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Interim report on the state of play of the SET Plan IPs and mapping of R&I activities

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EXECUTIVE SUMMARY

This report D1.1. - *Interim report on the state of play of the SET Plan IPs and mapping of R&I activities* relates to Task 1.1 - *State of play: mapping of open and covered activities* - of the SUPEERA project. This first interim report will be updated twice, in year 2 and 3.

The SUPEERA report first presents the progress of each Implementation Plan individually, using the data provided for the SET Plan annual progress report of 2019 (*Implementing the SET Plan: Progress from the Implementation Working Groups*[1]). This analysis intends to illustrate, in as much detail as possible, the progress of the SET Plan Implementation Plans and list the main limitations that preclude a clear insight of the state of progress of each of them.

Additionally, the report carries out a qualitative analysis in order to develop a better understanding of the working mechanisms of each Implementation Working Group and the reporting process they have adopted. This exercise was based on interviews conducted within the framework of the SUPEERA project with EERA members' representatives. The main purpose is to comprehend and analyse the perception of EERA members, members in one Implementation Working Group, on the reporting process, its challenges and effective practices.

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[1] Strategic Energy Technologies Information System (SETIS*), Implementing the SET-Plan: Progress from the Implementation Working Groups, Nov. 2019,* https://setis.ec.europa.eu/publications/set-plan-implementation-progress-reports/progress-implementation-working-groups-2019

LIST OF ACRONYMS

CCUS	Carbon Capture Use and Storage
CSP/STE	Concentrated Solar Power/ Solar Thermal Electricity
EE	Energy Efficiency
EERA	European Energy Research Alliance
ERA- Net	European Research Area Net
ETIP(s)	European Technology and Innovation Platform(s)
IPs	Implementation Plans
IWG(s)	Implementation Working Group(s)
JA(s)	Joint Action(s)
PED	Positive Energy Districts
PV	Photovoltaics
SETIS	Strategy Energy Technology Plan Information System
R&I	Research and Innovation
SET Plan	Strategy Energy Technology Plan
SUPEERA	Support to the coordination of national research and innovation programmes in n. areas of activities of the European Energy Research Alliance
TWGs	Temporary Working Groups
WP	Work Package

LIST OF TABLES AND CHARTS

I PRELIMINARY CONSIDERATIONS

1.1 SUPEERA in a few words

On January 1st 2020, SUPEERA project[2] - ***SUP****port to the coordination of national research and innovation programmes in areas of activities of the* ***E****uropean* ***E****nergy* ***R****esearch* ***A****lliance* – was launched.

The project aims at reaching four high level objectives:

1) Facilitate the coordination of the research community in support to the execution of the SET-Plan towards the Clean Energy Transition
2) Accelerating innovation and uptake by industry
3) Provide recommendations on R&I priorities and policy frameworks through the development and analysis of energy and macroeconomic indicators
4) Support and promote the connection of the SET-Plan and the Clean Energy Transition with all stakeholders

In order to realise the first high objective, the project aims at facilitating the implementation of the SET-Plan (the Strategic Energy Technology Plan) Implementation Plans, by assisting the energy research organisations involved in the SET-Plan itself. In specific, SUPEERA will focus on the identification, mobilisation and optimisation of primary EERA members' resources that can be engaged in the execution of the Implementation Plans. In addition to EERA members, the project encourages a stronger engagement of the RTOs located in so-called EU-13 countries with a low or even non-existent participation in the SET-Plan, which are not members of EERA. Within this Work Package 1, SUPEERA also aims at enhancing the exchange of information between the Implementation Working Groups (IWGs) and at making recommendations for joint actions concerning crosscutting and interdisciplinary activities. The second, third and fourth high level objectives will be reached through the activities foreseen by other work packages: helping the acceleration of the market uptake of low carbon energy technologies by the industry (WP2); exanimating the impact of EU policies in the view of bringing the SET-Plan forward in the broader context of the Clean Energy Transition (WP3) and supporting and promoting the SET-Plan and the Clean Energy Transition to other stakeholders (WP4).

[2] For more information see www.supeera.eu

Context

In 2007, the European Commission announced the creation of the SET-Plan, which was intended to be an instrument to boost R&I in the field of low carbon technologies. In 2015, the Commission adopted a new strategy concerning an Energy Union for the European Union. Out of the five dimensions of this new strategy, one was dedicated to Research, Innovation and Competitiveness that encompasses all dimensions of the Energy Union by boosting R&I to improve competitiveness in the *low carbon and clean energy technologies. Successively, the SET-Plan was remodelled to fit to the new context and priorities decided by the Commission and ten key actions were defined to achieve the transition to climate-neutrality by 2050. Building on these 10 priorities, 14 Temporary Working Groups (TWG), chaired by national representatives and including actors from research organisations and industrial entities, were set up to write 14 Implementation Plans (IPs), which cover all the Energy Union R&I priority areas and the 10 SET-Plan actions. After the release of the IPs and their endorsement by the Member states, the TWG were replaced by the corresponding Implementation Working Groups (in charge of executing the R&I activities listed under the IPs). The SET-Plan is supported by the open access SET-Plan Information System (SETIS – Joint Research Centre, European Commission) that provides up-to-date information on its activities covering all R&I priorities of the Energy Union.*

1.2 Monitoring the SET-Plan progress: SUPEERA objectives and deliverables

SUPEERA's first work package (WP1) aims at facilitating the execution of the SET-Plan Implementations Plans through the monitoring of the progress related to each of the IPs (Task 1.1), the mobilisation and optimisation of EERA resources for the execution of research and innovation (R&I) IPs activities (Task 1.2), and the identification of the cross-cutting topics (technological and non-technological) and synergies across the 14 IPs (T1.3).

This report (D1.1) relates to Task 1.1 - *State of play: mapping of open and covered activities* – co-led by CEA (Commissariat à l'énergie atomique et aux énergies alternatives) and EERA aisbl (European Energy Research Alliance), while assisted by Linked Third Parties of the project, namely DTU (Danmarks Tekniske Universitet), SINTEF (SINTEF - Stiftelsen for industriell og teknisk forsknin - Energi AS), and KIT (Karlsruhe Institute of Technology). The aim of this report is to provide a consolidated status of the progress of the implementation of the SET-Plan with emphasis placed on research and innovation, including major achievements and barriers.

D1.1 is an interim report and will be updated twice, in year 2 and 3 of project implementation. In its final version, the report will serve as a base for Task 1.2., in order to identify and map EERA resources (human resources, funding, and infrastructure) available for the execution of the Implementation Plans' activities. The outcomes will be used to provide preliminary recommendations on possible ways to link EERA resources with the needs of open activities (T1.2).

After the introduction (*1. Preliminary considerations*), this report continues with a section on the methodology and steps taken by EERA partners in order to gather the data necessary for the report (*2. Setting the scene and the adapted methodology*). Based on this methodology, the report

analyses the progress of 13 IWG (*3. State of Play*)[3]. This section is structured along each of the 13 Implementation Plans. The following section builds on the state of play to analyse the progress achieved by the SET-Plan and of the reporting process in 2019 (*4. Analysis*). Finally, the report ends with a conclusion and some preliminary recommendations on the way forward (*5. Conclusion*).

D1.1 will be disseminated through EERA channels, in particular to the EERA Joint Programs and other relevant stakeholders.

II SETTING THE SCENE AND THE ADAPTED METHODOLOGY

2.1 The SET-Plan annual progress report 2019

During the SUPEERA proposal preparation phase, the Strategic Energy Technologies Information System (SETIS) launched an initiative, with the objective to develop a working methodology based on indicators to monitor the progress of actions under the Implementation Plans.

A set of templates were subsequently produced to gather relevant data. The collected data was assembled in a report – *Implementing the SET-Plan: Progress from the Implementation Working Groups* – released during the SET-Plan conference in Helsinki (November 2019).

This publication offers an overview of this pilot phase of the SET-Plan monitoring process, presenting its state of implementation based on the inputs from the SET-Plan IWGs.

In this context, task 1.1 initial *raison d'être* was impacted and SUPEERA could not just report on the progress of the Implementation Working Groups as it was initially planned. In order to both 1) avoid overlapping and 2) enhance the approach and impact of task 1.1, tasks leaders, namely EERA aisbl and CEA, established a SUPEERA-SETIS collaboration[4] that will last until the end of SUPEERA project, as further detailed in section 2.3.

2.3 The initial planning and its adaptation

As a consequence of the Covid-19 crisis, a general lockdown was decided by the EU national governments in the beginning of March 2020. This situation has impacted the activities and the reporting exercise planned under Task 1.1, by creating some delay and difficulties to reach relevant stakeholders.

Despite several constrains on the access to information, planned face-to-face meetings and workshops with IWG were cancelled but instead, teleconferences and virtual meetings were

[3] Nuclear Safety IWG is not included in the analysis because the Nuclear Safety IWG Template was not provided in 2019
[4] More information page 9 of the report

carried out in order to obtain information concerning the identification of open activities as to their need.

As a consequence of these two factors, Covid-19 crisis and 2020 SETIS activity, the initial planning was modified and a new strategy was adopted.

Based on the Grant Agreement, SUPEERA initially planned to monitor the progress made by the Implementation Plans since their release[5].

Partners were expected to retrieve preliminary information from the annual report of the SETIS. In this report, the progress of the activities of each Implementation Plans are identified by colour, namely:

- **Green**: ongoing projects addressing the IP activity;
- **Orange**: the project has reached a level of maturity to enable it to ascend towards take-off for the execution of the IP activity;
- **Red**: no progress.

Building on this categorisation, SUPEERA planned to further investigate on the so-called "green activities", by sorting them between the still "open"[6] and the "closed" [7] R&I activities. In this context, "red" and "orange" activities are automatically identified as "open" activities. Those "open" activities were to be identified based on insufficient 1) research human resources or infrastructures, and 2) funding.

To gather necessary data for a more detailed state of play on the execution of the IPs, SUPEERA intended to establish contacts with representatives of the different IWGs to provide the new data. The outcomes of this additional exercise were intended to give an understanding of the gaps to be found in the IPs, and therefore would be the basis of preliminary recommendations on possible ways to link EERA resources with the needs of open activities (T1.2).

The main outcome of this additional exercise is to have a better overview of the existing gaps and different applied reporting methodology among IWG, which would feed the preliminary recommendations on matching EERA resources with the need of open activities (T1.2).

As described above, an enhance approach to Task 1.1 has been developed including the SUPEERA-SETIS collaboration, creating synergies between both initiatives.

Task 1.1 new approach

In order to facilitate the exchange of information between the two initiatives, the basis for a collaboration SUPEERA - SETIS is currently being defined and several actions have already been carried out during the first months of 2020.

The first meeting was held in Petten on January 31st, 2020 and was attended by EERA aisbl, CEA, the SETIS and DG RTD. During this meeting, the first steps to define the basis of the ongoing collaboration were taken.

[5] Most of the IPs were published between September 2017 and November 2018.
[6] Additional work needs to be done for their implementation.
[7] They are already implemented or very close to be.

Following this meeting, SUPEERA was invited to follow, as an observer, the workshop organised to design the new template that will be used to gather the information from each IWG to prepare the 2020 SET-Plan progress report. This workshop was attended by representatives from each of the Implementation Working Groups and held on February 27th, 2020.

The first step taken under this new scope was to establish a Pilot Action during 2020 for the analysis of the State of Play of the Implementation Plans of three IWGs, representing different sectors and levels of progress (IP on photovoltaics, on Energy Efficiency in Industry, and Battery). Best practices and lessons learnt from this pilot action will feed further analysis to be carried out on year 2 and 3.

The first draft of this report (to be updated on year 2 and 3) is based on the current data available in both 1) the 2019 SET-Plan progress report and 2) IWGs Templates. The complete analysis is included in the Section 3 “State of Play”.

A SUPEERA template was subsequently created to obtain more precise understanding of the progress of the activities of the three selected IWGs (see Annex 1). The SUPEERA template aimed at gathering additional information that was not included in the 2019 IWGs reports or were not consistent across the IPs. The main objective was to have a more precise picture of the state of execution of each IP activity (in terms of percentage), since the three colours system adopted (Green, Orange, Red) cannot offer that level of granularity. With the current “traffic lights” basis, it is not possible to establish if an activity labelled “green” is just starting and has some ongoing projects (15% of advancement) or if it is already very well advanced (85%), almost being completely implemented, and therefore not in need of significant additional efforts. Therefore, the IWGs representatives were requested to provide information on the support needed for the execution of the IP activities, especially in terms of funding (specifying, where possible, the needed amount), required expertise and necessary infrastructure.

In addition, the interlocutors were requested to indicate the crosscutting topics and synergies among IWGs already identified by the respective Implementation Plan and those not yet identified but relevant for the execution of one or more activities. Although basic information on these aspects is already included in both the 2019 SETIS report and the IWGs Templates, a more detailed insight is necessary for other project activities, as for example Task 1.3.

Finally, the IWGs representatives were solicited to provide additional information on the projects listed in the 2019 report covering single IP activities, by specifying the share of the budget that contribute to the execution of listed activities. This request appeared necessary since the link between the projects and the activities was clear for just few IWG report, while for most of them the information was not coherent and the share of the budget was missing. Hence, it is important to understand what share of project(s) is actually aligned with single IP activities. This allows a more precise assessment of the already mobilised funding.

2.4 A quantitative and qualitative analysis

For the analysis part of the Report (Section 4), both quantitative and qualitative approaches were adopted.

Concerning the quantitative approach, the preliminary analysis was based on data available in the 2019 SET-Plan progress report and IWGs Templates. The analysis aims to illustrate as detailed as possible the progress of the SET-Plan IPs to list the main limitations within current available data that preclude having a clear understanding of the state of progress of each IPs. A proper analysis should give an insight into the potential of the current reporting mechanism in understanding the SET-Plan ecosystem and eventually revealing possible obstacles that limit the extent and employability.

On the other side, project partners adopted a qualitative approach in order to better understand the working mechanisms of each IWGs and the adopted reporting process. In this regard, partners have contacted several representatives of EERA member organisations taking active part in the activities of the IWGs.

