

# SET4BIO

## RENEWABLE FUELS AND BIOENERGY FOR A LOW-CARBON EUROPE – ACCELERATING THE IMPLEMENTATION OF THE SET-PLAN ACTION 8

Horizon 2020, Grant Agreement no. 884524

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## EXECUTIVE SUMMARY

Deliverable 1.1 addresses SET4Bio's Task 1.1 governing the state of play of the research and innovation activities relevant for SET Plan IP8. The aim is mapping of the relevant ongoing and recently finished projects at EU and national level, especially for the SET Plan countries engaged in IWG8 as well as at European level. The projects covered in this deliverable contribute to the execution of IP8 covering the entire TRL spectrum, from research and development activities up to demonstration and scale-up initiatives.

The deliverable is organized as follows. The actual project list is presented in an excel file in Appendix 1, showing the ongoing and recently finished projects for EU and the individual countries, each in their own sheet. The list will be updated continuously throughout the project period with uploads every 12 months and serves as the basis of the [interactive map](#) available on the SET4Bio homepage showing the projects in their respective countries.

The first section of this document gives a background by describing the Set Plan Implementation Plan action 8 as well as the list of participating countries. Chapter 2 covers the value chains considered and Chapter 3 describes the data and information collection methodology. Chapter 4 summarizes the results of the efforts so far, while Chapter 5 gives a short conclusion and outlook.

The initial deliverable showed the challenges in data collection of relevance to follow up the progress of IP8, primarily due to the enormous differences in funding national projects and available data related to them. To improve the quality of the previous deliverable the data presented in this updated document has been further elaborated and systematized with the involvement of key national stakeholders/sources experts in the field of bioenergy/renewable transportation fuels in collecting and quality assuring the data. Among the upgrades included in the current work, it is worth mentioning the inclusion of the correlation between listed project and R&I activities of the SET Plan IP8, providing a clearer picture about the progress of the realization of IP8. Despite the quality gain of the data presented in this updated deliverable it is necessary to recognize that there are structural barriers that shall be overcome when aiming to collect, align and compare data effectively across Europe. There is a need to define a common taxonomy to characterize national and Europe projects facilitating comparisons to discuss best-practices/lessons-learned on funding mechanisms. Further, it is crucial that countries having several funding agencies establish coordination instruments to align national data within the country.

## PARTNERS

<p><b>RISE</b> - Research Institutes of Sweden AB, Sweden</p>	
<p><b>SINTEF</b> - SINTEF Energi AS, Norway</p>	
<p><b>FNR</b> - Fachagentur Nachhaltende Rohstoffe e.V., Germany</p>	
<p><b>CIRCE</b> - Fundacion Circe Centro de Investigación de Recursos y Consumos Energéticos, Spain</p>	
<p><b>VTT</b> - Teknologian tutkimuskeskus VTT Oy, Finland</p>	
<p><b>ETA</b> - ETA Florence Renewable Energies, Italy</p>	

### Statement of Originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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## 1. Introduction

The European Strategic Energy Technology Plan (SET Plan)<sup>1</sup> is a major tool to enable the transition towards a climate neutral energy system in Europe through the development of cost efficient low-carbon technologies. The Integrated SET Plan defines the European R&I targets in 10 key areas, of which one covering renewable fuels and bioenergy defined by "*Action 8: Bioenergy and Renewable Fuels for Sustainable Transport*". In December 2017, the representatives of the European Commission services, SET Plan countries and stakeholders agreed upon a SET Plan Declaration of Intent (DoI<sup>2</sup>), and later in June 2018 upon an Implementation Plan for Action 8 (IP8)<sup>3</sup>.

The overall objective of Work Package 1 in Set4Bio is to identify the most promising funding and financing mechanisms to realize the IP8 and to create awareness of funding needs and challenges among key stakeholders. Task 1.1 in the SET4Bio project has set a goal on mapping the most important ongoing and recently finished projects contributing to the realization of the IP8, *Bioenergy and Renewable Fuels for Sustainable Transport*, including, when data is available, an analysis of the funding schemes behind the projects, within both public and private funding, players involved, and committed resources. The work in Task1.1 during the past year has been focusing on upgrading of the existing and adding missing data as well as on systematizing and improving the presentation of the data for the countries involved in IWG8.

