					
Denmark	Danish Energy Agency	The agency has a global bilateral consultancy program that supports government-to-government collaboration among relevant authorities that are responsible for national energy systems and energy regulation. It is responsible for tasks linked to energy production, supply and consumption, as well as Danish efforts to reduce carbon emissions. Sits under the The Ministry of Climate, Energy and Utilities.	Grants			International	RET	
Denmark	Innovation Fund Denmark	The main funding agency of energy related research and development of technology in the national funding system. Sits under The Ministry of Higher Education and Science. Innovation Fund Denmark creates a framework for entrepreneurs, researchers and businesses so they can develop innovative and viable solutions to society's challenges. The agency is also funding the participation of Danish stakeholders in the EU-STI-programmes as well as providing funding for the joint	Grants		2 (per call)	India, China, Denmark	Innovations	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
		bilateral calls. Innovation Fund has active collaboration with India and China.						
Finland	Ministry of Education and Culture	The Ministry of Education and Culture oversees the university sector, although from a strategic and political stance, with direct oversight of university funding delegated to the Academy of Finland						
Finland	Ministry for Foreign Affairs through Academy of Finland	Has a role in mediating international relations between Finland and other countries, though in practice it is rarely a signatory in bilateral Cooperation Agreements. Oversees opportunities in international development cooperation for the private sector, though this remit does not have an R&I focus. EUR 129.7 million is proposed for development policy investments. At least 75% of the allocations made during the parliamentary term will be directed to climate finance.	Grants	2019	458	Finland	Unknown	
Finland	Academy of Finland	The Academy of Finland's mission is to fund high-quality scientific research, provide expertise in science and science	Grants	2020	423	Unknown	Unknown	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
		policy, and strengthen the position of science and research.						
Finland	Business Finland (formerly Tekes)	At Business Finland, new growth is created by supporting companies to go global, as well as funding innovations. The main beneficiaries of Business Finland funding are companies, but various funding streams are provided which link up business and universities in joint research projects. There are various funding schemes that target international activities. As a rule – because it contravenes the organisation's legal remit and Finnish law governing the expenditure of taxpayers' money – Business Finland cannot allocate any funding directly to third country partners under these schemes. There is, however, the option of a joint venture.	Grants and loans	2018	680	Finland	H2020	Market uptake measures projects
Finland	Ministry of Economic Affairs and Employment	Oversees the national energy and climate strategy. Oversees Business Finland (Finland's main funding agency in the context of R&I in RET). Develops the energy markets and the security of supply, promotes renewable energy and energy efficiency, and regulates nuclear energy. Is the signatory in bilateral cooperation agreements.				Finland	RET	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Finland	VTT Technical Research Centre of Finland	A visionary research, development and innovation partner. VTT drives sustainable growth and tackles the biggest global challenges of our time and turns them into growth opportunities.				Unknown	RET	
France	Alternative Energies and Atomic Energy Commission (CEA)	<p>The French Alternative Energies and Atomic Energy Commission (CEA) is a key player in research, development and innovation in four main areas: defence and security, low carbon energies (nuclear and renewable energies), technological research for industry, fundamental research in the physical sciences and life sciences.</p> <p>CEA covers research areas including nuclear power, alternative energies, defence, information technologies and health. It takes an active part in International research forums.</p> <p>In recent years the CEA has significantly increased its activities in alternative energies, in particular for the building and transport sectors.</p>	Funding mainly through Supernova Invest	2016	4814	International	Low carbon energies, including: renewables (solar) more efficient energy storage dynamic adjustment of supply and demand response through energy storage (batteries) hydrogen as an energy vector smart power grids	Collaborative research projects, up to technology readiness level (TRL) 5