The list of the contacted representatives and the questions provided to them can be found in Annex 2. The interviews were conducted by phone or email between the 15th of April and the 15th of May. All interviewees have given their consent to have their name appearing in this report[8].

The main objective was to understand and analyse the perception of the reporting process that EERA members have regarding the IWGs in which they are participating. This information was essential to complete the details on the limitations analysed above that prevent a complete and thoroughly overview of the reporting mechanism.

Finally, in the conclusion of this report, partners have listed preliminary recommendations on how to address the mentioned barriers and strengthen the cooperation among SET-Plan stakeholders for the future.

III STATE OF PLAY

Within this section, the Report proposes an analysis of the State of Play of the Implementation Plans that emerges from the information provided in the IWGs Templates and consolidated in the 2019 SET-Plan progress report.

Based on the IWGs Templates, data were explored in a factual way through a coherent and similar structure across the various Implementation Plans. However, since there is lack of data from several IWGs, it was not possible to adopt and replicate the uniformed structure for all IPs.

Each section relates to one IP and contains an analysis of the targets[9] of the concerned IP. It focuses on the relevance and the possible need of revision of these targets, together with an explanation of the prioritisation and progress of the planned activities[10]. Furthermore, it includes a delineation of the ongoing projects, with information on the quantity of activities, the amount of funding provided and the origin of this funding (European or National).

Concluding each section, a breakdown of the future funding opportunities for R&I activities in line with the referring IP.

[8] See Annex 2.
[9] Targets to be achieved to meet the IWG's objectives, as listed the declaration of intent and IP of each IWG.
[10] Activities listed in each IP to meet the identified targets.

3.1 Initiative for Global Leadership in Concentrated Solar Power

The Implementation Working Group on "**Global Leadership in Concentrated Solar Power**" is linked to Action 1, which refers "to sustain technological leadership by developing highly performant renewable technologies and their integration in the EU's energy system" and Action 2 "to reduce the cost of key technologies". The Implementation Plan was published in November 2017.

The IP sets two targets, one for the short-term and one for the longer-term. At the short-term level, the IP sought to achieve a cost reduction of technologies of at least 40% by 2020 (in comparison to 2013). This was meant to be visible on the supply price, which should be inferior of 10 c€/kWh [for a radiation of 2050 kWh/m2/year (conditions in Southern Europe)]. At the longer-term level, the IP aimed at the development of the next generation of CSP/STE technology.

In the 2019 SETIS report, both targets were deemed as not anymore relevant and both need revision. Concerning the short-term target, supply prices reached 7 cts€ /kWh in 2018. However, the objective is considered as not realistic due to the functioning of the RES procurement auction mechanisms. Concerning the longer-term target, the deployment of CSP/STE does not depend anymore on technology innovations but mainly on the market volume for proven technologies.

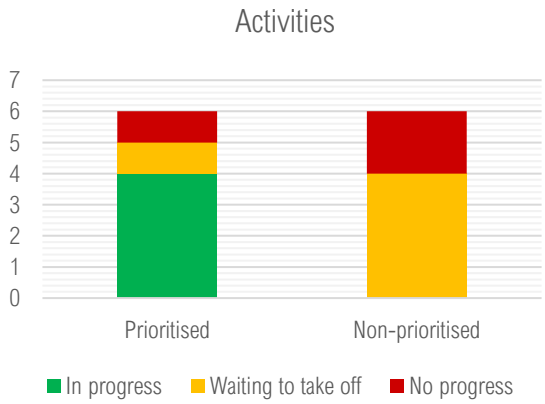

Figure 3.1.1 Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

The Implementation plan lists 12 activities, of which nine have reached some level of development. Only four activities (1/3 of the total) had ongoing projects addressing the activity. However, out of those 12 activities, six where labelled as a priority in 2019-20 for the success of the IP and all four activities progressing well were prioritised. Therefore, only two prioritised activities were not progressing fast enough namely:

- Development of advanced concepts for improved flexibility in CSP applications (awaiting to take off);
- Development and field test of CSP hybrid air Brayton turbine combined cycle sCO2 systems (no progress);

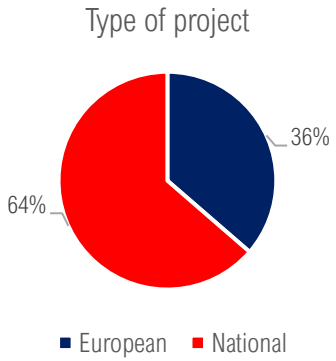

Figure 3.1.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

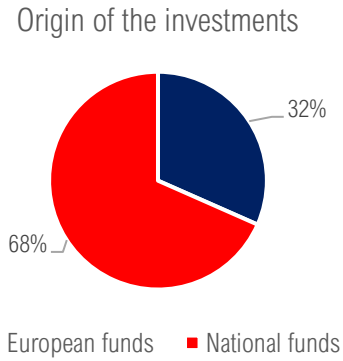

Figure 3.1.3 – Origin of the investments based on the available information reported by the IWG for the 2019 SETIS report

According to the data available in the 2019 SETIS report, the CSP/STE IP listed about 33 projects addressing its targets. The total amount channelled through the projects reaches €108,5 million. Out of these 33 projects, 21 projects were funded through national budget. These projects amount to around €34.3 million. Concerning the nationally funded projects, seemingly the only two active countries targeting the activities of this IP are Germany and Spain, with an equal effort. On the other hand, 12 projects were labelled European funding for a total amount of approximatively €74,193 million. One project started in 2015, five projects in 2016, seven in 2017, twelve in 2018 and nine in 2019. 2018 was therefore the most active year with 35% of the listed projects started at that date. The most targeted activities by the projects are activity 6 (14 projects), activity 9 (11 projects), and activity 5 (7 projects). These three activities were all labelled green and prioritised in the 2019 report.

In the 2019 report, the CSP/STE IWG lists five future calls, all at national level. With the given data, it is not possible to indicate a precise budget as only three of the five call provided this information. It is not yet possible to have a clear picture of the scope of the activity that will be funded by the future calls.

3.2 Initiative for Global Leadership in Photovoltaics

The Implementation Working Group on "**Global Leadership in Photovoltaics**", published in October 2017, is linked to Action 1. The action refers "to sustain technological leadership by developing highly performant renewable technologies and their integration in the EU's energy system" and Action 2 "to reduce the cost of key technologies".

The IP sets five overall targets, namely 1) major advances in efficiency of established technologies, 2) Reduction of the cost of key technologies, 3) further enhancement of lifetime, quality and sustainability and hence improving environmental performance, 4) enabling mass realization of "(near) Zero Energy Buildings" by Building-Integrated PV, and 5) major advances in manufacturing and installation. Those five overall targets are then subdivided in 11 targets.

In the SETIS 2019 report, eight targets were considered still relevant; while four targets need revision (one target is still relevant but needs at the same time to be revised). Mainly, the targets need revision as in the current state of play the goals have already been achieved or will most probably be very soon achieved.

The Implementation plan lists six activities, of which five have reached some level of development ("green" or "orange"). However, only half of the activities (3 of the total) had ongoing projects addressing the activity. However, out of those six activities, four where labelled as a priority in 2019-20 for the success of the IP and all three activities progressing well were prioritised. Therefore, only one prioritised activity was not progressing fast enough namely:

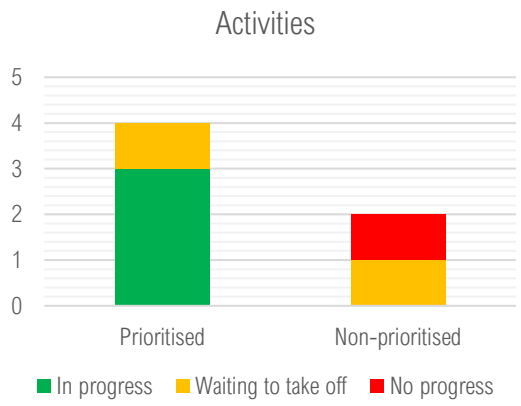

Figure 3.2.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

- PV for Building-Integrated PV and similar applications

According to the data available in the 2019 SETIS report, the PV IP listed 28 projects addressing its targets. The total amount channelled through the projects reaches €74,89 million. Out of these 28 projects, 20 projects were funded through national budget. These projects amount to €68.8million (92% of the total channelled amount of money). The majority of the nationally funded projects (11) are carried out by Germany, followed by Spain (6) and Norway (3). On the other hand, two projects were labelled as European, for an amount of €1.2 million (2% of the total amount). Finally, six of the projects could not be sorted as being funded either by national or European bodies, given the data that was accessible online. Those six projects amount to €4.89 million (6% of the total amount). Most of the projects started in 2018 (49%) while 32% started in 2017 and 21% in 2019. The most targeted activities by the projects are activity 1 (7 projects), and activity 4 (7 projects). Both activities are labelled orange (waiting to take off) but only activity 1 is prioritised in the 2019 report. The other three activities have four or five projects listed.

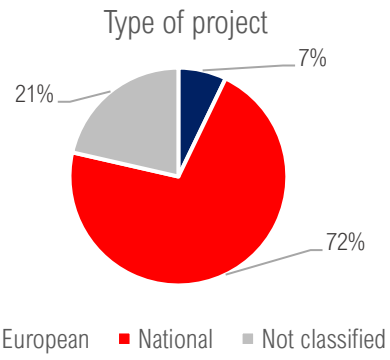

Figure 3.2.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

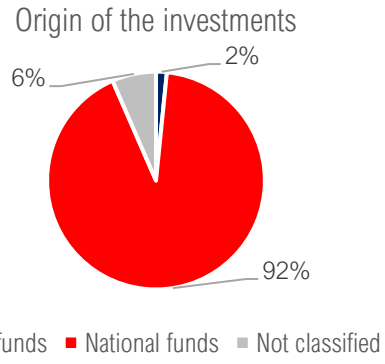

Figure 3.2.3 - Origin of the investments based on the available information reported by the IWG for the 2019 SETIS report

In the 2019 report, the IWG list ten future calls, all at national level. Given the available data, it was not feasible to state a precise budget; most of the calls in effect relate to the energy sector as a whole rather than to the PV only.

3.3 Initiative for Global Leadership in Deep Geothermal

The Implementation Working Group on "**Global Leadership in Deep Geothermal**" is linked to Action 1, which refers "to sustain technological leadership by developing highly performant renewable technologies and their integration in the EU's energy system" and Action 2 "to reduce the cost of key technologies". The Implementation Plan was published in January 2018.

The IP sets six targets, namely 1) Increase reservoir performance; 2) Improve the overall conversion efficiency; 3) Reduce production costs of geothermal energy; 4) Reduce the exploration costs; 5) Reduce the unit cost of drilling; and 6) Demonstrate the technical and economic feasibility of responding to commands from a grid operator, at any time. In the SETIS 2019 report, all of the targets were considered as still relevant in their original formulation.

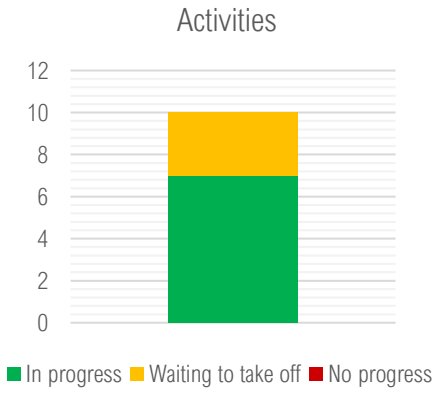

Figure 3.3.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS 2019 SETIS report

The Implementation plan lists 10 activities. All of them have reached some level of development. Furthermore, more than 2/3 of the activities (seven of the total) had ongoing projects addressing the activity. However, no prioritisation was given in the 2019 SETIS report. It is therefore not possible to state if the three lacking activity are maybe not considered as priority, which could relate to their actual state. Those three lacking activities are:

- Exploration techniques (including resource prediction and exploratory drilling);
- Integration of geothermal heat and power in the energy system and grid flexibility;
- Zero emissions power plants.

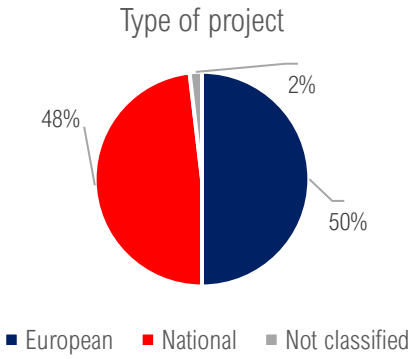

Figure 3.3.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

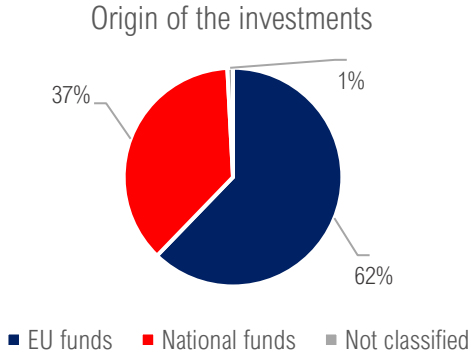

Figure 3.3.3 - Origin of the investments based on the available information reported by the IWG for the 2019 SETIS report

According to the data available in the 2019 SETIS report, the IP listed 54 projects addressing its targets. The total amount of the projects reaches approximatively €383,25 million. Out of these 54 projects, 26 projects were funded at national level. These projects received around €142,75 million (37,2% of the total channelled amount of money). The most active country is Germany, carrying out 11 of the nationally funded projects, followed by the Netherlands with 7 projects, and then Norway (4) France (2) and Switzerland (1).Two of the projects funded at national level are resulting from a collaboration of more countries: one including Iceland and Norway and the other Germany, the Netherlands, Belgium and France. On the other hand, 27 projects were funded at European level, for a total amount of about €240,5 million (62,8% of the total amount). One project remained unclassified. Most of the projects started between 2016 and 2019, even if several projects were listed for 2014 and 2015. 2018 was the most active year with 37% of the listed projects started at that date, while 20,4% of the projects started in 2019, and 16,7% in 2016. The most targeted activities by the projects are activity 6 (18 projects), activity 3 (13 projects), and activity 1 (11 projects). These three activities were all labelled green in the 2019 report, but no prioritization was given.

