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# Deliverable 1.2

## Second interim report on the state of play of the SET Plan IPs and mapping of R&I activities

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## Disclaimer

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## EXECUTIVE SUMMARY

This report *D1.2. – Second 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 identified SET Plan IPs activities* of the SUPEERA project. It was preceded by a first Interim report a year prior, approved by the European Commission in March 2021, and will be updated once more in the third year of the project.

The present report is structured in three main chapters. A year after the launch of SUPEERA, this report first sets the scene and introduces its objectives and methodology, both of which have been amended in February 2021, in accordance with the European Commission. These adjustments were made in order to enrich SUPEERA's monitoring of the Implementation Working Groups' progress towards the full implementation of the SET Plan; to tackle more precisely the challenges ahead of the remaining activities of the Implementation Plans of the SET Plan; to work in a complementary manner with SETIS, by building upon its own monitoring of the SET Plan implementation progress (*Implementing the SET Plan: Making the SET Plan fit for the EU Green recovery*) and bringing thereby an added value to the project.

In addition, given a high dynamic context of the SET Plan environment, which might bring to the SET Plan revision and/or partial adjustment in order to reflect new priorities/targets originated from the European Green Deal, Next Generation EU, and other relevant EU policies and strategies, the type and number of IPs activate considered by task 1.1 will be defined on a yearly basis with the European Commission.

In that respect, this second Interim report aims at delivering in-depth information and at analysing those activities of the Implementation Plans which are to be covered or are not yet covered (respectively orange and red activities) by concrete actions and or projects.

Subsequently, leaning on a set of interviews and surveys conducted with the supporting initiatives to the Implementation Working Groups e.g., JA-2 and ETIPs, the present report identifies in its second chapter key assets and opportunities provided by the SET Plan towards a more effective, cross-cutting, interdisciplinary and competitive energy research sector in the European Union, consistent with the targets of the European Green Deal.

The third chapter of this report finally gives an overview of the Implementation Working Groups' best monitoring and reporting methodologies and practices, as reported by their respective Supporting Initiatives, and carries out a qualitative analysis of the challenges and barriers that remain on the path towards full implementation of the SET Plan.

## LIST OF ACRONYMS

| | |
|---|---|
| AC | Associated Countries |
| CCUS | Carbon Capture Use and Storage |
| CET | Clean Energy Transition |
| CSP | Concentrated Solar Power |
| EC | European Commission |
| EE | Energy Efficiency |
| EERA | European Energy Research Alliance |
| EGD | European Green Deal |
| ETIP(s) | European Technology and Innovation Platform(s) |
| EU | European Union |
| IP(s) | Implementation Plan(s) |
| IWG(s) | Implementation Working Group(s) |
| MS | Member States |
| PED | Positive Energy Districts |
| PV | Photovoltaics |
| R&I | Research and Innovation |
| RTO(s) | Research and Technology Organization(s) |
| SETIS | Strategic Energy Technologies Information System |
| SET Plan | Strategy Energy Technology Plan |
| SI(s) | Supporting Initiative(s) to the IWG |
| SRIA(s) | Strategic Research and Innovation Agenda(s) |
| SUPEERA | Support to the coordination of national research and innovation programmes in areas of activities of the European Energy Research Alliance |
| WP(s) | Work Package(s) |

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# I PRELIMINARY CONSIDERATIONS

## 1.1 SUPEERA in a few words

In 2008 the European Commission launched the Strategic Energy Technology (SET) Plan, as an instrument to boost R&I in the field of low carbon technologies. Building on the SET Plan 10 priorities, 14 Implementation Plans (IPs) were written in order to cover all the Energy Union R&I priority areas, and Implementation Working Groups put 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.

Within this context, the SUPEERA project - *SUPport to the coordination of national research and innovation programmes in areas of activities of the European Energy Research Alliance* was launched on January 1st, 2020, and aims at reaching four high-level objectives:

1) Facilitating the coordination of the research community in support of the execution of the SET Plan towards the Clean Energy Transition
2) Accelerating innovation and uptake by industry
3) Providing recommendations on R&I priorities and policy frameworks through the development and analysis of the energy and macroeconomic indicators
4) Supporting and promoting 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 Implementation Plans, by assisting the energy research organisations involved in the SET Plan itself. In specific, SUPEERA focuses on the identification, mobilisation, and optimisation of primary EERA members' resources that can be engaged in the execution of the Implementation Plans actions.

Within its 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.

## 1.2 Monitoring the SET Plan progress: SETIS report for 2020

So as to provide the European Commission with accurate information on the implementation of the SET Plan, SETIS yearly assesses the progress from the IWGs on their respective activities and publishes the results of its work in a report: "*Progress from the Implementation working groups*". This report, *inter alia*, offers a concrete and up-to-date assessment of the implementation of the SET Plan IPs activities, and displays where additional efforts for their execution would be needed.

SETIS bases its analysis on its close interactions with the Implementation Working Groups, and on the following classification for each activity under current IPs:

- Green: ongoing projects are addressing the activity
- Orange: projects are expected to take-off in the near future to address the activity
- Red: preparatory work/no progress

In its yearly report, SETIS also assesses the relevance of the Implementation Plans and their targets and activities according to current technological and political priorities, collects potential needs of revision of these targets and activities, displays a non-exhaustive list of ongoing R&I project and their funding sources, and analyses ongoing collaborations or potential synergies between IPs.

In that respect, the SETIS report for 2020 analyses that between 2019 and 2020, "a*ll IWGs were advancing with the implementation plans*"[1]. Indeed, amongst the 143 activities identified across all IPs, an increasing number of them have projects ongoing, reaching 74% in 2020 (vs. 46% in 2019). The corresponding 1203 projects reported by the IWGs to SETIS have mobilised €13.2 billion since 2017, funded by national, regional, transnational, and/or EU funds.

Building upon SETIS' analysis, the tables, and charts below give us an overview of the progress reached by each IPs on their respective activities, and a comparison between the states of play for 2019 and 2020 respectively.

Concentrated Solar Power Implementation Plan

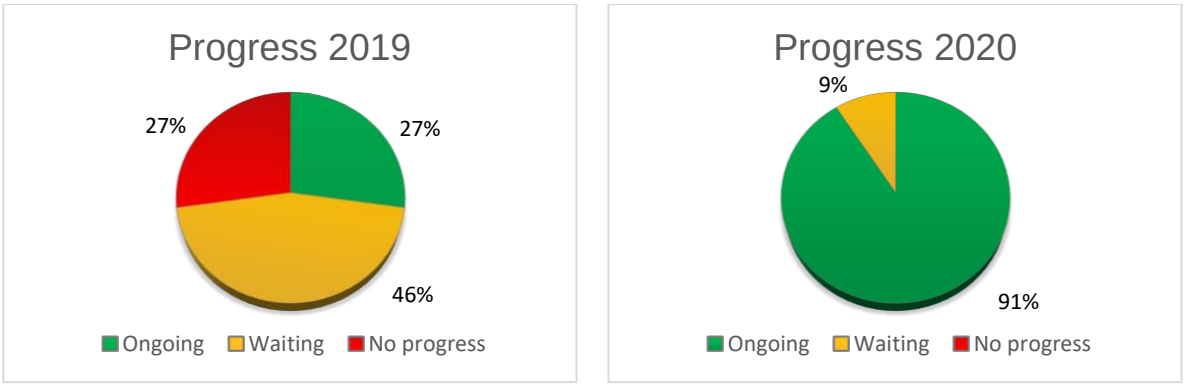


*Figure 1. CSP IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

[1] Strategic Energy Technologies Information System (SETIS), *Implementing the SET Plan: Making the SET Plan fit for the EU Green recovery, Nov. 2020*, https://setis.ec.europa.eu/publications/set-plan-implementation-progress-reports/progress-implementation-working-groups-2020

## Photovoltaics Implementation Plan

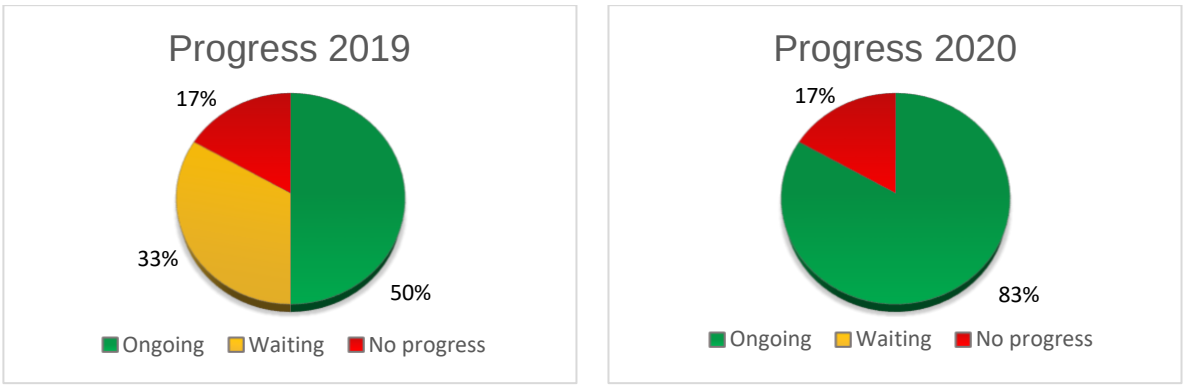


*Figure 2. Photovoltaics IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

## Deep Geothermal Implementation Plan

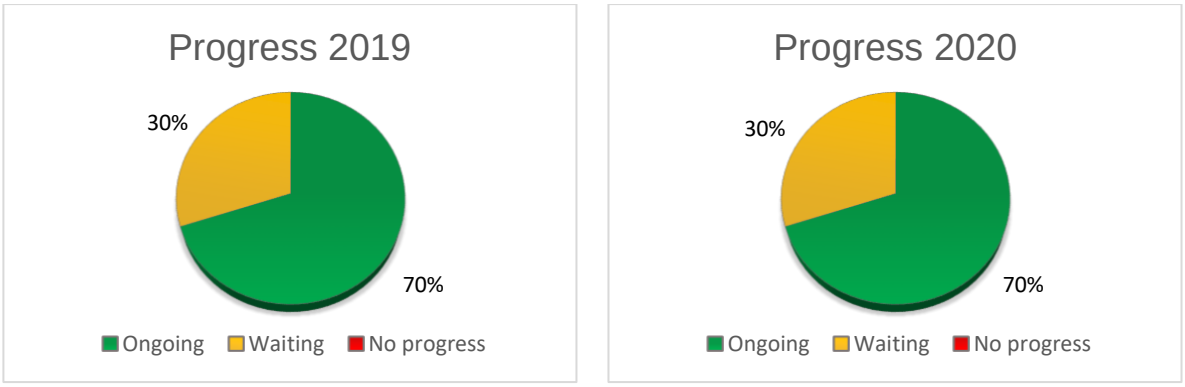


*Figure 3. Deep Geothermal IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

