European Commission

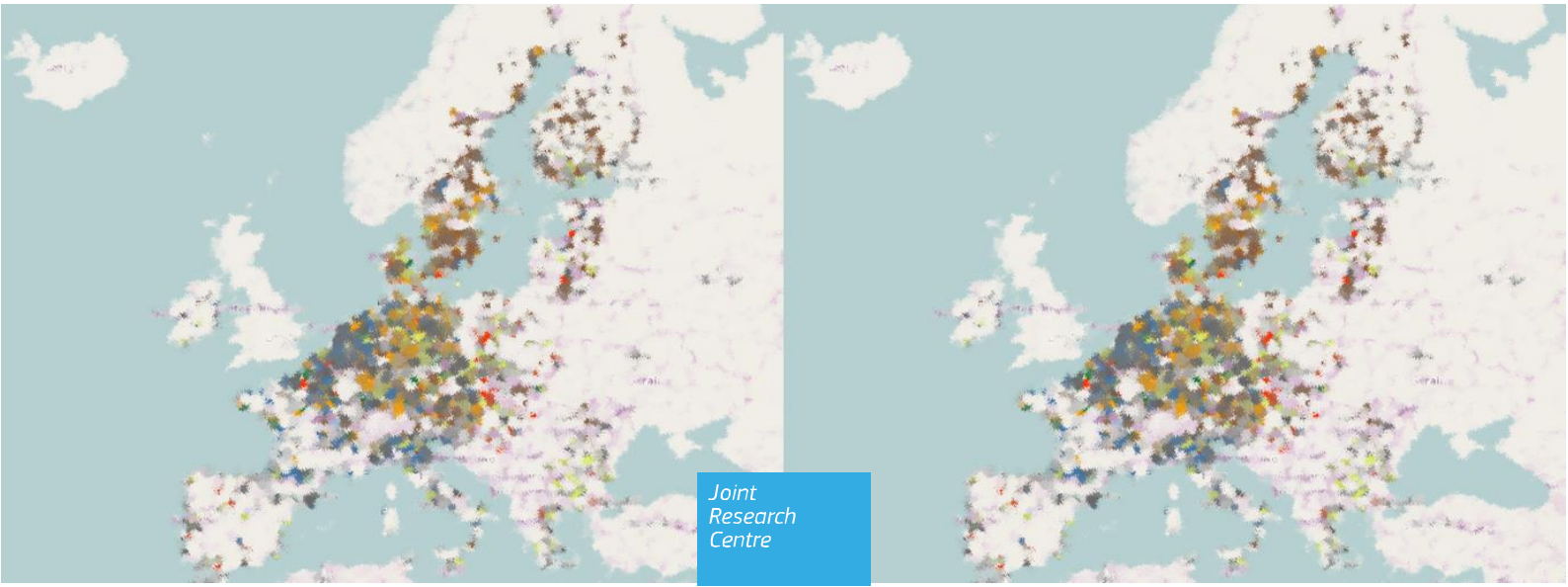
JRC SCIENTIFIC INFORMATION SYSTEMS AND DATABASES REPORT

Distribution of the bio-based industry in the EU

Database and visualisation

Parisi, C.

2020



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Authors

Claudia Parisi

Abstract

The EU bio-based industry is quickly evolving but clear data on the development of this emerging sector are still missing. This document illustrates the work of the JRC in building an extensive database of EU facilities producing different categories of bio-based products: chemicals, liquid biofuels, composites and fibres, biomethane, pulp&paper, sugar, starch and timber. The database is accompanied by an online interactive dashboard for visualisation of its content (https://datam.jrc.ec.europa.eu/datam/mashup/BIOBASED_INDUSTRY) in which the user is invited to apply the available filters (product category, feedstock origin, TRL and country) to discover the EU bio-based sector. An additional filter is also provided to identify EU biorefineries, according to the user's preferred definition of them.

1 Introduction

Nowadays, many industrial sectors are developing innovative products and value chains to substitute finite fossil feedstock resources with renewable raw materials. This change is the main focus area of the European Bioeconomy strategy (European Commission 2018) and is showing a growing trend, especially in chemical products and composite materials. However, clear data on the development of this emerging bio-based industry are still missing.

Biorefineries represent a key element in the European bio-based sector and are specifically addressed in the 2018 revision of the Bioeconomy Strategy, in particular in many concepts of Action 1 (Strengthen and scale-up the bio-based sectors, unlock investments and markets) (European Commission 2018). Biorefining is also one of the key enabling strategies of the circular economy, closing the loop in raw biomass materials (re-use of forestry, agricultural, aquatic, processing and postconsumer residues), minerals, water and carbon (de Jong, Higson et al. 2012). Therefore, the description of the distribution of biorefineries in the European Union together with an analysis of the main feedstock sources and products is key to describe the status of the bio-based sector in Europe and the main drivers for its future development. The JRC already made a first attempt to provide the description of facilities producing bio-based chemicals, liquid biofuels and biocomposites and fibres in the EU (Parisi 2018).

This document reports on the follow-up activity of the JRC, which consisted in expanding the initial database to additional facilities using biomass for product manufacturing (pulp&paper mills, sugar refineries, starch plants, biomethane plants and sawmills), for a total of 2,362 facilities, and the creation of an interactive visualisation platform representing their distribution. The interactive dashboard is available online (https://datam.jrc.ec.europa.eu/datam/mashup/BIOBASED_INDUSTRY, see Annex 1 for the QR codes) and offers the possibility of navigating through the data by filtering for different factors/elements: type of products, feedstock origin, country, TRL and biorefinery definition, as explained in the following paragraphs. It has to be noted that this version of the database and the accompanying visualisation tool, compared to the previous one published in 2018, does not include the United Kingdom after the end of the Brexit process on 31 January 2020. This difference is to be taken into account when comparing numbers.

2 Objectives and scope

This document aims to present an updated overview of the distribution of the bio-based industry in the EU, with a broader scope compared to the previous work of the JRC (Parisi 2018). The new update includes facilities using biomass (of first, second and so-called third generation) to produce the following:

— bio-based chemicals

— liquid biofuels

— bio-based composites and fibres

And the following additional facilities, compared to previously mentioned JRC study:

— pulp and paper

— biomethane

— starch, sugar and derived products

— timber (sawmills)

The JRC database was also integrated with a better representation of facilities at a pilot/demo stage, thanks to the input offered by the BBI-JU (Bio-Based Industries Joint Undertaking).