In the 2019 report, the Geothermal IWG lists five future national calls. Analysing the data, it was not possible to indicate a precise budget (estimation is over the billion euros since only Germany foresees future calls of €1,3 billion). There is not yet information of the scope of the activity that will be funded by these future calls.

3.4 Initiative for Global Leadership in Offshore Wind

The Implementation Working Group on "**Global Leadership in Offshore Wind**", published in June 2018, is linked to Action 1. The action refers "to sustain technological leadership by developing highly performant renewable technologies and their integration in the EU's energy system" and Action 2 "to reduce the cost of key technologies".

The IP sets three targets, namely 1) Reduce the levelised cost of energy (LCoE*) at final investment decision (FID) for fixed offshore wind by improvement of the performances of the

entire value chain striving towards zero subsidy cost level for Europe in the long term, 2) Develop cost competitive integrated wind energy systems including substructures which can be used in deeper waters (>50m) at a maximum distance of 50 km from shore with a LCoE* of less than 12 ct€/kWh by 2025, and 3) to less than 9 ct€/kWh by 2030, striving towards cost competitiveness. In the SETIS 2019 report, the first target was considered as still relevant, while the two other targets need revision, both of them because they were already achieved.

The Implementation plan lists nine activities, of which seven have reached some level of development. Only 1/3 of the activities (three of the total) had ongoing projects addressing the activity. All activities were labelled as priority in 2019-20 for the success of the IP and all three activities progressing well were prioritised. Two activities did not show any sign of progress, namely:

- Ecosystem and social impact
- Human Capital Agenda

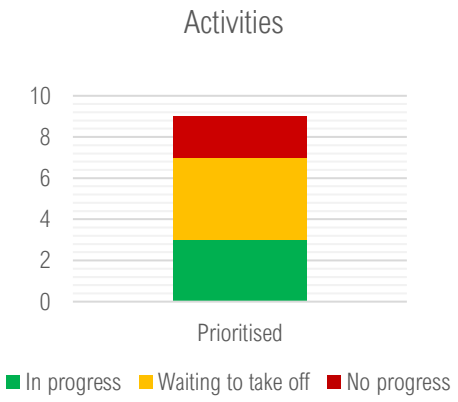

Figure 3.4.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

According to the data available in the 2019 SETIS report, the IP listed 23 projects addressing its targets. The total amount channelled through the projects reaches approximatively €138,62 million. Out of these 24 projects, 16 projects were funded through national budget. These projects amount to around €89,62 million (65% of the total channelled amount of money). The most active countries, according to the available information, are the Netherlands, implementing five different projects, and Germany hosting four projects. Denmark and Norway are also working towards the targets of this IP, carrying out three projects each. On the other hand, six projects received European funding, for a total amount of approximatively €47,5 million (34% of the total amount). One project could not be classified, for an amount of €1,5 million (1% of the total amount). Eleven projects started in 2017, eight projects in 2018, and four in 2019.

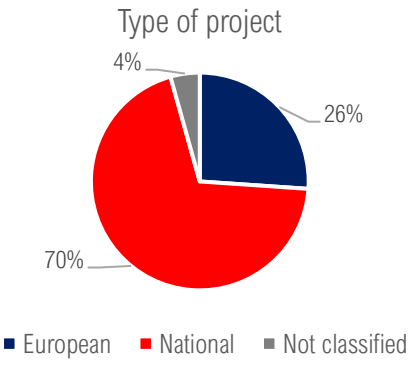

Figure 3.4.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

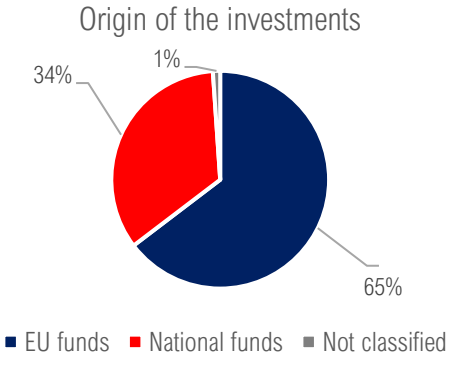

Figure 3.4.3 - Origin of the investments based on the available information reported by the IWG for the 2019 SETIS report

The year 2017 was therefore the most active year with 48% of the listed projects started at that date. The most targeted activities by the projects are activity 2 (nine projects), activity 4 (eight projects), and activity 6 (eight projects). Two of three activities were all labelled green and the third one orange. They were all three prioritised in the 2019 report (as the IWG prioritised all of the actions). Some activities were not linked to any project in particular (7 and 8), while five projects were linked to activities which do not match, strictly speaking, the nine activities of the IP.

In the 2019 report, the Offshore wind IWG lists 13 future calls, all at national level, though without specifying the budget (approx. €7 billion). As for other IWGs, most of the calls at this stage target energy sector technologies as a whole, while few of them identify wind as a priority.

3.5 Initiative for Global Leadership in Ocean energy

The Implementation Working Group on "**Global Leadership in Ocean energy**" is linked to Action 1, which refers "to sustain technological leadership by developing highly performant renewable technologies and their integration in the EU's energy system" and Action 2 "to reduce the cost of key technologies". The Implementation Plan was published in March 2018.

The IP sets three overall targets, namely 1) Development of cost competitive ocean energy technologies with high market potential for Europe, 2) Reduce the LCoE for tidal stream energy, and 3) Reduce the LCoE for wave energy technology. Those three overall targets are then subdivided in six targets. In the SETIS 2019 report, all of the targets were considered still relevant.

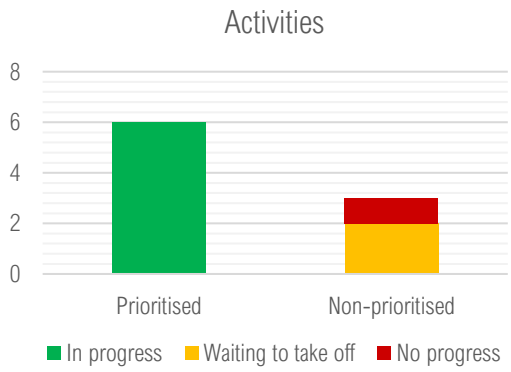

Figure 3.5.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

The Implementation plan lists nine activities, of which eight have reached some level of development. 2/3 of the activities (6 of the total) had ongoing projects addressing the activity. Furthermore, out of those nine activities, six where labelled as a priority in 2019-20 for the success of the IP and they perfectly match with the six activities progressing well. Only one activity is not progressing fast enough namely:

- Creation of an EU Insurance and Guarantee Fund to underwrite various project risks

According to the data available in the 2019 SETIS report, the Ocean IP only listed two projects addressing its targets. Due to the absence of available data, it is not possible to have a clear picture of the situation. For information, one of the projects is Oceantset with an amount of €1 million and the other is the ETIP Ocean with a dedicated amount of €975,260 million. Both of them have started in 2019.

In the 2019 report, the IWG lists one future call with an estimated budget of €41 million, starting in 2020.

3.6 Smart Solutions for Energy consumers

The Implementation Working Group on "**Smart Solutions for Energy consumers**" is linked to Action 3, which focuses on the creation of "technologies and services for smart homes that provide smart solutions to energy consumers". The Implementation Plan was published in November 2018.

The IP sets six targets, namely:

1) Demonstration and application of an interoperable reference architecture and a set of open interface standards as soon as possible, so that they will be the default architecture and standards that are used by new services by 2020;
2) Improve the performance of the tools for forecasting the electricity consumption of the smart home so that is within 80% of the real consumption 1 hour in advance;
3) Making available in the market 5 user-friendly interfaces/tools for energy management (including apps), in every MS, developed by start-ups and innovative service providers, that are part of a smart home service bundle;
4) Making available an agreed methodology (KPIs and protocols) to measure the consumer benefits and the success in use of tools and appliances that are deployed in the market;
5) The additional cost of sensors, controllers and actuators, their installation and maintenance should have a pay-back period of maximum 3 years;
6) Increased penetration of advanced energy sensors and controllers so that at least 80% of the electricity consumption and at least 80% of the total energy consumption is controllable through ICT in 80% of the homes in Europe by 2030. In the SETIS 2019 report, all six targets were considered still relevant.

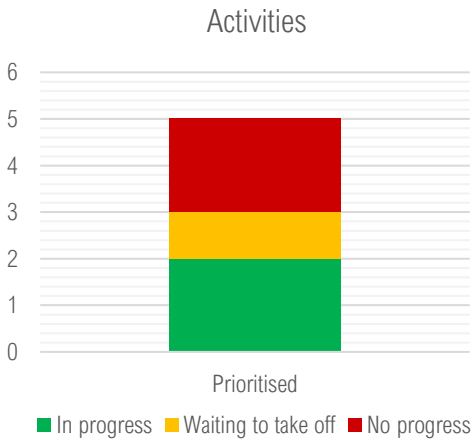

Figure 3.6.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

The Implementation plan lists five activities, of which three have reached some level of development. However, only two the activities had ongoing projects addressing the activity. However, no prioritisation was given in the 2019 SETIS report. It is therefore not possible to state if the three lacking activity are maybe not considered as priority, which could relate to their actual state. Those three lacking activities are:

- To create an Overview of reference architecture and standards available for projects (no progress);
- To support the development of energy services via apps and better forecasting through funding of R&I projects aimed to develop energy services dedicated to houses and commercial buildings. SMEs are specifically included in this action, since they have a large and so far, untapped potential for energy savings and cost reduction (no progress);

- To commit to promote the use of a common terminology and template to identify the reference architecture and standards used in projects that address (i.e.) energy services (awaiting to take off).

According to the data available in the 2019 SETIS report, the IP only listed two projects addressing its targets. These two projects received European funding for a total amount of €34 million.

In the 2019 report, the IWG identifies one future call with an estimated budget of €28 million, starting in 2020.

3.7 Europe to become a global role model in integrated, innovative solutions for the planning, deployment, and replication of Positive Energy Districts

The Implementation Working Group on "**Positive Energy Districts**" is linked to Action 3.2 of the SET-Plan on "Smart Cities and Communities" and aims to support the planning, deployment and replication of 100 "positive energy districts" by 2025 for sustainable urbanisation. The relative Implementation Plan was published in June 2018.

According to the 2019 report, the only agreed target[11] was still relevant and did not need revision. Moreover, 19 out of the 25 activities tackled by this IWG have reached a certain level of progress according to the 2019 report. However, still about ¼ of the planned actions are either completely inactive or waiting to take off. It is nonetheless important to underline that all the prioritised activities (22) are labelled green (activity in progress) except for three, namely:

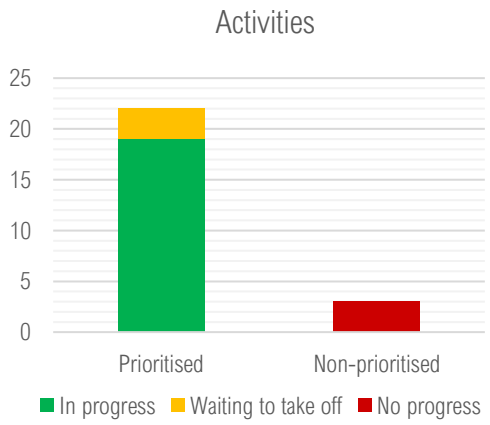

Figure 3.7.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

- ERA-Net Co-fund on PEDs, which is under preparation for the years 2019/2020;
- PED Replication and mainstreaming;
- Establishment of PED Mobilization and Replication Group comprising representatives of National City networks to work towards replication on national levels (Kick-off planned in 2020).

According to the current state of play, and the data, which is available in the 2019 report, there are 28[12] ongoing R&I programmes and projects, accounting for a total funding of approximately 1 249 million € between 2007 and 2030. Almost all of it is funded through national projects (19 projects for around €1 225 million). However, these numbers are to be taken consciously given

[11] "Europe to become a global role model in integrated, innovative solutions for the planning, deployment and replication of Positive Energy Districts with the aim to have at least 100 Positive Energy Districts by 2025, that are synergistically connected to the energy system in Europe".
[12] The figures are based on the ones given by the SETIS in its 2019 report. Given the nature of the available data, it was not possible to get a clear figure based on our own calculation.

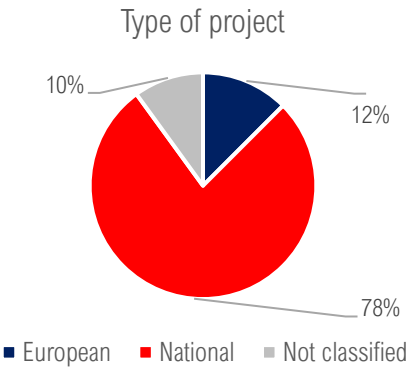

Figure 3.7.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

that the amount is incredibly high in comparison to any other IP. Furthermore, it was also not possible to link the projects with the relevant IP activities. In 2019, eight new projects have started, just about doubling the efforts of the previous two years. About 78% of these projects are funded with national investments, whereas the EU provides 12%. More specifically, the national funding is coming from countries like Austria, Belgium, Switzerland, Germany, Denmark, Latvia, The Netherlands, Norway, Romania, Sweden and Turkey, the most active being Austria, carrying on eight different projects. Given the extensive lack of information regarding the budgets of the listed projects (regarding both EU funded and nationally funded activities); it is not possible to draw a comparison on the actual amounts of investments coming from the two sources.

Considering the upcoming funding opportunities, three future R&I programme calls were listed in the 2019 report, two of them by ERA-Net, allocating 30M€ for Positive Energy Districts projects between 2021 and 2023. The third call is instead included in the PED Alignment Action, which incorporates about eight to ten different national and regional funding agencies for a total amount of 10 M€ between 2019 and 2020.

3.8 Increase the resilience and security of the energy system

The Implementation Working Group on "**Energy System**" is linked with the European Stakeholders Declaration for Action 4 "Increase the resilience and security of the energy system". The aim of this IWG can be summarized by the two agreed flagships: flagship 1 "Develop an optimised European power grid" and flagship 2 "Develop Integrated Local and Regional Energy Systems". The relative Implementation Plan was published in January 2018.