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
France	The Agency for Environment and Energy Management (ADEME)	ADEME supports and funds environment and energy research on a partnership basis. The ADEME was created in 1991 to promote innovation in the field of environment.				Africa	RET (energy and climate; sustainable consumption , waste and material management ; sustainable land management and preservation and remediation of environments (soil and air)	
France	National Research Agency (ANR)	ANR provides funding for project-based research in all fields of science - for both basic and applied research - to public research organisations and universities, as well as to private companies (including SMEs). Its activity also contributes to enhancing the competitiveness and the influence of French research in Europe and across the world. Energy and sustainable development is one of the main areas covered.				Unknown	RET	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
France	Agence Française de Développement (AFD) / French Development Agency	AFD is a financing company and a public industrial and commercial institution, acting as financier, advisor, partner and implementer to mobilise finance and expertise for development projects in emerging and developing countries. It is the main implementing agency for France's official development assistance to developing countries and overseas territories.				Unknown	RET	
Germany	Ministry for Economic Affairs and Energy	Responsible for energy policy in Germany, the research & innovation strategy laid down in the 7th Energy Research Programme "Innovations for the Energy Transition (7. Energieforschungsprogramm "Innovationen für die Energiewende") as well as aspects of international collaboration (addressed in the 7th Energy Research Programme), including activities related to the SET-Plan, Mission Innovation, the Clean Energy Managerial, and IEA Technical Collaboration Programmes (TCPs).						

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Germany	KfW banking group	The KfW accommodates loans at favourable conditions to retail customers, enterprises, non-profit organisations and municipalities to improve economic, social and environmental living conditions across the globe on behalf of the Federal Republic of Germany and the federal states.	Loans	2017	76.5	International	Unknown	Collaborative research projects, up to technology readiness level (TRL) 5
Germany	German Research Foundation	An institute, which provides financial support for research in higher education and public research institutions, amongst renewable energy. Besides, International collaborations and interchange are possible and desired in all DFG funding programmes.		2018	3400	International	RET	
Germany	DLR Project Management Agency	Research, innovation and education. Develops practical strategies, manage funding programmes and projects (for Government ministries, such as the Federal Ministry of Education and Research or the Federal Ministry for Economic Affairs and Energy), assists in dialogue processes and support knowledge transfer and utilisation on behalf of clients. DLR opens up networking opportunities and encourage International collaboration		2018	1035	International	RET	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Germany	International Bureau of the DLR	The International Bureau is part of the 'European and International Cooperation' department of the DLR Project Management Agency at the German Aerospace Centre (DLR). It has more than 20 years of experience in International research management and regional expertise related to various countries and regions on all continents. The International Bureau is using the funds provided by the Federal Ministry of Education and Research to explore, initiate and expand International cooperation activities of German universities, research institutions and companies.				International	RET	
Germany	Project Management Jülich	Manages R&I projects implemented within the 7th Energy Research on behalf of the Ministry for Economic Affairs and Energy. Implements (on behalf of clients) research and innovation funding programmes that have been tailored to meet their specific requirements and address socio-political needs.		2017	1610	International	RET	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Germany	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	Responsible for implementing energy agreements with a number of developing and emerging countries. As a service provider in the field of International cooperation for sustainable development and International education work, GIZ is dedicated to shaping a future worth living around the world. GIZ has over 50 years of experience in a wide variety of areas, including economic development and employment promotion, energy and the environment, and peace and security. Its main commissioning party is the German Federal Ministry for Economic Cooperation and Development (BMZ). When acting as funding entity (e.g. on behalf of BMZ), GIZ has three different types of financing agreements: subsidy agreements, grant agreements and financing agreements.				International (developing and emerging countries such as China and India, South Africa, Brazil, Mexico, Chile, Algeria, Morocco, Tunisia and Jordan)	RET	
Germany	Alliance Industry Research AIF	The leading national organisation promoting applied research and development benefiting Germany's small and medium-sized businesses.		2019	500	Unknown	RET	
Germany	Navigant	Navigant applies experience, foresight, and industry expertise to pinpoint emerging opportunities to help build, manage, and protect businesses' value. Responsible for energy agreements with countries of the Arabian Peninsula.				Arab peninsula	Unknown	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Germany	Adelphi	Adelphi is a leading independent think tank and public policy consultancy on climate, environment and development. Its mission is to improve global governance through research, dialogue and consultation. Adelphi offers demand-driven, tailor-made services for sustainable development, helping governments, international organisations, businesses and nonprofits design strategies for addressing global challenges. Responsible for implementing Energy Partnerships & Energy Agreements for selected countries (see Geographic scope).				Australia and Japan (Energy Agreements), USA, Canada and South Korea (Energy Partnerships)	Unknown	
Ireland	Department of Business, Enterprise and Innovation (DBEI)	DBEI has a primarily commercial focus, but part of its remit is to bring together research and commercial interests for Ireland's economic benefit. DBEI chairs the implementation group overseeing the national Innovation 2020 strategy - Ireland's strategy for research and development, science and technology. Funds both the agencies Science Foundation Ireland (SFI) and Enterprise Ireland (see below).						
Ireland	Department of Communications, Climate Action and Environment (DCCAE)	Oversees Ireland's energy policy agenda, and the Sustainable Energy Authority of Ireland (SEAI).						