## Offshore Wind Implementation Plan

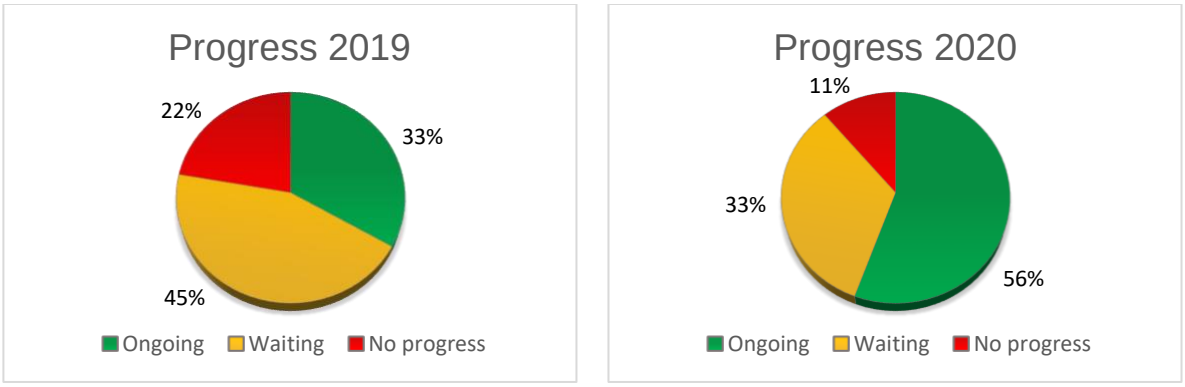


*Figure 4. Offshore Wind IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

## Ocean Energy Implementation Plan

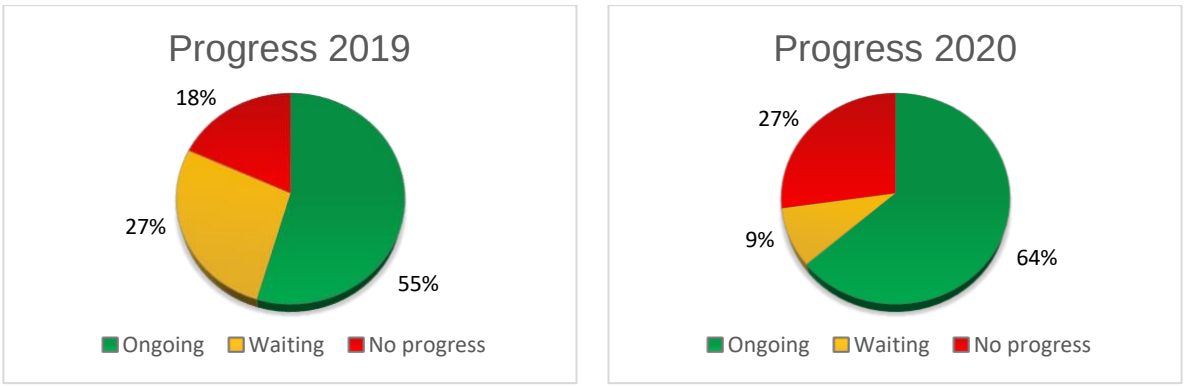


*Figure 5. Ocean Energy IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

## Positive Energy Districts Implementation Plan

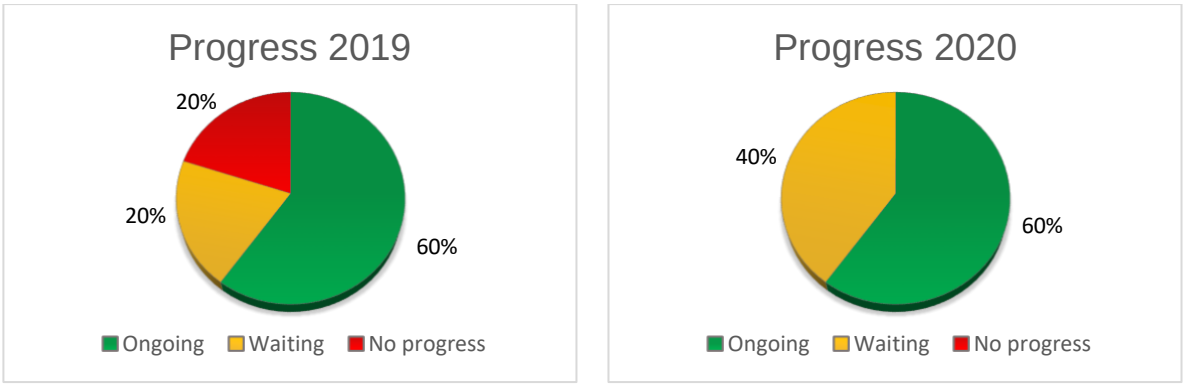


*Figure 6. PED IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

## Energy Systems Implementation Plan

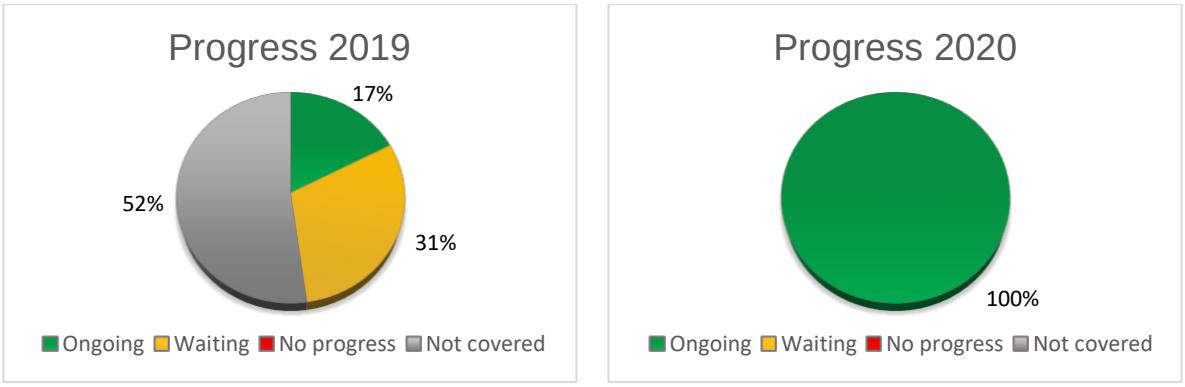


*Figure 7. Energy Systems IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

## Energy Efficiency (EE) in Buildings Implementation Plan

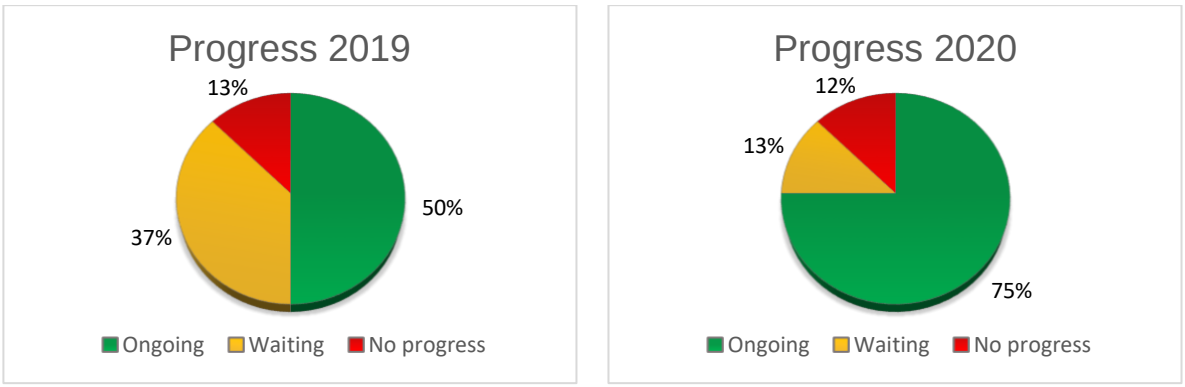


*Figure 8. EE in Buildings IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

## Energy Efficiency (EE) in Industry Implementation Plan

*Comment: Data on Energy Efficiency in Industry IP activities progress in 2019 is not available.*

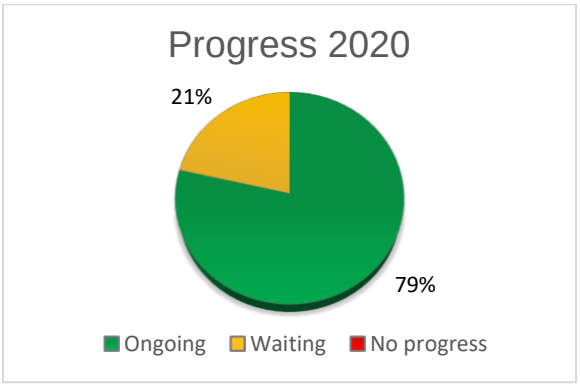


*Figure 9. EE in Industry IP progress, reported by the IWG for the 2020 SETIS report*

## Batteries Implementation Plan

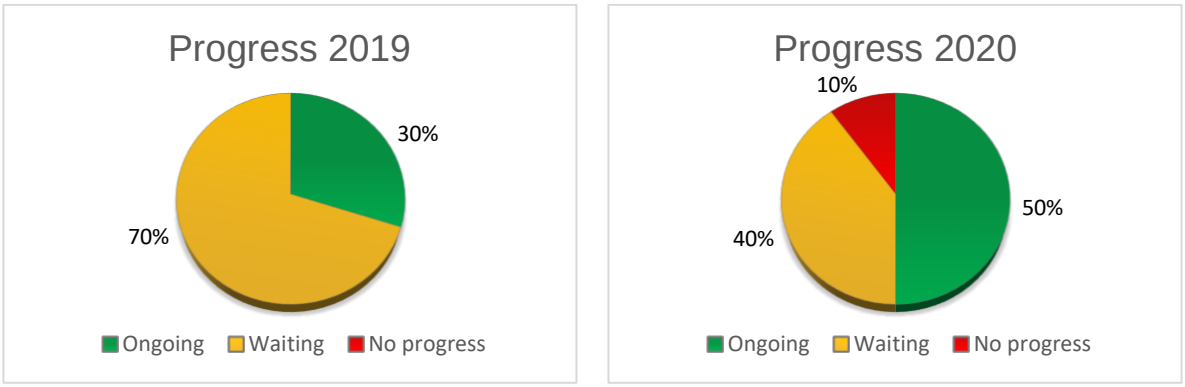


*Figure 10. Batteries IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

Renewable Fuels and Bioenergy Implementation Plan

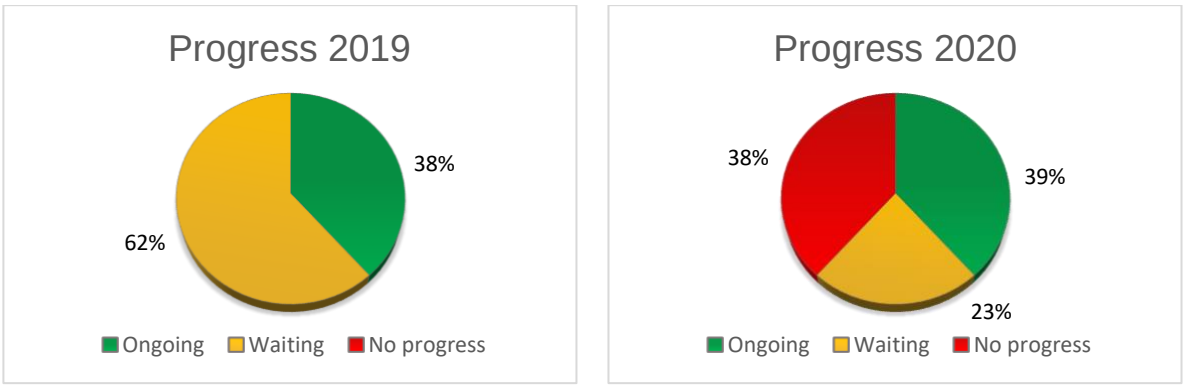


*Figure 11. Renewable Fuels and Bioenergy IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