The member countries of IWG8 are as follows:

- Austria
- Belgium
- Cyprus
- Finland
- France
- Germany
- Italy
- Netherlands
- Poland
- Portugal
- Spain
- Sweden
- Turkey

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<sup>1</sup> [https://ec.europa.eu/energy/topics/technology-and-innovation/strategic-energy-technology-plan\\_en](https://ec.europa.eu/energy/topics/technology-and-innovation/strategic-energy-technology-plan_en)

<sup>2</sup> <https://setis.ec.europa.eu/implementing-integrated-set-plan/renewable-fuels-and-bioenergy-ongoing-work>

<sup>3</sup> [https://setis.ec.europa.eu/system/files/setplan\\_bioenergy\\_implementationplan.pdf](https://setis.ec.europa.eu/system/files/setplan_bioenergy_implementationplan.pdf)

## 2. Value chains covered in the report

The IP8 along with DoI8 address three major goals in the field of bioenergy and biofuels: improve efficiency and reduce GHG emissions and costs of production. Due to the complexity of the field as well as versatility of the specific value chains, the IP8 identifies 13 research and innovation (R&I) activities to be implemented to meet the targets defined in DoI8/IP8. The 13 research and innovation activities are:

### Advanced Biofuels

1. Develop advanced liquid and gaseous biofuels through biochemical / thermochemical / chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy
2. Demonstrate advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy
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

### Other renewable liquid and gaseous fuels

4. Develop other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical /electrochemical transformation of energy neutral carriers with renewable energy
5. Demonstrate other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy
6. Scale-up other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy

### Renewable hydrogen

7. Develop and demonstrate the production of renewable hydrogen from water electrolysis and renewable electricity

### Bioenergy

8. Develop high efficiency large scale biomass cogeneration of heat and power
9. Demonstrate high efficiency large scale biomass cogeneration of heat and power
10. Scale-up high efficiency large scale biomass cogeneration of heat and power

### Intermediate bioenergy carriers

11. Develop solid, liquid, and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass
12. Demonstrate solid, liquid, and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass
13. Scale-up solid, liquid, and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass

Upon discussions with the IWG8 group at the start of the project, it was decided that the SET4Bio project adapted a portfolio management approach to assess the R&I projects in the member countries. The portfolios were identified as the ETIP Bioenergy value chains, however, this has not been implemented yet. Instead, this updated report assesses selected national/European projects covering one or several of the 13 R&I activities in the SET-Plan IP8 to determine the degree of contribution of each IWG8-country to the realization of the SET-Plan IP8.

### 3. Methodology - data collection

The gathering of new inputs to either upgrade existing data or include additional projects has been primarily relied on intelligence from key personnel from national agencies and national scientific experts from the EERA JP Bioenergy community and to a lesser extent on primary data from publicly available databases. Initially it was also foreseen to complement these data with inputs from SETIS, however, they did not have any additional information to include until now.

To improve the data quality, dedicated telco-meetings with each country representative were conducted to gain understanding about the initial contributions delivered to SET4Bio previously as well as provide updates from the respective countries. Several interactions through email and phone have been conducted regularly after the initial telco-meetings to check the progress of the collection process and to clarify doubts/questions. This approach has proved to improve the data quality of this deliverable and facilitate analysis of the data received.

The information that has been aimed to gather for each national/European project is the following:

- ✓ **Name** of the project
- ✓ **R&I activity** of IP8 associated to each project
- ✓ **Funding source**, distinguishing between governmental (ministerial) funding, typically allocated to a given research organization, and funding from national/regional funding agencies, associated to competitive funding
- ✓ **Country/region** where the project is established
- ✓ **Leading partner** in the project
- ✓ **Project lifetime**, with start and end date, and covering ongoing and recently finished (from 2018 onwards)
- ✓ **Technology Readiness Level (TRL)** associated to each project
- ✓ **Budgets**, discerning between total budgets and public ones
- ✓ **Type of funding**, featuring three categories, i.e., i) **public vs. private**, ii) **national vs. European**, and iii) **competitive**, typically through calls, vs. **institutional**, typically allocated directly from a Ministry/funding agency to a research organization in absence of a competitive process.