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Ireland	Department of Education and Skills	Oversees the education agenda, including the Irish Research Council (see below)						
Ireland	Department of Foreign Affairs and Trade	Covers Ireland's international relations portfolio.						
Ireland	Sustainable Energy Authority of Ireland	Guides energy policy including renewable energy priorities. Individuals from SEAI also represent Ireland in SET Plan meetings, and the SEAI helps the ensure that Ireland remains on track to meet SET Plan targets. Invests in research, development and demonstration projects, associated with the production, supply and use of energy. Nowadays, it participates in International collaborations focused on the development of low-carbon technologies through the International Energy Agency.				Unknown	RET	
Ireland	Science Foundation Ireland	Invests in academic researchers and research teams who are most likely to generate new knowledge, leading edge technologies and competitive enterprises in the fields of science, technology, engineering and maths.	Grants	2018	188.25	Unknown	Unknown	
Ireland	Enterprise Ireland	Ireland's enterprise development agency. Enterprise Ireland delivers a portfolio of funding initiatives that primarily target businesses. Focus on domestic concerns means that in practice it funds few if any commercially applicable R&I in RET projects				Unknown	Unknown	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Ireland	Irish Research Council	Funds research and projects based in Irish universities and research institutions. The main focus is on basic, academic research. The Irish Research Council offers various networking grants, fellowships and exchange schemes. A small number of these are through collaboration with funding agencies in third countries. SFI focusses largely on addressing companies' needs through matching with researchers in Ireland's higher education institutions. It also oversees a suite of 16 thematic research centres.	Grants			International (focus on USA)	RET	
Italy	Ministry of Foreign Affairs and International Cooperation (MAECI)	Stipulates bilateral Executive Programmes for Scientific and Technological Cooperation with the governments of third countries. After the stipulation of a bilateral agreement, MAECI, in conjunction with MIUR, opens a public call for projects (Projects of Major Importance / Progetti di Grande Rilevanza) to award to a winning bidder (Principal Investigator) the implementation of the tasks deriving from the agreement. These projects were awarded to and are being implemented mainly by different Italian universities and public Italian research bodies.				Italy	New Energy Sources, Oil Alternatives, Exploitation of Natural Resources	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Italy	Ministry of Education, University and Research (MIUR)	Within the Ministry, there is a national representative of Horizon activities related to energy (H2020 and Horizon Europe). Each Member State has a representative and all together the representatives prepare the H2020 Work Programme and discuss the topics of the calls, with the support of the European Commission. The Italian representative coordinates the Italian committee which prepares Italy's position for the H2020 discussions at EU level. The committee is made of ca. 120 stakeholders, both from the public and the private sector (i.e. ENEL, SNAM, etc.) and from research centres (i.e. technical universities, CNR, etc.), which contribute to the debate with the objective to facilitate their participation to the upcoming calls for projects. Within the committee, there is a representative for each sector (i.e. photovoltaic, geothermal, wind, smart grids, etc.).				Unknown	Unknown	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Italy	Ministry of Economic Development (MISE)	Responsible for the funding and implementation of multilateral agreements, such as Mission Innovation and Clean Energy Ministerial (CEM). In collaboration with MIUR, MISE is also responsible for the implementation of the SET Plan. Funding through the fund "ricerca di sistema". As MISE does not directly carry out research activities, Italy's funding for Mission Innovation are assigned from MISE to research centres (i.e. ENEA, CNR, RSE, OGS, IIT). These centres are entitled to 100% funding rate with no need for a public tender procedure, because they are public bodies. The criteria for them to receive MISE 's funding for Mission Innovation is to make all the results of their research publicly available.				Italy	Unknown	
Netherlands	Merian fund	Dutch Research Council (NWO) stimulates bilateral research through the Meridian fund. The Meridian Fund is a fund for International cooperation with (emerging) science countries and developing countries. The common thread within the Meridian Fund is International research to promote the achievement of the United Nations Sustainable Development Goals worldwide. The Meridian Fund finances the Dutch part of the bilateral research,	Grants		1.5	Brazil, China, India, Indonesia and South Africa	Unknown	Collaborative research projects, up to technology readiness level (TRL) 5