According to the 2019 report, six out of the 12 set targets need revision, namely:

- Develop and implement solutions to increase observability and controllability in the energy system;
- Develop and implement solutions and tools to manage the load profile by demand response and control, in order to optimise use of the grid and defer grid investments;
- Sub-Target: Develop and implement solutions to enable Renewable Energy Sources to provide grid services;

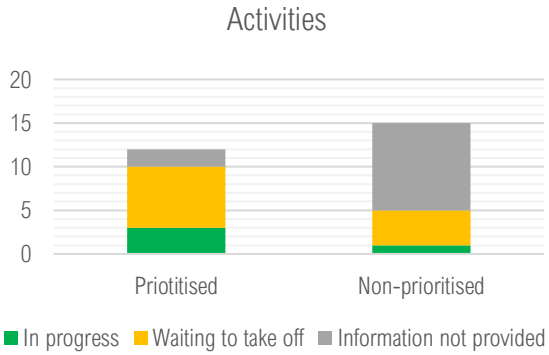

Figure 3.8.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

- Sub-Target: Develop and implement solutions to improve the flexibility capabilities for new as well as retrofitted thermal power plants;
- Reduce the cost of all energy storage solutions contributing to the minimisation of the overall system costs;
- Solutions for short-term storage should enable the reduction of the specific storage costs by at least 50% to 70%.

However, these last two, despite needing to be updated, are still considered relevant by the IWG. Only four out of the 27 planned activities have reached some level of progress, whereas eleven of them are ready to move forward with the projects. However, the information in the report is not complete, and therefore it is not clear what is the level of progress that the other 12 activities have achieved. Most importantly, out of the twelve activities with are considered as a priority, only three have been label "green", the rest is either waiting to take off or non-disclosed.

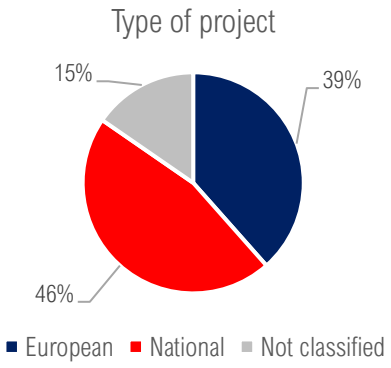

Figure 3.8.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

According to the current state of play, and the data, which is available in the 2019 report, there are 13 ongoing R&I projects, five of which are funded by European funds. Only €30 million were reported for some European projects. No information was given for the remaining European projects and all the national ones. Regrettably, two projects remain unclassified because of the lack of available information. Regarding the ones that are funded by national investments, the active countries are Austria, France and Switzerland. At least one new project was launched every year since 2014, with the exception of 2015. Regrettably, due to the lack of information, if was not possible to link these projects to the relevant activities or targets they are trying to achieve. The information on the budget of the various projects is missing in all but one entry. Therefore, it was not possible to draw a comparison on the actual amounts of investments coming from the national bodies and the EU.

Regarding future funding opportunities, only two entries are provided and refer to national funding calls within ERA-Net co-fund scheme, one starting in 2019 and one in 2020, allocating a total of 37-39 M€.

3.9 Energy Efficiency Solutions for Buildings

The Implementation Plan on "**Energy Efficiency Solutions for Buildings**", published in November 2018, plays a strategic role in a large number of EU energy policies, aiming to limit the energy demand, increasing EU energy security consequently. The Implementation Working Group on Energy efficiency in buildings (EEB) is currently working with a particular focus on cooling and heating technologies, given that the energy demand in those sectors amounts to more than half of the final energy *(Implementation Plan info)*.

According to the 2019 Implementation Working Group report, all of the eight envisaged targets are considered still relevant and in no need of revision in the near future. Moreover, four out of the eight planned activities have achieved at least some level of progress, including all the activities, which are considered as prioritised. Only one of the listed actions is considered completely inactive: "Prefabricated active modules for façades and roofs or Key Enabling Technologies for active building skins".

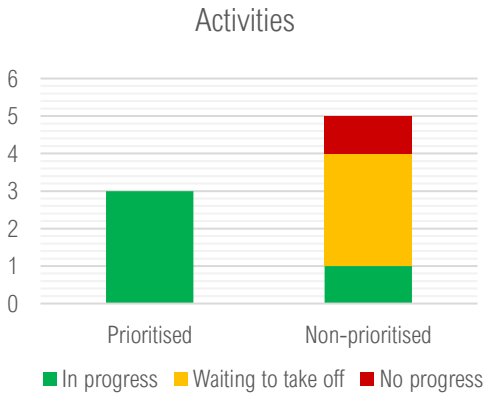

Figure 3.9.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

Considering the current state of play, there are at the moment 22 active projects or R&I programs working towards the targets set by the Implementation plan on EEB, and they are almost all by national or nationally allocated funds. They amount to €202 million. Three projects could not be labelled. They amount to €2 million. This lack of EU funded projects is an indicator of an incomplete information. In particular, the projects were developed by Germany, Ireland and France. Most of the currently active projects started between 2018 and 2019 and have an average duration of two or three years.

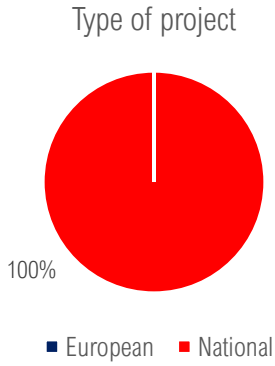

Figure 3.9.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

Finally, the 2019 IWG report lists seven future R&I programme calls related to this Implementation Plan, all of them originated from national or regional funding foreseen by Germany, Ireland and Belgium. Although the total budget is not provided, it is possible however to estimate the value of each program - between 8 to 10 M€.

3.10 Continue efforts to make EU industry less energy intensive and more competitive

The Implementation Plan on "**Energy Efficiency in Industry**", published in September 2017, is linked with SET-Plan Action n.6. The objectives and targets of the relative IWG are also harmonize with the four main pieces of EU legislation regarding energy efficiency of industrial companies: the Energy Efficiency Directive, the EU Emission Trading System Directive, the Industrial Emissions Directive and the Eco-design and Energy-labelling directives. The main goal of this IP is to ensure that industry contributes to climate change targets and to grant worldwide access to the same energy saving technologies for companies.

Regrettably, the 2019 report was not delivered by the IWG, and the only available information regards the prioritisation of the activities. The prioritised activities are the following:

- CO2 avoidance through hydrogen direct reduced Iron (CDA...Carbon Direct Avoidance);
- HIsarna smelting reduction process for lowering energy consumption and CO2 emissions of steel production;
- Power-to-X & Unconventional energy sources;
- Heat pumps and refrigeration converting low grade heat or cool into higher-grade heat or cool.

The particularity of this IWG is that no information on the budget has been provided, which prevents to analyse the current state of play and the future research and innovation opportunities for this IP.

3.11 Become competitive in the global battery sector to drive e-mobility and stationary storage forward

The Implementation Working Group on "**Batteries**" is linked with Action 7 of the SET-Plan, focusing on the development of new battery technologies applicable to e-mobility and stationary energy storage. This Implementation Working Group also play a key role regarding the R&I input for the European Battery Alliance, a political initiative established by the Commission in order to boost the engagement of the industrial sector in the energy transition. The relative Implementation Plan was published in November 2018.

According to the 2019 IWG report, only six out of the 20 envisaged targets are still considered relevant. All the other need a revision in the near future. Moreover, only three out of the ten planned activities have actually reached some level of progress (namely Advanced Li-ion batteries for e-mobility, Influence of Fast/Hyper charging Li-ion batteries on materials and battery degradation, Recycling of Batteries (Li-ion and post Li-ion), whereas the others are described as

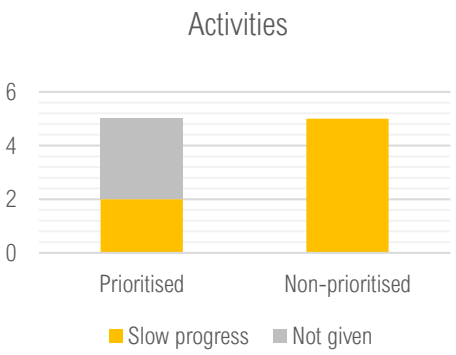

Figure 3.11.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

"slow". In particular, two out of the five prioritised actions are indeed waiting to take off. Nonetheless, the color-coding requested by the SETIS was not used by the IWG in its 2019 report, so the available information is not completely accurate.

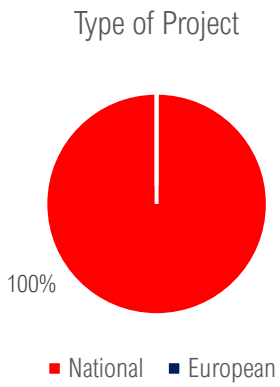

Figure 3.11.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

As reported by the 2019 IWG report, the Implementation Plan is currently counting on 44 among R&I Programs and Projects, however, the information seems to be only partial, given that all the listed activities belong to national funding frameworks or to nationally allocated funds pertaining to the European Regional Development Fund. Therefore, it is likely that EU directly funded projects (e.g. Horizon2020) were not included in the analysis, so the presented research picture is most probably incomplete. Nevertheless, even considering only nationally funded projects, the total investments already amount to around 249 M€. The majority of the projects tackle the development of technologies suited for e-mobility, e.g. advanced lithium-ion batteries and post-li ion technologies. The most active country endorsing this IP is France, counting on 14 different ongoing projects, followed by Germany (nine) and the UK (six), Belgium and Spain (three and four). For the other projects, it was not possible to establish an origin using the provided information or data available online.

Stakeholders engaged in reaching the targets of this Implementation Plan can rely on numerous calls, both national (mostly from France, Germany, Spain and Belgium), and European (ERA-Net and ERA-Min). In the Report, though, the IWG provided only a list of 16 ongoing funding projects, while and no information was provided on future calls.

3.12 Bioenergy and Renewable Fuels for Sustainable Transport

The Implementation Plan on "**Bioenergy and Renewable Fuels**" was developed in correspondence with Action 8 of the SET-Plan. According to the document, published in June 2018, the three envisage goals of this IP are: 1) improving performance of production, 2) reducing GHG emissions along the value chain and 3) reducing costs.

As reported by the linked IWG, out of the 13 agreed targets, only one is not consistent with the research effort anymore and will need reconsideration: in detail, the target pursuing a total production of 25 TWh (2.15Mtoe) of advanced biofuels by 2020 was deemed as "probably not realistic". On the other hand, all the planned activities as described as either "ongoing" or

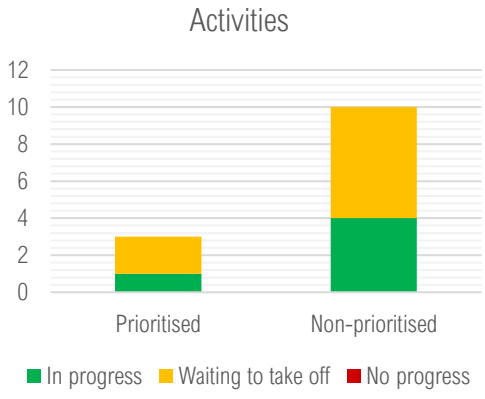

Figure 3.12.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

"waiting to take off", meaning that there will be some level of progress for all the research actions in the near future. Nonetheless, out of the three activities prioritised by the IWG, only one is already active[13].

Regarding the current state of play as described in the 2019 IWG report there are around 63 ongoing projects and activities, which is the greatest amount of active actions out of all the IWGs according to the information provided in the latest account. These projects amount to a total of €257,3 million. Out of these projects, 31 are funded with national or nationally allocated funds. Many of them lack information related to their budget. Given the available information, it is possible to link a total of €105,9 million. On the other hand, 24 projects are funded at the European level, for a total amount of €148,8 million. Finally, 8 projects could not be subdivided and amount to approximatively €2,6 million. In particular, the national investments come from Sweden, by far the most active with 32 ongoing projects, followed by Austria, Germany, Spain and the Netherlands. The listed projects all started between 2016 and 2019 (10-12 every year, with the exception of 2017, when Sweden activated 30 more than projects) and have an average duration of three to four years. Regrettably, given the fragmented description of the project, it was not possible to link the research efforts to the corresponding IP activities or targets.

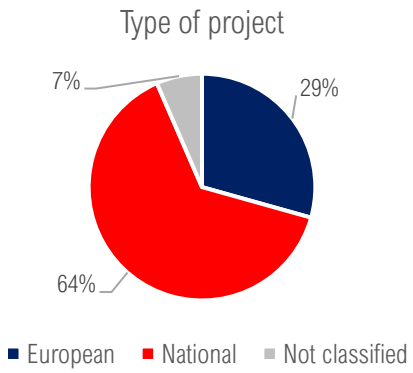

Figure 3.12.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

As far as the future framework is concerned, the IWG provided information on 14 ongoing or foreseen R&I program calls, both European and national (mostly from Austria, Germany and Spain). Some of the programs have already started and will continue planning funding calls for the next years; others will start between the end of 2019 and 2020.

3.13 Renewing efforts to demonstrate carbon capture and storage (CCS) in the EU and developing sustainable solutions for carbon capture and use (CCU)

The Implementation Plan focusing on "**Carbon Capture Storage and Use**", published in September 2017, is linked with Action 9 of the SET-Plan. The research efforts of this IWG tackle different issues, e.g. establishing a CCS hub/cluster and a European CO2 Storage Atlas.

According to the 2019 IWG report, five out of the ten agreed targets are not relevant anymore and need revision. Moreover, only two out of the eight planned activities are described as having reach a certain level of progress, namely "EU Projects of Common Interest for CO2 transport

[13] Develop advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy.

infrastructure" and "CCU Action", this latest one in particular is also deemed a priority by the IWG. All the other activities, including all the other prioritised ones, are defined as ready to foster projects and take off in the near future.