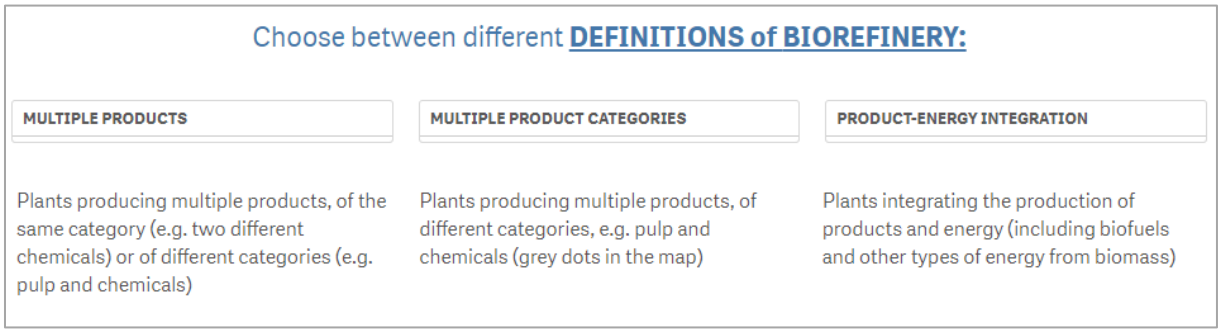
The study provides an interactive map of the facilities and a transversal analysis based on the type of products and feedstock sources per facility and per country. Biorefineries corresponding to a broader or stricter definition can be displayed, including the identification of those facilities in which the manufacturing of products is integrated with the production of energy from the biomass feedstock, thereby better contributing to the emerging circular economy.

Finished goods/products derived from bio-based products (i.e. plastic bottles derived from bio-based polymers or car parts derived from bio-based composites) are not included in the scope of this study.

3 Biorefinery definition

Several definitions of biorefinery have been elaborated in the last decades. According to the United States Department of Energy (US DOE 1997), a biorefinery is "an overall concept of a processing plant where biomass feedstocks are converted and extracted into a spectrum of valuable products". Other sources define a biorefinery as a more specific concept, more closely derived from the definition of an oil refinery by the petrochemical industry. For instance, a biorefinery is defined by de Jong et al. (2012) as a facility that performs the sustainable processing of biomass into a spectrum of marketable products (food, feed, materials, chemicals) and energy (fuels, power, heat), using a wide variety of conversion technologies in an integrated manner. This definition is also employed by the Bio-based Industry Consortium (BIC 2017).

The database built by the JRC and the relative visualisation platform now report data on 2,362 facilities using biomass for product manufacturing. It includes a wide range of plants, from innovative, recently built biorefineries in which the newest principles of circular economy are applied, to very traditional, decades-old plants obtaining products from biomass (e.g. some timber, paper or starch plants). Certainly they do not all fall within a definition of biorefinery, but many of them can be called biorefineries, depending on the chosen definition. The visualisation platform is designed in order to help the user choose its preferred definition. The following filter panes are provided in order to select a specific subgroup of bio-based facilities:



4 Methodology

The following info sources were incorporated to build the initial database (as reported in Parisi 2018):

- Biorefineries database built by Claudia Pecoraro in 2015 at the Directorate-General for Research and Innovation
- A database used for the JRC survey to European companies done by E4tech/AgraCEAS (https://ec.europa.eu/jrc/en/publication/eu-bio-based-industry-results-survey)
- Nova/BIC database on biorefineries in the EU (http://biconsortium.eu/news/mapping-european-biorefineries)
- Nova iBIB database (http://bio-based.eu/ibib/)
- List of BIC members
- Agrobiobase website (http://agrobiobase.com/en/database)
- BiofuelDigest website (http://www.ascension-publishing.com/BIZ/ABTDv18.xls)
- ePURE list of bioethanol plants (https://epure.org/resources/fact-sheets/)
- E4tech database used for the report on the sugar platform (http://www.e4tech.com/reports/from-the-sugar-platform-to-biofuels-and-biochemicals)
- List of commercial biorefineries included in the BioRefineries Blog (https://biorrefineria.blogspot.com.es/p/listado-de-biorrefiern.html?m=1)
- List of bioenergy plants provided by the ETIP (European Technology and Innovation Platform) (http://www.etipbioenergy.eu/databases/production-facilities)
- Bureau Van Dijk's Amadeus database (https://www.bvdinfo.com/en-gb
- Kompass Online Directory on business information (https://bg.kompass.com/)

The following new sources were integrated in 2019:

- BBI JU database of facilities of demonstration (TRL 6-7) and flagship (TRL 8) projects
- Pulp&paper mills: Fastmarkets RISI – Asset Database (RISI: pulp&paper industry intelligence) – 2015 contract with Joint Research Centre.
- Sugar refineries: CEFS: European Association of Sugar Manufacturers (https://cefs.org/sugar/)
- Starch plants: STARCH Europe (https://starch.eu/) – ppt presentation
- European Biomethane Map published in 2018 from a collaboration between the European Biogas Association (EBA) and Gas Infrastructure Europe (GIE): https://www.europeanbiogas.eu/wp-content/uploads/2019/05/2018.01.09.GIE_BIO_2018_A0_1189x841_FULL_415_clean_final.pdf
- Sawmills: sawmill database (https://www.sawmilldatabase.com/nearbysawmills.php)

Additionally, data were validated through information obtained from grey literature, online press and companies' webpages as well as support by external experts.

Depending/relying on the identified data about production, it was determined for each facility if it integrates the production of bio-based products (like chemicals, composites&fibres, pulp&paper, starch&sugar and timber) and energy (like biofuels, biomethane and/or other types of energy from biomass).

It is to be noted that the dataset on facilities producing other types of energy from biomass (249 in total) is not comprehensive as many plants producing only bioenergy (not biofuels and not bio-based products) have not been identified. Therefore, these 249 plants are not included in the maps to avoid confusion, but are taken into consideration in the case of integrated production (bio-based products and energy).

For sugar facilities it was assumed that they are all integrated with bioethanol production, according to the general information in the webpage of CEFS (European Association of Sugar Manufacturers): link. Pulp&paper mills were all indicated as integrated facilities, according to the information received from RISI.

5 Results

The content of the database, created through the described methodology, is visualised in an online interactive dashboard (https://datam.jrc.ec.europa.eu/datam/mashup/BIOBASED_INDUSTRY, see Annex 1 for the QR codes) in which different filters can be applied to retrieve different types of useful information. The following figures provide some of the possible results.

