GREEN POWERED FUTURE
MISSION

SEPTEMBER 2022

ACTION PLAN 2022–2024

DISCLAIMER

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FOREWORD

To help achieve global climate goals, it is crucial that emissions from the power sector fall by 80% in the next decade, with a major acceleration in clean energy innovation. The integration of variable renewable energies (VRE) at scale is considered one of the most significant challenges of the next decade. Bold actions are required to achieve the pace of deployment and higher levels of distributed VRE are needed to ensure that all countries can build a green energy future.

The Green Powered Future Mission

The Green Powered Future Mission (GPFM), launched within the second phase of the global initiative Mission Innovation (MI2.0), is a **public-private partnership** with members from MI countries, private sector companies and international organisations. It aims to demonstrate that by 2030, power systems in different geographies and climates can effectively integrate **up to 100% variable renewable energies**, like wind and solar, in their generation mix, and maintain a cost-efficient, secure and resilient system.

The GPFM is a 10-year endeavour which will accelerate innovation in clean energy by demonstrating innovative solutions to transform the present system. It is organised around three R&I pillars covering the whole spectrum of power system innovation needs:

- Pillar 1 - **Affordable and reliable VRE**
- Pillar 2 - **System flexibility and market design**
- Pillar 3 - **Data and digitalisation for system integration**

Figure 1 – The Green Powered Future Mission coalition

GPFM members identified 10 Tipping Points that need to be reached by 2030 to provide confidence to governments, industry and system operators that power systems can run with up to 100% VRE in their generation mix, whilst maintaining cost-efficiency, security and resilience.

To accelerate the progress towards these Tipping Points, the Mission identified the main barriers and related innovation priorities, categorised across the 3 R&I pillars, that would help achieve 2030's goal. To accelerate energy system modernisation and decarbonisation, Innovation Priorities across the three R&I pillars should be tackled. GPFM R&I activities will rely on large-scale demonstrations, replicability studies and digital solutions to build a "**Toolbox**" from which countries can pick and customise innovative solutions as appropriate to their own geography, system conditions and national strategies.

The GPFM Coalition

The GPFM is co-led by China, Italy and the UK and relies on a strong international coalition composed of 27 active members including MI Member countries, international organisations and private sector companies (see Figure 1).

Through their commitment, the GPFM will lead the way in R&I towards global power system transformation and progress the clean energy revolution in this decade.

The Mission leverages the power of its public-private partnership as an effective way to bring together the resources and knowledge that are needed to address the identified innovation priorities. Pooling resources, skills and expertise will bring benefits in terms of cost-efficiency, scale of impact, ability to simultaneously tackle numerous challenges, and a global perspective on innovation challenges.

The GPFM will continue its effort to further build its coalition to gain and expand its global view, to incorporate any missing stakeholders, and to be able to mobilize larger amount of R&I resources.

The first sprint of activity and the Action Plan 2022-2024

During the first sprint of activity GPFM Members identified a set of key global innovation priorities and crucial pathways to achieve the Mission's goal by 2030. Grouped within 17 main R&I themes, the **Top-100 global Innovation Priorities** were ranked by urgency and importance and included in the **Joint Roadmap of Global Innovation Priorities**, which was published at COP 26 in Glasgow in November 2021. This Joint Roadmap formed the basis for the development of the present Action Plan, highlighting R&I areas and Innovation Priorities under which to concentrate efforts towards the objective of validating innovative solutions.

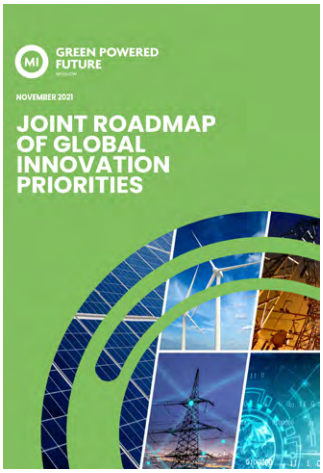
It is essential to accelerate the clean energy transition by boosting innovation. The Joint Roadmap and the present Action Plan show how governments are putting R&I, demonstration and deployment at the core of energy and climate policy and how Government support is needed to accelerate the roll-out of demonstration projects, leveraging private investment in R&D, and boosting overall deployment levels to help reduce costs. According to IEA, around USD 90 billion of public money needs to be mobilised globally as soon as possible to complete a portfolio of demonstration projects before 2030. Currently, only roughly USD 25 billion is budgeted for that period[1]. The Mission Action Plan is a document that will take the GPFM to its delivery phase by showcasing the selected flagship projects and member's R&I activities to address the most urgent global innovation priorities identified for the period 2022-2024.

The following Action Plan sets out the R&I activities and tasks the GPFM coalition members will undertake during the action plan period 2022-2024 (Chapter 2), ranging from feasibility studies, flagship projects and demonstrators to knowledge sharing, capacity building and CBA studies. It also provides a high-level description of the two flagship projects to be implemented (Chapter 3); sets out a monitoring process for the Mission (Chapter 4); and showcases the continuous engagement of the Mission with other international initiatives (Chapter 5).

[1] https://www.iea.org/reports/net-zero-by-2050

Chapter 1

GLOBAL INNOVATION PRIORITIES



AT COP26 IN NOVEMBER 2021 IN GLASGOW THE GREEN POWERED FUTURE MISSION (GPFM) RELEASED A JOINT ROADMAP IDENTIFYING THE TOP 100 GLOBAL INNOVATION PRIORITIES AND RANKING THEM IN TERMS OF IMPACT AND URGENCY. THIS JOINT ROADMAP DRAWS A PATHWAY TO GUIDE R&I INVESTMENTS, ENERGY POLICY, AND INTERNATIONAL COOPERATION TOWARDS CLEAN ENERGY MODERNISATION AND DECARBONISATION.

To draw a pathway towards reaching the target of integrating up to 100% VRE sources in the power system generation mix by 2030, **the GPFM developed the Joint Roadmap of Global Innovation Priorities.** Released at COP26 in November 2021, the document identifies **17 Research and Innovation (R&I) themes and the top 100 Innovation Priorities (IPs) to be tackled.** These are not only the breakthrough technological needs but are fundamental R&I advancements that need to be addressed through collaborative research, demonstration projects and knowledge sharing.

The Joint Roadmap was developed as a result of a thorough consultative process, involving GPFM's Members representing governments, power sector leaders and international organisations. This resulted in a document that addresses the whole spectrum of power system innovation and global in scope.

Through comprehensive analysis, consultations, and surveys with Mission's Members and grid stakeholders across the globe, each innovation priority identified was assessed in terms of its: Importance/ Impact, Urgency and Interdependency.

To achieve tangible outcomes against these Innovation Priorities, innovative solutions need to be validated and implemented in relevant and different grid infrastructures such as for example rural versus urban networks. Therefore, it was important that the Joint Roadmap evidenced the GPFM members strong interest to host, support, and contribute to national pilots and large-scale demonstration projects in their respective territories.

Following comprehensive analysis on the global Innovation Priorities and thanks to the above-mentioned consultative process, the Top-100 Innovation Priorities across the three R&I pillars have been defined in terms of urgency, impact and importance and ranked as higher (near-term, within 3 years), medium (to be achieved in the next 4-6 years) or lower priority (long-term, to be achieved in the next 7-10 years).

The following action plan builds from the Joint Roadmap and the ambition of GPFM to deliver innovative solutions and R&I under priority areas across territories; setting out the R&I activities the GPFM members intend to take in the Action Plan period 2022-2024. In addition, as stated in the Joint Roadmap, the results obtained by R&I projects addressing the identified priorities will constitute a "**Toolbox**" from which countries can pick and customise innovative solutions as appropriate to their own geography, system conditions and national strategies.

The Joint Roadmap of Global Innovation Priorities is public and can be downloaded from the following **link.**

Chapter 2

COALITION'S MEMBERS R&I PROGRAMMES AND ACTIVITIES

BUILDING FROM THE ROADMAP, THIS SECTION OF THE ACTION PLAN SETS OUT THE INNOVATION LANDSCAPE IN TERMS OF THE MISSION MEMBER'S ONGOING AND UPCOMING R&I PROGRAMMES AND ACTIVITIES THAT ADDRESS 50 OF THE IDENTIFIED MOST URGENT INNOVATION PRIORITIES (IP) AND SETS OUT HOW THIS INFORMATION WAS COLLECTED.

Following the publication of the Joint Roadmap, the GPFM members agreed to focus on a subset of the identified IPs across the 3 Pillars that represent near-term and medium-term IPs to be achieved within 3 years and the next 4-6 years, respectively. If successfully addressed, these **50 most urgent IPs** (as reported in figure 3) are expected to make a breakthrough within the next 3 years to reach the Mission's goal.

The 50 most urgent IPs: R&I programmes and activities data collection

In order to assess the status of, and collate, R&I programmes and activities covering the 50 most urgent innovation priorities by Mission members, the GPFM started a process to collect relevant information and data. Via surveys, online sessions and Executive Committee meetings information was collected on dedicated ongoing and foreseen R&I funding and activity by Mission members that is and will address one or more of the 50 most urgent Innovation Priorities identified in the Joint Roadmap. This exercise - made for a clear assessment of the current status of the innovation field, including existing and ongoing activity and results to accelerate the achievement of the Mission's goal - allowed for avoidance of duplicated effort thus, to ensure the most efficient utilization of the available R&I resources. Moreover, it highlighted possible contributions that GPFM could provide to further and foreseen R&I activities and demonstration projects. This exercise was well received by the GPFM coalition members and produced a broad range of responses and detailed information about 38 R&I Programmes and 37 R&I activities from MI countries, private sector and international organizations.
The main outcomes of the R&I programme survey are summarised in figure 2.