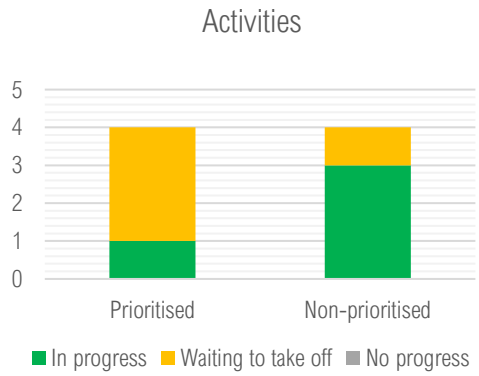

Figure 3.13.1 - Activities progress, based on the available information reported by the IWG for the 2019 SETIS report

Regarding the present R&I situation, the report displays a list of 22 ongoing projects and programs: 13 are funded by the EU (€88,4 million) and nine by national investments (€271,5 million). The total investments involved in these activities is around 360 million €. However, there seems to be a discrepancy regarding the tackled activities, supposedly targeted by the ongoing projects, are at the same time described as "waiting to take off" i.e. there is no active project at the moment. Norway is the most active country supporting this Implementation Plan, as far as national efforts are concerned. The other countries, which are currently managing R&I projects working on CCU and CCS targets, are Germany, France and the UK.

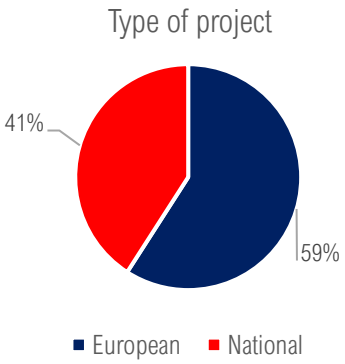

Figure 3.13.2 - Type of project based on the available information reported by the IWG for the 2019 SETIS report

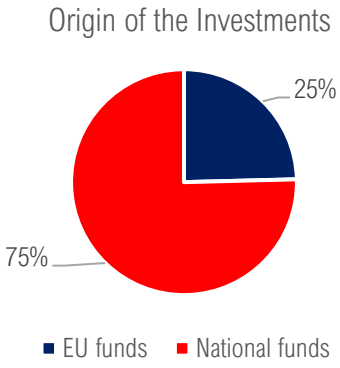

Figure 3.13.3 - Origin of the investments based on the available information reported by the IWG for the 2019 SETIS report

Within the 2019 report, the IWG listed 10 future calls and funding opportunities: four of them belong to national frameworks, namely in the UK and Norway, and the other six refers to funding from the European Union. These calls will be published between the end of 2019 and 2021 and will amount to a total investment of around 385 M€.

IV ANALYSIS

This analysis intends to present a consolidated overview of the progress of the SET-Plan as a whole, assembling the inputs previously presented for each Implementation Plan. The aim is to present a coherent and consistent overview of the IWGs, to provide a clear picture of the state of play of the different IPs and of the SET-Plan as such.

The first sub-section presents a cross-IPs comparison. This activity proved to be rather challenging, as the available data is often fragmented and insufficient for a through and complete analyse. For instance, some information, which could provide a more precise understanding of the IPs progress, is not included in the original template. On the other side, significant part of information that the IWGs communicated is missing/incomplete/inconsistent, hence does not match the original intention and purpose of the reporting process. Significant example is offered by the IP on Energy Efficiency in industry, which provided very scarce information, making the report itself unfit for the analysis.

Despite these objective challenges, SUPEERA partners engaged in providing additional elements functional to analysis of the IPs progress presented by the IWGs. Beyond the value of the quantitative analysis as such, this section illustrates the nature of information that can be retrieved from a detailed analysis when more coherent and uniformed set of details offered.

In the second sub-section, and in view of better understanding the dynamic underlying the reporting process within single IWGs, partners gathered information from individual interviews[14] with EERA members involved in one of those IWGs. EERA members have been solicited to give their insights on:

- the progress of “their” IWG;
- the reporting process;
- their role within the IWG and on their potential role in the next reporting process.

Based on the inputs collected, it was possible to delineate major obstacles for the actors in gathering and communicating adequate information necessary for the successful outcome of the reporting process, making a final understanding of the state of play of the SET-Plan progress difficult and unclear.

4.1 Quantitative analysis of the available data

In this sub-section, the analysis is carried out relying on set of data related to the IPs targets, activities, projects and future calls.

Targets and their relevance

For most of the IPs, the initial targets are still relevant, although set up between September 2017 and November 2018. For six IPs - Deep Geothermal, Energy Efficiency in Buildings, Energy

[14] See Annex 2.

Efficiency in Industry, Energy Consumers, Ocean, and Positive Energy Districts - all of their targets are still relevant. For Renewable Fuels and Bioenergy all but one targets are still valid, (out of 13). For the Implementation on PV, seven out of 11 targets are still relevant.

In this context, only five IPs need a profound revision of their targets (Batteries, CCUS, CSP/STE, Energy Systems, and Offshore Wind). Particular is the case of the IP CSP/STE, which IWG stated that all three targets need to be revised.

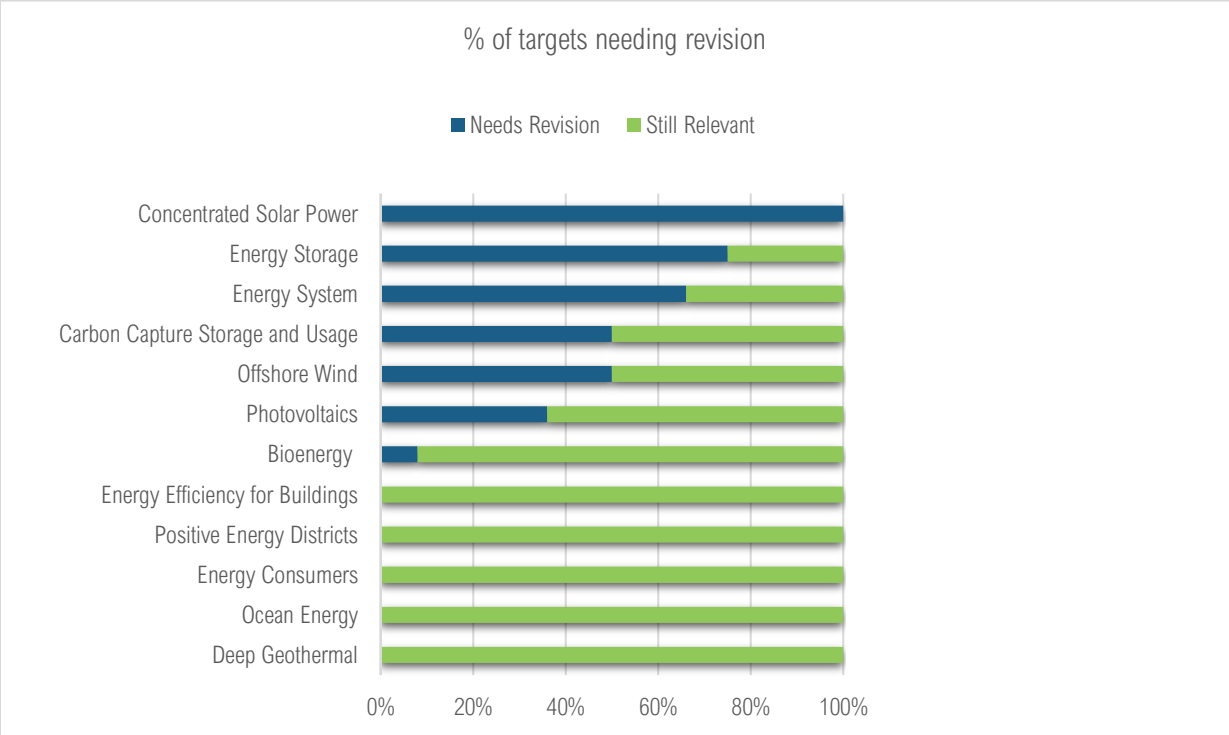

Figure 4.1.1 - Percentage of IPs targets needing revision based on the available information reported by the IWG for the 2019 SETIS report

Whilst the major reason for the revision is the fulfilment of the originally defined targets (as for Batteries, CSP/STE, Offshore Wind, and CCUS), in most of the cases, the revision is due to:

1) The achievement of those targets;
2) A change of priority or policy direction;
3) The impossibility to reach the initial targets.

While there is more than a year gap between the release of the first IPs and the last ones, this does not seem to have an impact on their progress. Indeed, out of the four IPs, which need a revision of their targets due to quick progress, two of them were published in September 2017, one in June 2018 and the last one in November 2018.

Given the available data, it is however not possible to state for most of the IPs what is the pace of progress towards the targets. It could be useful to be able to evaluate to what extent each target is progressing. Indeed, while a target is still valid, the situation differs greatly if the targets is progressing steadily or if not much progress has been done during that year.

The Implementation Plans activities

On a general basis, almost half of the total number of R&I activities included in all the IPs are progressing. They are mentioned as "green" (i.e. there are ongoing projects addressing these activities) by the IWGs themselves. This represents 45% of all the activities listed in the IPs, after two to three years since their release (endorsement). However, and more importantly, this illustrates that more than half of the activities have not yet been launched. In detail, 38% are expected to take-off in the near future ("orange" activities) and 17% do not show any progress ("red" activities). Furthermore, only six IPs have at least the half of their activities progressing well (Deep Geothermal, EE in Buildings, Energy Systems, Ocean, Photovoltaics, and Positive Energy districts).

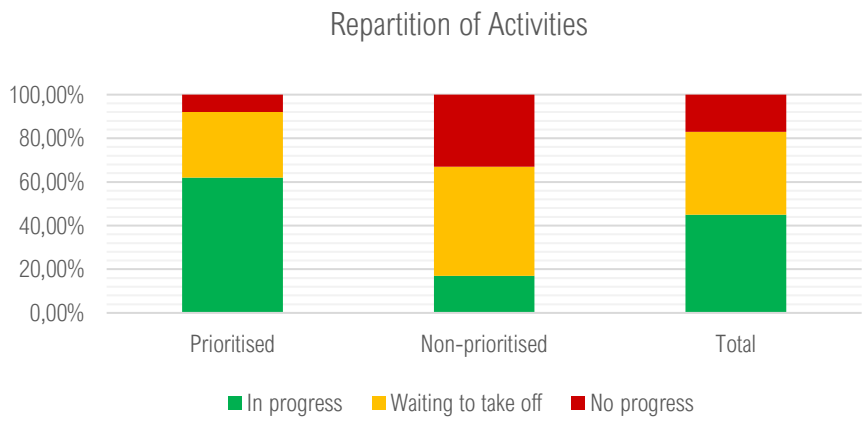

Figure 4.1.2 – Repartition of the Activities among the IPs based on the available information reported by the IWG for the 2019 SETIS report

If the prioritised and non-prioritised activities are analysed separately, two very different developments emerge:

- On the side of the prioritised activities, which is naturally more important, 62% of them are progressing well (green), while 38% show little or no progress (30% are waiting to take off and 8% show no progress).
- Looking at the non-prioritised activities, only 17% are progressing (green) while 50% are still awaiting to take off and 33% show no progress.

Concerning the prioritised activities, substantial efforts may have been dedicated to their execution, which would explain the very clear difference with the non-prioritised activities. In more details, out of ten IPs (since Deep Geothermal, EE in Industry and Energy Consumer have not provided any prioritisation), the majority of activities is labelled green (6 out of 10).

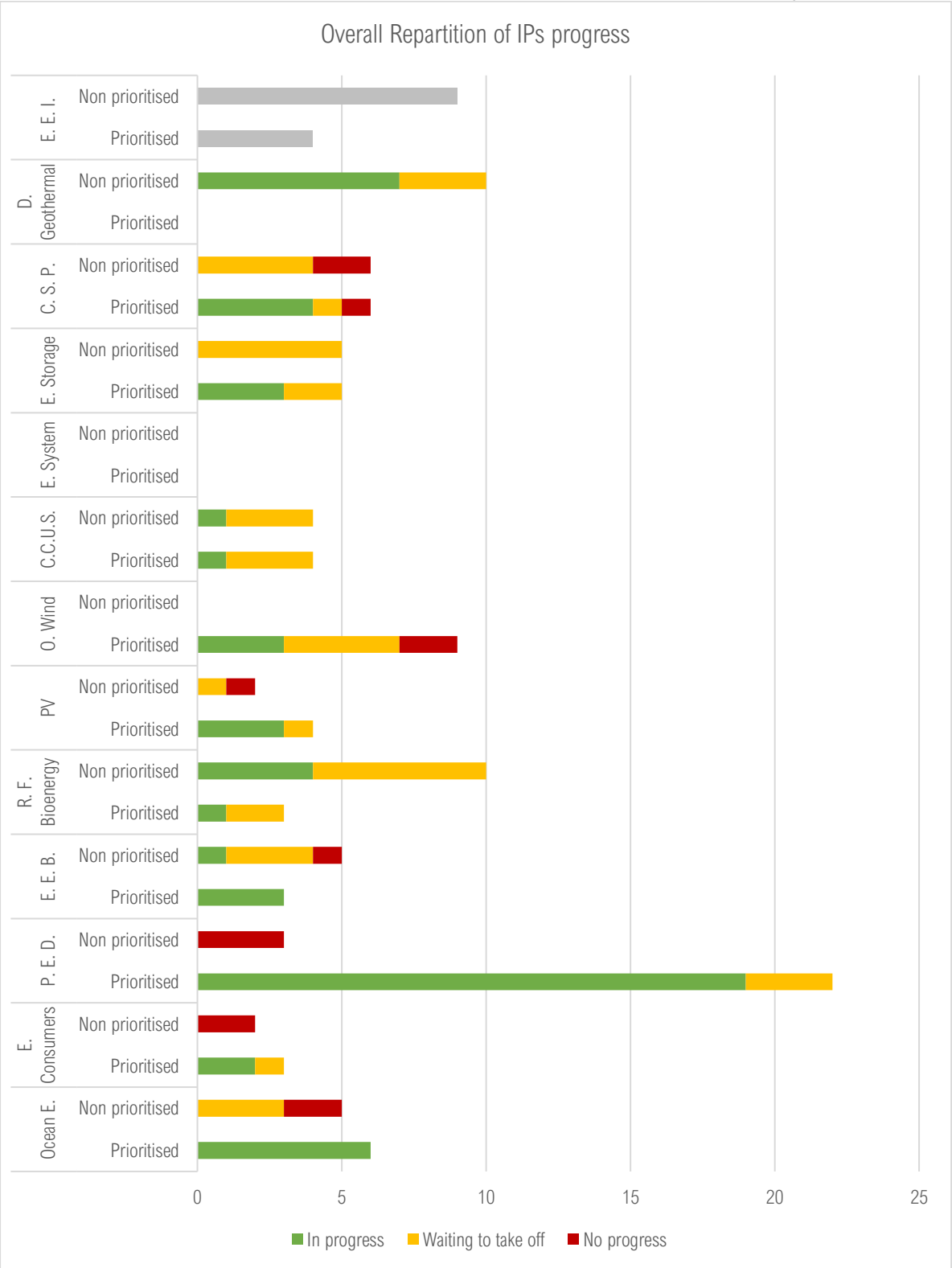

Figure 4.1.2 – Repartition of the IP's progress based on the available information reported by the IWG for the 2019 SETIS report

Therefore, only CCUS, Energy Systems, Offshore Wind, and Renewable Fuels and Bioenergy do not demonstrate satisfactory results even if the respective activities are labelled as a priority. On the other hand, Positive Energy Districts, Ocean Energy, EE in Buildings and CSP/STE are progressing in their prioritised activities (either all of them are labelled green or a large majority). Hence, Energy systems is the only IP that demonstrates overall and continuous progress, but mainly on non-prioritised activities, while Batteries and CSP/STE are showing major progress in their prioritised activities (less than half of their activities are progressing, but more than half of the prioritised activities are labelled as “green”).