Figure 1. Map of the distribution of the bio-based industry in the EU

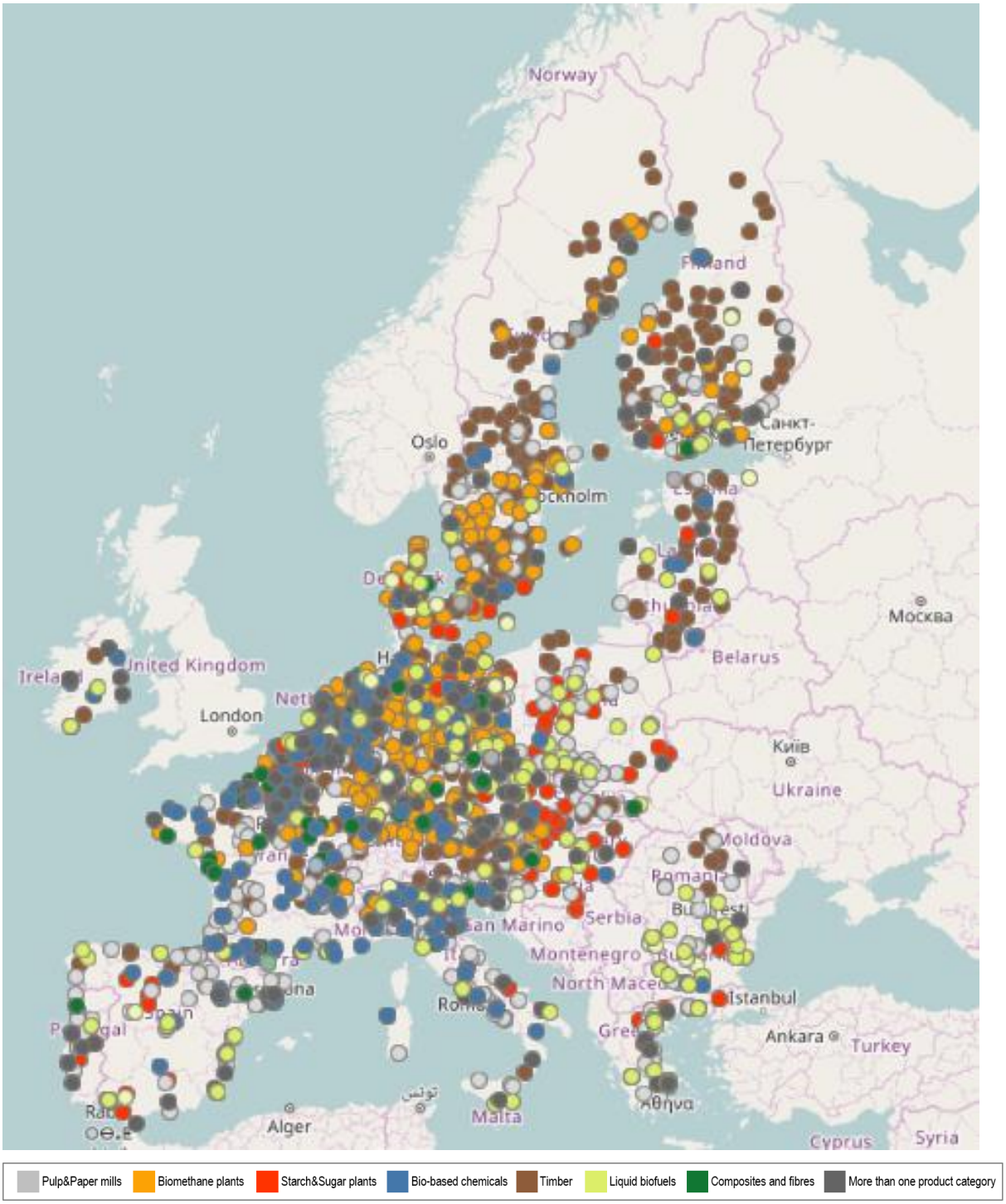


Figure 1 show the full content of the database (2,362 facilities in total), illustrated in a map and including the seven categories of bio-based products reported. Dark grey dots indicate facilities manufacturing products of more than one category. For a better visualisation of the distribution of the bio-based production per category, please, see Figure 3.

Figure 2. Number of bio-based facilities by product category

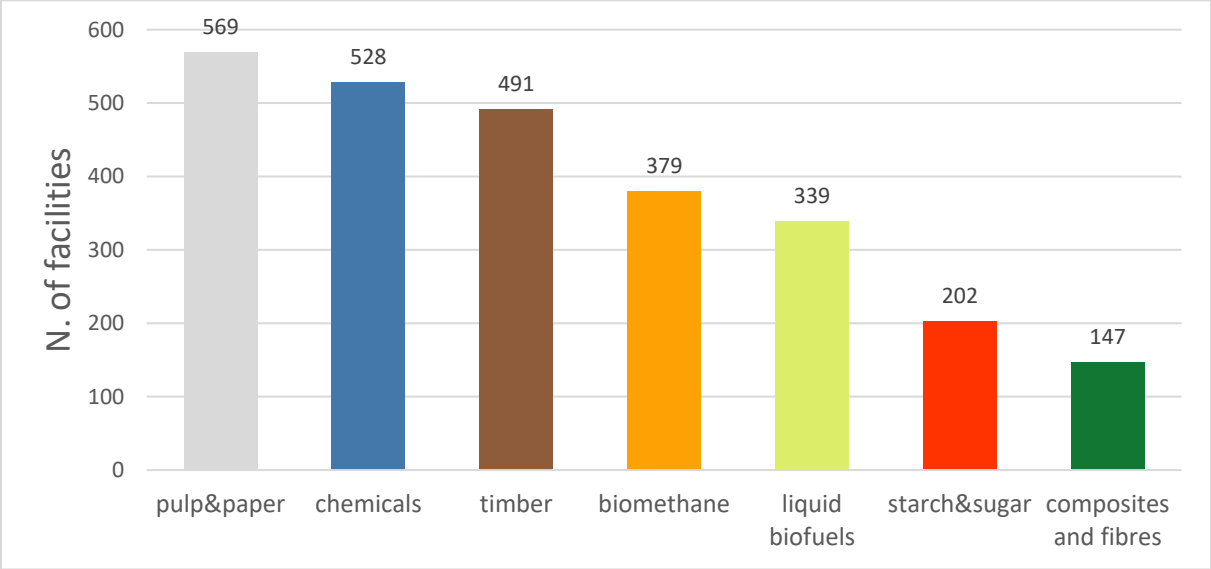


Figure 2 show the total number of facilities per product category. Some facilities (the dark grey dots in Figure 1) produce more than one product category. Therefore, those plants are counted more than once in the graph.