The association of a R&I activity to each project has been determined by the project topic (advanced Biofuels, other renewable liquid and gaseous fuels, renewable hydrogen, bioenergy, intermediate bioenergy carriers) and the TRL (divided into development, demonstration and scale-up). This information is crucial to monitor the progress of the realization of IP8, being able to on one hand identify which of the 13 R&I activities are further ahead in their implementation and which ones are given a lower priority and, on the other hand comprehend the degree of commitment of each IWG8 country in the realization of IP8.

The second essential data collected in this work is the allocated resources, providing total budgets as well as public budgets. On many occasions, the difference between them corresponds to funding from the private sector. The IP8 shows an estimation of the volume of investment for the successful implementation of all 13 R&I activities (~106 bill. EUR) as well as for each of them. Further, the IP8 estimates (see Appendix 2 for more information and numbers) the share of this investment among sectors, i.e., industry, Member States/Associated countries (MS/AC) and the EU and the largest portion of the financing is clearly attributed to the private sector (~73 %), followed by national public funding (~21 %) and the EU (~6%). By collecting project budgets and compare them with the aforementioned estimation one can easily picture the advance of the realization of IP8 in its totality as well as at R&I level.

The third crucial information to gather is the type of funding, closely related to the funding source and budgets, and divided into three subcategories (except for the EU projects). The first one is the geographical origin of funding, distinguishing between regional, national, and European projects as well as co-funded projects which are particularly necessary to national alignment across Europe. The second subcategory indicates whether the funding is public, private or a combination of those. This piece of information is highly relevant to monitor the progress of IP8, knowing that the private sector is expected to contribute to the realization of the 13 R&I activities at a great measure (73 %). The third and final subcategory defining the type of funding reveals whether the projects are funded by funding agencies through a competitive process (proposal selection) or directly from national/regional governments (ministries). If a significant proportion of the projects are funded through competitive calls, it means that the funding agencies have the capability of proposing future calls adjusting the focus to the needs of the IP8 according to its progress. On the opposite, if a country funds the majority of their projects directly from governments, it is then up to the governments or the top management of the research organizations to allocate the resources to their priority projects. For the EU projects the type of funding distinguishes between Research and Innovation actions (RIA), Innovation actions (IA) and Coordinated and Support actions (CSA), following the definition given by the EC.



## 4. Mapping of Ongoing and Recently Finished Projects - Results

The available information on the ongoing and recently finished projects is presented in an excel sheet in Appendix 1. The excel sheet is to a significant extent based on the SETIS template for the reporting questionnaire. This section presents a short summary of the results.

### Projects at EU Level

The information on EU projects gathered in 2020 has been upgraded substantially, particularly in terms of R&I activities and budgets. About 75% of the listed projects focus on production of advanced biofuels and among those a hand-full of projects integrate the production of bioenergy carriers. The remaining 25% is a good mixture of projects addressing production of bioenergy carriers, heat and power, other renewable fuels and hydrogen. Approximately 60% of the listed initiatives are at development scale (TRL 3-5), about 30% at demonstration scale (TRL 6-7) and only a couple of projects are expected to close at commercial scale (TRL 8-9). Major efforts shall thus concentrate on upscaling the technologies from lab- and demo-scale, with a greater involvement of industry to successfully advance in the realization of IP8.

The coordination of the projects is spread across Europe, however, it must be noted that not a single project is led by one of the EU-13 countries added after 2004, reflecting the rather low or even non-existent participation of those countries in the realization of IP8. It is therefore of foremost importance to widen the activity of those countries towards the SET-Plan, hence contributing to a more cohesive Europe.

### Projects at National Level

#### 1. Austria

The project information has been primarily extracted from two public databases, i.e., The Austrian Research Promotion Agency FFG (<https://projekte.ffg.at/projekt>) and The Austrian Climate and Energy Fund (<https://www.klimafonds.gv.at/projekte/>, <https://energieforschung.at/projekte/>). A substantial share (~37%) of the funding is allocated to projects focusing on other renewable fuels. The rest of the funding is evenly distributed among projects addressing hydrogen (~29%), heating and power (26%) and to a slightly lesser extent advanced biofuels (~21%). About 75% of the initiatives are at low TRL (3-5) and approximately 20% are at medium TRL (6-8). Only 1 project claims commercial scale (TRL 9). Practically all projects, except two private investment projects, are funded through the Austrian Research Promotion Agency and all of those have a public-private approach and are funded through competitive processes.