However, the three colours system does not offer the necessary information on the level of maturity: i.e. the so-called “green” category includes activities at very diverse stages.

1) For instance, one activity could be labelled as “green” if many projects are currently addressing this activity. Hence, such activity could be at higher level of execution and therefore close to be fully implemented.
2) Another “green” activity instead could also have several projects in support of its execution; however, their scope and contribution are limited keeping the action at lower level of maturity and far from being fully executed.

Therefore, the label green may encompass different situations related to the execution of activities which does not provide a clear overview on their state of maturity. Consequently, it is not possible to assess whether, and to which extent, additional resources are needed. As a remedy, the differentiation between green activities could be implemented, for instance subdividing them by percentage of advancement (10%-20%; 20-40%; 40-60%; 60%-80%; 80%-100%)

Additionally, and based on several comments partners have collected (see next sub-section), it is not always possible to state definitely that an activity is classified “orange” or “red”, either because IWGs are not aware of ongoing projects or because the IWGs are not in the position (due to lack of resources) to gather adequate information about said activity. Concretely, an activity could be progressing but the IWG, not having had access to the information for any reason, will have classified it as “orange” or “red”. Consequently, and depending on the number of cases this occurred, the final result might be distorted and inadequate for further analysis.

That the “traffic light” system has not been always properly used is also proofed by the fact that the Implementation Plan on batteries decided to flag only the activities with slow progress, discarding other IP activities. Similarly, two IWGs have not provided any specification on the prioritisation.

In conclusion, given the differences on the way the information was communicated by the IWGs and free interpretation of the categories, it is arduous to state clearly to what extent the IPs are progressing. It can be assumed, although only partially, that the IWGs are extensively engaged in the execution of the respective IPs; yet it is difficult to establish to what degree of maturity, since is a rather important part information still missing.

The repartition of the projects

As for the section above, the results of this activity are generated by rather limited and fragmented data and therefore the clear scan exam of the projects covering the execution of the IPs activities is subject to these circumstances.

Evidence of this is shown by a large number of projects that miss essential entries and specifications, as for instance:

- the amount of allocated budgets;
- their reparation by years and/or IP actions;
- in case of some plurennial projects (that started before 2017) it the part of the budget covering the reporting period is missing.

More precisely, no information was given on IP Ocean and EEI; insufficient information on IP Energy Consumer - only 2 projects amounting to 34 mil € - while by contrast IWG PV listed more than 28 projects for around 70 mil €.

Due to this incomplete data, it proved complex to analyse the state of the art related to the projects section. It emerged, in fact, that the only applicable approach is to rely exclusively on data and figures contained in SETIS 2019 report, avoiding any complementary breakdown.

Based therefore on a very rough data, a list of about 300 to 350 projects indicated by all the IWGs can be provided.

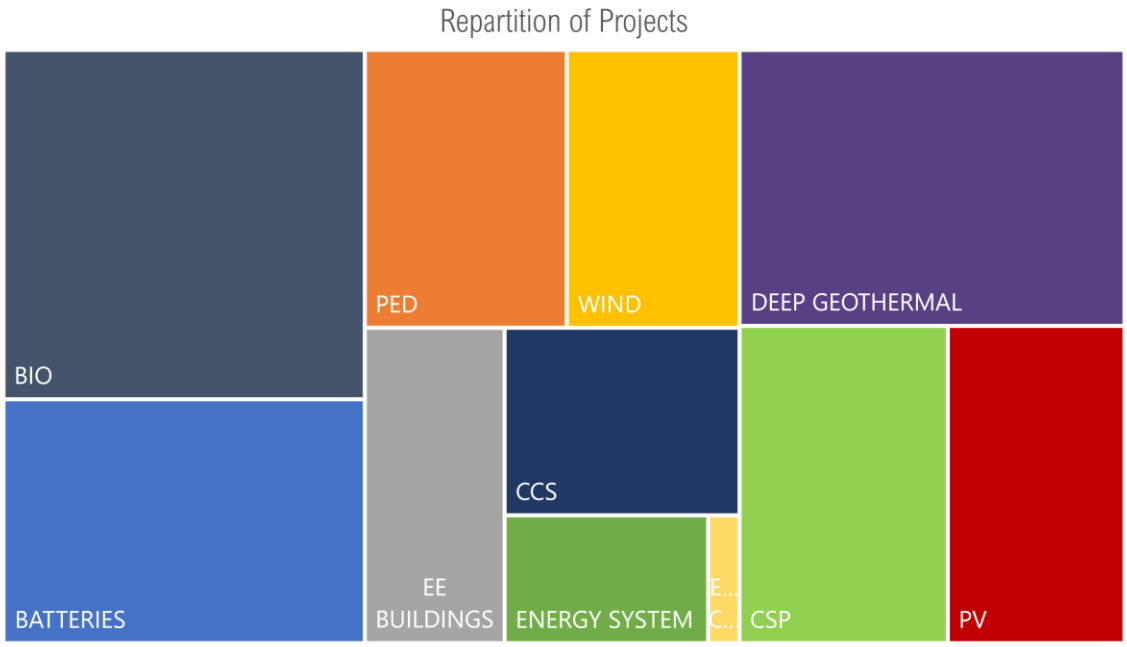

Figure 4.1.3 – Repartition of the Projects among the IPs based on the available information reported by the IWG for the 2019 SETIS report

The total budget allocation reaches approximatively €3 billion which represents about 15% of the initially stated needs by the IWGs in their IPs.

According to the categorisations carried out by the SUPEERA team, approx. 64% of the total number of analysed projects (211 projects) are funded at national level; 29% (97 projects) are directly financed at the European level while 7% could not be classified (24 projects).

Regarding the total budget of the projects, on the other side, those funded by Member States/Associated Countries represent a 77% of the total amount, while 22% is generated by European projects. The total amount deriving from unclassified projects is negligible.

It emerges, from gathered data, that the contribution of national projects (both in terms of number of projects and their value) is higher than the funding provided directly by the EU.

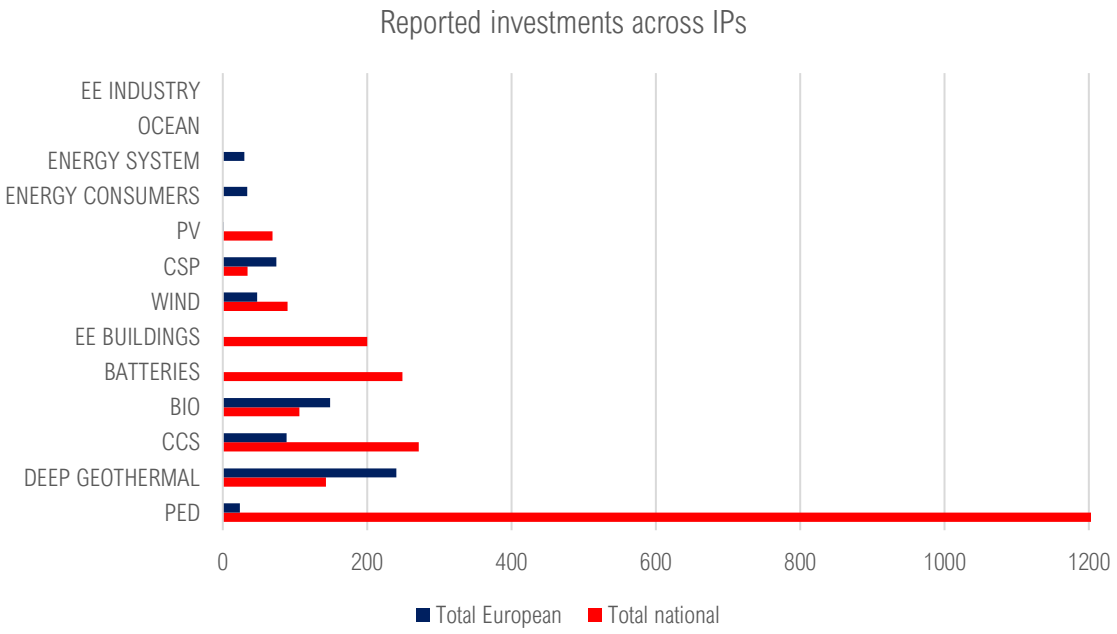

Figure 4.1.4 – Reported investments across IPs based on the available information reported by the IWG for the 2019 SETIS report

An isolated case that deserves mentioning is the Implementation Plan on Positive Energy District. This IP reported approximatively €1,2 billion generated by national projects which represents more than 1/3 of the total amount reported by all the Implementation Plans and more than 1/2 of the amount reported for the national projects. In this situation, the figures reported by the IWG might result from an error. Therefore, it is noteworthy how the final considerations on projects contributing to the execution of the SET-Plan change if the given figures on PED are not taken into account.

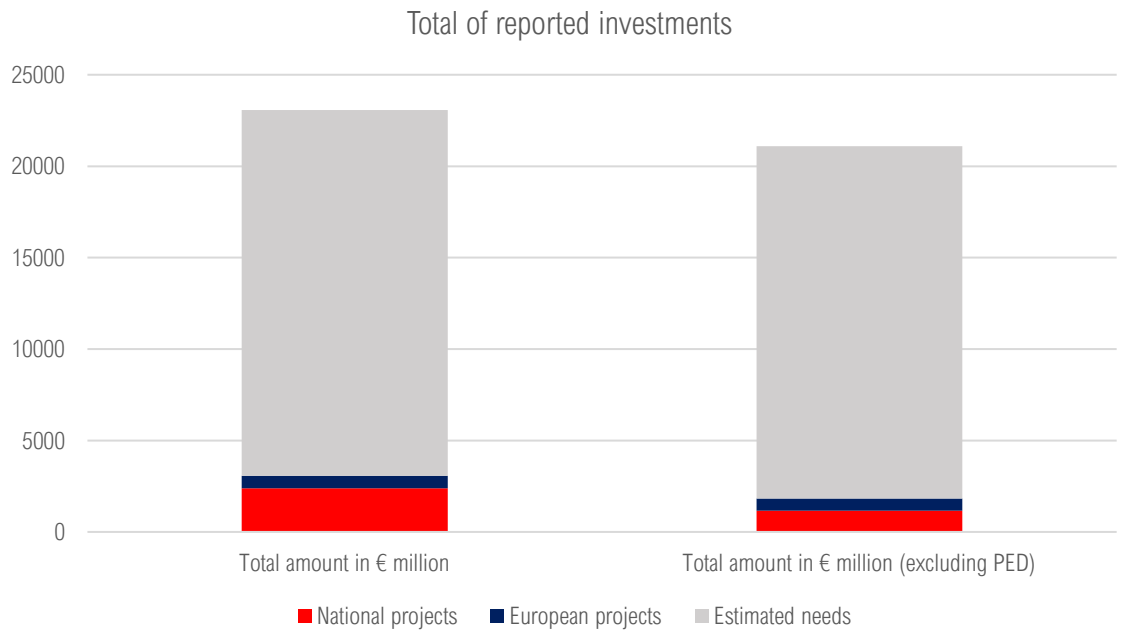

Figure 4.1.5 – Total amount of reported investments based on the available information reported by the IWG for the 2019 SETIS report

In effect, if the contribution of the IP on Positive Energy Districts is omitted, the total investments reach €1,8 billion (less than 10% of the needs initially stated by the IWGs in their IPs). While the repartition between national and European projects remains about the same, national projects now amount to 63% of the total and European project to 36%. Here it is evident that national and European projects are much closer in terms of funding per project.

When it comes to the country of origin of funding, it is worth noticing that more details on the projects and their budgets have been gathered from Germany. It was listed that Germany was carrying out 56 different R&I projects and activities funded on national/regional level, covering almost all of the IPs the country is supporting, with the only exception of the IP on the Energy Systems. Other examples are France and Spain which finance 22 and 30 projects respectively, although they result active in only a half of the IPs they officially endorsed. On the other hand, and according to the provided information, countries such as Belgium, Sweden or Turkey, active in several IPs, result to finance only one or two projects.

There is a considerable amount of countries, that despite officially endorsing various IPs, are not associated with any nationally funded projects within the 2019 IWG report. Italy, for example, is reportedly endorsing all of the IPs, even chairing two of them (“Bioenergy and Renewable Fuels for Sustainable Transport” and “Increase the resilience and security of the energy system”) while according to the IWGs data the country does not appear to be active towards the targets of any of them.