Survey outcomes

The survey and data collection exercise showed that despite differences in terms of funding intensity and

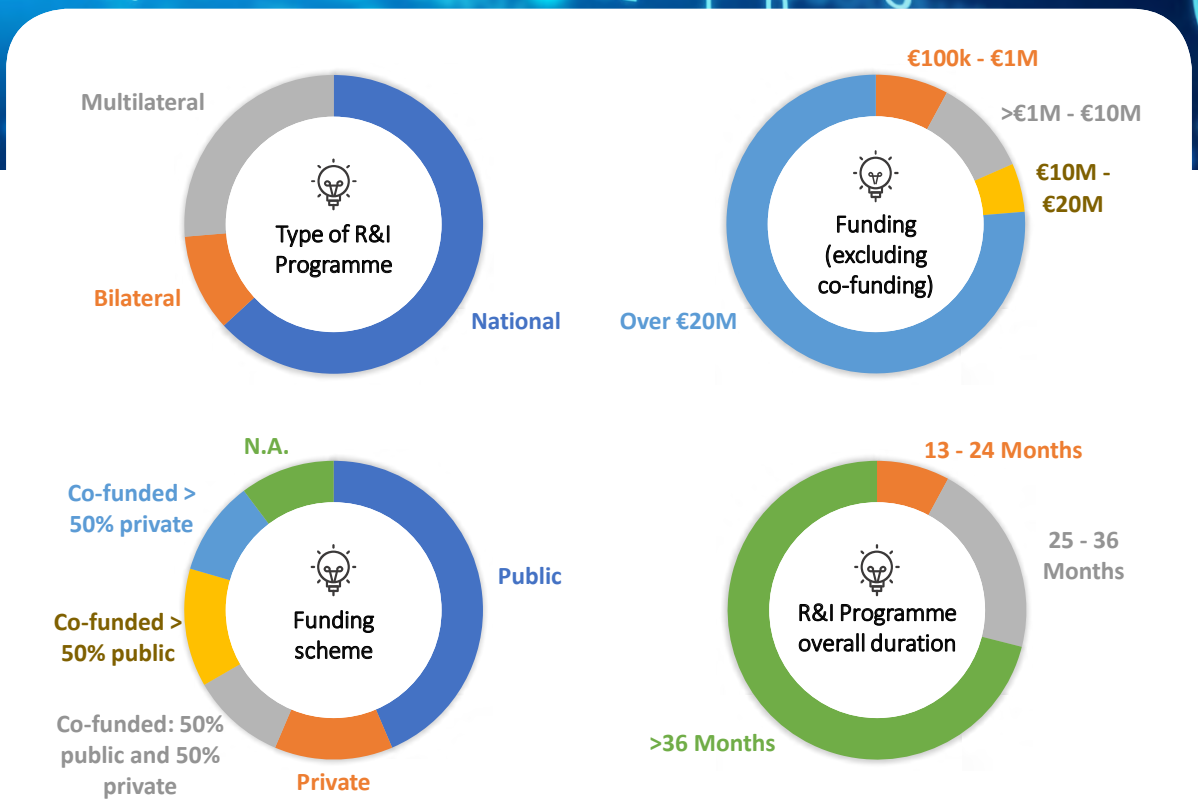


Figure 2 – GPFM member's R&I programmes and projects survey's main outcomes

activity type, **all 50 IPs are well covered by the ongoing R&I programmes and activities of Mission's members,** and there are no critical R&I gaps (see Figure 4). With regard to R&I Programmes, the survey showed that the majority of GPFM members are deeply engaged in national programmes, with a number of projects and activities also being international in scope, entailing bilateral or multilateral cooperation with the involvement of two or more countries.

The GPFM will be key to boost the international dimension of these R&I programmes by providing an ecosystem to promote results dissemination and exploitation.

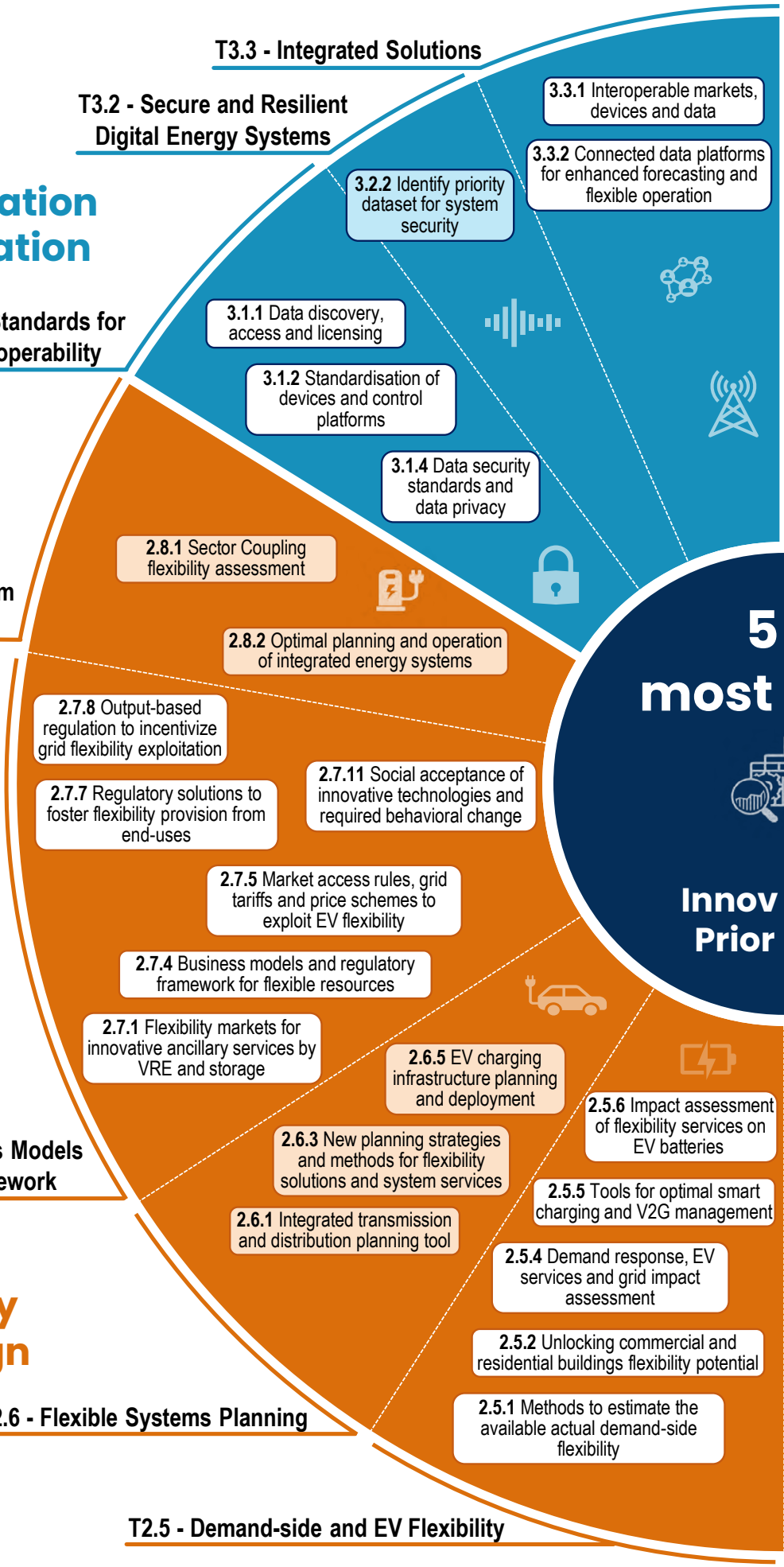
Regarding the amount of funds per R&I project, the survey evidenced that across all R&I projects, the vast majority of funding programmes exceed 20 M€ over a period of 3-4 years; in fact, more than 75% of R&I projects receive over 20 million Euros funding. The total amount of funded R&I programmes and activities by the coalition members is estimated to exceed 1 B€, which can support the overall stretch goal of GPFM.

In addition, survey results showed that ongoing R&I programmes are supported by significant public funding, with private investments also relevant to the development of R&I programmes and activities. A high percentage of co-funded programmes is very encouraging as the GPFM aims to launch relevant demonstration activities which could rely on effective public-private partnerships.

Further detail on survey findings is presented in the graphics in figure 4.

This type of data collection exercise will be repeated on an annual basis as part of the Mission's monitoring process to keep this information updated and track progress. Notably, all ongoing examined R&I programmes and activities will reach their main achievements in a period of less than 3 years from now and hence will be able to contribute to the population of the GPFM Toolbox and to the Action Plan 2022-2024.