#### 2. Belgium

The country is divided into three very distinguished regions, i.e. the Flemish and Walloon Regions and the Brussels-Capital Region. As for 2020, this update shows only data from the Region of Wallonia, provided by the Public service of Wallonia (SPW), however contact with the Region of Flanders is been established in 2021 and their inputs shall be included in the 2022 update. Based on the received information, it appears that Wallonia has most of its R&I

focus on biogas and renewable hydrogen production and to a lesser extent on heat and power purposes. The majority of the projects address low TRLs ( $\leq 5$ ) so efforts are needed in advancing towards up-scaling the technologies. So the Region of Wallonia contributes first and foremost to the realization of R&I activities 4, 7. These projects are primarily funded with public resources. In some occasions there are public-private collaborations, however the funding from industry is rather limited, reaching up to 40% share in best-case scenarios. Therefore, there is an apparent demand for encouraging the private sector to take a more active role the coming years.

### 3. Cyprus

No additional updates have been collected in 2021. In 2020 only a few small biogas R&I projects were running within IP8. Information on them, however, was not available. In 2020 there were no national funding instruments available for biomass and biofuels installations.

### 4. Finland

The inputs from Finland are shared by two of the most important funding agencies, i.e., Business Finland and Academy of Finland, funding high and low TRL, respectively. Unfortunately, the inputs lack information about TRLs and R&I activities, not allowing an interpretation on the contribution of Finland to the realization of IP8. It is therefore crucial that both funding agencies include this missing information in their data-collection/presentation. All projects funded by Academy of Finland are completely funded by public resources through competitive calls and those funded by Business Finland, also through competitive processes, require the participation of industry. In general terms one could say that the private sector contributes with about 50% of the funding share which is possibly one of the largest shares from the industry across Europe.

### 5. France

No information has been provided yet, however the contact is established.

### 6. Germany

The list of relevant projects in Germany has been substantially updated, based on the publicly available databases [enArgus](#), owned by the Federal Ministry for Economic Affairs and Energy and [Projektdatenbank der FNR](#), owned by the Federal Ministry of Food and Agriculture (BMEL). It is worth noting that projects funded by BMEL are typically rather small budget wise, so not all listed projects can be found in the database as individual projects, as they have been partly clustered in Appendix 1 for the sake of simplicity.

As reported in the previous version of this deliverable, most of the projects still focus on lab-pilot scale anaerobic digestion and to a lesser extent large-scale heat and power. Further, the updates indicate a gradual increased focus on hydrogen and advanced biofuels, both at development and demonstration scale. Approximately 70% of the projects are 100% publicly funded, usually by a federal ministry, and the other 30% sets public-private cooperation. The funding is allocated through competitive processes. With regards to budgets, the enArgus database only shows the public funding, so unfortunately, we are not in a position to indicate in financial terms to which extent the private sector is engaged in the realization of IP8. Nearly all listed projects are nationally funded, except one state-regional project and one

transnational projects, and thus they are conducted in Germany. However, there is one interesting demonstration project (TRL 6-9), Haru Oni, that even though it is funded by Germany it is conducted in Chile under the so-called German-Chile Energy Partnership. Due to better natural conditions - abundant and cheap wind energy - Chile was chosen to build the demonstration facility. Relevant industrial partners are part of this initiative. This particular showcase indicates two options for Europe: moving (parts) of the business outside Europe, e.g., to places with favorable natural conditions and lower costs, with a potential risk of technology drains and new dependencies or keeping control over the full value chain in Europe with potentially higher costs and lower efficiency.

#### **7. Italy**

No information has been provided yet, however the contact is established.