Finally, it might be concluded that a more accurate synopsis on ongoing project would be only possible if a predefined and agreed methodology is put in place which would permit a collection of uniformed data. The availability of data on the national level, as indicated for example in France

and Spain or limited/inexistent data from IWG Smart Solutions for Energy Consumers" and "Initiative for Global Leadership in Ocean Energy" clearly indicates a need for a different way in collection, processing and using data which eventually calls for a better and permanent coordination of relevant stakeholders (IWGs, national funding agencies/bodies, RTOs etc).

Concerning the future calls, only five IPs listed ten or more calls while five IPs listed five or less calls. Furthermore, the data is often very scarce (no budget or information about the targeted activities indicated) and the entries in the list do not always refer to future calls but to already existing calls, which will end after 2020.

Consequently, in the current situation, the data can only be used to provide some information to external stakeholders, who may not be aware of the mentioned existing or future calls. However, it is very difficult to imagine that the listed calls are the only ones to be considered in relation to the different technologies. This is why it cannot be used as a tool to foresee the progress in the coming months/years and gives no indication on the pace of progress for the different Implementation plans.

4.2 Qualitative analysis of the interviews

To complement the previous quantitative analysis, six interviews were held with some members of EERA being active, at different level, in an IWG. The list of interviews can be found in annex 2.

While this activity was not initially planned in Task 1.1, the idea emerged when analysing the data from the available SET-Plan progress report of 2019. As the this was insufficiently detailed or were missing, it seemed necessary to get a better understanding of the situation directly from IWGs. Being the reporting process in effect subject to the dynamics inherent to each IWGs – which by consequence differs from one IWG to another – a direct approach could have allowed an in-depth examination of the state of play.

To this regard, SUPEERA partners decided to lead several interviews within a sample of IWGs in order to 1) get an insight on the current IP progress, 2) understand better how the reporting process was internally managed and 3) discuss and propose ideas on possible ways to enhance the whole process for 2020.

Based on these interviews, the main barriers were first addressed and analysed. Subsequently, various best practices, helping one or another IWG in gathering quality data, were listed. Finally, some preliminary suggestions were drawn on possible ways to enhance the reporting process for the years to come.

It is important to highlight that the situation differs from one IWG to another, and what can be proper for some, or a majority of the IWGs, is not applicable for all of them. The following elements rather show a trend that could be identified from the interviews.

The main challenges to gather relevant and quality information

- **Dynamics within the IWGs**

Different internal dynamics may have an impact on the quality of the collected information. Since the IWG are operating on voluntary basis, the underlying reporting dynamics refer principally to the willingness of its components to contribute to the reporting process at whole.

Given the premise, the current state of the art differs greatly among the IWGs: some IWGs appear to be at a standstill while others show a low level of activity. The number of meetings held by single IWG can serve as an example: while an IWG is officially running, a more in-depth analysis on the internal situation shows that the envisaged activities have a limited range. Consequently, the stakeholder contribution may be limited to the minimum and much information may never be passed on to members contributing effectively to the execution of the IPs activities. When even relevant information exist, members may not have incentive in providing those data, as they are not involved in any of activity within the IWG. This context of weak interconnection may therefore not provide the right incentive and means for the members to provide suitable and coherent information.

The voluntary basis involvement of relevant stakeholders within each IWG therefore determinate the result of the reporting analyses. For future reporting activities, it would be recommended therefore to establish a common and shared denominator, which would give an impetus to all members to participate in the process, obviating on one side to the potential and unequal engagement of all the members and, on other side, stimulate them to provide all necessary data for a complete report.

The above-mentioned gains even more on importance if the IWG members' participation depends on the priorities defined by countries of origin. For instance, political reasons were mentioned as one of the reasons behind the lack of feedbacks from the members. Therefore, the "national" willingness to participate and support the IWGs activities proves to be as important as the level of activity of a single member within this IWG.

- **Lack of financial resources to get the accurate information**

The quality of the reporting is intrinsically linked to the quality of the information that was gathered. However, the absence of a proper financial support for carrying out the reporting process, was often pointed out as one of the major obstacles in gathering proper information.

Member States and Associate Countries have different mechanism through which the execution of single projects is monitored and reported (centralized vs regional/local data monitoring and reporting system). For the countries with more decentralised system it is therefore more arduous to gather complete information on specific projects covering SET-Plan IPs priorities.

Additionally, not all the countries are represented in one IWG, which makes it increasingly difficult to have access to the data for these countries.

Finally, since the participation in the IWG is on voluntary basis and given the fact that reporting the exercise requires time and financial resources, the information provided relied mainly on the availability and the willingness of the participants to contribute.

- **Complexity of the system**

The complexity of the SET-Plan environment was sometimes pointed out as an additional difficulty for the IWGs' members. This complexity mainly refers to the multiple actors and layers that are intrinsic in the SET-Plan environment (IWGs, ETIPs, JAs, SETIS, SUPEERA, other relevant stakeholders). The IWG members therefore might not always have a clear overview of neither the state of play nor the IWG. This eventually might prevent them to completely comprehend the SET-Plan dynamics and request for additional and ad hoc actions.

Consequently, this complexity, which for some IWG members makes role of different actor not clear and prevents a fluid communication, might discourage more proactive participation.

The facilitating practices to gather more structured information

- **The internal organisation of the IWGs**

A clear internal organisation appeared as one of the main arguments to support effective work and reporting.

Therefore, a well-defined repartition of the tasks and the internal communication within the IWGs, including contributions from supporting initiatives (as for instance PV Impact), can facilitate gathering of more accurate information.

Communication within external stakeholders, on the other side, is essential and often ensured by regular meetings held by the IWGs. These external stakeholders are relevant contributors in gathering missing information.

What emerged from the feedbacks, as a conclusion, is that a well-structured IWG and the presence of a core-working group is a critical point for the success of the report process.

- **A potential deriving from the SET-Plan environment**

Despite the fact that the SET-Plan environment represents a rather high level of complexity - due mainly to the involvement of numerous stakeholders of different nature - it is also an effective tool for the execution of the IPs.

Each IWG, depending on its internal organisation, is supported by initiatives (funding schemes) such as ETIPs, Joint Actions (JAs) and ERA Nets. All the solicited EERA members involved in the IWGs underlined the relevance and the essential contribution those three funding schemes have in the execution of the respective IPs.

From the received feedbacks, it emerged that a role of the single supporting schemes (whether ETIPS, JA or ERA-Nets) is not perceived equally by all the IWG. While several IWGs strongly rely on these initiatives, through continuous communication and coordination, other do not profit entirely from these resources. To achieve a maximum impact at the SET-Plan level as a whole, a more structured (or even uniformized) collaboration between these actors is recommended.

V CONCLUSION AND WAY FORWARD

This report addressed and gave a preliminary analysis on the state of play of the open and covered activities of the Implementations Plans, as elaborated by the Implementation Working Groups of the SET-Plan.

This interim version aimed at drawing a first set of observations concerning the progress of each IP and, when the available data permitted it, analysed the progress of the SET-Plan as a whole (quantitative analysis). This exercise is followed by the detailed scrutiny of the working mechanisms of each IWG (qualitative analysis) in order to have the most accurate picture possible on both the challenges and achievements of the current state of play.

For a broader across IPs comparison, the report relied on the data made available by the IWGs during the SET-Plan annual progress report 2019. What emerged from this context, is that most of the IPs' initial defined targets are still relevant while five IPs need a revision of more than half of the respective targets. In most cases, the revision is needed because targets are already achieved, thus the reallocation of the efforts needs to be agreed and implemented. On the other side i.e. for a minor part of targets to be revised, the reason lies in a redefinition either of priorities or policies direction that have made their execution irrelevant requiring now new and different approaches.

A more in-depth examination of the Implementation Plans' activities shows that almost half of them are considered as progressing (labelled green: "in progress"): in effect, 62% of the activities indicated as a priority by the IPs are in the state of advancement ("green activities"). By deduction, it can be noticed that 55% of the total activities (38% of the prioritised activities) are not yet progressing. The Report therefore concentrates on challenges and opportunities that go beyond the preestablished categorisation method (a so called "traffic lights") to apprehend a real up-to-date situation.

The projects' value reported by the IWGs amounts to €3 billion which represent about 15% of the originally identified needs. More specifically, approximatively 64% of the total amount can be labelled as "national" funding (the one allocated by Member States'/Associated Countries' bodies), while 29% can be labelled as "European" funding (projects directly funded by institutions and agencies of the EU). The source for remaining 7% could not be clearly identified from available data. A significant number of projects and respective amounts were communicated by the IWG on Positive Energy District, which represent more than a third of the total reported funding. As for single MS/AC contributions and related projects, Germany stands out as the most consistent and active country, followed by France and Spain. On the other hand, Belgium, Sweden and Turkey are the countries that provided the least information on projects.

With a goal to delimitate a broader context of the reporting process and in order to add a value to the present Report (that could be otherwise considered as a mere interpretation of the SETIS 2019 report), SUPEERA partners have conducted several interviews with EERA members present in different IWGs. It appeared essential, in effect, to gather information, subjective per nature, on the current IPs' progress and the way the reporting process was internally managed. A set of questions where distributed to EERA members with a purpose to gather "first-hand" information related to the internal dynamics of the IWGs, financial resources on the disposal and

their understanding of the SET-Plan environment. The report attempted then to identify the facilitating practices related to the internal organisation of the IWGs, the role of the Member States and Associated Counties and, finally, the potential benefits of the SET-Plan environment.

To summarize this first Interim report on the progress of the execution of the SET-Plan IPs, several preliminary conclusions can be drawn.

Firstly, to apply a cross IP analysis and to have a general overview of the progress of each Implementation Plan, the data contained in both the SETIS report *Implementing the SET Plan: Progress from the Implementation Working Groups* and single IWGs reports proved to be fundamental to build this Report. However, the latter cannot be considered as complete and exhaustive in all its parts. The reasons for these limits can be identified in several inherent characteristics of the IWGs it selves and in the context in which this Report has been produced.

The functioning of the Implementation Working Groups is mainly based on the availability and the willingness of the participants to contribute and, eventually, on the support of the external stakeholders. These differences in operative mechanisms made the reporting process diversified and complex. This resulted on one hand in valuable input while, and, on the other, could not provide a harmonized and comprehensive set of data.

In addition, the changing context related to the implementation of the Project and of this specific activity required a new approach. The starting date of SUPEERA (January 2020, when the official SETIS reporting was already concluded) and the Covid-19 crisis, have influenced the initial plan of the task. Several mitigation actions, which partially counterbalanced the unfavourable circumstances and facilitated eventually the release of this Report, have been put in place. However, there are still actions to be undertaken in order to reach all the objectives defined for this task, as for example provide more granularity on the resources that are needed to execute open IPs activities in terms of funding, human resources and/or infrastructure.

The aim is to continue developing this task, for which a more structured collaboration with SETIS in 2020 reporting process will be sought, while a new and more efficient communication between SUPEERA and EERA members taking part in IWG activities will be defined. These two approaches should result in a more consistent and functional Interim report on the state of play of the SET-Plan Implementation Plans in the next two years.

ANNEX 1 - Template for gathering additional information from IWGs

Page 1

Activity number	Implementation Plan activity (as in the endorsed IP)	Progress	% of execution of the activity	For activities below 100%: is additional support needed ? (yes/no)	If not, why don't you need support ?	If yes, please specify your needs					Cross-cutting topics	
						Funding (precise amount needed in million €)	Comments on funding	Expertise (precise amount of FTE needed)	Comments on expertise	Infrastructure (please specify the kind of infrastructures, and what are the barriers to have access to them)	PIs indicate any cross-cutting topics already defined by the activity	PIs indicate any cross-cutting topic which is not defined in your IP at present but would be useful to support the execution of one or more activities/sub-activities

Page 2

Project name	Website or short description*	Start year*	End year*	Budget (EUR million)*	Relevant activities addressed/ targets achieved*	Please specify to which activity(ies) the project is related (indicate activity number)	Share of the budget going to the mentioned activity (*if several, please try to divide the budget as much as possible among the different activities*) In million €

* Information already provided by the IWGs for the 2019 report. This was already filled in this template.

ANNEX 2 - List of the interviews and contacted representatives of EERA member organisations

All the interviews were conducted between April 15th to May 15th, 2020.