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
		the foreign part is financed by the partner country						
Netherlands	The Ministry of Economic Affairs and Climate Policy	For high TRL, the Ministry of Economic Affairs and Climate (along with RVO) is responsible for implementation.				Unknown	Unknown	
Netherlands	NWO (Dutch Research Council)	NWO aims to promote scientific research, which has scientific and social impact on International level. As a national research organisation with an active contribution to various parts of the national science and innovation policies, NWO plays different roles: financing, programming, bringing together, supporting and influencing. NWO is not directly devising new CAs, but rather facilitating the agreements. NWO is continually in talks with countries about collaboration and has the ambition to be more agenda driven. NWO can fund research in third country research but this is a general instrument and not for specific agreements. NWO very recently launched an instrument aimed at fostering collaboration with some countries - science diplomacy.	Grants and loans	2018	1220	International	RET	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Netherlands	RVO (Netherlands Enterprise Agency)	Provides grants (ISDE) for private entrepreneurs and in some cases for International commercial businesses to support the development of renewable energy resources.	Grants and loans	2019	160	International	RET	
Netherlands	WOTRO	NWO-WOTRO is a sub-organisation of NWO. NWO-WOTRO Science for Global Development programmes, funds and monitors innovative research on global issues, with a focus on sustainable development and poverty reduction. NWO-WOTROs research projects are realised by interdisciplinary teams of researchers	Grants and loans			International	Sustainable Development and Poverty Reduction	
Netherlands	TNO	TNO connects people and knowledge to create innovations that boost the sustainable competitive strength of industry and well-being of society. It is an applied research institute, which mainly receives funding directly from the Ministry of Economic Affairs or through RVO, but can co-fund projects with NWO.				International	Unknown	
Poland	Ministry of Science and Higher Education					Unknown	Unknown	
Poland	National Centre for Research and Development (agency for applied	Support of the Polish research units and enterprises in developing their abilities to create and use solutions based on scientific research results in order to encourage economy development and to the benefit of society.		2017	1209	International	RET	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
	research supervised by MSHE)							
Poland	National Centre of Science (NCN) (agency for basic research supervised by MSHE)	NCN is a government agency, supervised by the Ministry of Science and Higher Education, set up in 2011 to support basic research in Poland. Basic research is defined as empirical or theoretical endeavours undertaken to gain new knowledge of the foundations of phenomena and observable facts, without any direct commercial use.	Grants		313	International	Unknown	
Spain	CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas)	The CIEMAT is a public research body assigned to the Ministry of Science and Innovation under the General Secretariat for Research, focusing on energy and environment and the technologies related to them. Its R&D&I activity is framed in national and international settings, and is complemented by activities such as education, technology transfer, rendering technical services, advising to the administrations and representation of Spain in a diversity of international forums.				International	RET	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
Spain	Spanish Foundation for Science and Technology	FECYT is a public foundation under the Ministry of Science, Innovation and Universities. FECYT was founded in 2001 with the aim of promoting scientific research of excellence as well as the development and technological innovation necessary to increase the competitiveness of Spanish industry and improve the quality of life of citizens, encouraging collaboration between agents involved in R & D and the dissemination and communication of research and innovation results.			3.25	Spain	Innovations	
Spain	National Renewable Energy Centre (CENER)	The National Renewable Energy Centre of Spain (CENER) develops applied research in renewable energies, and provides technological support to companies and energy institutions in six areas: wind, solar thermal and photovoltaic solar energy, biomass, smart and efficient buildings and districts, and grid integration of energy				Unknown	RET (wind, solar thermal and photovoltaic solar energy, biomass, smart and efficient buildings and districts, and grid integration of energy)	
Spain	Centre for Energy, Environment and Technological	The CIEMAT as public body for research in the fields of energy, environment and technology, develops its R&D around technological projects which form a bridge between R&D&I and social interest goals.				International	RET	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
	Research (CINEMAT)							
Spain	Centre for Industrial Technological Development (CDTI)	Public Business Entity, answering to the Ministry of Economy and Competitiveness, which fosters technological development and innovation activities of Spanish companies. CDTI channels the funding and supports applications for national and international RDI projects of Spanish companies.				Unknown	RET	
Sweden	Swedish Energy Agency	This agency promotes (International collaboration for) sustainable energy systems, combining ecological sustainability, competitiveness and security of supply.				International	RET	
Sweden	VINNOVA	Aims to become a leading global player in research and innovation by showing that Sweden is an attractive country for investment and entrepreneurship.				International	RET	
Sweden	The Swedish Research Council for Environment, Agricultural Sciences and Spatial	Formas encourages and supports scientifically significant research related to sustainable development. Funded projects cover a wide range of approaches from basic research to more applied efforts.				Unknown	RET	