#### **8. The Netherlands**

Similar to the results reported in 2020, the projects were acquired from the following database: <https://projecten.topsectorenergie.nl/projecten>. This website is only in Dutch, making it a barrier for non-Dutch speaking citizens. Fortunately, The Netherlands Enterprise Agency (RVO) was available to translate, validate and structure the information through several telco-meetings and interactions. A substantial proportion of the projects are already at pilot/demonstration scale and focus on the production of bioenergy intermediates such as pyrolysis oil and syngas and other renewable fuels such as biogas as well as large-scale biomass cogeneration of heat and power. Another significant volume of the research in the Netherlands addresses the production of advanced biofuels, however most of these projects are still at lab/pilot scale. Beyond that, it seems like hydrogen projects are gradually receiving more financing support. Nearly all projects, regardless their research focus, are funded through the Netherlands Enterprise Agency (RVO), hence through competitive calls, and all of them require the participation of industry (public-private funding). Depending on the funding program the public subsidies are between 40-60% and the remaining sum is funded by the private sector.

#### **9. Poland**

No additional updates have been collected in 2021. In 2020, Poland did not have any strategic large R&D program dedicated to bioenergy. There were smaller bioenergy R&D projects financed by several cross and multi-thematic energy R&D programmes. The Polish research programs and projects are administered by the Ministry of Science and Higher Education as well as two national funding agencies (National Centre for Research and Development - for applied research and National Centre of Science - for basic research). There is no information available about the individual projects.

#### **10. Portugal**

The list of projects is based on first-hand key information provided by Portuguese senior research experts in the field of bioenergy and biofuels. The detailed information related to these projects was extracted from the project's websites, however it was very limited and

hence, it therefore insufficient to be able to extract any conclusions. Additional contact with the main funding agencies is planned during the second half of 2021 to improve the quality of existing data and collect new, reliable data for future work.

#### 11. Spain

Based on the presented projects, the main research focus (~50%) is on the production of advanced biofuels through valorization of various waste resources. About 1/3 of these initiatives are at pilot-demonstration scale and the rest at lower TRL. Besides advanced biofuels, the other two key research areas are on hydrogen and on other renewable fuels, being all of them at lab-scale. All these national projects are funded by two public bodies, i.e., Centre for the Development of Industrial Technology (CDTI), and the State Research Agency (AEI). About half of the projects are public-private, with the involvement of industry, and the other half are public-public. The results indicate that industry funds approximately 25% of the projects currently listed, thus contributing to the realization of IP8 moderately. Some of the public-private projects are funded through competitive proposals whereas others receive institutional funding, i.e., public funding in absence of competitive processes. However, in these cases the funding agencies apply a threshold requirement to ensure high-quality projects. As for the public-public initiatives, all projects are granted after a competitive selection and if so, part of the funding originates from the government (through the agency) and the remaining funding comes from the public research organization that has received the funding.

#### 12. Sweden

No additional updates have been collected in 2021. In 2020, a selection of projects has been received from the Swedish Energy Agency. All projects presented are within advanced biofuels topic, most of them in development stage (TRL 2-5).

#### 13. Turkey

The data collection for Turkey has been provided by the national funding agency Tubitak. The data show that Turkey has a rather broad spectrum of research focus with similar funding support priorities on hydrogen, advanced biofuels and other renewable fuels (biogas). The main difference between them is the TRL, being slightly higher for some of the advanced biofuels projects (up to TRL7) as compared to the other research areas (up to TRL5-6). Most of the projects are nationally funded through The Scientific and Technological Research Council of Turkey except a couple of transnational projects with funding contribution from the EU. As for the type of funding and in contrast to most of the other countries described above, the totality of the projects is publicly funded, without the need for private funding. This funding approach makes the contribution of private funding to the realization of IP8 a real challenge so hopefully this approach can be modified inspired by other national funding schemes described in this report to incentivise the involvement of the industry with own resource commitment.

A schematic summary of the collected data is presented in the table below. The countries for which information is lacking or misses validation are highlighted in grey.