The following figures show the results of the application of certain filters in the visualisation platform. More options can be explored by the user when navigating through the page.

Figure 3. Disaggregation of the EU bio-based industry per type of bio-based production

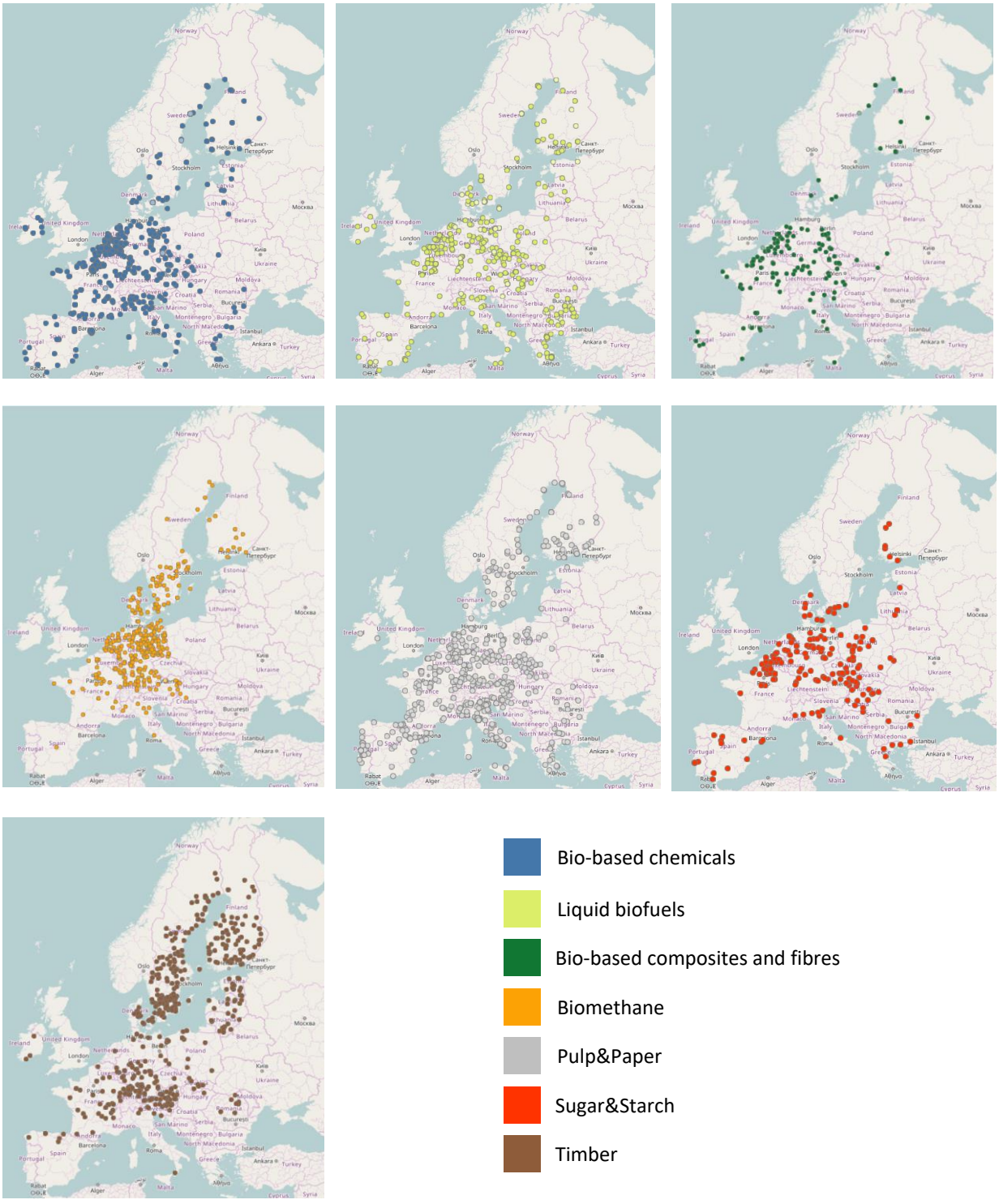


Figure 3 shows the disaggregation of all 2,362 facilities in each product category. Some facilities (the dark grey dots in Figure 1) produce more than one product category. Therefore, those plants appear in more than one map of Figure 3. Dots in lighter colour in the maps of bio-based chemicals, liquid biofuels and composites&fibres indicate facilities that are currently inactive (but not necessarily as a permanent status).