Selected Country	Funding Entity	Description	Funding Approach	Budget year	Total Funding Budget (million € per year)	Geographic Scope	Thematic Scope	R&I Actions Taken
	Planning (Formas)							
Sweden	The Swedish Research Council	The Swedish Research Council is Sweden's largest governmental research funding body, and supports research of the highest quality within all scientific fields.	Grants		633	Unknown	Unknown	

Annex 6: Funding profiles

Networking projects

Description of R&I action

Networking projects are projects or initiatives which seek to preserve or establish official relationships between individuals and/or research entities from EU Member States and third countries, for the purposes of strengthening cooperative linkages, stimulating dialogue and knowledge exchange.

Funding profile

Organisational set-up

Networking projects between EU Member States and a third country are mainly set-up by EU Member State ministries and their counterpart in the third country. In some Member States, the funding agencies are involved in setting up networking projects. However, typically as no funding is attached to the networking projects, the funding agencies do not play a large role. Nevertheless, if specific actions such as attending workshops/conferences are attached to the networking project, funding agencies can be involved. The ministries involved in each Member State varies but the most frequent ones are the research ministry, the energy ministry and the foreign affairs ministry.

The multilateral cooperation agreements that are used to facilitate networking projects include primarily the SET Plan, Mission Innovation and CEM. These three multilateral cooperation agreements are forums and are focused on providing strategic guidance and networking opportunities.

Objectives

For most networking projects international cooperation is seen as main objective with R&I in RET seen as a secondary objective.

Funding approach

Networking projects typically do not have funding attached to it. If there is funding involved its usually Member States paying for their domestic partners' travel cost or attendance cost. For example, in Germany within the bilateral agreements Energy Partnerships and Energy Dialogues, funding is provided to organise dialogue formats such as conferences and study tours in Germany and the partner countries. In the Netherlands, the NWO very recently launched an instrument that aimed at fostering collaboration with some countries. This instrument involves the funding of travel costs for participants to attend workshops. These workshops are not under a MoU but it might be used to setup a meeting to facilitate the creation of a new MoU.

Multilateral agreements (such as SET Plan, Mission Innovation and CEM) do not have specific budget lines, but Member States fund representatives to attend the forums.

Scope & Timeframe

As most bilateral CAs include networking as one of their objectives, both the time frame and geographic scope is large. The geographic scope includes the following third countries: China, India, Indonesia, USA, South Africa, Vietnam, Chile, Tunisia, Japan, South Korea, Argentina, Mexico, Qatar, Algeria, Australia, Azerbaijan, Brazil, Haiti, Honduras, Morocco, Colombia, Kuwait, Russia, and Cuba. The timeframe of the CAs range from 1990's to 2019.

Joint programme, collaborative research projects and collaborative demonstration projects

Description of R&I actions

Joint programmes are those which are jointly designed, funded and implemented with third countries. They consist of R&I projects in the field of renewable energy technologies, resulting in a new product, process or service.

Collaborative research projects (up to TRL 5) are pre-commercialised projects or initiatives which are carried out by multiple individuals/research entities from various countries and encompass initial basic technology development up to the validated of RE technologies in relevant environments.