	R&I activity	Funding source	TRL	Type of funding	Budgets
<b>Austria</b>	<ul style="list-style-type: none"> <li>• Other renewable fuels (++)</li> <li>• Hydrogen, Heat &amp; power, advanced biofuels (+)</li> </ul>	<ul style="list-style-type: none"> <li>• Funding agency</li> </ul>	<ul style="list-style-type: none"> <li>• Low (<math>\leq 5</math>, +++)</li> <li>• Medium (6-8, +)</li> </ul>	<ul style="list-style-type: none"> <li>• Public-private (+++); private (+)</li> <li>• Competitive (+++)</li> </ul>	<ul style="list-style-type: none"> <li>• Most of the budgets available</li> </ul>
<b>Belgium</b>	<ul style="list-style-type: none"> <li>• Hydrogen and other renewable fuels (++)</li> <li>• Heat &amp; power (+)</li> </ul>	<ul style="list-style-type: none"> <li>• Ministries</li> </ul>	<ul style="list-style-type: none"> <li>• Low (<math>\leq 5</math>)</li> </ul>	<ul style="list-style-type: none"> <li>• Public (++) ; public-private (+)</li> <li>• Competitive (+)/institutional (+)</li> </ul>	<ul style="list-style-type: none"> <li>• All budgets available</li> </ul>
<b>Cyprus</b>					
<b>Finland</b>		<ul style="list-style-type: none"> <li>• Funding agencies</li> </ul>		<ul style="list-style-type: none"> <li>• Public-private (Business Finland); public (Academy of Finland)</li> <li>• Competitive (+++)</li> </ul>	<ul style="list-style-type: none"> <li>• Business Finland: all budgets available</li> <li>• Academy of Finland: only public budgets available</li> </ul>
<b>France</b>					
<b>Germany</b>	<ul style="list-style-type: none"> <li>• Other renewable fuels (++)</li> <li>• Hydrogen, advanced biofuels, and heat &amp; power (+)</li> </ul>	<ul style="list-style-type: none"> <li>• Ministries</li> </ul>	<ul style="list-style-type: none"> <li>• Medium (6-8, ++)</li> <li>• Low (<math>\leq 5</math>)</li> </ul>	<ul style="list-style-type: none"> <li>• Public (++) ; public-private (+)</li> <li>• Competitive (+++)</li> </ul>	<ul style="list-style-type: none"> <li>• Only public budgets available</li> </ul>
<b>Italy</b>					
<b>The Netherlands</b>	<ul style="list-style-type: none"> <li>• Bioenergy carriers and advanced biofuels (++)</li> <li>• Heat &amp; power (+)</li> </ul>	<ul style="list-style-type: none"> <li>• Funding agency</li> </ul>	<ul style="list-style-type: none"> <li>• Low to medium (5-7)</li> </ul>	<ul style="list-style-type: none"> <li>• Public-private (+++)</li> <li>• Competitive (+++)</li> </ul>	<ul style="list-style-type: none"> <li>• All budgets available</li> </ul>
<b>Portugal</b>					
<b>Poland</b>					
<b>Spain</b>	<ul style="list-style-type: none"> <li>• Advanced biofuels (++)</li> <li>• Other renewable fuels and hydrogen (+)</li> </ul>	<ul style="list-style-type: none"> <li>• Funding agencies</li> </ul>	<ul style="list-style-type: none"> <li>• Low (<math>\leq 5</math>, ++)</li> <li>• Medium (6-7, +)</li> </ul>	<ul style="list-style-type: none"> <li>• Public-private (++) ; public-public (++)</li> <li>• Competitive (++) / institutional (++) ; competitive-institutional (+)</li> </ul>	<ul style="list-style-type: none"> <li>• All budgets available</li> </ul>
<b>Sweden</b>	<ul style="list-style-type: none"> <li>• Advanced biofuels (++)</li> </ul>	<ul style="list-style-type: none"> <li>• Funding agencies</li> </ul>	<ul style="list-style-type: none"> <li>• Low (<math>\leq 5</math>, ++)</li> </ul>	<ul style="list-style-type: none"> <li>• Competitive (++)</li> </ul>	
<b>Turkey</b>	<ul style="list-style-type: none"> <li>• Hydrogen, advanced biofuels, and other renewable fuels (+)</li> </ul>	<ul style="list-style-type: none"> <li>• Funding agency (++)</li> <li>• Ministries (+)</li> </ul>	<ul style="list-style-type: none"> <li>• Low (<math>\leq 5</math>, +++)</li> </ul>	<ul style="list-style-type: none"> <li>• Public (+++)</li> <li>• Competitive (+++)</li> </ul>	<ul style="list-style-type: none"> <li>• All budgets available</li> </ul>