Pillar 3
Data and Digitalisation for System Integration



Pillar 2
System Flexibility and Market Design

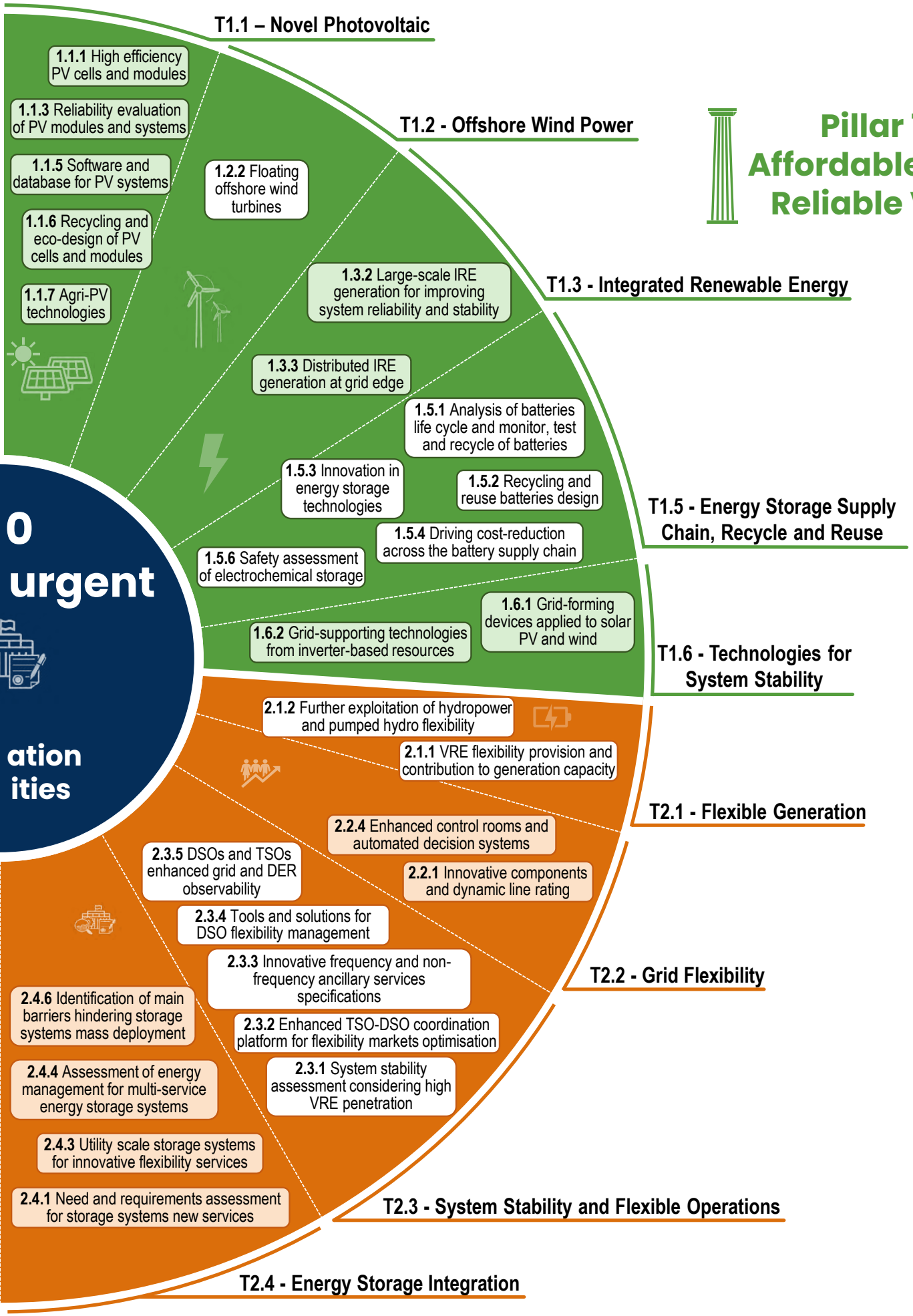


Figure 3 – The 50 most urgent Innovation Priorities

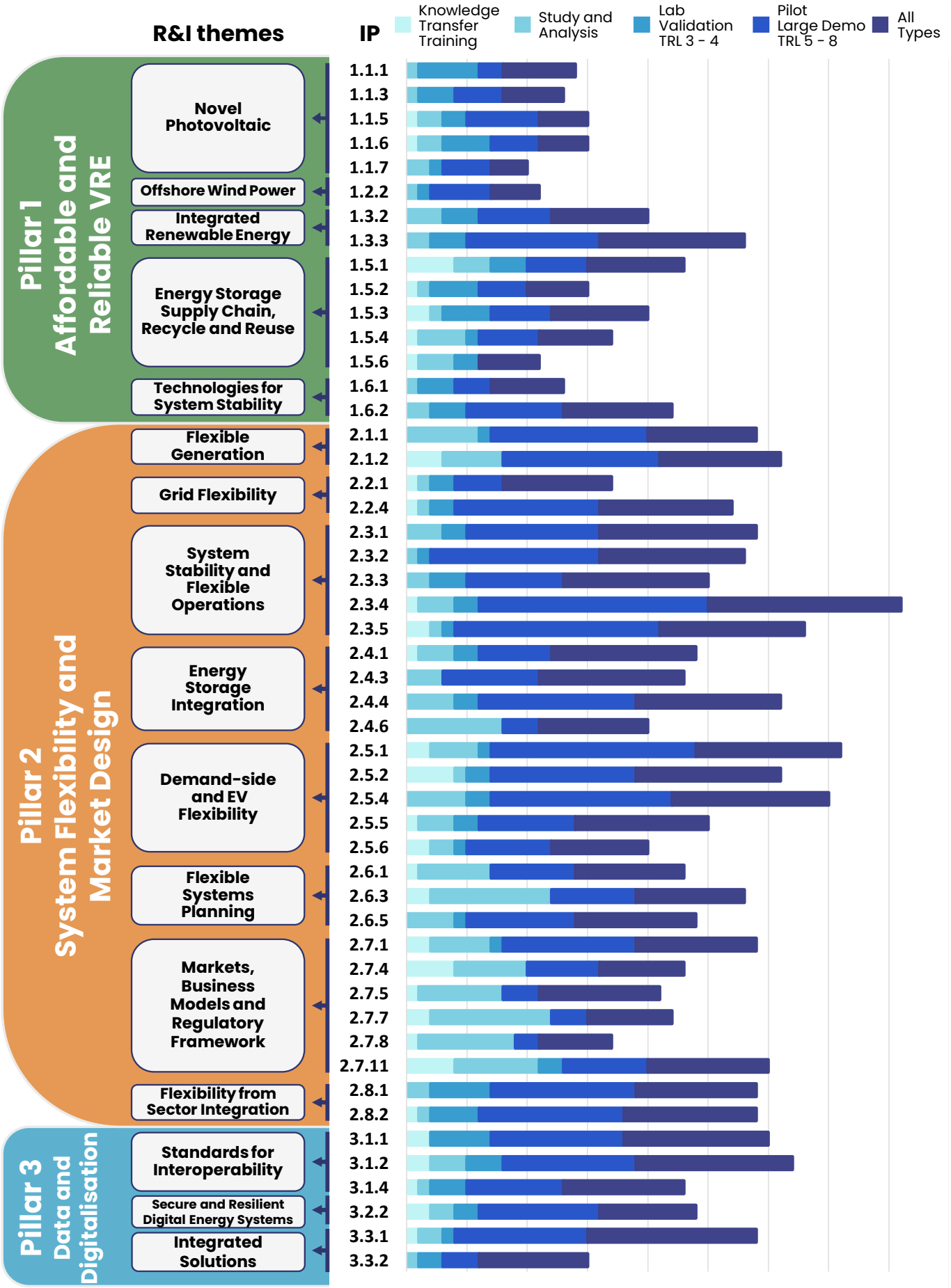


Figure 4 – R&I programmes and activities covering the 50 most urgent innovation priorities by Mission members. The different types of the ongoing and foreseen activities are marked by different colours

Chapter 3

FLAGSHIP PROJECTS 2022-2024

IN ADDITION TO THE RANGE OF R&I ACTIVITY BY MISSION MEMBERS REPORTED IN CHAPTER 2, THE FOLLOWING CHAPTER SETS OUT THE TWO SPECIFIC FLAGSHIP PROJECTS THAT WILL BE DELIVERED BY THE MISSION AS PART OF THE ACTION PLAN IN THE PERIOD 2022-2024.

Introduction

GPFM Members are committed to supporting the achievement of the Mission goal by launching dedicated demonstration projects[2] alongside the R&I activity as presented in Chapter 2. To achieve significant reductions in CO_2 emissions by 2030, huge leaps in clean energy innovation are needed to drive the uptake of technologies that, according to IEA[3], are already today in the mature or early adoption stage. Demonstration activity is instrumental since major innovation efforts must take place this decade in order to bring these new technologies to market in time.

Top 100 Global Innovation Priorities

Action Plan 2022-2024

Flagship Projects (FP)

FP1: 5 Demos in five continents: launching of large Demos with up to 80% VRE by 2024

FP2: Multilateral research programme to tackle 20 of the identified Innovation Priorities by 2023

Green Powered Future Mission Toolbox

SGIA Smart Grids Innovation Accelerator (*)
(*) As part of the GPFM Internet Platform

Figure 5 – Concept view of the GPFM Flagship Projects 2022-2024

[2] Large-scale demonstrators represent real-scale power systems and, if proven in this environment, a selected solution can be readily implemented in similar contexts around the world with minor remaining issues related to its replicability and scalability. A typical large-scale demo aims at reaching TRL 7-8, entails megawatt-scale and could require funding in the range of tens of Millions of Euro. It is likely to involve providers of technologies, products or services, network operators, and field operators in charge of installation, operation and maintenance.

[3] https://www.iea.org/reports/net-zero-by-2050

Starting from the main R&I themes and the Top-100 global Innovation Priorities (IPs) identified in the GPFM Joint Roadmap, the Mission has set out Flagship Projects to be launched and implemented in the mission's sprint 2022-2024. **Flagship Projects (FP)** will be key in addressing the most relevant and urgent Innovation Priorities and accelerating clean energy innovation. The two flagship projects that the GPFM is launching are:

- FP1 – **5 demos in five continents:** launching of large Demos with up to 80% VRE by 2024
- FP2 - **Multilateral research programme** to tackle 20 of identified Innovation Priorities by 2023

GPFM members deeply engaged and contributed to shaping these two flagship projects allowing for ambitious but manageable targets. Thanks to the combined efforts of public and private sector members, the GPFM aims to achieve ambitious and impactful results at pre-commercial level. For this reason, it is worth noting that intellectual property rights will be duly managed to allow for collaboration at both pilot and demo level. Specific MoUs will be signed, if deemed necessary, in order to promote effective collaboration within the framework of GPFM activity and to foster information sharing while guaranteeing intellectual property rights are properly managed.
To support the development of the two flagship projects and facilitate the dissemination of results, the GPFM is committed to developing an Internet-based Platform dedicated to the Green Powered Future Mission – the GPFM Platform (see Chapter 5).

FP1 – 5 demos in five continents: launching of large Demos with up to 80% VRE by 2024

Scope and objectives

The main goal of this flagship project is to launch 5 large-scale demonstration projects (or demos) in five continents amongst Asia, Australia, Europe, North America, South America, and possibly Africa, where different innovative technical, regulatory and market solutions may be implemented and validated experimentally in different climates and geographies. The main outcomes from the demos, such as best practices and key exploitable results, will populate the GPFM Toolbox to be widely and publicly disseminated, contributing to knowledge and know-how exchange, and capacity building, in countries not directly participating in Mission Innovation.
Demo projects will be developed in light of the overall Mission's goal to reach 100% VRE. However, the validation of innovative solutions allowing large demos to be run reliably and efficiently with up to 80% VRE is considered as a necessary intermediate step for this activity sprint (2022-2024). Successful demo projects can serve as the basis to implement additional innovative solutions thus allowing to further increase the VRE grid penetration from 80% up to 100%.