Collaborative demonstration projects (from TRL 5-7) are projects or initiatives that are carried out by multiple individuals/research entities from various countries and focus on demonstrating/validating RE technologies, i.e. system prototype demonstrations in operational environments.

Funding profile

Organisational set-up

A variety of bodies are involved with the implementing and funding of joint activities including ministries, funding and implementation agencies. Even though ministries are often used to facilitating cooperation agreements, the funding agencies take a leading role in funding and implementing the actions under the agreements. However, for some joint activities, no cooperation agreements are needed and funding agencies directly cooperate with the agency in the third country.

CEM was the primary multilateral agreement engaged for joint programmes. For collaborative research projects and demonstration projects the main instrument were the IEA-TCPs. SET Plan was cited as being used by some countries.

Objectives

For most joint programmes, collaborative research projects and collaborative demonstration projects the objective is unknown. Given the desk research and stakeholder interviews it appears that here the main objective is increase international collaboration as well as export

Funding approach

Member States typically fund joint activities through grants for domestic partners. The size of the grant varies depending on the type of stakeholder involved. The partners in third countries typically do not receive funding from Member States.

Several IEA-TCPs have (national) budget available for the implementation of projects (on joint agreed topics).

Scope & timeframe

Most of the bilateral CAs are from 2011 onwards but the full range does include three specific CAs that date back to the early 1990s. China, India, Indonesia, USA, South Africa, Vietnam, Chile, Tunisia, Japan, South Korea, Argentina, Mexico, Qatar, Algeria, Australia, Azerbaijan, Brazil, Haiti, Honduras, Morocco, Colombia, Kuwait, Russia, UAE, Israel, Jordan, Kazakhstan, Nigeria, Georgia, Guatemala, Cuba, and Saudi Arabia.

Market uptake measures projects and others

Description of R&I action

The market uptake measures project are projects or initiatives which aim to move pre-commercialised but technologically proven RE technologies from the (late) development stage to commercial uptake.

Funding profile

Organisational set-up

The organisational set-up of market uptake measures is similar to that of the organisational set-up of joint activities. The funding agencies take a more leading role in these types of projects; however, the number of funding agencies involved in each Member State is smaller and the TRL level of these projects is higher and thus not funded by some agencies.

IEA TCPs was the primary multilateral agreement engaged for market uptake projects.

Objectives

For most market uptake measure projects, the objective is unknown. Given the desk research and stakeholder interviews it appears that here the main objective is to increase international collaboration as well as provide platforms for companies in Member States to export their products to third countries.

Funding approach

The funding approach for most market uptake measures is similar to how joint activities are funded through co-financing with third countries and providing grants to national partners.

Scope & timeframe

Most of the bilateral CAs are from 2011 onwards but the full range does include three specific CAs that date back to the early 1990s. The geographic scope includes China, Indonesia, Argentina, China, India, Mexico, South Africa, Algeria, Azerbaijan, Brazil, Haiti, Honduras, Japan, Morocco, Tunisia, Cuba, Taiwan, Colombia, and South Korea.

Annex 7: Overview of international R&I in RET actions within Horizon 2020 – Work Programme 2018-2020 – 10 – Secure, clean and efficient energy, of 2 July 2019

LC	Countries	RET Field	Title	Scope	RET Action	Amount Planned
LC-SC3-RES-1-2019-2020	All Mission Innovation countries	All RET	Developing the next generation of renewable energy technologies	Due to the pre-competitive nature of the research activities of this type, particular emphasis is put on including international cooperation opportunities whenever relevant to the proposal and the domain, in particular in the context of the Mission Innovation Challenges.	TRL 3/4	2-4 million
LC-SC3-RES-3-2020	US and/or China	Solar Fuels (linked t to Mission Innovation challenge 4 and 5)	Alternative renewable fuels from sunlight for energy transport and chemical storage	Advanced biofuels for energy and transport through photochemical/photo biochemical or electro chemical reaction	TRL 3/4	2-4 million
LC-SC3-RES-20-2020	Gulf Region	CSP	Efficient combination of Concentrated Solar Power and desalination (with particular focus on the Gulf Cooperation Council (GCC) region)	In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is encouraged, in particular with Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. The participation of organisations from these countries as partners in the project will be positively evaluated.	TRL 6	6-10 million
SC3-RES-25-2020	Japan	Advanced biofuels and alternative renewable fuels excluding hydrogen (linked to Mission Innovation Challenge 4)	International cooperation with Japan for R&I on advanced biofuels and alternative renewable fuels	Development of disruptive catalytic technologies	TR3	2-5 million
LC-SC3-RES-29-2019	All Mission Innovation countries	Solar Fuels	Converting Sunlight to storable chemical energy	As part of Mission Innovation actions, the project will be required to contribute towards the activities of the "Converting Sunlight Innovation Challenge". Beside solving the technical challenge, the	TRL4-5	2-3 million