Figure 4. Pilot, demo and R&D bio-based plants in the EU

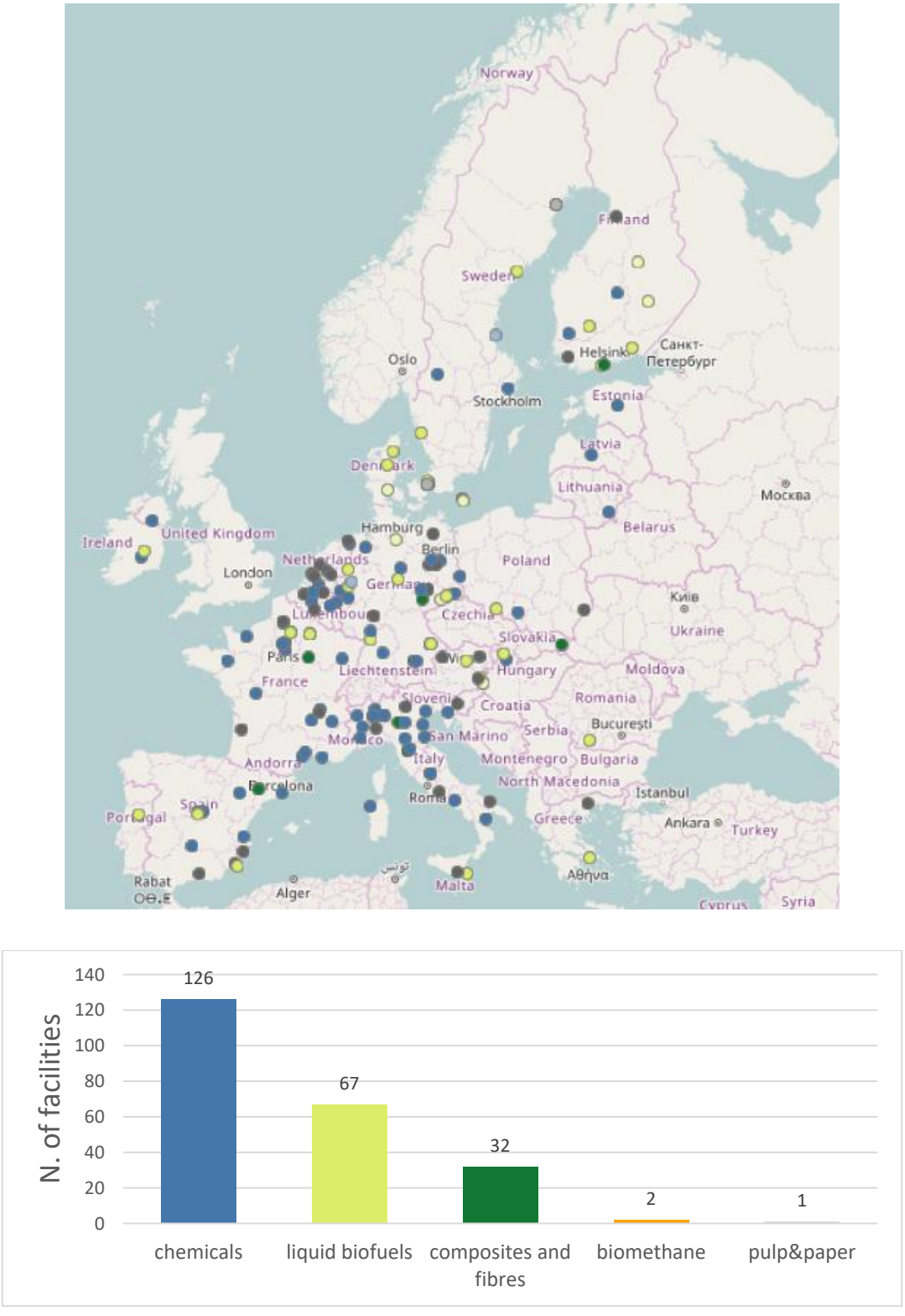
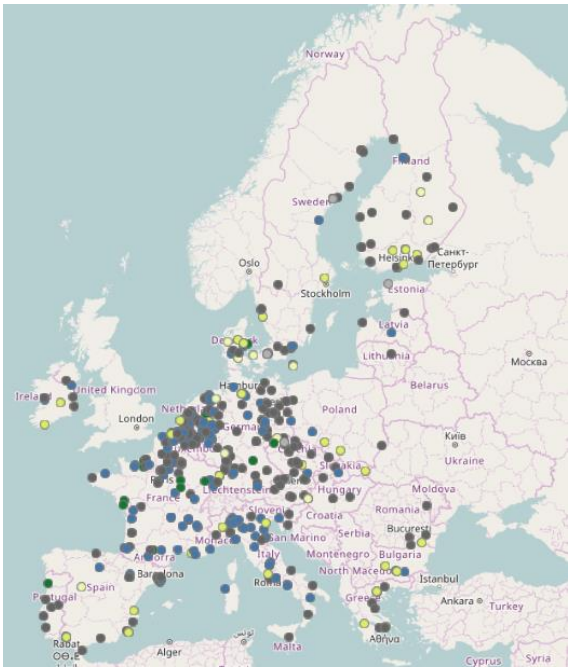


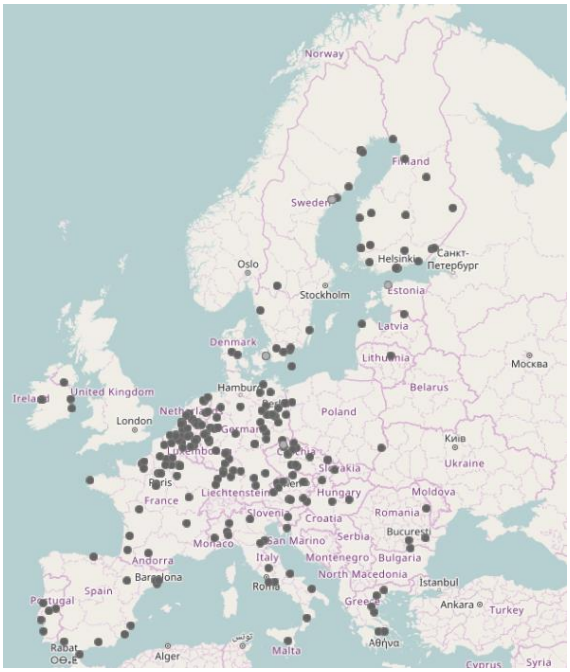
Figure 4 shows the distribution of bio-based facilities identified as smaller size plants which did not yet reach the commercial phase, including pilot, demo and R&D facilities. The graph under the map shows the distribution in terms of product categories. The dark grey dots in the map show plants that produce more than one product category and are therefore counted more than once in the graph.

Figure 5. Distribution of biorefineries in the EU depending on the chosen definition

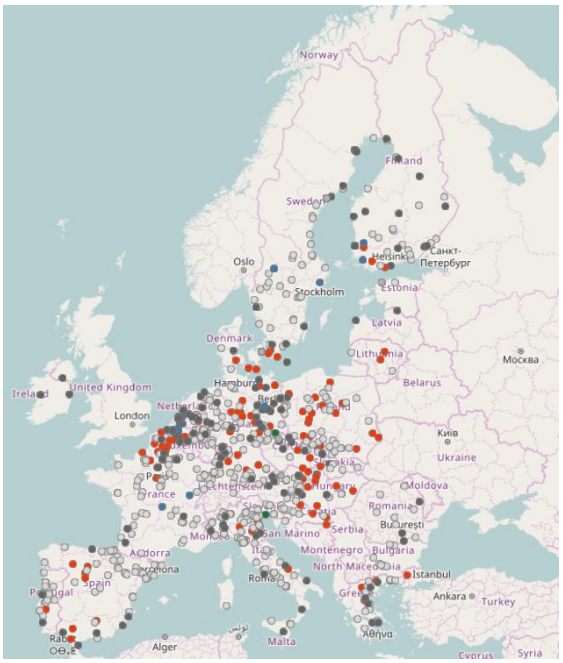
478 plants producing multiple products, of the same category (e.g. two different chemicals) or of different categories (e.g. pulp and chemicals):



240 plants producing multiple products, of different categories, e.g. pulp and chemicals (grey dots in the maps):