Carbon Capture Utilisation and Storage (CCUS) Implementation Plan

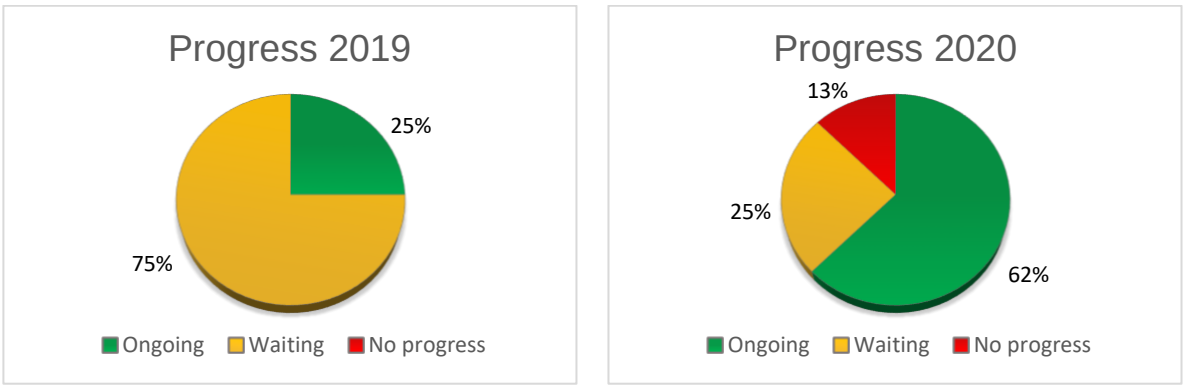


*Figure 12. CCUS IP progress, comparison of activities reported by the IWG for the 2019 and 2020 SETIS report*

Overall, the implementation of the SET Plan is moving forward: amongst the 143 activities endorsed to meet the targets of the SET Plan IPs, 50% will have started by the end of 2021, according to SETIS 2020 report. As of today, only 36 activities remain behind schedule (labelled as orange or red).

Given the fast-changing environment of the Clean Energy Transition process and increasing contributions in the execution of the IPs, the IWGs have been asked to self-assess the relevance of respective IPs and targets. 9 IWGs over 13 suggest that their IPs need to be revised (the revision of one has already been approved) while 6 of 13 IWGs prospected new targets aiming at the alignment of their IPs with the European Green Deal and Next generation EU.

As SUPEERA's first Work Package (WP1) aims at facilitating the execution of the SET Plan Implementations Plans, by providing a clear and consolidated analysis of the state of progress of those IPs actions whose implementation status need more accurate analysis, SETIS's report is key to complete this goal.

## 1.3 Amended actions and revised methodology: building upon D1.1

The present deliverable was preceded by a first report *D1.1 - Interim report on the state of play of the SET Plan IPs and mapping of R&I activities*, which aimed at both displaying the first mapping of all open and covered activities of the IPs and assessing their respective progress towards achieving the targets of the SET Plan. D1.1 relied, on one hand, on the data made available by SETIS 2019 progress report, and on the other, on a set of interviews conducted by SUPEERA partners with EERA members present in different IWGs, which aimed at furthering the project's qualitative analysis of the progress made by each IWG. In order to add value to the study already conducted by SETIS in its yearly report of the SET Plan, D1.1 attempted to further its analysis by identifying the facilitating practices related to the internal organisation of the IWGs, the role of the Member States and Associated Countries and, finally, the potential benefits of the SET Plan environment.

Building upon the conclusions of D1.1 and learning from the opportunities and difficulties identified in the making-process of this first deliverable (fast-changing environment, difficulty to gather relevant information in order to add value to SETIS' yearly assessment), both EERA and CEA worked in close collaboration to redefine the methodology that would improve the quality, added-value and the relevance of the following deliverables of this task. A proposal for amendment was submitted to the European Commission, which included a new methodology for this specific task and adapted specific objectives while maintaining the original high-level one.

Consequently, and in consultation with the European Commission, the type and number of IPs activities under the focus of this task are to be defined on a yearly basis in order to deepen the complementarity with SETIS' annual progress report to direct its analysis towards the European Union's political priorities and to provide concrete and up-to-date information on the needs for additional efforts in the implementation of the SET Plan.

In that respect, the present report focuses on providing an overview of the barriers of the IPs activities that in SETIS 2020 report were labelled as "orange" and "red", which are impeding those actions to progress (and to turn "green"). Additionally, this report relies on a set of interviews and surveys conducted with the supporting initiatives of the IWGs to reduce the number of solicitations received by the IWGs and to ensure on-time and sufficient contributions for this task.

The present report, being the second interim report of this task, will again be updated in year 3 of the project implementation. In its final version, the present report will serve as a base for Task 1.2 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 recommendations on possible ways to link EERA resources with the needs of open activities (T1.2). D1.2 will be disseminated through EERA channels, in particular to the EERA Joint Programs and other relevant stakeholders.

# II THE SET PLAN – STAKEHOLDERS' PERCEIVED ADDED-VALUE

## 2.1 A framework for R&I collaboration in low carbon technologies

Since its inception in 2008, the SET Plan aims at giving all stakeholders a clear overview of the current energy research challenges and priorities for the European Union and at displaying a set of targets, consistent with the objective of the Clean Energy Transition.

Amongst the pillars of the SET Plan, the IWGs are most certainly key: gathering the most relevant stakeholders involved in the development of their respective fields, they embody the necessary dialogue between Member States/Associated Countries and the European Union.

Their work intends to enable the outlining of common assets, targets, and research agendas amongst MS/AC as well as the monitoring of current research and industrial activities in order to allow synergies to develop and to deliver on key objectives of the Energy Union.

To document and challenge the relevance of the SET Plan in its function, SUPEERA partners contacted initiatives in support of the IWGs (JA-2 and ETIPs) to provide up-to-date feedback on the opportunities that they perceived in the execution of the SET Plan. The following analysis is based on gathered data, originating from interviews and surveys conducted with those IWGs SIs concerned with "red" and "orange" activities needing additional effort to take-off.

Firstly, a consensus amongst the supporting initiatives included in this study is that the SET Plan represents a **privileged framework for continuous collaboration,** allowing all stakeholders to gather and discuss policies and actions aiming at achieving climate and energy targets of 2030, including the direct interaction with Member States/Associated Countries and the European Commission.

By establishing a long-term framework for collaboration, the SET Plan facilitates the coordination across borders, structures European and national research programmes, and triggers investments on common priorities in low-carbon technologies. Several supporting initiatives added that the SET Plan enables the inclusion of those parties who do not usually participate directly in the policy-making process of the European Union.

In that respect, IWGs meetings are an opportunity to allow a group of very diverse stakeholders to get together and address high-level strategic topics, such as energy technologies, enablers, and non-technical barriers towards the delineated targets. These events are held regularly by several of the IWGs, enabling cross-cutting topics to be addressed, and common issues to be tackled altogether, in a structured way.

This collaborative function of the IWGs is becoming even more important when it comes to the execution of the European Green Deal, which is providing already a strong boost to the

European transformative process requiring therefore prompt reactions of all parties involved. In this light, the IWGs are called not only to continue working on the development of low-carbon technologies, which are *inter alia* already highly competitive with fossil-fuel-based power generation, but to address also other factors pertinent to climate, environment, and social sustainability. In other words, SUPEERA interlocutors all agree that the IWGs need to pursue a holistic and trans-disciplinary approach since the achievement of climate neutrality is above all a societal challenge.

One of the perceived added values of the SET Plan as a collaborative tool is its role in the acceleration of technology deployment by **closing the gap between R&I and the market.** When analysing the lagging activities, the SUPEERA interlocutors underlined how the changed context requires a new focus on the relationship between research and innovation activities. While this necessity became clear with the European Green Deal, its urgency is preponderantly laid down in the Next Generation EU recovery package aiming at EU's economic recovery from the Covid-19 pandemic. According to the supporting schemes to IWGs covering the most mature technologies (in particular offshore wind and photovoltaic), the updated targets show the requirement of an earlier and efficient uptake and upscale of technologies to reach the higher 2030 ambition. Should the projected expanded deployment on the EU market be realised, the EU industry may count on a strong internal market, while a less ambitious goal, i.e., a lower deployment, will require a development of the markets also outside the continent. In either case, and though the SET Plan already provides a basis for the development and deployment of clean energy technologies, its role in facilitating the corresponding acceleration (through adequate funding instruments) is becoming crucial in steering the European innovation cycle and the competitiveness of the EU system.

Finally, the SIs underline the significance of the collaborative function of the SET Plan in overall **reaching the goals of the Clean Energy Transition and the European Green Deal.** Given that the SET Plan structure presents the possibility to put together a wide network of stakeholders (MS/AC, industries, project promotors, NGOs, RTOs, etc.), its environment is therefore perceived by most IWGs SIs as a nudge where altogether different perspectives can confront themselves and potentially merge. A strong and efficient collaboration between the different Supporting Initiatives and core IWGs team is most of the time the angular stone to reach the common objectives of the European Green Deal and Clean Energy Transition at large. One of the main challenges of the IWGs is to coordinate all these stakeholders from the EU and national levels and from different research hubs to reach a consensus on how to implement the targets of the IPs and to reach them. In order to do so, some IWGs proceed by describing the targets, mapping the challenges ahead, and finding ultimate solutions to manage these challenges. In that respect, some IWG SIs considers that the European Green Deal was an important external factor that highlighted the need for an update of the targets of their IPs, as well as the need for a higher ambition going to 2030 and 2050 within their IWG, where all activities must support the objective of climate neutrality.

According to some IWGs SIs, the effort emphasized towards the implementation of real and tangible projects is key. Indeed, it enables stakeholders to see the direct impacts of the

activities. For instance, regarding the example of the CCUS IP, new targets were set, focusing on showcasing the progress made by specific projects, such as the Northern Lights project in Norway, or similar projects conducted in Rotterdam and Antwerp. This focus on real-life projects ensures that the progress made is tangible to contributors. Additionally, working on real-life projects can have the effect of a virtuous circle, when it brings up new technical, political challenges that circulate back as new R&I challenges, to be tackled within the IWG. Building upon its key role as a collaboration platform for all energy stakeholders in their respective fields, SET Plan has a clear potential to challenge energy research, and by doing so, catalyse the implementation of the new European objectives included in the European Green Deal and other European strategies.