GPFM role and approach

The five demos will look to tackle the 50 most urgent innovation priorities (see figure 3) among the Top-100 identified in the Joint Roadmap. Amongst others, the following innovation challenges are expected to be addressed by the demos: breakthrough in affordable and reliable VRE technologies, unlocking of and cooperation among different flexibility sources, data effective exploitation, new market design, innovative regulatory frameworks and the interaction with other energy vectors towards a fully integrated system.
These five demonstrations will also be included in the GPFM's platform for publicity and promotion. We also strongly encourage and call on a wider range of stakeholders around the world to participate in these demonstrations. For the specific demonstration, the ownership of intellectual property rights will be separately specified.

Implementation of the demos

The large continental demos to be implemented will be broad in scope and will rely on **national pilots**[4]

[4] Pilots aim at reaching TRL 6-7 and could require funding in the range of a few Millions of Euro and involve providers of technologies, products or services and network operators. Demonstration size and scale shall be sufficient to gather all the necessary information for the cost-benefit analyses as well as to perform the replicability and scalability analyses.

at different suitable locations, in terms of available VRE sources and grid infrastructure. National pilots will be highly complementary in nature and each participating GPFM member/pilot will define the specific R&I topics and related Innovation Priorities (IPs) - amongst the 50 identified as most urgent - to be addressed, as well as the number of pilots to be launched by Q1 2024, according to their R&I needs and strategy, and available resources.

It is anticipated that national pilots will tackle several of the identified **50 IPs** and possibly utilise existing grid infrastructure in order to shorten the time to start the experimental activity and to limit investments thus, having the potential to support more pilot projects in parallel.

To allow for the needed level of coordination, five **continental task forces** will be established to map out the specific innovation priorities addressed by each individual national pilot and share learning as pilots are delivered.

Each continental task force will engage the national pilot coordinators and the main public and private partners involved, to monitor progress and foster the sharing of results. All task forces will nominate a lead member and an alternate member that will be responsible to provide periodic updates on progress to Pillar Leads and the GPFM community by means of update to the Mission ExCo meetings and internal and public workshops. The co-leading members of GPFM will look to support the delivery of the demos by assisting the collaboration and sharing of learning across the pilots which make up each continental demo.

Feasibility studies and related analyses will be an important activity preceding national pilots launching and for GPFM members to quantify the required financial resources at the time of launch and till their successful completion.

Despite the bottom-up approach used to launch and support national pilots, FP1 will ensure strong coordination, high complementarity, synergy and dissemination amongst the different pilot projects as follows:

- **High complementarity** - in terms of different Innovation Priorities addressed by the different national pilots thus, maximizing the chances to cover all identified 50 IPs.
- **Strong synergy** - in several cases the same IP will be tackled in more than one pilot project; this will allow to either compare and analyse alternative solutions or similar solutions, but in different grid contexts and/or geographies.
- **Extensive replicability** – GPFM will assure that national pilots will validate innovative solutions with a high degree of replicability promoting applications of the validated solutions in different geographies and climates. Validated innovative solutions and main outcomes will populate the GPFM Toolbox thus, promoting the full replication of best practices and exploitable results.
- **Dissemination** – the results of the demo projects will be broadly disseminated by different means (e.g., workshops, webinars, publications, etc.), fostering the replication of the tested solutions. Additionally, the Mission will offer significant opportunities for knowledge and best practices sharing, also contributing to capacity building in countries not directly participating in the initiative.

Private sector engagement

The effective engagement of the industry and the private sector is important in launching effective pilot and demo projects.

The GPFM already accounts among its members, key private sector players from co-Leading countries (system operators, manufacturers and standardization bodies among others).

National pilots could include the participation of private sector actors not limited just to GPFM members only and are likely to involve **open calls** of strong consortia including companies from the whole value chain of the electro-energetic system bringing in expertise, knowledge and know-how for the implementation of innovative and breakthrough solutions.

Expected timeline and milestones

The first main milestone **(M1-FP1)** foreseen under this flagship project will be to define the scope of the national pilots by the end of Q4 2022.

Where relevant, this will include the identification of the relevant primary use cases to be analysed for each national pilot and the coordination needed among them at continental level. This should allow for the interconnection of national pilots where possible and the avoidance of duplication of efforts, maximising investments cost-effectiveness. At this stage, innovation pathways will be defined as well as the role of all the needed actors to be involved in each individual pilot projects under definition.

The second foreseen main milestone **(M2-FP1)** relates to the development of the design of the national pilots, and where relevant pilot projects feasibility studies. This milestone may entail several key activities including data mining, studies and analysis, numerical simulations, CBA and laboratory-scale testing as appropriate and/or needed.

The outcomes from this activity will be made available at the end of Q2 2023, laying the ground for the selection and delivery of national pilots. Different aspects may be analysed, from technical to financial and regulatory, to launch cost-effective and highly valuable demonstration projects.

Finalising the selection of national pilots to be supported is expected to be undertaken by Q4 2023, with the launching of national pilots and of the resulting five large demos across five continents to follow in Q1 2024, constituting **M3-FP1.**

The above process and timelines for the realisation of Demos is indicative, and it may be that some national pilots enter development and delivery phases faster than expected.

Dedicated public workshops will be organized throughout 2023 and 2024 to share the main results from the scoping, design and launch stages with all GPFM members and external stakeholders.

Moreover, technical workshops with key experts actively involved in national pilots - from the GPFM and beyond - will be periodically organised to inform about main progress, to discuss suitable R&I strategies and approaches to tackle specific innovation challenges, and to maximize knowledge transfer and know-how sharing.

Periodic progress reports (every 12 months) summarizing the performed activities and the main results achieved will be part of the Mission's monitoring process and will also be made available through the **GPFM Toolbox and the internet-based platform.**

Transversal/enabling activities

GPFM 2022-2024 activity sprint will be supported and highly benefit from a number of enabling activities including the following.

Standards and protocols are a critical component to delivering the GPFM vision and ensuring a smooth integration between different technologies in a changing energy system.

BSI, the National Standards Body of the UK, along with other standardization bodies in different countries will support the Green Powered Future Mission by developing a Standards Centre of Excellence that will provide the infrastructure and the framework to develop a consistent standards-based approach to support the Mission.

Subject to demand and available external funding, it will work closely with MI demonstrator projects to identify standards gaps and capture the learnings and outcomes into guidance/standards so that the centre becomes a hub of expertise on the use of standards in energy transformation.

National pilots and continental demos examples

Example 1 - **Asian Demo**

This large demo will initially rely on the Intergovernmental International Scientific and Technological Innovation Cooperation Program of China's Ministry of Science and Technology.

The Chinese government will provide funding support for a national pilot that foresees a three-year implementation period (2022-2025) and is expected to involve private enterprises providing 50% contribution to the above funding.
This will strive to solve more than 30% of the innovation priorities of Pillar 1, including high-power offshore wind, new photovoltaic power generation, offshore full direct current, ecological environment impact monitoring and other technologies. At the same time, this will solve the gap in the construction of an Internet platform dedicated to GPFM and ensure Mission members can share learning to accelerate the innovative research and development, pilot demonstration and integrated application of key renewable energy technologies.
This pilot, to be later complemented by other coordinated national pilots as launched by other Asian countries strongly committed in the GPFM, amongst others will include the following tasks:

- Design, simulation and grid integration of large-scale offshore wind power and of novel PV technologies, and of the related field-testing platform.
- Design, control and stability of novel DC power system for offshore RES and field-testing platform.
- Power generation performance monitoring as well as environmental and ecological impact monitoring of large-scale offshore wind and photovoltaic systems.

The GPFM's coalition includes members that are playing a leading role in the field of photovoltaic and wind power from cutting-edge technology to pilot production and industrial applications. Based on mutual trust, they will work together to promote the implementation of GPFM activity.
The GPFM Asian members, namely China, India, Japan, South Korea, and the Kingdom of Saudi Arabia, are keen to be involved in such a flagship project by also reporting on various renewable energy projects currently operating or in the implementation phase. The projects would be selected based on their relevance to the identified Innovation Priorities in the Joint Roadmap, to analyse and share the acquired knowledge with the Mission's members.
The main topics covered by this continental demo will include:

- Technical roadmap of floating offshore wind turbine and large offshore wind turbine.
- Simulation and optimization of ground multi-degree of freedom loading system for transmission chain of high-power offshore wind turbine.
- Design of photovoltaic demonstration platform and system monitoring technology.
- High efficiency and low cost back contact crystalline silicon battery and module technology.
- Study on long-term reliability and sustainability of PV modules and systems.
- Design and optimization scheme of technical verification platform for all DC system and stability evaluation.
- Overall technical scheme for ecological environment monitoring of wind power and photovoltaic system in marine climate.
- Online monitoring technology of meteorological and water elements of photovoltaic system in marine climate.
- Environmental risk analysis of key materials of photovoltaic system in marine climate.
- Efficient and flexible control technology of distributed integrated renewable energy system at the edge of power grid.
- New control architecture, modelling and energy management technology of integrated renewable energy system.

Example 2 - **European Demo**
A large demo consisting of several national pilots will be established in Europe. European GPFM members will contribute with national pilots sharing learning from their R&I activities. By means of a systemic approach, this demo will seek to address a large number of the identified Innovation Priorities in a highly

complementary way. Amongst others, the following R&I tasks will be considered:

- Demonstrating promising solutions, including sustainable smart electricity networks, EV, storage and sector integration, to enhance power system, grids resilience and flexibility.
- Defining and validating architectures and platforms to create a data ecosystem supported by open standards for interoperability in compliance with privacy policies.
- Implementing experimental sandboxes to explore and validate innovative market design and regulatory frameworks.
- Developing advanced solutions for urban networks such as demand side, electric vehicles, aggregators and distributed energy resources management.
- Demonstrating the capabilities of hydrogen for cost competitive long-duration energy storage and first-of-a-kind green hydrogen projects covering highly flexible, grid-responsive electrolyser operation providing a spectrum of grid services.

A schematic representation of the Asian and European continental demos and their related link to national pilots is reported in figure 6 where the reported maps are for illustrative purpose only.