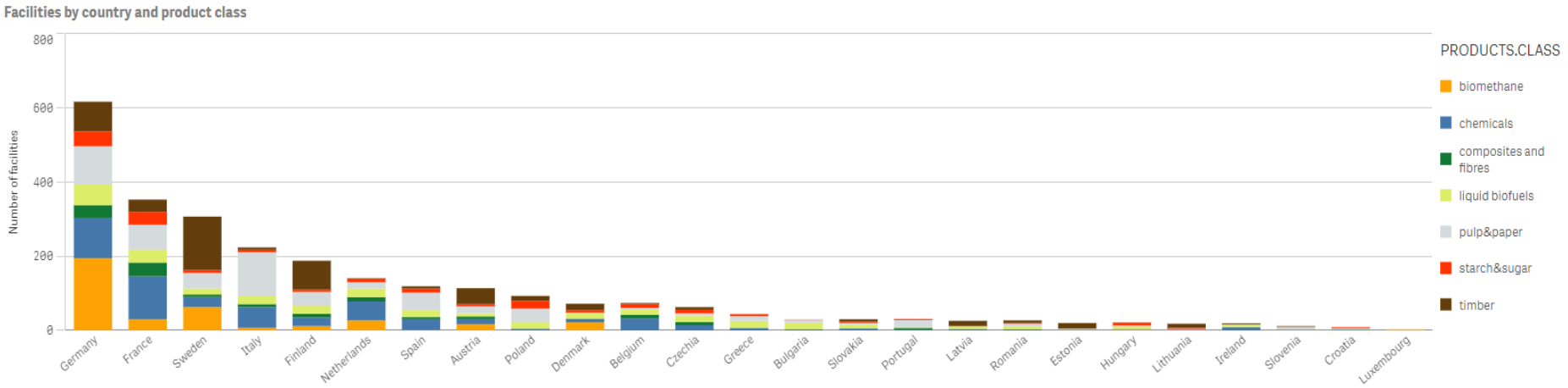


788 plants integrating the production of products and energy (including biofuels and other types of energy from biomass):



As explained in chapter 3, Biorefinery definition, the visualisation platform offers the possibility of filtering for different combination of bio-based plants that reflect different definition of biorefineries. The three resulting maps are shown in Figure 5. For a better identification of the product categories covered, the online visualisation platform should be used by applying different product filters.

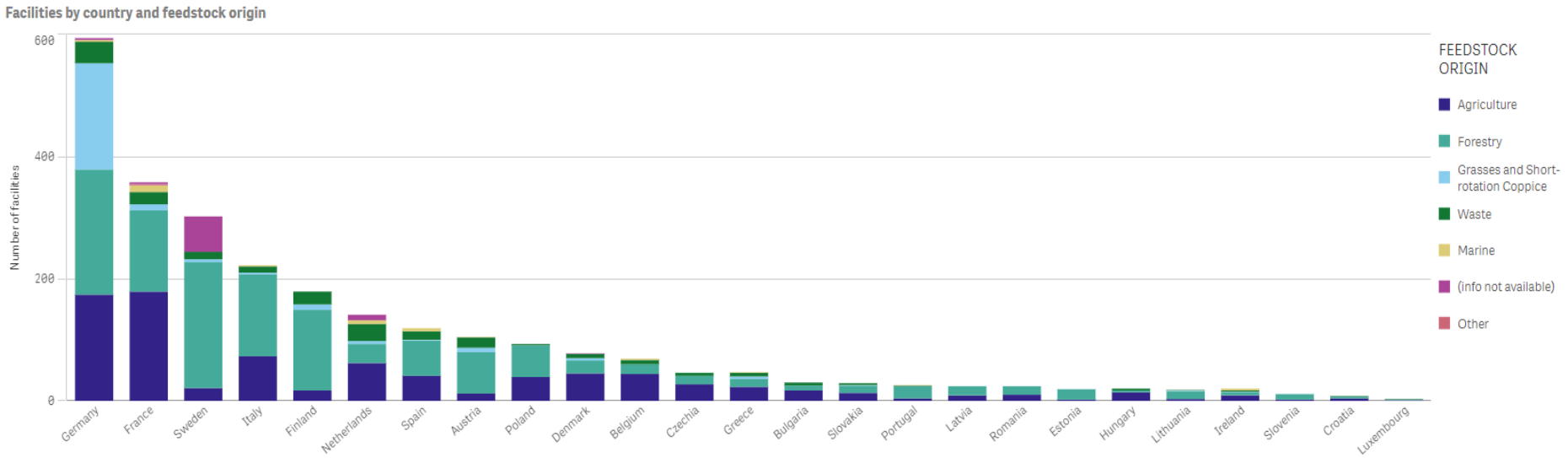
Figure 6. Geographical distribution of the EU bio-based industry by country and product category



The graph of Figure 6 shows the number of bio-based facilities per product category and per country. Again, since some facilities produce more than one product category and are therefore counted more than once in the graph. Also, it is important to take into consideration that the graph is based on the number of facilities per country, independently of their size, and not on production quantities.

According to the retrieved information, Germany and France dominate the scene in total and in most categories, followed by Sweden, thanks to the high number of Swedish sawmills.

Figure 7. Geographical distribution of the EU bio-based industry by country and feedstock origin



The graph of Figure 7 shows the number of bio-based facilities per feedstock origin and per country. Some facilities employ feedstock belonging to more than one origin group and are therefore counted more than once in the graph. Also, it is important to take into consideration that the graph is based on the number of facilities per country, independently of their size, and not on biomass quantities used.

Compared to the corresponding graph reported in the previous JRC publication on the matter (Parisi 2018), forestry-based feedstock is now predominant in terms of numbers of facilities, due to the addition of sawmills and pulp&paper mills to the database.

6 Conclusions and future steps

The database of bio-based facilities in the EU constitutes a very useful tool to better understand the state-of-the-art and the development of the bio-based industry. The database already covers a very broad range of different facilities, giving a diversified picture. However, additional product categories could be added to the scope of the database, in order to give a more comprehensive vision of the EU bio-based industry, like, e.g., dairy industry, biogas small plants, etc.

Additionally, further research can be performed to determine the level of development of the bio-based industry in the EU and the potential for future growth in terms of number and location of new biorefineries. Future steps in this direction are being carried out by linking the location of current bio-based facilities with the specific kinds of locally available biomass (with main focus on agriculture and forestry at the moment), to establish optimal locations of new biorefineries for the best exploitation of local resources.