## 2.2 Alignment of national Strategic Research and Innovation Agendas

MS/AC and the EU are targeting largely the same challenges and priorities, therefore effective coordination is important to ensure better planning of activities, foster complementarities, and avoid duplication of effort. Nevertheless, alignment could be challenging due to the different structuring of EU and national funding programmes. For this reason, most of the solicited supporting initiatives consider essential contributing to SET Plan-related activities as it facilitates the alignment of R&I agendas, stimulates complementarity and coordination of national programmes with European ones, and fosters pooling of resources between the Member States and Associated Countries.

More specifically SIs consider that, on the one hand, the SET Plan enables MS/AC to get a clear overview of the next priorities in order to use their own resources more effectively and to look for synergies with research and innovation priorities at the European level. On the other hand, SET Plan allows countries to access complementary knowledge and/or research capacity from other countries to address specific societal challenges leading to tangible research activities.

A good example of this alignment effort is given by the Photovoltaic IWGs. The corresponding supporting initiative considers that the SET Plan had a role in unifying the PV landscape, which is indeed particularly scattered. Concretely, Implementation Plans and the work of IWGs enable to get a clear overview of the priorities and contributed to RTOs, companies, and funding agencies in their decision-making process. In addition, as the actions identified and the targets set by the SET Plan give to stakeholders an overview of what is happening across European countries, it provides clarity on actions undertaken by the MS/AC and on what can be considered as the best practice and what needs to be improved. Moreover, it helps to align countries through political, legislative, and institutional shortcomings linked to various national policies.

Finally, and in a more nuanced note, it has been perceived by most of IWGs SIs that the SET Plan's potential for added-value is not always clear for some of its stakeholders, especially industrial ones, as it is rather a long-term approach potential, building upon high-level

strategies and prioritization. Furthermore, a few stakeholders do not always grasp the benefits of potential synergies between the different sectors of the SET Plan.

## 2.3 Mobilization of adequate financial resources

Resources for the execution of the SET Plan Implementation Actions and the right **financing instruments** are mobilized by activating and coordinating a wide number of stakeholders, both private and public, in addition to the MS/AC and the EU, in a concerted effort towards common priorities.

Nearly all approached SIs consider the added value of the SET Plan in this matter is a two-fold. On one side, its function can improve the mobilisation of overall investments in Research and Innovation. Based on different sources (such as internal reports and official EU publication), both public and private spending trends for R&I are stagnant and, in some cases, even lower compared to previous years, and this occurs in the context where investment in the SET Plan activities represents only 15% of the estimated needs up to 2030.
This proves how the SET Plan governing bodies should assume a more proactive role in leveraging financial resources already available through Horizon Europe, Innovation Fund, Invest EU, and Next Generation EU.

On the other side, the SIs identified SET Plans' added value in the optimisation of the use of current EU and MS/AC budgets. This role is considered crucial as it makes it possible to maximise the participation of national organizations in both national and EU projects. Relevant representatives from entities in charge of funding schemes are involved in the governance structure of the IWG, allowing them to map the interests and capacities of stakeholders and match them with actual funding opportunities.

In addition, the projects funded by the financial resources generate new challenges that circulate back to be tackled by the community creating a virtuous circle. The SIs also consider that the focus is on "real-life" projects to show the added value and impact of projects.

Eventually, the SET Plan establishes sector indicators to monitor the technology market evolution over time. Those targets that have been built on consensus between the different stakeholders and how to reach them are perceived as an added value for some SIs.

# III REPORTING ON SET PLAN ACTION: BUILDING ON THE EXPERIENCE OF THE SUPPORTING INITIATIVES

## 3.1 Identified obstacles and barriers towards full implementation of the SET Plan actions

In order to build on SETIS' analysis of the SET Plan's implementation progress, and to identify the remaining challenges towards the take-off of all the SET Plan R&I activities, Supporting Initiatives of the IPs IWGs were asked to determine what are, in their views, the obstacles and barriers left towards the full execution of respective IPs activities. In this regard, and for each of those activities that were labelled as "orange" (projects are expected to take-off in the near future to address the activity) or "red" (preparatory work / no progress of the activity) under the SETIS' 2020 Progress report, identified barriers are tabled below.

### 3.1.1 Concentrated Solar Power IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| Development of supercritical steam turbines optimised for the specifics of CSP applications | • **Lack of funding**<br>Although various turbine manufacturers have shown their interest in developing the targeted items, there has been a lack of dedicated public funding (for example, there were no correspondent H2020 calls issued). Public funding schemes could help in catalysing cooperation and enabling technical progress.<br><br>• **Market concentration**<br>Only a few EU countries have a turbine manufacturing industrial sector. In that respect, EU-TURBINES (European industrial association of turbine manufacturers) has only 6 members, whereas ESTELA (European CSP industrial association) has more than 100 members.<br><br>• **Non-prioritized activity by the sector**<br>This R&I activity was ranked ninth (low priority) in the CSP IP because the CSP sector considered it was not very likely to be implemented in the short-term. Indeed, most RTOs and R&D centres, for the time being, do not |

| | |
|---|---|
| | prioritize turbine or power block-related R&I topics. They consider that other current topics are more relevant to tackle the potential progress of current technologies and their cost reduction. |

*Figure 13. Identified barriers and obstacles in the execution of the CSP IP's activities, according to contacted members of this IPs' supporting initiative*

### 3.1.2 Photovoltaics IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| Cross-sectoral research at lower TRL | • **The definition of the activity is too broad**<br>The definition of this activity is perceived as too broad. As such, it makes it rather difficult to link and follow up relevant ongoing projects. Additionally, low TRL projects can sometimes be already included in other activities of the IP.<br><br>• **Non-prioritized activity by the sector**<br>Addressing low TRL projects is not considered the main priority by the sector. |

*Figure 14. Identified barriers and obstacles in the execution of the Photovoltaics IP's activities, according to contacted members of this IPs' supporting initiative*

### 3.1.3 Deep Geothermal IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| Exploration techniques (including resource prediction and exploratory drilling) | • **Lack of funding**<br>There is a lack of funding for this R&I activity and for market development in this sector, compared to other energy sources' sectors. Indeed, there remains a lack of awareness about geothermal, its potential, and its role in decarbonisation. In that respect, there were in 2019 no private projects related to this R&I activity, and the total amount of the private financial contribution in cofounded projects was below 400k€. |
| Integration of geothermal heat and power in the | • **Failure of instruments**<br>The sector of geothermal heat and power suffers from distorted competition with the fossil fuels sectors (subsidies, carbon prices, market rules with incumbents, especially for heating and cooling). |

| | |
|---|---|
| energy system and grid flexibility | |
| Zero emissions power plants | • **Policy and regulatory barriers**<br>The concept of "zero-emission" could use some clarification. Indeed, the emission of water vapor from geothermal plants has never been categorized. |

*Figure 15. Identified barriers and obstacles in the execution of the Deep Geothermal IP's activities, according to contacted members of this IPs' supporting initiative*

### 3.1.4 Offshore Wind IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| System Integration | • **Rump up in funding**<br>Ramp up in funding in the area, with tendencies to be more energy system focused thus leading to potential omission of wind specific R&D in project<br><br>SI expects to see more R&D in this area especially as research assessment move from assessing cost to assessing value of technologies and projects |
| Wind Energy Industrialisation | • **Lack of public funding**<br>A recent range of project have been initiated after the last survey in some MS (such as DK) but otherwise little advancement in publicly funded projects<br><br>SI considers this area where to expect to see more progress as industrialisation is clearly defined as a key driver for continued cost reductions by the industry |
| Ecosystem and social impact | • **Lack of funding**<br>There is an increasing attention to these aspects, but the question is how it will translate into funded projects. Indeed, relative to other R&D areas this sees little progress beyond single projects |
| Human Capital Agenda | • **Non-prioritized activity by the sector**<br>Area tends to fall between two chairs in terms of funding. Major topic for industry and not covered by R&D projects |

*Figure 16. Identified barriers and obstacles in the execution of the Offshore Wind IP's activities, according to contacted members of this IPs' supporting initiative*

### 3.1.5 Ocean Energy IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| Installation, logistics, and infrastructure | • **Lack of business models**<br>There is no dedicated supply chain for ocean energy.<br><br>• **Lack of information**<br>Sufficient and relevant information could not be gathered on ongoing projects related to this activity. |
| Creation of an EU insurance and guarantee fund to underwrite various project risks | • **Non-prioritized activity by the sector**<br>Work has taken off to define the structure of the targeted fund. Nevertheless, the extent of this activity is not perfectly clear for the sector yet. |
| Development of certification and standards to support the offshore renewable technology sector | • **Different levels of commitment of involved actors**<br>Indeed, ocean energy is already subject to a dedicated international Technical Committee (IEC TC 114)[2], and to specific standards. However, closer collaboration between the Ocean energy IWG and IEC would contribute to further the SIs understanding of the remaining gaps and challenges going forward. |
| De-risking environmental consenting through an integrated programme of measures | • **Technical barriers**<br>Environmental consenting challenges can vary amongst jurisdictions. Both the Ocean energy IWG and the Ocean energy ETIP have been monitoring and gathering information on consenting practises per Member State at a high level. Yet, keeping track of environmental consenting changes within all EU Member States is a rather challenging activity, which would benefit from a more efficient process. |

*Figure 17. Identified barriers and obstacles in the execution of the Ocean Energy IP's activities, according to contacted members of this IPs' supporting initiative*

[2] *Marine energy – Wave, tidal, and other water current converters* (TC 114) – International Electrotechnical Commission

### 3.1.6 Positive Energy Districts IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| PED Guides and Tools | *No feedback received.* |
| PED Replication and Mainstreaming | *No feedback received.* |

*Figure 18. Identified barriers and obstacles in the execution of the PED IP's activities, according to contacted members of this IPs' supporting initiative*

### 3.1.7 Energy Efficiency in Buildings IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| Living labs – Energy technologies and solutions for decarbonized European quarters and Cities | • **Technical barriers**<br>Even though the activity is moving forward and ready to take-off, providing enough staff to start such a task remains challenging. In that respect, higher public funding would be beneficial. |
| Cost reduction and increase in efficiency of micro CHP/CCHP | • **Lack of funding**<br>Projects are ready to take-off, but there were no funding opportunities available, yet. In Horizon Europe however, a funding scheme is going to be dedicated to "Cost-effective micro-CHP and hybrid heating systems", starting as soon as 2021. |

*Figure 19. Identified barriers and obstacles in the execution of the EE in Buildings IP's activities, according to contacted members of this IPs' supporting initiative*