LC	Countries	RET Field	Title	Scope	RET Action	Amount Planned
				consortium is expected to budget the participation in the development of the Challenge work plan through activities such as dissemination, exchange of researcher and networking as well as through contributing in official meetings.		
LC-SC3-RES-30-2019	World	All RET	Demonstration of plug and play solutions for renewable off-grid electricity	Demonstrations shall take place in at least two communities with diverse physical landscape and climate conditions, which are located in different continents.	TRL7-8	5 million
LC-SC3-RES-34-2020	Central Asia	Hydro	Demonstration and sustainable Hydro Power solutions targeting small scale hydro power potential in Central Asia	Hydro Power projects up to 10 MW installed capacity based on European Hydro Power technology research and industry partners and the Central Asian hydro power sector	TRL 6/7 to TRL 7/8	7-10 million
LC-SC3-RES-36-2020	Canada	Biofuels (linked to Mission Innovation Challenge 4)	International cooperation with Canada on advanced biofuels and bioenergy	Development of the full supply chain of biomass-to-bioenergy applications Thermo-chemical, biochemical and chemical processing of biomass to advanced biofuels	TRL3 to TRL5	2-5million
LC-SC3-RES-37-2020	World	Biofuels (linked to Mission Innovation Challenge 4)	Combined clean biofuel production and phytoremediation solutions from contaminated lands worldwide	The proposed solution will contribute towards the Mission Innovation Challenge 4. This is a global challenge that calls for international cooperation.	from TRL 3-4 to TRL 4-5	2-4 million
LC-SC3-ES-1-2019	Canada	All RET	Flexibility and retail market options for the distribution grid	In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation with Canada is required under this topic.	TRL 5-8	6-8 million

LC	Countries	RET Field	Title	Scope	RET Action	Amount Planned
SC3-JA-5-2020 (3)	Africa	All	Long Term EU-Africa Partnership for Research and Innovation actions in the area of renewable energy	Priority actions for next steps of RE development End of life and second life management of RE components Smart stand- alone systems Smart grid for off grid applications Processes and appliance for productive uses Innovative solutions for domestic uses (clean cooking, domestic biogas...) (4)	Joint action (research projects, demonstration projects, technology transfer projects) Networking projects	15 million
LC-JA-2-2018-2019	SET Plan	Solar Thermal (CSP/STE° Offshore Wind PV Ocean Energy Deep Geothermal Carbon Capture and Storage Renewable Fuels Bioenergy	Support to the realisation of the implementation plans of the SET Plan	Set Plan Implementation Plan	Coordination and Support Action	1 million per Set Plan X10
Public procurement - 40	Mission Innovation	All	Information Dissemination and logistic support for EU in mission Innovation	Supporting services		0.8 million

Annex 8: Overview of ERA-NET programmes involving non-EU countries (Horizon 2020 Associated Countries included)