The JRC is also planning to make future updates of the map of bio-based facilities, depending on policy needs and available resources. In this direction, users of the online platform are welcome to inform the JRC (through the email address JRC-DATAM@ec.europa.eu) in case they identify wrong or missing information in the list or classification of bio-based facilities.

References

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List of figures

Annex: On-line resources

An interactive dashboard presenting this report's main results is available on the public website "JRC agro-economic portal DataM". Links can be also accessed with the below QR codes.

Figure A1. QR code – DataM URL

https://datam.jrc.ec.europa.eu

Source: JRC, 2020.

Using DataM users can access and analyse main results of the report through an interactive dashboard.

Figure A2. QR code – Bio-based industry dashboard

https://datam.jrc.ec.europa.eu/datam/mashup/BIOBASED_INDUSTRY

Source: JRC, 2020.

DataM interactive dashboards allow users to undertake their own analysis of the dataset. They consist of a number of sheets that allow analysing data from different perspectives.

Figure A3. Navigating within the sheets

Source: JRC, 2020.

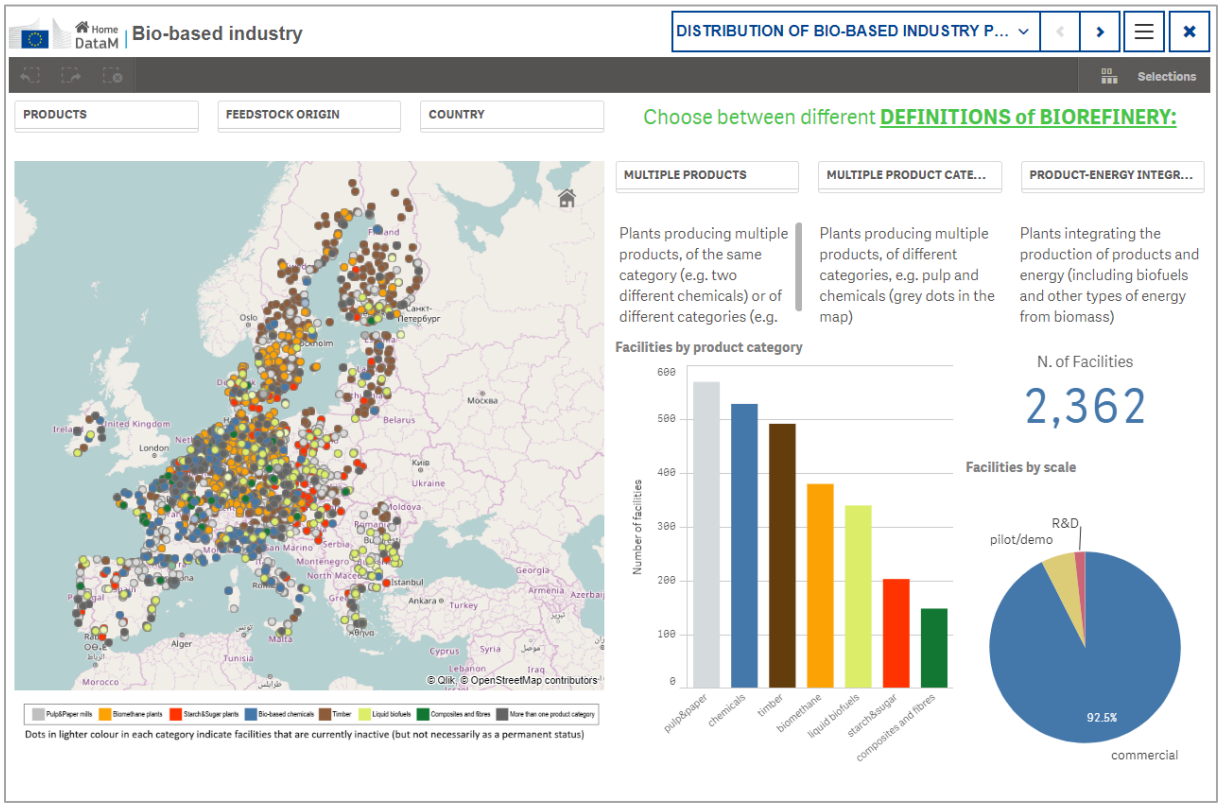
Each sheet consists of a screen with a number of different visualisations (tables, charts and maps) and some filtering boxes.

The key strength of the tool is that all these visualisations are interactive and interrelated. This allows users to study the data by means of simple mouse gestures.

The DataM visualisation framework is quite intuitive; some basic guidelines to facilitate its use will follow.

All DataM dashboards are similar to the example shown in Figure A4 below.

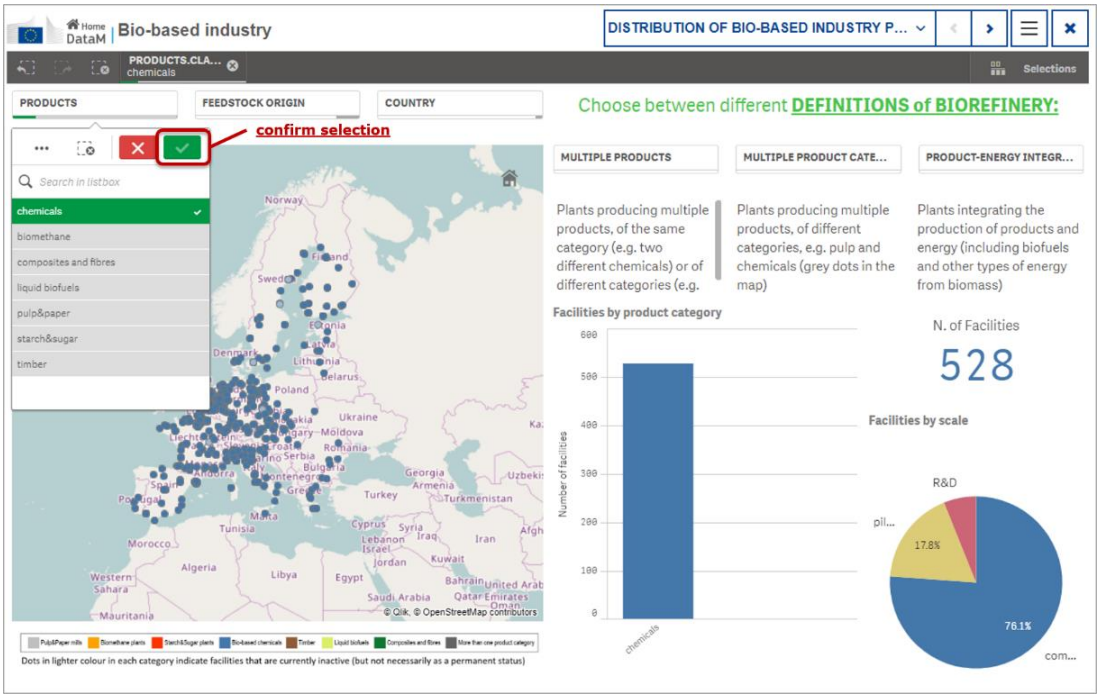
Figure A4. How the dashboard looks like



Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: Bio-based industry and biorefineries, accessed on 21/02/2020.