### 3.1.8 Energy Efficiency in Industry IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| Top Gas Recycling – Blast Furnace (TGR-BF) using plasma torch | • **Lack of business models**<br>There could be not enough economic incentive to invest.<br>• **Policy and regulatory barriers, failure of public instruments** |

| | |
|---|---|
| | Several drawbacks in the regulatory and funding environment for the sector are identified as barriers for this R&I activity to take-off:<br>- Lack of clarity on the possibility for synergies of the different funding sources (complexity of the setting of the different funding sources, suitability of financing gap when dealing with disruptive technologies, the complexity of the EU taxonomy).<br>- Lack of long-term approach in the sequencing of the financing sources.<br>- Lack of carbon border adjustment mechanism.<br>- Too many available funding schemes (need of one-stop-shop principle).<br>- Lack of harmonization in the definition of fund gaps.<br>Overall, the regulatory environment is perceived as unstable. |
| Polygeneration (heat, cold, electrical power) and hybrid plants | • **Technical barriers**<br>Specifically for this activity and particularly on advanced compact CHP-plants of industry scale, the IP target focuses on components only, which need to be adjusted to the operating scenarios. At present, sources of excess heat of industrial power generation are not fully explored. In particular, problems have to be overcome since industrial CHP cycles are dominated by the steam and heat demands for the industrial processes.<br>The implementation of a pilot demonstration could be an interesting approach in order to showcase achieved improvements.<br><br>• **Failure of instruments**<br>Differences between national financing schemes can hinder the possibilities of combining funds from several member countries.<br>Moreover, there can be a lack of a long-term vision in calls, while projects may take up to 10 years to reach goals. In addition, some calls focus on place-based initiatives, preventing cooperation even within one country.<br><br>• **Non-priorized activity by the sector**<br>There is difficulty to find end-users willing to embark on research projects and implement the Pilot stage of a project. |

| | |
|---|---|
| Non-conventional energy sources in process industry | • **Failure of instruments**<br>SMEs and start-ups have had difficulties in accessing funding: there is often too limited time for enterprises to apply for funding dedicated to SME/Start-ups, making it difficult to address large and very capital-intensive projects. Furthermore, too many calls are limited to just one project, excluding interesting and innovative approaches. The lack of knowledge concerning the funding potential at the EU, national and regional levels can also be a barrier, as well as the too many different timings of calls for funding at the EU, national and regional levels. In addition, the too many differences in how projects are evaluated at the EU and national levels make it a rather complex challenge to fund a project. It can be difficult to build consortia with partners from other countries or regions. In that respect, pilot-scale facilities could also be initiated in order to highlight the potential. At present time, most of the results are obtained in rather small to lab-scale installations.<br>• **Technical barriers**<br>The efficient conversion of renewable energy into new energy sources is still a technical issue.<br>• **Lack of business models**<br>Processes need to be converted from batch into continuous, and a new way of monitoring, to be defined. But these processes cannot be up scaled on existing plants. In that respect, the need for new installations would also mean a high CAPEX cost.<br>A good LCA study could be necessary to show the potential for additional savings (on top of the energy savings). |

*Figure 20. Identified barriers and obstacles in the execution of the EE in Industry IP's activities, according to contacted members of this IPs' supporting initiative*

### 3.1.9 Batteries IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| Advancement of batteries for stationary energy storage | • **Policy and regulatory barriers**<br>The regulatory situation seems to be complex and is not uniform across Europe. In some countries, there remain some regulatory hurdles, which do not facilitate stationary storage. |

| | |
|---|---|
| | • **Non-prioritized activity by the sector**<br>Li-ion batteries are the main technology in focus due to cost reductions from the economics of scale. This can make it very difficult for other battery technologies to compete even if they have the potential for lower cost upon significant upscaling i.e., economies of scale, and have less dependence on CRMs.<br>However, this situation is evolving and as we see increased demand from the automotive sector for Li-ion batteries, a scarcity may drive alternative battery chemistries for stationary storage.<br><br>• **Technical barriers**<br>A further complication is that Stationary energy storage provides a wide range of services, which have very different performance requirements. In addition, research on second life batteries from the automotive sector competes with alternative chemistries.<br><br>• **Different levels of commitment of involved actors in the reporting process**<br>In collecting data, few members participated. The national collection of data could sometimes be incoherent. There also needs to be more coordination with NRCG. Furthermore, there are potential overlaps with other initiatives (both higher and lower TRLs). |
| Post-Li ion for e-mobility | • **Technical barriers**<br>Strides are being made in solid-state batteries with Li anodes. Some stakeholders may foresee that Non-Li-based batteries will not fit for e-mobility.<br><br>• **Different levels of commitment of involved actors in the reporting process**<br>In collecting data, few members participated. The national collection of data could sometimes be incoherent. There also needs to be more coordination with NRCG. Furthermore, there are potential overlaps with other initiatives (both higher and lower TRLs). |
| Foster development of materials processing | • **Different levels of commitment of involved actors** |

| | |
|---|---|
| techniques and components for fast industrialization compatible with present mass production lines | IPR related to this R&I activity is often kept within the industry sector, and the corresponding developments are not necessarily carried out with public funding and shared in open publications.<br><br>• **Different levels of commitment of involved actors in the reporting process**<br>In collecting data, few members participated. The national collection of data could sometimes be incoherent. There also needs to be more coordination with NRCG. Furthermore, there are potential overlaps with other initiatives (both higher and lower TRLs). |
| Foster development of cell and battery manufacturing equipment | • **Non-prioritized activity by the sector**<br>This has been an area that has been neglected in the past. Nevertheless, there is currently a strong focus on this target, and EU-related calls are expected to open soon.<br><br>• **Different levels of commitment of involved actors in the reporting process**<br>In collecting data, few members participated. The national collection of data could sometimes be incoherent. There also needs to be more coordination with NRCG. Furthermore, there are potential overlaps with other initiatives (both higher and lower TRLs). |
| Hybridisation of battery systems for stationary energy storage (ESS) | • **Non-prioritized activity by the sector**<br>There has been little focus on this R&I activity until now. Nevertheless, projects should take-off in the coming years, in order to exploit potential synergies between technologies. This will also apply to other specific sectors such as aviation and maritime where the use of batteries and other energy sources will provide the optimal effect and cost combined with lowers CO2 emissions.<br><br>• **Different levels of commitment of involved actors in the reporting process**<br>In collecting data, few members participated. The national collection of data could sometimes be incoherent. There also needs to be more coordination with NRCG. Furthermore, there are potential overlaps with other initiatives (both higher and lower TRLs). |

*Figure 21. Identified barriers and obstacles in the execution of the Batteries IP's activities, according to contacted members of this IPs' supporting initiative*

### 3.1.10 Renewable Fuels and Bioenergy IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| Demonstrate advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy<br><br>Scale-up advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy<br><br>Demonstrate other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy<br><br>Scale-up other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy<br><br>Develop high efficiency large scale biomass cogeneration of heat and power<br><br>Scale-up high efficiency large scale biomass cogeneration of heat and power<br><br>Demonstrate solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass | • **Uncertain market pull**<br>For a long time, the market pull was uncertain. It hindered demonstration and the scaling-up of activities. This uncertainty is shifting, and there some activities should take-off soon.<br><br>• **Lack or failure of instruments**<br>For some activities, there was a real lack of instruments or a failure of these instruments. This is progressively shifting too.<br><br>• **Policy and regulatory barriers** *(this barrier relates more specifically to the activities affected by regulations on the sector of gas)*<br>There has long been a lack of legislation, especially in the sector of gas fuels.<br><br>• **Non-prioritized activity by the sector** *(this barrier relates more specifically to the activities dedicated to the development of large-scale biomass)*<br>The market has changed, and some priorities and concept definitions have evolved. Namely, the efficiency criterion is not perceived as a very important parameter anymore, because the market has changed radically: it is not needed and not seen any more as the best application for biomass. Most probably, projects have shifted or changed towards more flexibility and integration instead of higher efficiency. |

| | |
|---|---|
| Scale-up solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass | |

*Figure 22. Identified barriers and obstacles in the execution of the Renewable Fuels and Bioenergy IP's activities, according to contacted members of this IPs' supporting initiative*

### 3.1.11 Carbon Capture Utilisation and Storage IP

| "Orange" or "red" actions | Identified barriers |
|---|---|
| Delivery of a whole chain CCS project operating in the power sector | • **Lack of business models**<br>There is a lack of business cases and business models for CCS.<br><br>• **Regulatory or policy barriers**<br>There is a lack of EU and/or national support schemes which could carry projects in the absence of a functioning price on carbon – a non-delivering EU ETS system. In general, in the carbon sector, there remains a high political uncertainty. For instance, as for low-carbon hydrogen with CCS, the current strategy does not specify any targets for production (2030 – 2040 - 2050), nor does it incentivize the role of CO2 infrastructure in this respect. This may delay the delivery of large-scale, low-carbon hydrogen volumes, which are needed for industrial decarbonisation.<br><br>• **Non-prioritized activity by the sector**<br>CCS only progressively gains traction as a technology that will be essential in the industrial decarbonisation of the European energy-intensive industry. Recently, several stakeholders have also expressed interest in applying CCS for clean power generation. In that respect, the CCUS Implementation Plan targets have been updated in line with the new ambitious European climate targets. |
| Establish a European CO2 Storage Atlas | • **Lack of funding**<br>There is a lack of funding, or limited funding available from European funding programmes such as the Innovation Fund. The Innovation Fund – in its current set up – does not encourage investments in CO2 storage capacity. |

| | |
|---|---|
| | • **Regulatory or policy barriers**<br>There is a need for more political support.<br><br>• **Social acceptance**<br>There is a need to improve public and social acceptance for CO2 storage both offshore and later onshore.<br><br>• **Non-prioritized activity by the sector**<br>The progress on this target has been slow. This target remains valid in its current formulation, but it still will be met at a later stage (2025-2030). Support from policymakers could be beneficial in order to tackle the barriers around CO2 storage. |
| Unlocking European Storage capacity | • **Lack of funding**<br>There is a lack of funding or limited funding available from European funding programmes such as the Innovation Fund.<br><br>• **Lack of information**<br>There is a lack of clarity regarding CO2 liability risks for long-term storage needs.<br>In addition, this activity suffers from the absence of a European CO2 Storage Atlas.<br>• **Non-prioritized activity by the sector**<br>The progress on this target has been slow. This target remains valid in its current formulation, but it still will be met at a later stage (2025-2030). Support from policymakers could be beneficial in order to tackle the barriers around CO2 storage. |

*Figure 23. Identified barriers and obstacles in the execution of the CCUS IP's activities, according to contacted members of this IPs' supporting initiative*

| | 1. CSP | 2. Photovoltaics | 3. Deep Geothermal | 4. Offshore Wind | 5. Ocean Energy | 6. PEV | 7. EE for Buildings | 8. EE in Industry | 9. Batteries | 10. Ren. Fuels & Bio. | 11. CCUS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Policy and regulatory barriers, Lack of legislation | | | X | | | | | X | X | X | X |
| Lack of funding | X | | X | | | | X | | | | X |
| Lack of instruments, Failure of instruments | | | X | | | | | X | | X | |
| Lack of business models, Uncertain market pull, Market failures | X | | | | X | | | X | | X | X |
| Different levels of commitment of involved actors, Non-prioritized activity by the sector | X | X | | X | X | | | X | X | X | X |
| Different levels of commitment of involved actors in the reporting process | | | | | | | | | X | | |
| Technical barriers | | | | | X | | X | X | X | | |
| Lack of information | | | | | X | | | | | | X |
| The definition of the activity is too broad | | X | | | | | | | | | |
| Social acceptance | | | | | | | | | | | X |
| Required revision of the IP | X | | X | X | X | | | X | X | X | X |

*Figure 24. Comparison of identified barriers and obstacles in the execution of each IP's activities according to contacted members of IPs' supporting initiatives, put in perspective with required revisions of IPs according to SETIS 2020 report on the progress of the SET Plan implementation*

Figures 13-23 show an overview of the main barriers identified by the supporting initiatives as ones impeding IPs action to take-off and to be successfully executed, while Figure 24 schematically reassumes these barriers per their nature. It emerges, not without surprise, that a majority of barriers are not related to lack of funding but are instead identified as being policy and regulatory ones, as not prioritised by the corresponding sector and that are suffering the uncertainty of the market pull.