Several coalition members (e.g., GSE in Italy) play a central role in the national energy and climate sectors. They contribute to the creation of a secure, sustainable, affordable and competitive energy system in order to tackle climate change, achieve sustainable growth and environmental targets, as envisaged by European targets by managing national RES support schemes and several sectorial initiatives.

Therefore, they are keen to work together with international public and private partners developing technical activities and promoting innovative solutions dedicated to a green powered future. Coalition Members that are part of the European Demo will share learnings and information in order to develop the foreseen pilots. The main topics covered by these pilots are expected to include:

- Consideration of flexibility energy ecosystems in the context of the specific features of mountain territories and urban areas
- The strong digitization of the system, for example through installation or exploitation of advanced sensors and the creation of "digital twins" of the network
- Implementation of advanced automation and monitoring solutions for medium and low voltage networks in areas urban
- Integration of electric vehicles, aggregators, and the management of distributed energy resources and distributed storage
- Floating PV generation on existing hydropower water storage basins
- Implementation of Energy Storage Systems, and the combination of this with existing hydropower plants and/or reverse pumping, exploiting ducts infrastructure already in place
- Implementation of innovative forecasting models for water availability to optimize scheduling of production from hydropower
- Grid reliability and flexibility, for example enabled by specific devices in case of adverse natural events
- Hydrogen production from renewable energy sources
- Optimization of load patterns in self-consumption communities or energy communities implemented with RES plants
- Behind-the-meter and/or RES-combined storage solutions, smart devices and software to test systems that can reach up to 100% of energy self-consumption

Further examples

A similar approach will be implemented in North America, South America and Oceania taking into consideration that these continental demos will rely on fewer GPFM members. According to the interest shown by the involved GPFM members, the **South American** demo will focus on tackling a number of IPs by validating innovative solutions to enhance

system flexibility and how to decarbonise effectively and reliably off-grid systems in the Amazon region. In addition, the South American demo will focus on pilots to test local market flexibility service models in order to assess their economic impacts and benefits also with a view to optimizing operation, planning and long-term grid investments. Provided that funding is secured, a potential **North American** demonstration project could be identified in the smart energy systems space to address key GPFM innovation priorities. These priorities for demonstration include but are not limited to: (1) validity of methods to estimate the actual demand-side flexibility available, inclusive of flexibility potential in commercial and residential buildings; (2) innovative tools and devices for optimal smart charging, vehicle-to-grid (V2G) management, EV services and grid advanced automation; and (3) various scenarios of flexibility markets for innovative ancillary services by distributed energy resources such as VRE and storage. Concerning the **Australian/Oceanian** demo, a large-scale demonstration will focus on operational experiences of a GW scale electricity region (South Australia), connected to the main Australian grid (the National Electricity Market (NEM)). This system regularly operates on very high shares of variable renewable energy, consisting of wind and solar generation plus large-scale battery energy storage, with excess energy being exported via interconnectors to eastern Australian states. The system has both the ability and experience of operating islanded from the wider Australian grid for periods of weeks, while maintaining system strength and capacity.

The operational experiences with this large system will be coupled with results from other pilots and research activities to guide R&D efforts to progress

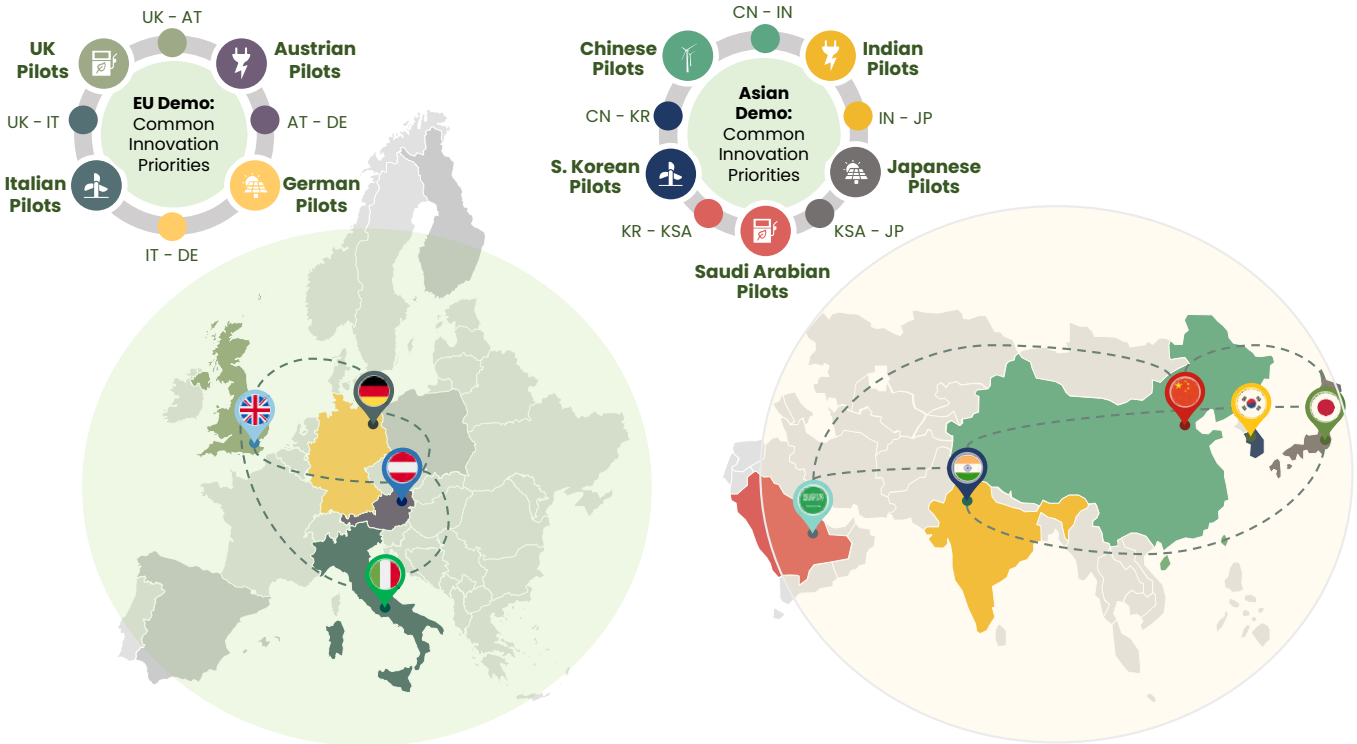


Figure 6 – Examples for the European and Asian Demos (the above maps are for illustrative purpose only)

the key challenges in the Australian context, including supporting very high levels of distributed renewables; the capability of distributed resources to contribute to electricity system services; and the system architectures to support these changes.
For what concerns R&I activities related to a possible **African** Demo, the IEA 3DEN initiative is developing policy guidance for emerging economies on digitalisation for power system resilience and decarbonisation for emerging economies, including a regional focus on Africa, in particular Tunisia, Morocco and South Africa. Part of this work will cover lessons learned from pilot projects implementation and guidance on replication and scaling up. In conjunction, the Italian government is supporting an implementation phase administered by UNEP with funding for smart grids pilots. The results and insights from these projects will be widely shared with the GPFM through the 3DEN initiative.

FP2 - Multilateral research programme to tackle 20 of identified Innovation Priorities by 2023

Scope and objectives

The main goal of this flagship project is to launch by Q1 2023 a multilateral research programme supported by a number of coalition members **to tackle 20** of the 50 Innovation Priorities ranked as most urgent in the Joint Roadmap. This Flagship Project intends to increase opportunities for international cooperation by aligning national R&I sources, sharing R&I national results of transnational relevance, and launching calls at regional and international level.
To make this possible, FP2 will secure R&I funding, made available by governments and energy funding agencies involved, to support MI members' national, regional and international research activities on the identified Innovation Priorities.

Implementing method

The launch of a multilateral research programme will drive collaboration among participating Mission members. This flagship project will ensure that the Mission remains focused on issues beyond technology barriers such as market design, regulatory framework, etc., that can play an important role in unlocking innovative solutions.
International organisation GPFM members will support this process especially by participating in targeted discussions, sharing insights on investments and trends in innovation as well as joining experts' workshops. The GPFM will seek effective collaboration with other relevant initiatives acting towards the modernisation of the energy system as a way to advance faster towards the identification and validation of innovative solutions for their future deployment.
To develop this flagship project effectively, the GPFM will take inspiration from ongoing successful multilateral programmes such as the **"MI Call series"** and the European **"Clean Energy Transition Partnership"** (CETPartnership), co-funded by Horizon Europe Framework Programme, where a strategic partnership of national and regional R&I programmes is contributing substantially towards a common goal. Other relevant programmes directly involving GPFM members, which will support coordination among all different system stakeholders to deliver accessible and transparent data and tools for electricity modelling, will be considered as a reference and starting point.
The Mission FP2 also plans to coordinate, pool, and strengthen regional, national and international R&I funding programmes thus, to accelerate innovative solutions development.

Innovation priorities to be tackled

To define which Innovation Priorities should be tackled by this flagship project, the GPFM set up a Task Force with members coming from both the public and the private sector representing three continents. In particular, representatives from Australia, Austria, Canada, China, Germany, Italy and private sector GPFM members from China, Italy and UK actively contributed to the task force activities.