(+++)  
(++) present to a large extent; (++) present to a moderate extent; (+) present to a little extent

## 5. Conclusions and Outlook

The first update of the deliverable D1.1 for Task 1.1 for the time period M7-M18 includes data with a higher degree of elaboration, systematization, and validation, allowing for clearer picture of the current situation on research and innovation within renewable fuels and bioenergy at country level as well as within Europe. Despite this improvement in terms of both quantity and quality there are still a number of challenges remain to collect and validate data such as language differences, lack of available data and lack of systematization in presenting such data or missing contact with key national staff.

The table summarizing the national projects in chapter 4 illustrates that all IWG8 countries diversify their research and innovation investments in several technologies. Projects addressing R&I activities on "other renewable fuels" are being prioritized in nearly all IWG8 countries, with Austria, Belgium and Germany as key contributors. This is also the case for hydrogen, however to a lesser extent, and with Belgium as a main driver. In addition, this update shows an increased focus on advanced biofuels, being the national focus in practically all nations and with Spain and The Netherlands as clear European catalysts in this field. Several countries are investing in production of heat and power from biomass, however, it seems like the number of initiatives is slightly less than the other R&I strategic fields. Finally, and with regards to bioenergy carriers, with the information available at this stage, it is a research area with poor national investment at the moment in general terms, despite having many EU projects at this area. There is only one country, The Netherlands, that clearly prioritizes research and innovation investments on that at a significant scale. All in all, one could conclude that there seems to be national alignment across Europe on multiple key strategic priorities for renewable fuels and bioenergy. This is essential to pave the way for more and better coordination among the individual countries but at the same time efforts are needed to avoid work duplications.

The table presented above also shows that practically all countries the R&I projects are funded by funding agencies through competitive calls and that means that they have the capability of proposing future calls adjusting the focus to the needs of the IP8 according to its progress.

The matureness of the technologies addressed in the projects listed in this report is on average between low and low-to-medium, with TRLs, ranging from 3 and reaching 6-7. The information available in this report reveals that industry's engagement and investment in R&I projects should be deeper and larger. The absence of the projects mainly funded by industry can be due to two reasons. One of them is that they are not public and reported, hence not found and presented here, or they are non-existent. Several countries have a public-private funding scheme, requiring the involvement of the private sector in R&I initiatives, however, the private sector's participation found to be generically speaking and in economic terms has been poor when compared to the estimates reported to be achieved in IP8. Hopefully, adjustments in existing or establishment of new funding schemes reinforcing the financial contribution of the private sector to R&I activities will be considered in the near future.

Future work will concentrate on collecting data from the countries where the information is still lacking. A meeting with national funding agencies is also planned in order to share the findings obtained so far and share and showcase best-practices.



## Appendix 1 - mapping results

Please see the separate excel file: SET4Bio D1.1 Project\_list\_July 2021.xlsx



## Appendix 2 - IP8 value chains and investment budgets

### ETIP Bioenergy Value chains

#### Priority Value Chains (PVC)

- PVC1: Transport fuels via gasification
- PVC2: Power and heat via gasification
- PVC3: Transport fuels via pyrolytic and thermolytic conversion
- PVC4: Intermediate bioenergy carriers for power and heat
- PVC5: Alcohol fuels from cellulosic sugars
- PVC6: Hydrocarbon fuels from sugars and alcohols

#### Established Value Chains (EVC)

- EVC1: Transesterification to biodiesel
- EVC2: Hydrotreatment to HVO
- EVC3: Sugar and starch fermentation to ethanol
- EVC4: Anaerobic digestion to biogas
- EVC5: Small-scale combustion for residential heat
- EVC6: Large-scale combustion for heat and power
- EVC7: Biomass co-firing for heat and power

#### Development Pathways (DP)

- DP1: Conversion of aquatic biomass

#### Hydrogen Pathways (HP)

- HP1: Hydrogen from green power
- HP2: Power-to-X

### The 13 R&I activities

From SET Plan Implementation Plan, Action 8.