Nonetheless, these preliminary findings are generated almost exclusively from the surveys received and filled-in by the SIs, and it is SUPEERA partners' recommendation to validate them by involving also the main representatives of each of the interested IWG. Being most of

these issues rather technical, the reinforcement of cooperation instruments between involved stakeholders (SET Plan SG – IWG – SETIS – JA-2 & ETIPs – EERA) is a key to a better understanding of future developments of single Implementation Plans.

## 3.2 Feedback from the Supporting Initiatives on the reporting process

After an initial series of interviews (the received data analysis was described in the previous chapter), SIs were requested to give their feedback (following a survey template, see Annex 2) on their coordination practices and SET Plan reporting process/methodology, as well as to identify the challenges and suggestions to improve the procedure. Below are presented the consolidated results.

The main challenge identified by most SIs is to **engage with all relevant stakeholders in order to monitor and report on the progress of each IP activity**. Although the SET Plan offers a unique collaborative framework where all parties involved can efficiently work together in the execution of the IPs (as mentioned in Chapter II), there are still some challenges that prevent this process to be fully displayed. In fact, while there is wide consensus on the underlying methodology, a diversified array of interpretations arising from individual stakeholder vision may prevent a smooth execution of the monitoring and reporting process. If most of the SIs position themselves as centralized, coordinating points, every member of their respective IWGs do not necessarily contribute directly to the monitoring process, nor are they expected to. For instance, some SIs led the reporting process, liaised directly with SETIS, and to ensure mobilisation and representation of all stakeholders, mobilized only a core group of representing IWG members. Others have mobilised all IWG members in the reporting process, as well as relevant local agencies, in order to collect the most exhaustive data. Most SIs assisted stakeholders in the completion of the questionnaire when needed, and when relevant, even pre-filled the questionnaire before sending it to their IWG members. Some SIs also built on the organisation of a series of events (workshops, conferences, meetings) attended by IWG members and ETIPs. Others adopted a more targeted approach and sent a series of surveys dedicated to each stakeholder's relevant level of information (high-level for the Member States, more detailed and concrete for developers). Finally, for its endorsement by the IWG, several SIs presented the completed forms to their respective IP communities, before handling the results to SETIS.

Yet, IWGs can still have trouble in engaging with all their stakeholders, especially when they are not assisted by any kind of structured supporting initiative. As involvement from stakeholders is required voluntarily, it can be challenging for IWGs to get the necessary feedback: indeed, the effort to compile all national and international ongoing and relevant projects, linked to all the IP's topics, can be extremely high, especially for the Member States representatives. In that respect, these IWGs consider they lack the means to carry out an exhaustive, in-depth analysis of the SET Plan implementation.

A second challenge identified by interviewed SIs is to **gather sufficient and up-to-date information on energy research activities, in order to display the most accurate view and prioritize targets**. It is especially the case when the relevant information is subject to disclosure restraints. Information about ongoing projects can indeed be sensitive to share, for industrial stakeholders for instance, and thus project managers can be reluctant to participate in the reporting process.

Furthermore, some SIs reported that it can sometimes be difficult to identify the correct project leaders or the right contact person to collect information on a project (e.g. when projects are spread across countries). In addition, at the Member States level, research can differ in timelines and prioritisation, making it difficult to carry out a like-with-like analysis. In gathering sufficient information on ongoing projects or ready to take-off projects, SIs dedicate a considerable amount of their time trying to identify and engage with the right contact person, and in the event of default, to find alternative contacts in order to collect sufficient feedback information. The process of gathering data on ongoing projects becomes even more complex when it entails the screening of sub-national levels (regional and local – depending on MS/AC internal territorial organisation). To overcome these difficulties, some SIs consider that extra support of the SET Plan Steering Group members could be useful, for example sharing contacts of funding bodies/agencies in charge of national/regional/local funding schemes.

Due to a large number of small ongoing projects, as well as the important number of actors and skills in value chains, some SIs reported that the monitoring of projects can be an arduous exercise, as IWGs cannot have technical experts in all fields of technologies. In order to overcome this situation, these SIs consider there could be a clarification of the targeted types of projects by their respective IPs, of the part of the value chain they fall in, and a limit fixed on the maximum budget of the projects monitored, including a certain amount of public invested money.

Eventually, some SIs identify that their reporting process could improve by relying on a highly automated system: project managers could fill in an online form and put in simple but specific figures about their KPI's. In addition, several SIs wonder if there could be identified **additional means of mobilisation and motivation for Member States, as for them to engage in the reporting process**.

The third main challenge identified by IWGs SIs is to **report the progress of each activity in a structured, harmonized way as to provide stakeholders with an accurate state of play**. Indeed, in the context of SETIS' yearly assessment of the SET Plan Implementation progress, activities are expected to be sorted out regarding the number of projects addressing each activity. Simultaneously, R&I activities are also prioritized according to their potential impact on the execution of the IPs, and on the achievement of the targets.

Yet, this monitoring and reporting exercise represents different challenges to IWGs in several ways. Firstly, IWGs can have trouble in linking a project to a specific activity or choosing only one activity to which a project can be linked amongst their IP. For instance, some SIs have

had difficulties in linking projects and funding budgets to activities, when there were no dedicated funding programmes in some countries for their IPs subject, namely. These SIs thus believe that a more accurate reporting process could focus on exemplary projects instead of a list of small projects.

In addition, many SIs consider that sorting out the activities using the current "traffic light" system can be challenging too, or even inappropriate. The classification of activities is indeed perceived by these SIs as open to free interpretation. In that respect, for the 2020 exercise, some SIs have labelled their respective activities intending to stress out additional information about their activities' status: e.g. fewer projects are addressing an activity in comparison with others, or the SIs encountered difficulties in getting the right information on an activity on due time. Other IWGs have identified an important number of relevant projects and considered that it was necessary to group them and to adopt a more general approach on the progress achieved in each area. In that respect, they think the coloring of each activity could be more nuanced, to reflect more accurately their activities status. To these SIs views, it could be useful **to adopt a new coloring/ranking system, to make it possible to select different colors for the same activity** (for example, with a system of numbers reflecting the number of projects).

Moreover, the prioritization of activities under the SETIS reporting process could also be quite a challenge for IWGs. For one thing, most of them did not conduct any analysis to quantify the impact of activities on the overall progress of the sector, in order to prioritize them. Some SIs thus consider that there can be a risk in setting-up a prioritization between activities, that the ranking becomes a barrier for the development of projects linked to low prioritized activities, even though their impacts on the overall implementation of the SET Plan targets cannot or was not quantified. In that respect, they question the relevance of the purpose and outcome of this prioritisation - indeed, all activities could be perceived as priorities to achieve the targets. In addition, some SIs consider that the reporting template should also take into account that activities can indeed be on the right track, but continuous support and high involvement are still necessary. They would find it useful to highlight in the report when support from policymakers is needed in the long-term, or in the short-term. These SIs felt that including **a comment section could also be useful, in order to give this feedback directly to SETIS**.

Finally, as some IWGs shifted their labelling of activities from "green" or "orange" in 2019 to "red" in 2020, SIs concerned were asked about the rational of these evolutions. The main reason lays in the fact there is no unique and generally accepted mechanism against which the progress of the execution of the IPs can be measured and assessed. This is particularly true for those IPs which, given their nature, may include different sectors, targets, terminology, and scope. As a practical consequence, different information, terms, and approaches are applied to monitor different actions within the same Implementation Plan. In addition to this broader consideration on why various 2019 green activities turned in 2020 into orange or even red, SIs have indicated more straightforward reasons to explain these shifts such as the postponement of previously envisaged projects due to lack of funding or limited funding available; absence of policy framework for the deployment of single technologies and/or measures or, as an extreme example, the change of experts within the IWG in charge for the reporting of the progress of single IPs activities.

# IV CONCLUSION

Following the revision of methodology and objectives of task 1.1 of SUPEERA, this second interim version aims at providing a clear and consolidated analysis of the state of progress of those IPs actions which were labelled as “orange” (projects are expected to take-off in the near future to address the activity) or “red” (preparatory work / no progress of the activity) under SETIS 2020 Progress report, and as such, were deemed to need more accurate analysis. To apply a cross IP analysis and to have a general overview of the progress of each IP, the data contained in the SETIS 2020 report “*Implementing the SET Plan: Making the SET Plan fit for the EU Green recovery*” proved to be fundamental. In order to further SETIS’ analysis and to collect more in-depth concrete information on the SET Plan Implementation challenges, this report also relies on a series of surveys and interviews conducted with the Supporting Initiatives (JA-2 and ETIPs) of the Implementation Working Groups of the SET Plan.

In that respect, this report first analyses that 36 activities (labelled as “orange” or “red”) out of 143 of the SET Plan IPs are lacking behind in 2020. Compared to 66 “orange” and “red” activities reported in 2019 the main conclusion is that every IWG is progressing with the execution of their respective IPs.

Amongst SIs, the SET Plan is perceived as key to addressing the Clean Energy Transition, while its structure and governance are deemed to present several opportunities: the capacity to bring all stakeholders of the energy research sector into a discussion and facilitate their dialogue; to contribute to reaching the goals of the Clean Energy Transition and of the European Green Deal; to foster the alignment of national Strategic Research and Innovation Agendas; to accelerate technology deployment by closing the gap between R&I and market; and to mobilize the right financing instruments by activating and coordinating a wide number of stakeholders, both private and public, in addition to the MS/AC and the EU, in a concerted effort towards common priorities. In sum, the SET Plan is seen as a key and useful framework to deliver crosscutting, interdisciplinary low carbon energy research in Europe.

Addressing the remaining challenges towards the full implementation of the SET Plan, and in particular, challenges faced by IWGs when tackling those activities that are lacking behind, several obstacles and barriers were identified by IWGs SIs in order to turn “red” and “orange” activities into “green” ones (that is to say, to enable the take-off of projects addressing the activity). These identified barriers were tabled at the activity and IP levels. Overall, three main barriers to the take-off of IPs activities were identified by interviewed SIs: policy and regulatory barriers; different levels of commitment of involved actors / non-prioritization of activities by the correspondent sector; and the uncertainty of the market pull.