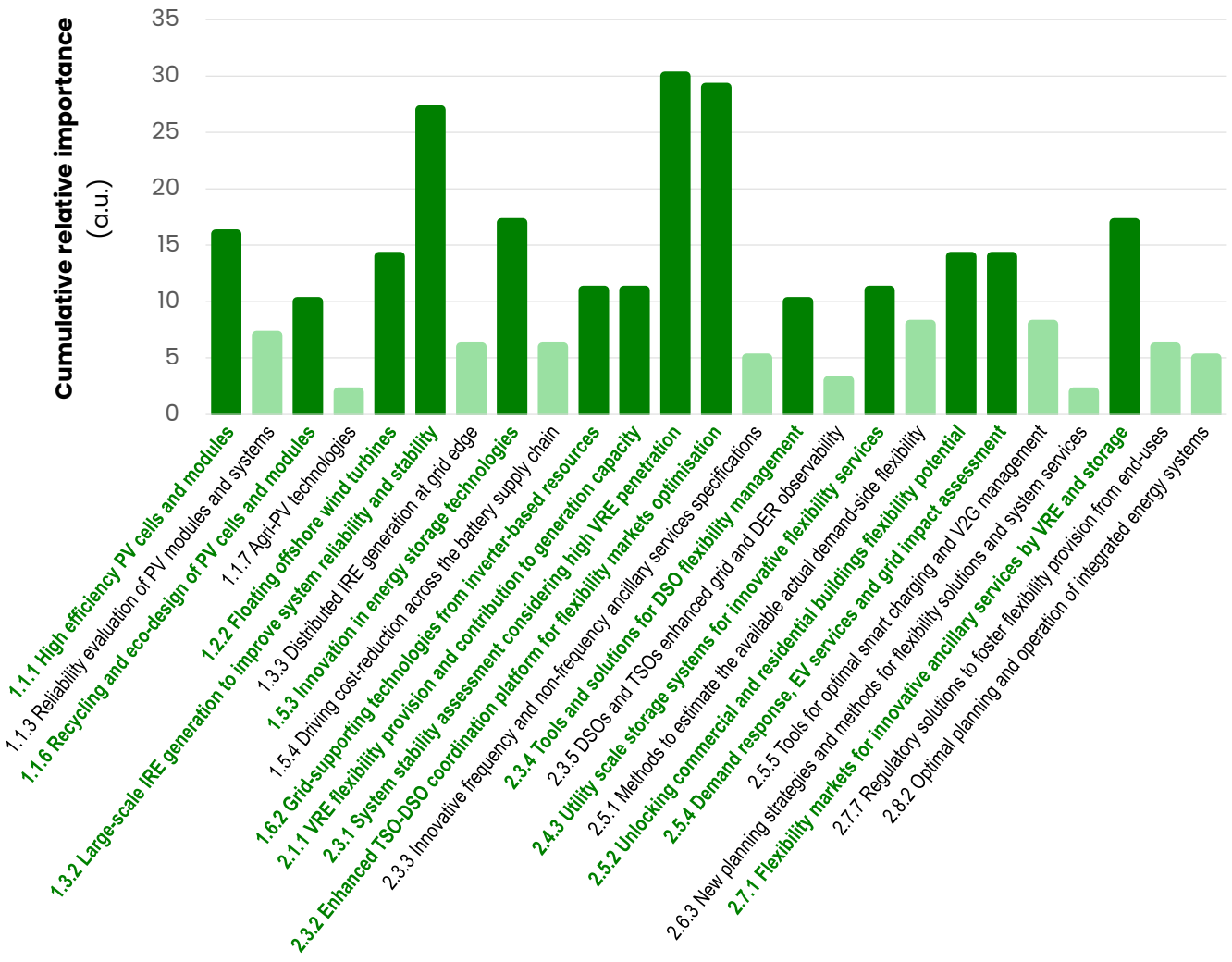


Figure 7 – Survey results: Innovation Priorities relative importance for FP2

The Innovation Priorities to be tackled by FP2 have been selected through task force members' reply to a survey, extensive discussions and consensus meetings. Each task force members was asked to select the top eight Innovation Priorities amongst the 50 most urgent IPs, and to rank them in terms of relative importance for being tackled by this flagship project, according to their country or organization. Besides, task force members indicated the type of activities they would be able to support or would be

willing to be engaged in among the following ones: pilots/demos, laboratory validations, studies and analysis, knowledge transfer and training.
The task force members indicated 28 Innovation Priorities (out of 50) as appropriate to be addressed by this flagship project. The graph in figure 7 reports the survey results for the 25-selected IPs in Pillars 1 and 2.
This chart shows the relative cumulative importance of the identified IPs as obtained by summing up the relative score stated by each task force member by assigning the value of 1 to the IP with the lowest relative relevance and 8 to the IP with the highest relative relevance. Considering the survey outcomes, the task force members agreed to select the Innovation Priorities with a degree of relative importance equal or higher than 10 for the FP2 initial phase (2022-2024). In this way, **14 R&D Innovation Priorities** have been identified by the FP2 task force to focus on during the first cooperation and multilateral research programme and they are marked with dark green bars in the graph of figure 7.
In particular:

- 6 IPs from Pillar 1 "Affordable and reliable VRE" have been selected, with a good coverage of different R&I topics such as: high efficiency and recyclability of PV modules, floating offshore wind development, large scale VRE to improve system flexibility, integration of innovative storage technologies and grid supporting converter for VRE.
- 8 IPs from Pillar 2 "System flexibility and market design" have been selected thus to address: system stability and flexibility assessment, TSO-DSO coordination, tools for DSO flexibility management, energy storage systems integration (including long-term energy storage), demand-side management and EV services exploitation. Further, a priority on market for innovative flexibility services has been also selected.
- Moreover, all the 6 IPs from Pillar 3 "Data and digitalisation for system integration" are also indirectly addressed since they underpin at a great extent the selected priorities for Pillar 1 and 2, and the overall system development.

As a result, the multilateral research programme launched by GPFM FP2 and its first open calls will focus and tackle **20 IPs out of 50** of the identified most urgent Innovation Priorities. The GPFM ExCo members acknowledged the excellent work performed by the task force members and endorsed their suggestions. The selected IPs represent a very good compromise since FP2 will have an impactful approach by effectively addressing multiple innovation challenges but at the same time do not dilute the available resources on too many IPs in parallel.
The GPFM members decided to focus this multilateral research programme on some selected Innovation Priorities in order to concentrate efforts and financial resources, and accelerate the deployment of key innovations, thus enabling the uptake of clean energy solutions in the near future. It should be noted that this short list of Innovation Priorities is not "exclusive" as GPFM members have already relevant ongoing and upcoming programmes to address other relevant R&I.
Moreover, the IPs not selected to be tackled within the Action Plan 2022-2024 will most probably be addressed in the upcoming periods after a new GPFM members assessment in 2024. It is important to mention that many of ExCo members already expressed their availability and willingness to launch or align relevant funding opportunities on the selected Innovation Priorities starting from Q1 2023.

Public funding and private sector engagement

The contribution from both the public and private sector will be essential for the successful implementation of this flagship project. Public sector will be the prime mover, launching new funding opportunities and aligning the ongoing funding schemes to cover the selected Innovation Priorities. Consortia including private sector actors such as system operators, SME, spin-off companies, and RTOs will be key in submitting sound project proposals in reply to FP2 open calls addressing some of the selected IPs. Partnership with regional and international platforms will also be used to develop at best the FP2 multilateral research programme.

R&I funding, main milestones, and timeline

The Mission set out to strengthen the cooperation with CETPartnership but also exploring cooperation opportunities with other ongoing funding programmes. In this regard, the GPFM will harmonize the first open calls of the FP2 Multilateral Research Programme foreseen for year 2023 with the CETPartnership second round of calls. It has already been confirmed that both R&I topics and timing could be very much aligned.

The possibility to have a dedicated FP2 call module within the CETPartnership platform can be targeted as an important milestone for year 2023.

Moreover, CETPartnership and GPFM key members plan to hold periodic meetings and annual Joint Events to share insights on issued calls, IPs gap analysis, and supported R&I projects in order to improve synergies and establish a fruitful collaboration.

GPFM members have also planned to launch an extended survey on priorities among GPFM members in Q4 2023 to increase the degree of coverage of the innovation priorities from 2024 and beyond.

This could be a suitable way to also support the following round of FP1 national pilots and continental demos.

Flagship Projects Gantt chart

The following Gantt chart reports the breakdown of the main activities to be developed within FP1 *"5 demos in five continents"* and FP2 *"Multilateral research programme"* and the main milestones to be reached in the period 2022-2024 (Figure 8).

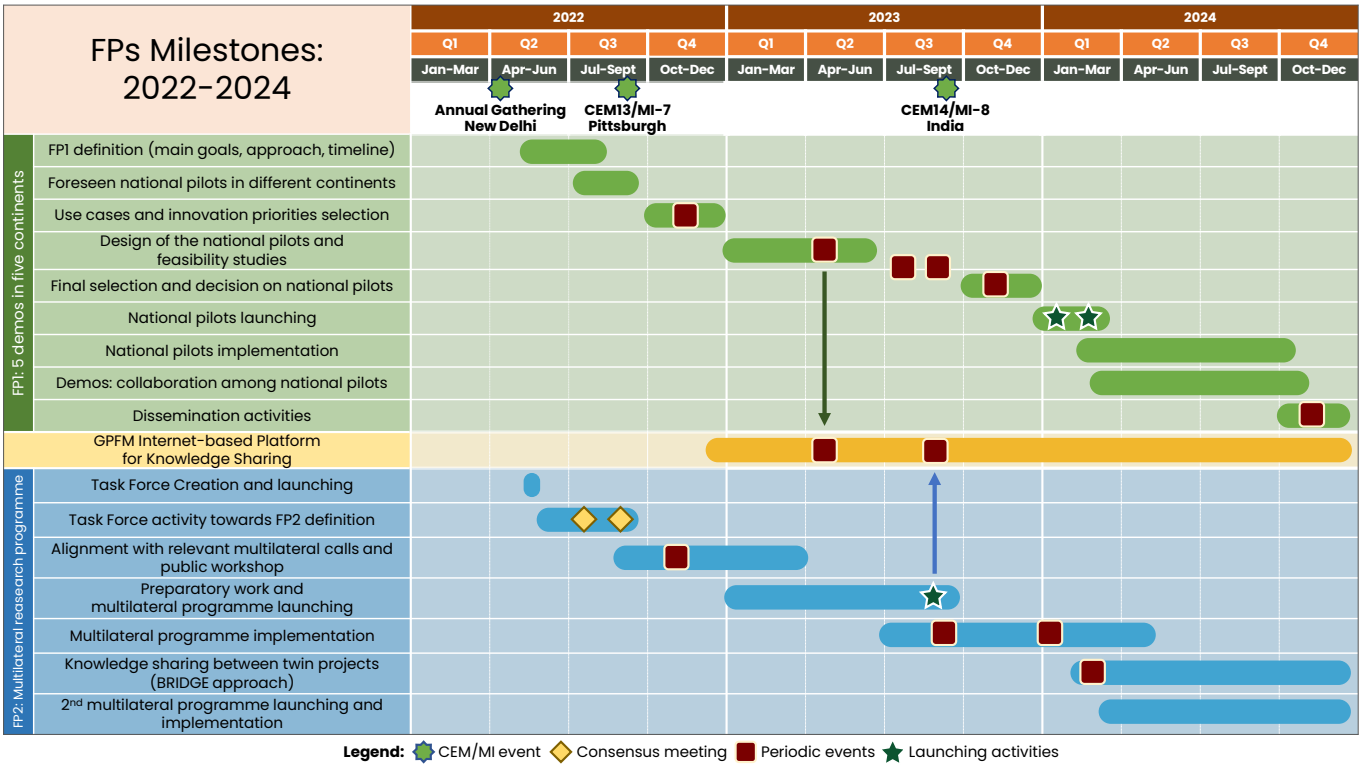


Figure 8 – GPFM Gantt chart for FP1 and FP2 and related main milestones for 2022-2024

Chapter 4

MONITORING PROCESS AND KPI

THE MISSION ACTION PLAN RECOGNIZES THE ESSENTIAL NEED OF DEFINING AND SETTING UP A PROCESS TO MONITOR PROGRESS FOR THE MISSION AT THE BEGINNING OF THE DELIVERY PHASE.