By clicking on any visualisation, for example by clicking on "PRODUCTS" and "chemicals" in the top left hand side of the screen, all the visualisations are recalculated using data concerning only bio-based chemicals, as shown in the figure. The map and the graphs (also in the second page) will change according to the new selection.

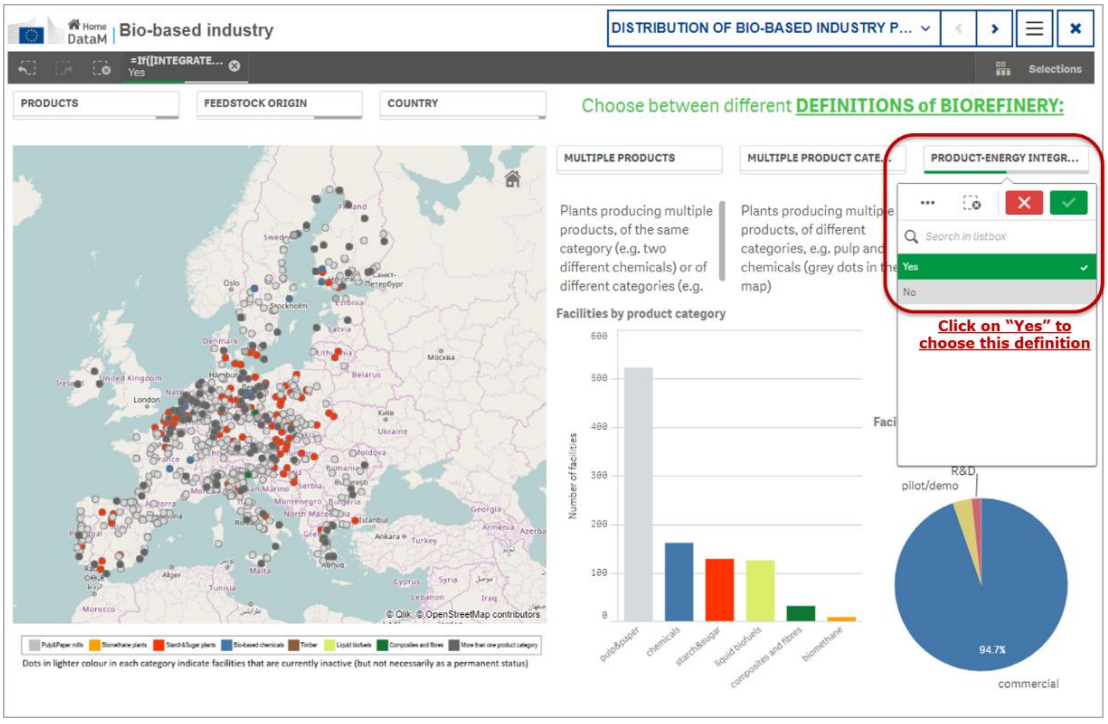
Figure A5. Making an interactive selection



Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: Bio-based industry and biorefineries, accessed on 21/02/2020.

Also, different definitions of biorefineries can be selected. For example, only facilities integrating the production of material and energy can be selected, as shown in figure A6 below.

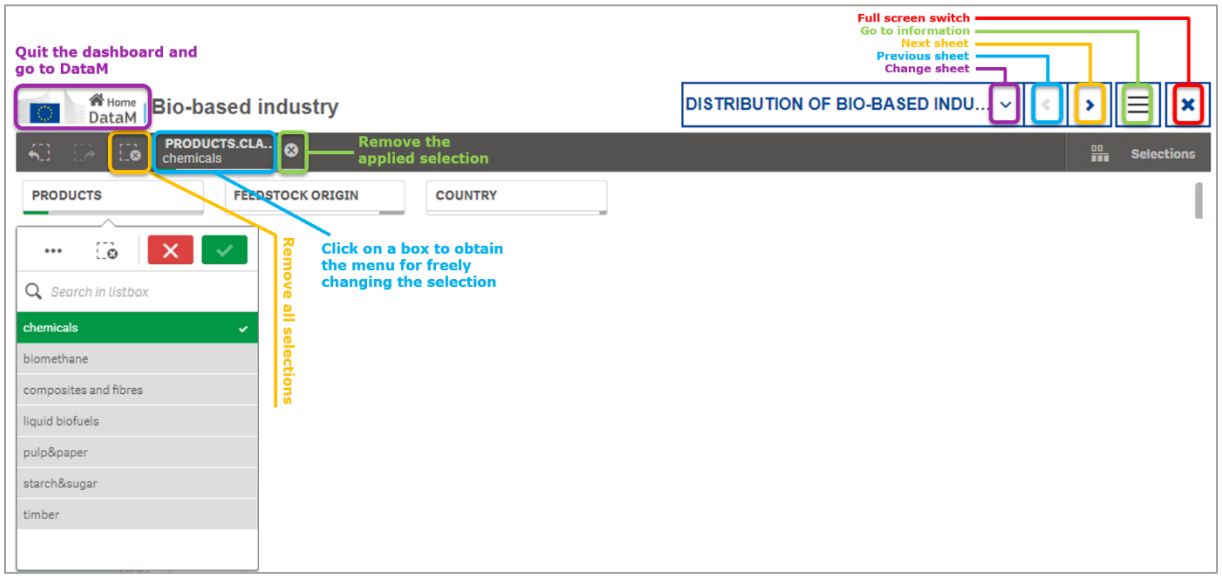
Figure A6. Result of an interactive selection



Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: Bio-based industry and biorefineries, accessed on 21/02/2020.

The currently active selections are always shown in the dark-grey bar at the top. Selections can be cancelled or changed as explained in figure A7 below.

Figure A7. Instructions to change selections



Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: Bio-based industry and biorefineries, accessed on 21/02/2020.

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