ACRONYM	FULL NAME	START DATE	END DATE	FUNDING FRAMEWORK	NETWORK TYPE	COUNTRIES	COORDINATOR	NON-EU COUNTRY INVOLVED
<u>CSP ERANET</u>	Joint programming actions to foster innovative CSP solutions	31/05/2019	01/05/2024	Horizon 2020	ERA-NET Cofund	8	<u>AGENEX</u>	Israel Switzerland Turkey
<u>Solar Cofund 2</u>	SOLAR-ERA.NET Cofund 2	01/06/2018	31/05/2023	Horizon 2020	ERA-NET Cofund	13	<u>NET</u>	Switzerland Israel Turkey
<u>EN SGplusRegSys</u>	A European joint programming initiative to develop integrated, regional, smart energy systems enabling regions and local communities to realise their high sustainable energy ambitions	01/01/2018	31/12/2023	Horizon 2020	ERA-NET Cofund	19	<u>BMVIT</u>	Israel Norway Turkey
<u>GeoERA</u>	Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe	01/01/2017	31/12/2021	Horizon 2020	ERA-NET Cofund	31	<u>TNO</u>	Albania Bosnia and Herzegovina Norway
<u>Geothermica</u>	GEOTHERMICA ERA-NET Co-fund Action	01/01/2017	31/12/2021	Horizon 2020	ERA-NET Cofund	14	<u>NEA</u>	Iceland Switzerland Turkey
<u>SOLAR-ERA.NET Cofund</u>	SOLAR-ERA.NET Cofund	01/11/2016	31/10/2021	Horizon 2020	ERA-NET Cofund	12	<u>NET</u>	Switzerland Turkey
<u>ERA-GAS</u>	ERA-NET for Monitoring and Mitigation of Greenhouse Gases from Agri- and Silvi-Culture	01/05/2016	30/04/2021	Horizon 2020	ERA-NET Cofund	15	<u>Teagasc</u>	New Zealand Norway Turkey

<u>ACT</u>	Accelerating CCS technologies as a new low-carbon energy vector	01/02/2016	31/01/2021	Horizon 2020	ERA-NET Cofund	9	<u>RCN</u>	United States Norway Switzerland Turkey
<u>BESTF3</u>	Bioenergy Sustaining the Future	01/01/2016	31/12/2020	Horizon 2020	ERA-NET Cofund	10	<u>DECC</u>	Taiwan
<u>DemoWind 2</u>	DemoWind 2 ERA-NET Cofund action - delivering cost reduction in offshore wind	01/01/2016	31/12/2020	Horizon 2020	ERA-NET Cofund	7	<u>DECC</u>	Taiwan
<u>ERANet SmartGridPlus</u>	ERA-Net Smart Grids Plus: support deep knowledge sharing between regional and European Smart Grids initiatives	30/01/2015	29/04/2020	Horizon 2020	ERA-NET Cofund	20	<u>BMVIT</u>	Switzerland Turkey
<u>ENSCC</u>	ERA-NET Smart Cities and Communities	01/12/2014	31/05/2020	Horizon 2020	ERA-NET Cofund	12	<u>BMVIT</u>	Switzerland Turkey
Others relevant ERA-NET programme involving third countries (Horizon 2020 associated countries included)								
<u>ERANet-LAC</u>	Network of the European Union, Latin America and the Caribbean Countries on Joint Innovation and Research Activities	01/10/2013	01/12/2017	FP7	ERA-NET	16	<u>German Aerospace Center (DLR)</u>	Argentina Barbados Brazil Chile Mexico Panama Peru Turkey Uruguay
<u>ERA.Net RUS plus</u>	Further linking Russia to the ERA: Coordination of MS/ AC S&T programmes towards and with Russia	01/11/2013	01/10/2019	FP7	ERA-NET plus	18	<u>German Aerospace Center (DLR)</u>	Russia Israel Moldova Switzerland Turkey Serbia (Observer)

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The main aim of the study is to analyse how the international cooperation efforts of Member States complement EU initiatives and efforts in the field of energy research collaboration, and to assess which actions at EU level would improve synergies and additionally between the EU and Member States. The research methods employed through this study included documentary collection and analysis, interviews with Member State representatives, and a final expert workshop. First, current cooperation mechanisms are examined, with regard to bilateral Cooperation Agreements and multilateral frameworks, in order to profile and understand current strategic approaches to international research and innovation in renewable energy technology. Second, the specific focus turns to funding entities (national agencies or organisations that are mandated by their governments to manage the funding of projects) in order to profile implementation approaches. Third, the Horizon 2020 and Horizon Europe perspective is incorporated through a review of relevant Horizon 2020 actions. Finally, five strategic recommendations for future EU-led action are proposed in two groups; recommendations to further improve EU R&I international cooperation in the field of renewable energy technologies, and recommendations for Horizon Europe.

Studies and reports