The following section sets out and defines a monitoring process for members to report and track progress against the Mission Action Plan, in particular the R&I activities as set out in Chapter 2 and the Flagship Projects as set out in Chapter 3.

Objectives of the monitoring process

The Mission considers four objectives to the Action Plan monitoring process:

1. To offer clarity to members on GPFM expected outputs over the Action Plan period, setting out what further work is expected and when.
2. To drive forward, report and track progress of the R&I activity and commitments showcased by members in the action plan which address the near-term (high) innovation priorities.
3. To drive forward, report and track progress of the Mission's Flagship proposals.
4. To establish and track KPIs for the Mission.

Regarding the fourth objective, these KPIs are intended to measure and track performance of the Green Powered Future Mission itself, and its actions to deliver the Action Plan as described, included intended R&I activity, flagship projects, dissemination and engagement. It is expected that in order to monitor and measure performance of specific R&I and Demo pilot projects, monitoring approaches and KPIs specific to that innovation project may be developed separate to these wider Mission KPIs.

The Mission intends to achieve these four objectives through the following monitoring process.

Yearly action plan update

The Mission intends to institute yearly update for the Action Plan which will result in an updated document, published annually ahead of the Ministerial.

The Mission will maintain a central master spreadsheet of Programmes and Projects submitted by members in response to the initial Action Plan R&I survey (see Chapter 2), and each year Members will be asked to provide an update on their R&I activities in this master sheet via a data collection exercise. This mechanism will give members the opportunity to report progress annually and for the Mission to monitor progress of member activities closely and to arrange wider dissemination events based on the outcomes of these activities.

Key Performance Indicators (KPIs)

The Mission also intends to set out and use Key Performance Indicators (KPIs) to monitor progress of the Mission as a whole. These will also be reported on as part of the yearly update described above. The suggested KPIs for the Green Powered Future Mission are as follows, these encompass monetary, project/Innovation priorities, and organisational performance indicators:

- Cumulative funding spent (this will be taken as the cumulative spend on R&I activities highlighted by members as contributing to the most urgent Innovation Priorities as set out in Chapter 2)
- Number of Innovation priorities tackled by Mission's partners - this will be a combination of the Innovation Priorities as tackled by R&I activity (Chapter 2), and Innovation Priorities as tackled by Flagship projects (Chapter 3)
- Number of demo projects underway (this will be the number of projects which are instigated as part of the continental demos under Flagship Project 1)
- Number of members actively contributing to the Mission (this will be taken as the number of members contributing R&I activities and involved in the Flagship Projects)
- Regular organization and engagement in Mission ExCo meetings (this will be taken from statistics of attendance at regular Mission ExCos)
- Regular update of the GPFM progress against the action plan (this will be monitoring the regular and annual publication of the Action Plan update)
- External engagement and knowledge dissemination of the Mission outputs (this will include regular update of the GPF Internet-based platform, and the measurement of number of opportunities and engagement in dissemination activity).

Chapter 5

INTERNATIONAL COLLABORATION AND DISSEMINATION

THE GREEN POWERED FUTURE MISSION IS ACTIVELY COMMITTED TO INTERNATIONAL COLLABORATION AND HAS ESTABLISHED FRUITFUL CONNECTIONS WITH KEY GLOBAL INITIATIVES IN THE CLEAN ENERGY INNOVATION FIELD, ENSURING THAT RESOURCES, KNOWLEDGE AND BEST PRACTICES ARE SHARED WIDELY AND ARE ABLE TO MAKE THE TRANSITION AFFORDABLE AND EFFICIENT FOR ALL COUNTRIES.

Coordination with selected international initiatives

International collaboration is critical to address unprecedented global challenges, ensuring that resources, knowledge and best practices are shared widely. With its track record of successful R&I collaborations and its global network of clean energy innovation leaders, the GPFM is committed to drive the innovation efforts in this area and help make the transition affordable and efficient for all countries. The GPFM aims to engage a broad set of key stakeholders including governments and governmental organisations, public research centres and academia, international organisations and the private sector.

Strong engagement with MI members as well as active support from other key regional and global initiatives on the relevant topic are crucial to mobilise resources and know-how from key innovators in the private sector.

International organisations and global initiatives active in the field of energy innovation, research and analysis are crucial stakeholders to engage and collaborate with. Hence, it is vital that the GPFM is additive to the sector and works effectively with other key initiatives and stakeholders which share the common goal of efficient integration of high shares of VRE.

The foreseen collaboration with key global initiatives will enable the promotion of strong synergy and complementarities in terms of clean energy challenges not directly covered by the GPFM. The main initiatives which this Mission has already established connections to leverage synergies and effective collaboration on mutually interesting topics are the following:

- International Smart Grid Action Network (ISGAN)
- Digital Demand-Driven Electricity Networks (3DEN) Initiative
- The Power Breakthrough of the Breakthrough Agenda
- Global Power System Transformation Consortium (G-PST)
- CEM workstreams active in this space e.g., 21CPP, (ISGAN), LTES, etc.
- Long Duration Energy Storage (LDES) Council
- European Technology & Innovation Platform on Smart Networks for Energy Transition (ETIP SNET).

Examples of outputs of selected collaborations and initial connections include:

- Successful organization of a **joint side event with ISGAN** which took place on 6th April during the Mission Innovation Annual Gathering in New Delhi, India, to discuss and agree upon the specific R&I challenges to be tackled within the collaboration and their relative priorities.
- Periodic meetings with the ISGAN team for the preparation and submission of a joint side event approved by CEM13/MI-7 organizers and to take place on September 2022 at the Global Clean Energy Action Forum in Pittsburgh, PA, U.S. This event will showcases the collaboration between GPFM and ISGAN aimed to accelerate development and demonstration of innovative solutions for the power systems transition to net zero emissions. Several announcements are planned at this event such as the **GPFM-ISGAN MoU signature** and Flagship projects launching.

- Successful meetings and ongoing dialogue with the Urban Transitions Mission (UTM) leaders to explore possibilities for collaboration. This exercise evidenced a high complementarity and a potential strong synergy between GPFM and UTM, in terms of topics, coalition members and stakeholders that will be instrumental to help both missions to accelerate towards their overarching goal. Apart from possibly launching some selected joint R&I activities on the identified mutually interesting R&I topics, **UTM and GPFM are willing to join forces** in addressing one or more urban network demos. The UTM-GPFM collaboration will entail organizing periodic joint workshops and public conferences to share approach and initial results to be spread among the missions' members and beyond by means of an integrated internet-based knowledge sharing platform.

In launching and running large-scale demonstration projects, the Mission aims to work with other MI Missions and stakeholders which share the common goal of modernizing and decarbonizing the energy system such as the Clean Hydrogen Mission for the integration of Power to Gas technologies in power systems, the Urban Transitions Mission for integrated urban flexibility, ISGAN to blend efforts in smart grids deployment, as well as other key global initiatives.

Workshops and dissemination activities

To accelerate further multilateral cooperation and promote dedicated dissemination activities, the GPFM has already started engaging with key international stakeholders.

Initial activities will focus on the development of a **knowledge sharing hub's structure** and the activities that will be delivered as part of the hub, which could include:

- Disseminating project level outcomes
- Setting up networking events/ platforms
- Delivering joint international research activities across MI countries
- Developing channels for international and public-private collaborations

The GPFM members recognise the paramount importance of an effective and mutually fruitful interaction with the industry sector and hence aim to establish structured engagement routes with all key actors in the power-energy system value chain. In this view, Transmission and Distribution System Operators (TSOs and DSOs) are critical stakeholders for this Mission. In fact, many innovative solutions need to be tested on the ground, therefore the access to the power network would be required.

Overall, information sharing and new collaboration opportunities at international level will be exploited to accelerate energy system innovation. To achieve this, the GPFM will target leading policy makers and industry representatives to establish a close dialogue, foster mutual learning and exchange of best practices on technologies, policies, regulations, and market designs that could enable a faster transition to a smarter and more flexible power system. The geographical diversity will be considered to explore different contexts, similarities and challenges and enable the Mission to truly address a global challenge through cooperation.

In this view, by Q2 2023 the Mission will develop the **GPFM internet-based Platform** that aims to serve as data platform for demos, workspace for members and experts, and as dissemination tool to showcase the results and achievements of the Mission. The GPF internet-based platform will rely on a cloud-based architecture for GPFM members internal use as well as for external users. The GPFM Platform development is led by China that assigned 150+ k$ for its first phase development. Italy and possibly other core team members will contribute with dedicated in-kind resources.