- Tiina Koljonen (EERA JP Economic, Environmental and Social Impacts of the Energy Transition) for the IWG on Energy Consumers
- Marie Bysveen (EERA JP on CCS) for the IWG on CCUS
- Mattias Andersson (EERA JP on Wind Energy) for the IWG on Offshore Wind
- Ivan Gordon (EERA JP on Photovoltaic Solar Energy) for the IWG on Photovoltaics
- Inga Berre (EERA JP on Geothermal) for the IWG on Deep Geothermal
- Andrea Monti (EERA JP Bioenergy) for the IWG on Bioenergy and Renewable Fuels

ANNEX 3 - Table of the activities repartition along their state of progress

- 🟢 Ongoing projects addressing the IP activity
- 🟡 Waiting to take off
- 🔴 No progress
- X The activity is prioritised by the IWG

IP: Initiative for Global Leadership in Concentrated Solar Power

Number	Actions	Priority	Progress
1	Advanced linear concentrator Fresnel technology with direct molten salt circulation as heat transfer fluid and for high temperature thermal energy storage		🟡
2	Parabolic trough with molten salt		🟡
3	Parabolic trough with silicon oil		🟡
4	Solar tower power plant to commercially scale-up and optimize the core components of the open volumetric air receiver technology	X	🟢
5	Improved central receiver molten salt technology	X	🟢
6	Next generation of central receiver power plants	X	🟢
7	Pressurized air cycles for high efficiency solar thermal power plants		🟡
8	Multi-tower central receiver beam down system		🔴
9	Thermal energy storage	X	🟢
10	Development of supercritical steam turbines optimised for the specifics of CSP applications		🔴
11	Development of advanced concepts for improved flexibility in CSP applications	X	🟡
12	Development and field test of CSP hybrid air Brayton turbine combined cycle sCO2 systems	X	🔴

IP: Initiative for Global Leadership in Photovoltaics

Number	Actions	Priority	Progress
1	PV for BIPV and similar applications (building integrated PV includes here the integration of PV into the infrastructure)	X	🟡
2	Technologies for silicon solar cells and modules with higher quality	X	🟢
3	New multi-junction PV technologies for highest efficiencies at reasonable costs	X	🟢
4	Development of PV power plants and diagnostics		🟡
5	Manufacturing technologies for silicon and thin-film PV	X	🟢
6	Cross-sectoral research at lower TRL		🔴

Initiative for Global Leadership in Deep Geothermal

Number	Actions	Priority	Progress
1	Geothermal heat in urban areas	Not provided	🟢
2	Materials, methods and equipment to improve operational availability (high temperatures, corrosion, scaling)	Not provided	🟢
3	Enhancement of conventional reservoirs and deployment of unconventional reservoirs	Not provided	🟢
4	Improvement of performance (conversion to electricity and direct use of heat)	Not provided	🟢
5	Exploration techniques (including resource prediction and exploratory drilling)	Not provided	🟡
6	Advanced drilling/well completion techniques	Not provided	🟢
7	Integration of geothermal heat and power in the energy system and grid flexibility	Not provided	🟡
8	Zero emissions power plants	Not provided	🟡
9	NTBE A. Increasing awareness of local communities and involvement of stakeholders in sustainable geothermal solutions	Not provided	🟢
10	NTBE B. Risk mitigation (financial/project)	Not provided	🟢

IP: Initiative for Global Leadership in Offshore Wind

Number	Actions	Priority	Progress
1	System Integration	X	🟡
2	Wind Energy Offshore Balance of Plant	X	🟢
3	Floating Offshore Wind	X	🟢
4	Wind Energy Operations and Maintenance	X	🟡
5	Wind Energy Industrialisation	X	🟡
6	Wind Turbine Technology	X	🟢
7	Basic Wind Energy Sciences	X	🟡
8	Ecosystem and social impact	X	🔴
9	Human Capital Agenda	X	🔴

IP: Initiative for Global Leadership in Ocean energy

Number	Actions	Priority	Progress
1	Tidal Energy technology device development and knowledge building up to TRL6	X	🟢
2	Tidal energy system (device and array) demonstrations and knowledge building in operational environment (TRL 7-9)	X	🟢
3	Wave energy - technology device development, including system demonstration and knowledge building (up to TRL6)	X	🟢

4	Wave energy – device and array system demonstration at large scale device and early demonstration array scale and leading onto large scale deployment (TRL 7-9).	X	🟢
5	Installation, logistics and testing infrastructure as well as supply chain development for the wave and tidal sectors		🟡
6	Development of stage gate metrics (technical standards and guidelines) for wave technology evaluation.	X	🟢
7	Facilitating access to investment finance for ocean energy technology development.		🟡
8	Creation of an EU Insurance and Guarantee Fund to underwrite various project risks: This would be targeted at the first ocean energy projects to cover technology risks such as availability, performance, failures, etc. A common reserve fund available to multiple projects in the initial farm or plant roll-out, to spread the risk and reduce the cost of providing guarantees.		🔴
9	Wave Energy Europe Pre Commercial Procurement (PCP) action for development of wave energy technology.	X	🟢
10	Development of certification and standards to support offshore renewable technology development.		🔴
11	De-risking environmental consenting through an integrated programme of measures.		🟡

IP: Smart Solutions for Energy consumers

Number	Actions	Priority	Progress
1	To create an Overview of reference architecture and standards available for projects;		🔴
2	To commit to promote the use of a common terminology and template to identify the reference architecture and standards used in projects that address (i.e.) energy services;	X	🟡
3	To commit to using SAREF (Smart Appliances REFerence) as a standard ontology for Demand Side Flexibility projects	X	🟢
4	To commit to developing and promoting the use of a reference architecture for energy services for consumers at smart home and city level. Therefore it was agreed to set up a Working Group composed of Member States, DG ENER, DG CNECT and JRC to develop this reference architecture. This WG will also develop a common terminology and template mentioned in action 2.	X	🟢
5	Based on the above, to support the development of energy services via apps and better forecasting through funding of R&I projects aimed to develop energy services dedicated to houses and commercial buildings. SMEs are specifically included in this action, since they have a large and so far untapped potential for energy savings and cost reduction		🔴

IP: Europe to become a global role model in integrated, innovative solutions for the planning, deployment, and replication of Positive Energy Districts

Number	Actions	Priority	Progress
1	European Positive Energy Cities Platform	X	🟢
1.1	PED Cities Workshop organised with 70+ participants from 39 cities and 19 countries in April 2019	X	🟢

1.2	Concept for PED community building and PED replication in September 2019	X	●
1.3	Establishment of PED City Panel as Advisory Board to the SET-Plan Action 3.2 in November 2019	X	●
2	PED Innovation Labs	X	●
2.1	Establishment of Funding Agency Working Group – Positive Energy Districts (FAWG-PED) to launch a series of transnational joint calls in April 2019, 22 regional and national R&I Funding Agencies participate	X	●
2.2	Endorsement of framework for a transnational joint call agenda by the SET-Plan Action 3.2 Countries in June 2019	X	●
2.3	Preparation and launch of first transnational joint call on PEDs in autumn/winter 2019/2020	X	●
2.4	Survey launched to regional and national R&I Funding Agencies to gain overview about national PED Programmes in September 2019	X	●
2.5	ERA-Net Cofund on PEDs under preparation in 2019/2020	X	●
3	PED Guides and Tools	X	●
3.1	Publication of PED Booklet with structured overview of PED (candidates) in European cities (first version in April 2019, second version scheduled for November 2019)	X	●
3.2	Draft PED Framework Definition developed and launch of national consultation process for all SET-Plan Action 3.2 countries and expert workshop, endorsement is expected end 2019/beginning 2020	X	●
3.3	Framework for PED Certification planned		●
4	PED Replication and Mainstreaming	X	●
4.1	Establishment of PED Mobilization and Replication Group comprising representatives of national city networks to work towards replication on national levels (Kick-off planned in 2020)	X	●
5	PED Monitoring and Evaluation		●
5.1	Development of common PED Monitoring and Assessment based on PED Framework Definition is planned		●
6	Establishment of the Programme Management Structure	X	●
6.1	Terms of Reference for the Steering Committee of National Delegates have been endorsed in June 2019, 15 countries committed as active partners to the SET-Plan Action 3.2	X	●
6.2	Programme Management Team has been established with 9 experts (3,5 FTE) from 4 countries	X	●
6.3	Financial model for the implementation of the programme management structure the SET-Plan Action 3.2 has been endorsed by the Steering Committee in June 2019	X	●
6.4	Establishment of the PED Stakeholders Group and structure dialogue with the Steering Committee of national delegates	X	●
7	Coordination of national R&I Policies on PEDs	X	●
7.1	National coordination of SET-Plan Action 3.2 and JPI Urban Europe countries towards a co-funded partnership on sustainable, smart and inclusive cities and communities	X	●

IP: Increase the resilience and security of the energy system

Number	Actions	Priority	Progress
1	Systemic and socio-economic impact of digitalisation in the energy system	X	●
2	Cybersecurity of critical energy infrastructure		●
3	Market design for trading of heterogeneous flexibility products		●
4	Regulatory innovation zones	X	●
5	Process chain for interoperability of ICT systems	X	●
6	Increased observability and controllability of MV and LV networks with high penetration of distributed energy resources	X	Not provided
7	Smart and flexible grid design, planning and operation based on an enhanced transmission grid observability in uncertain framework	X	Not provided
8	Customer participation and new markets and business models		Not provided
9	EV/PHEV charging infrastructure and integration in smart energy system		Not provided
10	Demand response engineering		Not provided
11	Interactions between flexible generation and the power system: control strategies, ancillary services in scenarios in presence of very large penetration of renewables and low mechanical inertia		Not provided
12	Adaptation and improvement of technologies to novel power-to-gas and power-to-liquid concepts		Not provided
13	Developing the next generation of flexible hydro power plants		Not provided
14	Developing the next generation of flexible thermal power plants		Not provided
15	Increase the flexible generation by mean of the use of integrated storage in generation assets		Not provided
16	Multiservice storage applications to enable innovative synergies between system operators and market players		Not provided
17	Advanced energy storage technologies for energy and power applications		Not provided
18	Reduction of return temperatures in current DH networks	X	●
19	Optimised low temperature and highly flexible (micro) DH and DC networks		●
20	Increasing the short-term flexibility of DH networks and enabling its efficient utilisation		●
21	Increasing the long-term flexibility of heating and cooling systems		●
22	Transnational joint programming platform on smart, integrated, regional energy systems	X	●
23	Creating and linking living labs for integrated local and regional energy systems	X	●
24	Cross-linking of large demonstration projects	X	●

25	Optimised planning, managing and monitoring of integrated regional energy systems	X	●
27	Families of living labs to develop technology- service systems for direct use of PV energy on an aggregated level of multifamily buildings, districts or communities	X	●
26	Create an innovation environment for smart services in cooperation with ICT platform providers	X	●

IP: Energy Efficiency Solutions for Buildings

Number	Actions	Priority	Progress
1	New materials for buildings		●
2	Prefabricated active modules for façades and roofs or Key Enabling Technologies for active building skins		●
3	Digital planning and operational optimization	X	●
4	Living labs - Energy technologies and solutions for decarbonized European quarters and Cities	X	●
5	Cost-efficient, intelligent, flexible heat pumps (also thermally driven) and heat pumps for high temperatures	X	●
6	Multi-source District Heating integrating renewable and recovered heat sources, higher temperature District Cooling and optimization of building heating system, to minimize the temperature levels in district heating networks		●
7	Cost reduction and increase in efficiency of micro CHP/CCHP		●
8	Compact thermal energy storage materials, components and systems		●

IP: Continue efforts to make EU industry less energy intensive and more competitive

Number	Actions	Priority	Progress
11	Steel sector		Not provided
1.1	CO2 avoidance through hydrogen direct reduced Iron (CDA...Carbon Direct Avoidance)	X	Not provided
1.2	HIsarna smelting reduction process for lowering energy consumption and CO2 emissions of steel production	X	Not provided
1.3	Top Gas Recycling – Blast Furnace (TGR-BF) using plasma torch.		Not provided
2	Chemical sector		Not provided
2.1	Chemical reactor, process and plant (re)design and optimisation – Process intensification		Not provided
2.2	Separation technologies		Not provided
2.3	Power-to-X & Unconventional energy sources	X	Not provided

3	Heat/cold recovery		Not provided
3.1	New technologies for utilization of high temperature waste heat in industrial systems, considering the whole energy cycle from the heat production to the delivery and end use, including environmental impact.		Not provided
3.2	Heat pumps and refrigeration converting low grade heat or cool into higher grade heat or cool	X	Not provided
3.3	Heat-to-Power (electrical) recovery (low and high temperature)		Not provided
3.4	Polygeneration (heat, cold, electrical power) and hybrid plants		Not provided
4	System Integration		Not provided
4.1	Industrial Symbiosis. Symbiosis between energy intensive industries to valorise energy losses streams and better manage energy globally		Not provided
4.2	Non-conventional energy sources in process industry		Not provided
4.3	Digitisation: Further integration in process and plant management including plant/process design phase and processing plant retrofit		Not provided
4.4	Improving exchange of technological, economic, behavioural and social knowledge; training, capacity building and dissemination		Not provided

IP: Become competitive in the global battery sector to drive e-mobility and stationary storage forward

Number	Actions	Priority	Progress
1	Material-Chemistry-Design-Recycling		
1.1	Advanced Li-ion batteries for e-mobility	X	●
1.2	Influence of Fast/Hyper charging Li-ion batteries on materials and battery degradation	X	●
1.3	Advancement of batteries for stationary energy storage		●
1.4	Post-Li ion for e-mobility		●
1.5	Recycling of Batteries (Li-ion and post Li-ion)	X	●
1.6	Lithium recovery from European geothermal brines and sustainable beneficiation processes for indigenous hard rock occurrence of Li		●
2	Manufacturing		●
2.1	Foster development of materials processing techniques and components for fast industrialization compatible with present mass production lines	X	●
2.2	Foster development of cell and battery manufacturing equipment	X	●
3	Application & Integration		●
3.1	Hybridisation of battery systems for stationary energy storage (ESS)		●
3.2	Second-use and smart integration into the grid		●

IP: Bioenergy and Renewable Fuels for Sustainable Transport

Number	Actions	Priority	Progress
1	Develop advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy	X	●
2	Demonstrate advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy	X	●
3	Scale-up advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy	X	●
4	Develop other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical /electrochemical transformation of energy neutral carriers with renewable energy		●
5	Demonstrate other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy		●
6	Scale-up other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy		●
7	Production of renewable hydrogen from water electrolysis and renewable electricity		●
8	Develop high efficiency large scale biomass cogeneration of heat and power		●
9	Demonstrate high efficiency large scale biomass cogeneration of heat and power		●
10	Scale-up high efficiency large scale biomass cogeneration of heat and power		●
11	Develop solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass		●
12	Demonstrate solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass		●
13	Scale-up solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass		●

IP: Renewing efforts to demonstrate carbon capture and storage (CCS) in the EU and developing sustainable solutions for carbon capture and use (CCU)

Number	Actions	Priority	Progress
1	Delivery of a whole chain CCS project operating in the power sector		●
2	Delivery of regional CCS and CCU clusters, including feasibility for a European hydrogen infrastructure		●
3	EU Projects of Common Interest for CO2 transport infrastructure		●
4	Establish a European CO2 Storage Atlas	X	●

5	Unlocking European Storage capacity	X	🟡
6	Developing next-generation CO2 capture technologies	X	🟡
7	CCU Action	X	🟢
8	Understanding and communicating the role of CCS and CCU in meeting European and national energy and climate change goals		🟡