Furthermore, building upon SIs experience and feedback on the yearly reporting process led by SETIS, several challenges were identified, and opportunities for improvement were suggested. IWGs, assisted by SIs, are indeed committed to engaging with all stakeholders in order to get the most exhaustive view of the SET Plan implementation progress, to gather sufficient and up-to-date information on energy research activities in order to display the most

accurate view and prioritize targets and to report the progress of each activity in a structured, harmonized way as to provide stakeholders with an accurate state of play. Yet, some IWGs and their respective SIs still encounter difficulties in the monitoring process of their IPs activities; either because they lack the means to complete the process and to compile data, or because they cannot manage to create sufficient, on-time mobilisation of relevant stakeholders, or because they consider some adjustments in the reporting process itself are needed.

The amendment to the Grant Agreement and the subsequent revision of this specific task of SUPEERA proved to be beneficial to all parties involved in the monitoring and reporting process. It allowed SUPEERA to further its analysis of the state of play of the activities of the SET Plan, building upon SETIS' yearly assessment report in a more complementary way and therefore avoiding overlaps as well as to apply more methodological flexibility to reflect new priorities and targets originated from the European Green Deal, Next Generation EU, and other relevant EU policies and strategies and. Finally, it consented to deliver a very first attempt of the consolidated overview of the factors that by SIs are perceived as the obstacles for the execution of SET Plan IPs actions still lagging behind.

In addition, the discussions and various exchanges of information with IWG SIs allowed SUPEERA to get a broader and more in-depth analysis of the methodology followed and the challenges faced by IWG SIs during the monitoring process and providing suggestions on how to improve the overall monitoring process. Moreover, specific information on the types of barriers and parameters that are impeding orange and red activities to progress and to eventually turn green were also collected.

To smoothen the reporting process and reduce the number of solicitations towards IWGs, some of the IWGs SIs still considered that enhancing the already existing, and much appreciated, collaboration between SETIS, IWG SIs, SUPEERA, and other relevant stakeholders would be beneficial to support the achievement of the overarching objectives of the Integrated SET Plan.

# ANNEX 1 – Template of the first set of interviews with the Supporting Initiatives of the IWGs

**Questions**

*General questions*

1) *Why has the SET Plan an added value for your sector? What impact does it have on it?*

2) *Could you give us some success stories from your initiative and from the IWG? How did they directly participate in the successful implementation of some of the IWG activities (helping them to turn green)?*

3) *What are the good practices you would like to share with other supporting initiatives/ IWGs?*

*Specific questions on orange and red activities*

4) *How do you classify between "green", "orange" and "red" activities?*

5) *Why are some activities lacking behind ("orange" and red")? What are the main barriers they face, which impede them to become green (lack of funding, technical barriers, non-technical and regulatory barriers, administrative issues, or other issues)?*

## ANNEX 2 – Template for gathering additional information from the Supporting Initiatives of the IWGs

### *1) About the reporting process*

The SETIS (JRC) published in **November 2020** its second report monitoring the implementation of the SET Plan. For this purpose, the SETIS circulated an **online form** to gather relevant information.
Could you detail to us the **process/methodology you followed to fill in the 2020 form?**

**The process should refer to the following questions, if possible, for you to answer:**

1) Who is leading the process (*no name, only role, and affiliation*) and what is the role given to the supporting initiative?

2) How was the work organised within the IWG?
   - Were all the members involved or was it a core group of members?
   - Did the R&I community take part (*if yes, on which actions*)?
   - Did industrial entities/stakeholders take part (*if yes, on which actions?*)

3) Briefly describe the methodology used to gather information:
   - Whom did you contact to get information (*national/regional agencies, ministries, EERA Joint Programmes, case-by-case individual contacts…?)*
   - Whom from the above was the most responsive in the process
   - Channels and tools used (*mails, questionnaires, bi/multilateral meetings, etc.*)

4) How exactly is the progress monitored for your specific IP: i.e., what are the elements triggering the shift of an action from one category to another (*red →orange →green*):
   a) By considering only relevant projects addressing the activity and/or;
   b) There are also qualitative and quantitative indicators for each IP action (KPIs) (*briefly explain*);
   - Target objectives (*briefly explain*);
   - Experts ad hoc judgements;
   - Other (*briefly explain*)?
   c) Other

5) Which elements are taken into consideration when prioritising R&I actions?

6) Please list up to five major challenges encountered in performing this activity (*of monitoring process*).

7) Please list up to five suggestions on how to improve the process.

### *2) About the "orange" and "red" actions*

For each orange and red actions listed below, could you **list the barriers** you perceive as impeding these actions to turn "green" (*ie. to be supported by more projects*).
These barriers can refer to both IWG **external parameters** (*such as lack of funding, technical barriers, non-technical and regulatory barriers, administrative issues…* ***please precise as***

***much as possible***), or IWG **internal parameters** (*actions being too broadly defined, change of focus within the R&I community, participating countries prioritization, etc.*)

*In the previous meeting, we talked about the following barriers:*
*[Pre-filled according to the first set of interviews by CEA/EERA]*
**Please develop, if possible, and distribute for each activity:**

| Actions | Barriers referring to external parameters | Barriers referring to internal parameters |
|---|---|---|
| | | |
| | | |

## ANNEX 3 – List of contacted and interviewed supporting initiatives of the SET Plan IWGs

All the interviews and surveys were conducted between February and March 2021.

- Service Contract led by ECORYS in support of the IWG on Energy Efficiency in Industry
- IMPACTS9, SI of the IWG on CCUS
- SET4BIO, SI of the IWG on Renewable Fuels and Bioenergy
- OceanSET, SI of the IWG on Ocean Energy
- PV-IMPACT, SI of the IWG on Photovoltaics
- SETWind, SI of the IWG on Offshore Wind
- HORIZON STE, SI of the IWG on CSP
- GEOTHERMICA, SI of the IWG on Deep Geothermal
- ETIP Batteries, ETIP of the IP on Batteries
- IWG on Energy Efficiency for Buildings

# ANNEX 4 – Tables of the activities repartition among IPs and comparison of their state of progress between 2019 and 2020

## Legend

- Ongoing projects addressing the IP activity
- Waiting to take-off
- No progress
- Not covered

## Concentrated Solar Power Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | Advanced linear concentrator Fresnel technology with direct molten salt circulation as heat transfer fluid and for high temperature thermal energy storage | 2020 - 2021 | ● | ● |
| 2 | Parabolic trough with molten salt | 2020 - 2021 | ● | ● |
| 3 | Parabolic trough with silicon oil | 2020 - 2021 | ● | ● |
| 4 | Improved central receiver molten salt technology | 2020 - 2021 | ● | ● |
| 5 | Next generation of central receiver power plants | 2020 - 2021 | ● | ● |
| 6 | Pressurized air cycles for high efficiency solar thermal power plants | 2020 - 2021 | ● | ● |
| 7 | Multi-tower central receiver beam down system | 2020 - 2021 | ● | ● |
| 8 | Thermal energy storage | 2020 - 2021 | ● | ● |
| 9 | Development of supercritical steam turbines optimised for the specifics of CSP applications | 2022 - 2025 | ● | ● |
| 10 | Development of advanced concepts for improved flexibility in CSP applications | 2020 - 2021 | ● | ● |
| 11 | Development and field test of CSP hybrid air Brayton turbine combined cycle sCO2 systems | 2022 - 2025 | ● | ● |

## Photovoltaics Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | PV for BIPV and similar applications (building integrated PV includes here the integration of PV into the infrastructure) | 2022 - 2025 | ● | ● |
| 2 | Technologies for silicon solar cells and modules with higher quality | 2020 - 2021 | ● | ● |
| 3 | New multi-junction PV technologies for highest efficiencies at reasonable costs | 2020 - 2021 | ● | ● |

| | | | | |
|---|---|---|---|---|
| 4 | Development of PV power plants and diagnostics | 2022 - 2025 | 🟢 | 🟡 |
| 5 | Manufacturing technologies for silicon and thin-film PV | 2020 - 2021 | 🟢 | 🟢 |
| 6 | Cross-sectoral research at lower TRL | 2025 onward | 🔴 | 🔴 |

## Deep Geothermal Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | Geothermal heat in urban areas | 2020 - 2021 | 🟢 | 🟢 |
| 2 | Materials, methods and equipment to improve operational availability (high temperatures, corrosion, scaling) | 2020 - 2021 | 🟢 | 🟢 |
| 3 | Enhancement of conventional reservoirs and deployment of unconventional reservoirs | 2020 - 2021 | 🟢 | 🟢 |
| 4 | Improvement of performance (conversion to electricity and direct use of heat) | 2020 - 2021 | 🟢 | 🟢 |
| 5 | Exploration techniques (including resource prediction and exploratory drilling) | 2020 - 2021 | 🟡 | 🟡 |
| 6 | Advanced drilling/well completion techniques | 2020 - 2021 | 🟢 | 🟢 |
| 7 | Integration of geothermal heat and power in the energy system and grid flexibility | 2020 - 2021 | 🟡 | 🟡 |
| 8 | Zero emissions power plants | 2020 - 2021 | 🟡 | 🟡 |
| 9 | NTBE A. Increasing awareness of local communities and involvement of stakeholders in sustainable geothermal solutions | 2020 - 2021 | 🟢 | 🟢 |
| 10 | NTBE B. Risk mitigation (financial/project) | 2020 - 2021 | 🟢 | 🟢 |

## Offshore Wind Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | System Integration | 2020 - 2021 | 🟡 | 🟡 |
| 2 | Wind Energy Offshore Balance of Plant | 2022 - 2025 | 🟢 | 🟢 |
| 3 | Floating Offshore Wind | 2020 - 2021 | 🟢 | 🟢 |
| 4 | Wind Energy Operations and Maintenance | 2022 - 2025 | 🟢 | 🟡 |
| 5 | Wind Energy Industrialisation | 2022 - 2025 | 🔴 | 🟡 |
| 6 | Wind Turbine Technology | 2022 - 2025 | 🟢 | 🟢 |

| | | | | |
|---|---|---|---|---|
| 7 | Basic Wind Energy Sciences | 2020 - 2021 | 🟢 | 🟡 |
| 8 | Ecosystem and social impact | 2022 - 2025 | 🟡 | 🔴 |
| 9 | Human Capital Agenda | 2022 - 2025 | 🟡 | 🔴 |

## Ocean Energy Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1.1 | Tidal Energy technology device development and knowledge building up to TRL6 | 2020 - 2021 | 🟢 | 🟢 |
| 1.2 | Tidal energy system demonstration in operational environment (TRL 7-9) | 2020 - 2021 | 🟢 | 🟢 |
| 1.3 | Wave energy technology development and demonstration up to TRL 6 | 2020 - 2021 | 🟢 | 🟢 |
| 1.4 | Wave energy system demonstration and deployment TRL 7-9 | 2020 - 2021 | 🟢 | 🟢 |
| 1.5 | Installation, logistics and infrastructure | 2022 - 2025 | 🔴 | 🟡 |
| 1.6 | Standards and guidelines for evaluation of wave energy technologies. | 2020 - 2021 | 🟢 | 🟢 |
| 2.1 | Creation of an investment fund for ocean energy farms | 2022 - 2025 | 🟢 | 🟡 |
| 2.2 | Creation of an EU insurance and guarantee fund to underwrite various project risks. | 2022 - 2025 | 🟡 | 🔴 |
| 2.3 | Wave Energy Europe Pre Commercial Procurement (PCP) action for development of wave energy technology. | 2020 - 2021 | 🟢 | 🟢 |
| 3.1 | Development of certification and standards to support the offshore renewable technology sector. | 2022 - 2025 | 🔴 | 🔴 |
| 3.2 | De-risking environmental consenting through an integrated programme of measures | 2022 - 2025 | 🔴 | 🟡 |