#### Renewable Fuels for Sustainable Transport

##### Advanced biofuels

**#1 Develop** advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy

**#2 Demonstrate** advanced liquid and gaseous biofuels through biochemical / thermochemical/ chemical conversion from sustainable biomass and/or from autotrophic microorganisms and primary renewable energy

**#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

##### Other renewable liquid and gaseous fuels

**#4 Develop** other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical /electrochemical transformation of energy neutral carriers with renewable energy

**#5 Demonstrate** other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy



**#6 Scale-up** other renewable liquid and gaseous fuels (excluding hydrogen) through thermochemical/ chemical/ biochemical/electrochemical transformation of energy neutral carriers with renewable energy

**Renewable Hydrogen**

**#7 Develop and Demonstrate** the production of renewable hydrogen from water electrolysis and renewable electricity

**Bioenergy**

**#8. Develop** high efficiency large scale biomass cogeneration of heat and power

**#9 Demonstrate** high efficiency large scale biomass cogeneration of heat and power

**#10 Scale-up** high efficiency large scale biomass cogeneration of heat and power

**Intermediate Bioenergy Carriers**

**#11 Develop** solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass

**#12 Demonstrate** solid, liquid and gaseous intermediate bioenergy carriers through biochemical / thermochemical/ chemical conversion from sustainable biomass

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

The detailed programme of the R&I activities is provided in Annex I.

## Financing R&I activities: total investment

	Billions €	Industry	MS Funding	EU
<b>Total Bioenergy and Renewable Fuels for Sustainable Transport</b>	<b>106,61</b>	<b>77,74 73%</b>	<b>22,23 21%</b>	<b>6,64 6%</b>
<b>Renewable Fuels for Sustainable Transport</b>	<b>84,81</b>	<b>62,34 74%</b>	<b>17,48 21%</b>	<b>4,99 6%</b>
<b>Advanced Biofuels</b>	<b>73,00</b>	<b>53,75 74%</b>	<b>15,00 21%</b>	<b>4,25 6%</b>
#1 Development	1,00	0,25 25%	0,50 50%	0,25 25%
#2 Demonstration	2,00	1,00 50%	0,50 25%	0,50 25%
#3 Scale-Up	70,00	52,50 75%	14,00 20%	3,50 5%
<b>Other renewable liquid and gaseous fuels</b>	<b>11,40</b>	<b>8,35 73%</b>	<b>2,36 21%</b>	<b>0,69 6%</b>
#4 Development	0,20	0,05 25%	0,10 50%	0,05 25%
#5 Demonstration	0,40	0,20 50%	0,10 25%	0,10 25%
#6 Scale-Up	10,80	8,10 75%	2,16 20%	0,54 5%
<b>#7 Renewable Hydrogen</b>	<b>0,41</b>	<b>0,24 59%</b>	<b>0,12 28%</b>	<b>0,05 13%</b>
TRL 2-6 (Development)	0,10	0,03 25%	0,05 50%	0,03 25%
TRL 7-8 (Demonstration)	0,06	0,03 50%	0,02 25%	0,02 25%
TRL 9 (Scale-Up)	0,25	0,19 75%	0,05 20%	0,01 5%
<b>Bioenergy</b>	<b>11,30</b>	<b>8,03 71%</b>	<b>2,45 22%</b>	<b>0,83 7%</b>
#8 Development	0,50	0,13 25%	0,25 50%	0,13 25%
#9 Demonstration	0,80	0,40 50%	0,20 25%	0,20 25%
#10 Scale-Up	10,00	7,50 75%	2,00 20%	0,50 5%
<b>Intermediate Bioenergy Carriers</b>	<b>10,50</b>	<b>7,38 70%</b>	<b>2,30 22%</b>	<b>0,83 8%</b>
#11 Development	0,50	0,13 25%	0,25 50%	0,13 25%
#12 Demonstration	1,00	0,50 50%	0,25 25%	0,25 25%
#13 Scale-Up	9,00	6,75 75%	1,80 20%	0,45 5%

## Members

IWG #8 (at this moment):

- Countries: FI, IT, FR, CY, DE, ES, NL, PL, PT, SE, TR ... and EC: JRC, RTD, ENER
- ETIPs Bioenergy & RHC, FCH-JU, EERA-Hydrogen, VTT, Fraunhofer Ins., ENI