The GPFM Internet-based platform will integrate advanced functionalities for data collection and sharing, cooperative work and services, experts knowledge exchange and transfer thus, to establish an expert think-tank and international forum mechanism for the Mission. Moreover, it will provide the needed open dialogue space to promote the innovation and industrial-scale application of the Mission results and to generate

further influence to the global power industry. The main functional modules of the GPFM platform includes three main parts: one dedicated to Mission' members internal use, the SGIA, and the GPFM Toolbox.

The existing **SGIA**[5] **(Smart Grid Innovation Accelerator)** semantic platform, developed by MI IC1 on Smart Grids in the first phase of Mission Innovation, will be fully embedded and constitute an important building block of the GPFM Platform. In fact, the SGIA allows open knowledge sharing, thus catalysing public and private sectors joint efforts towards the deployment of innovative technologies and solutions worldwide. The SGIA covers not only technical but also policy & regulatory aspects by gathering key documents, information, data, best practices and project results from several relevant stakeholders with the specific aim to be replicated and adopted broadly. Exploiting a semantic engine, advanced AI algorithms and machine learning models, the SGIA automatically gathers all essential information from the documents within its database and provides enriched, easily searchable and browsable documents. Moreover, interlinked entities and relationship from documents are used to build the SGIA knowledge graphs, which fosters an innovative way of exploring information based also on natural language queries.

The "**Green Powered Future Toolbox"**, storing all the validated innovative solutions achieved through the flagship projects, will be hosted on the GPFM Platform. All member countries will be able to pick and customise technical, market and regulatory solutions from this Toolbox according to their national strategies and needs in view of their successful replication in different geographies and system conditions.

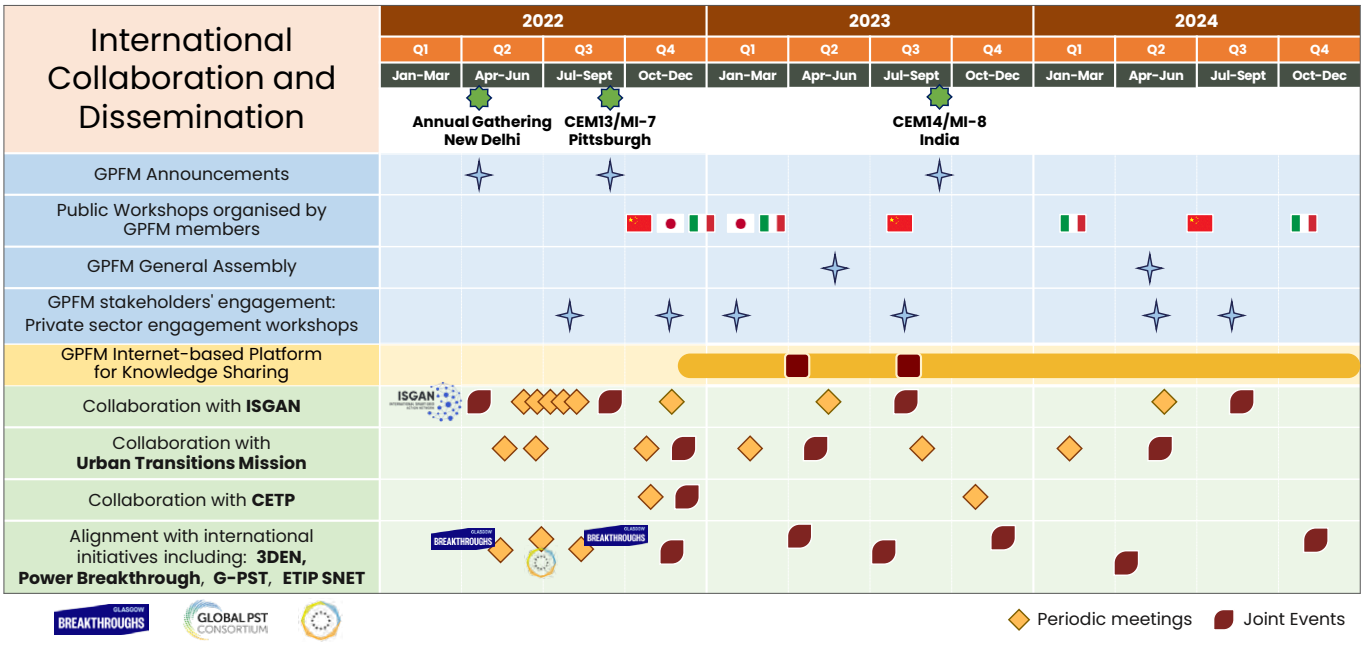


Figure 9 – GPFM International activities 2022-2024

[5] www.mi-sgiaplatform.net

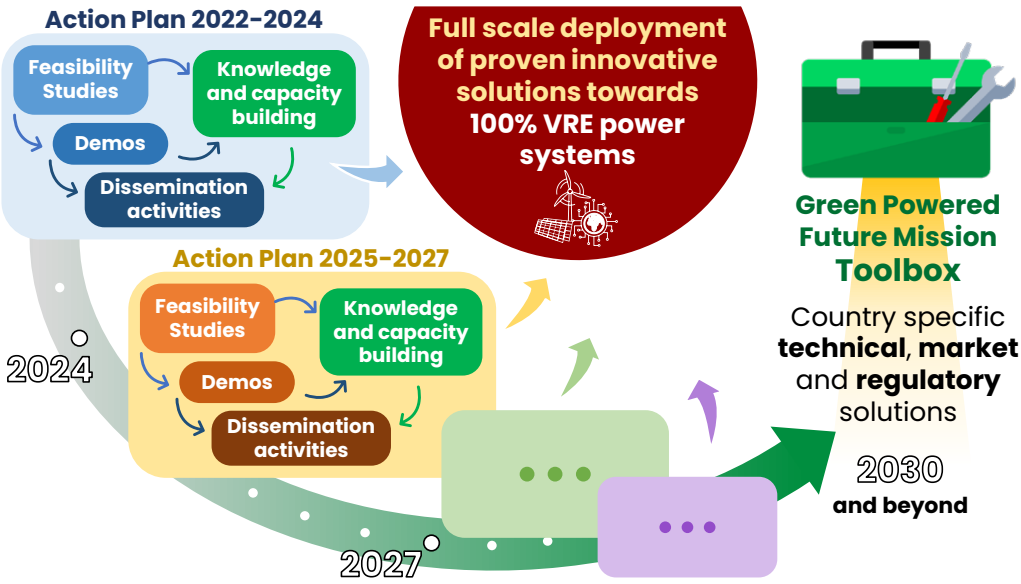


Figure 10 – Implementation "phases" towards the Mission's Toolbox development

Chapter 6

CONCLUSIONS AND ADDITIONAL ACTIONS TOWARDS THE NEXT PERIOD (2025-2027)

THE ACTION PLAN WILL TAKE THE MISSION TO ITS DELIVERY PHASE BY SHOWCASING THE FLAGSHIP PROJECTS AND ACTIVITIES GPFM MEMBERS WILL BE UNDERTAKING TO ADDRESS THE HIGH AND NEAR-TERM GLOBAL INNOVATION PRIORITIES IDENTIFIED IN THE MISSION ROADMAP FOR THE PERIOD BETWEEN 2022 AND 2024.

Electricity is becoming the core of the energy system: it will play a key role across all sectors, from transport and buildings to industry. According to the IEA's net-zero by 2050 document[6], electricity generation will need to reach net zero emissions globally in 2040 and will be well on its way to supplying almost half of total energy consumption. This will require huge increases in electricity system flexibility and the deployment of several new technological solutions.

The Action Plan outlines the most urgent actions to be implemented to achieve very high shares of grid integrated VRE and takes the Mission into its delivery phase. It incorporates significant efforts from both public and private stakeholders as well as international organizations, and sets out specific actions for the implementation phase of 2022-2024 which will tackle the high and near-term global innovation priorities identified in the Mission Joint Roadmap. In this Action Plan, the coalition of GPFM proposed two key flagship projects, including FP1 five demonstrations in five continents: launching of large demonstrations with up to 80% VRE by 2024, and FP2 multilateral research programme to tackle 20 of the identified Innovation Priorities by 2023. Galvanizing the Coalition's efforts and collaboration across the Mission and more widely will be key to the successful development and deployment of these identified flagship projects and R&I activities, and the demonstration of innovative solutions across a range of contexts and a variety of power system conditions to achieve the Mission's objective.

Actions towards the next period (2025-2027)

In the three years following this action plan period (i.e.,2025 – 2027), based on the path to realisation of innovative solutions set out in this document, the coalition will seek to further develop and deploy innovative solutions in line with the innovation priorities identified, and will strive to address more than 70% of the innovation priorities by 2027. In addition, the replicability and scalability of the validated innovative solutions will also be the focus of the next period action plan. Building on the proposed flagship projects, it is necessary to formulate longer-term programs and plans to achieve a 100% variable renewable energy system. The Mission, through its actions, can provide learnings, new ideas, and exemplars for policy makers to develop long-term policies to further ensure the achievement of a green powered future by 2030.

[6] https://www.iea.org/reports/net-zero-by-2050

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MISSION INNOVATION

Green Powered Future Mission Coalition

China *- Ministry of Science and Technology (MOST)*
Italy *- Ministry for Ecological Transition (MITE)*
United Kingdom *- Department for Business, Energy and Industrial Strategy (BEIS)*

Australia *– Department of Industry, Science, Energy and Resources (DISER)*
India *– Department of Science and Technology (DST)*
Saudi Arabia *– Ministry of Energy*
IRENA – International Renewable Energy Agency
World Bank Group
Alperia SpA, Italy
Areti SpA, Italy
Enel Grids, Italy
National Grid Group, United Kingdom
Icebreaker One, United Kingdom
LONGi Green Energy Technology Co., Ltd., China
Xinjiang Goldwind Science Technology Co., Ltd., China

Austria *– Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK)*
Brazil *– Energy Research Office (EPE)*
Canada *– Natural Resources Canada/Ressources Naturelles Canada (NRCan/RNCan)*
European Commission *– Directorate-General for Research & Innovation*
Germany *– Federal Ministry for Economic Affairs and Climate Action (BMWK)*
Japan *– Ministry of Economy, Trade and Industry (METI)*
Republic of Korea *– Ministry of Trade, Industry and Energy (MOTIE)*
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