## Positive Energy Districts Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | European Positive Energy Cities Platform | 2020 - 2021 | 🟢 | 🟢 |
| 2 | PED Innovation Labs | 2020 - 2021 | 🟢 | 🟢 |
| 3 | PED Guides and Tools | 2022 - 2025 | 🟡 | 🟢 |
| 4 | PED Replication and Mainstreaming | 2022 - 2025 | 🟡 | 🟡 |
| 5 | PED Monitoring and Evaluation | 2020 - 2021 | 🟢 | 🔴 |

## Energy Systems Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | Systemic and socio-economic impact of digitalisation in the energy system | 2020 - 2021 | ● | ● |
| 2 | Cybersecurity of critical energy infrastructure | 2020 - 2021 | ● | ● |
| 3 | Market design for trading of heterogeneous flexibility products | 2020 - 2021 | ● | ● |
| 4 | Regulatory innovation zones | 2020 - 2021 | ● | ● |
| 5 | Process chain for interoperability of ICT systems | 2020 - 2021 | ● | ● |
| 6 | Increased observability and controllability of MV and LV networks with high penetration of distributed energy resources | 2022 - 2025 | ● | ● |
| 7 | Smart and flexible grid design, planning and operation based on an enhanced transmission grid observability in uncertain framework | 2022 - 2025 | ● | ● |
| 8 | Customer participation and new markets and business models | 2022 - 2025 | ● | ● |
| 9 | EV/PHEV charging infrastructure and integration in smart energy system | 2020 - 2021 | ● | ● |
| 10 | Demand response engineering | 2022 - 2025 | ● | ● |
| 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 | 2020 - 2021 | ● | ● |
| 12 | Adaptation and improvement of technologies to novel power-to-gas and power-to-liquid concepts | 2020 - 2021 | ● | ● |
| 13 | Developing the next generation of flexible hydro power plants | 2020 - 2021 | ● | ● |
| 14 | Developing the next generation of flexible thermal power plants | 2020 - 2021 | ● | ● |
| 15 | Increase the flexible generation by mean of the use of integrated storage in generation assets | 2020 - 2021 | ● | ● |
| 16 | Multiservice storage applications to enable innovative synergies between system operators and market players | 2022 - 2025 | ● | ● |
| 17 | Advanced energy storage technologies for energy and power applications | 2022 - 2025 | ● | ● |
| 18 | Reduction of return temperatures in current DH networks | 2025 onward | ● | ● |
| 19 | Optimised low temperature and highly flexible (micro) DH and DC networks | 2025 onward | ● | ● |
| 20 | Increasing the short-term flexibility of DH networks and enabling its efficient utilisation | 2025 onward | ● | ● |
| 21 | Increasing the long-term flexibility of heating and cooling systems | 2025 onward | ● | ● |

| | | | | |
|---|---|---|---|---|
| 22 | Transnational joint programming platform on smart, integrated, regional energy systems | 2022 - 2025 | 🟢 | 🟢 |
| 23 | Creating and linking living labs for integrated local and regional energy systems | 2022 - 2025 | 🟢 | 🟡 |
| 24 | Cross-linking of large demonstration projects | 2020 - 2021 | 🟢 | 🟢 |
| 25 | Optimised planning, managing and monitoring of integrated regional energy systems | 2020 - 2021 | 🟢 | 🟢 |
| 26 | 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 | 2020 - 2021 | 🟢 | 🟡 |
| 27 | Create an innovation environment for smart services in cooperation with ICT platform providers | 2020 - 2021 | 🟢 | 🟡 |

## Energy Efficiency (EE) in Buildings Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | New materials for buildings | 2020 - 2021 | 🟢 | 🟡 |
| 2 | Prefabricated active modules for façades and roofs or Key Enabling Technologies for active building skins | 2020 - 2021 | 🟢 | 🔴 |
| 3 | Digital planning and operational optimization | 2020 - 2021 | 🟢 | 🟢 |
| 4 | Living labs - Energy technologies and solutions for decarbonized European quarters and Cities | 2022 - 2025 | 🔴 | 🟢 |
| 5 | Cost-efficient, intelligent, flexible heat pumps (also thermally driven) and heat pumps for high temperatures | 2020 - 2021 | 🟢 | 🟢 |
| 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 | 2020 - 2021 | 🟢 | 🟢 |
| 7 | Cost reduction and increase in efficiency of micro CHP/CCHP | 2020 - 2021 | 🟡 | 🟡 |
| 8 | Compact thermal energy storage materials, components and systems | 2020 - 2021 | 🟢 | 🟡 |

## Energy Efficiency (EE) in Industry Implementation Plan

| Number | Actions | Priority | Progress 2020 |
|---|---|---|---|
| 1 | Steel sector | | |
| 1.1 | CO2 avoidance through hydrogen direct reduced Iron (CDA...Carbon Direct Avoidance) | 2022 - 2025 | 🟢 |
| 1.2 | HIsarna smelting reduction process for lowering energy consumption and CO2 emissions of steel production | 2022 - 2025 | 🟢 |

| | | | |
|---|---|---|---|
| 1.3 | Top Gas Recycling – Blast Furnace (TGR-BF) using plasma torch. | 2022 - 2025 | ● |
| 2 | Chemical sector | | |
| 2.1 | Chemical reactor, process and plant (re)design and optimisation – Process intensification | 2022 - 2025 | ● |
| 2.2 | Separation technologies | 2022 - 2025 | ● |
| 2.3 | Power-to-X & Unconventional energy sources | 2022 - 2025 | ● |
| 3 | Heat/cold recovery | | |
| 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. | 2022 - 2025 | ● |
| 3.2 | Heat pumps and refrigeration converting low grade heat or cool into higher grade heat or cool | 2022 - 2025 | ● |
| 3.3 | Heat-to-Power (electrical) recovery (low and high temperature) | 2022 - 2025 | ● |
| 3.4 | Polygeneration (heat, cold, electrical power) and hybrid plants | 2022 - 2025 | ● |
| 4 | System Integration | | |
| 4.1 | Industrial Symbiosis. Symbiosis between energy intensive industries to valorise energy losses streams and better manage energy globally | 2022 - 2025 | ● |
| 4.2 | Non-conventional energy sources in process industry | 2025 onward | ● |
| 4.3 | Digitisation: Further integration in process and plant management including plant/process design phase and processing plant retrofit | 2020 - 2021 | ● |
| 4.4 | Improving exchange of technological, economic, behavioural and social knowledge; training, capacity building and dissemination | 2022 - 2025 | ● |

*Comment: Data on Energy Efficiency in Industry IP activities progress in 2019 is not available.*

**Batteries Implementation Plan**

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | Material-Chemistry-Design-Recycling | | | |
| 1.1 | Advanced Li-ion batteries for e-mobility | 2022 - 2025 | ● | ● |
| 1.2 | Influence of Fast/Hyper charging Li-ion batteries on materials and battery degradation | 2022 - 2025 | ● | ● |
| 1.3 | Advancement of batteries for stationary energy storage | 2025 onward | ● | ● |
| 1.4 | Post-Li ion for e-mobility | 2025 onward | ● | ● |
| 1.5 | Recycling of Batteries (Li-ion and post Li-ion) | 2022 - 2025 | ● | ● |
| 1.6 | Lithium recovery from European geothermal brines and sustainable beneficiation processes for indigenous hard rock occurrence of Li | 2020 - 2021 | ● | ● |

| | | | | |
|---|---|---|---|---|
| 2 | Manufacturing | | | |
| 2.1 | Foster development of materials processing techniques and components for fast industrialization compatible with present mass production lines | 2022 - 2025 | 🟡 | 🟡 |
| 2.2 | Foster development of cell and battery manufacturing equipment | 2022 - 2025 | 🔴 | 🟡 |
| 3 | Application & Integration | | | |
| 3.1 | Hybridisation of battery systems for stationary energy storage (ESS) | 2025 onward | 🟡 | 🟡 |
| 3.2 | Second-use and smart integration into the grid | 2022 - 2025 | 🟢 | 🟡 |

## Renewable Fuels and Bioenergy Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | Develop advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy | 2022 - 2025 | 🟢 | 🟢 |
| 2 | Demonstrate advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy | 2022 - 2025 | 🔴 | 🟡 |
| 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 | 2020 - 2021 | 🟡 | 🟡 |
| 4 | Develop other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical /electrochemical transformation of energy neutral carriers with renewable energy | 2022 - 2025 | 🟢 | 🟡 |
| 5 | Demonstrate other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy | 2022 - 2025 | 🔴 | 🟡 |
| 6 | Scale-up other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy | 2020 - 2021 | 🟡 | 🟡 |
| 7 | Production of renewable hydrogen from water electrolysis and renewable electricity | 2020 - 2021 | 🟢 | 🟡 |
| 8 | Develop high efficiency large scale biomass cogeneration of heat and power | 2022 - 2025 | 🔴 | 🟢 |
| 9 | Demonstrate high efficiency large scale biomass cogeneration of heat and power | 2022 - 2025 | 🟢 | 🟢 |

| | | | | |
|---|---|---|---|---|
| 10 | Scale-up high efficiency large scale biomass cogeneration of heat and power | 2025 onward | 🔴 | 🟢 |
| 11 | Develop solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass | 2022 - 2025 | 🟢 | 🟢 |
| 12 | Demonstrate solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass | 2022 - 2025 | 🔴 | 🟡 |
| 13 | Scale-up solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass | 2020 - 2021 | 🟡 | 🟡 |

## Carbon Capture Utilisation and Storage (CCUS) Implementation Plan

| Number | Actions | Priority | Progress 2020 | Progress 2019 |
|---|---|---|---|---|
| 1 | Delivery of a whole chain CCS project operating in the power sector | 2022 - 2025 | 🟡 | 🟡 |
| 2 | Delivery of regional CCS and CCU clusters, including feasibility for a European hydrogen infrastructure | 2020 - 2021 | 🟢 | 🟡 |
| 3 | EU Projects of Common Interest for CO2 transport infrastructure | 2020 - 2021 | 🟢 | 🟢 |
| 4 | Establish a European CO2 Storage Atlas | 2025 onward | 🔴 | 🟡 |
| 5 | Unlocking European Storage capacity | 2025 onward | 🟡 | 🟡 |
| 6 | Developing next-generation CO2 capture technologies | 2020 - 2021 | 🟢 | 🟡 |
| 7 | CCU Action | 2020 - 2021 | 🟢 | 🟢 |
| 8 | Understanding and communicating the role of CCS and CCU in meeting European and national energy and climate change goals | 2020 - 2021 | 🟢 | 🟡 |