Interreg Alpine Space

Co-funded by the European Union

CERVINO

CERVINO
Creating an EneRgy data exchange and VIsualizatioN tOol for the alps

Report D1.2.1

Lead Partner: Regional Agency for Infrastructure development, building Renovation and Energy of Liguria – IRE spa (Lead partner)

Activity 1.2 Developing a tool allowing for effective management of energy data within the Alpine Space.
Leader Organization: AURA-EE

February 2024

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Acknowledgments & Disclaimer

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Preface

The EUSALP (EU Strategy for the Alpine Region) Action Group 9 (AG9) promotes energy efficiency and encourages the production and utilization of renewable energy sources in the EUSALP macro-region[1]. To define, implement, and monitor the effectiveness of energy policies, reliable energy data are required. For this purpose, AG9 developed the Energy Survey to collect regional and national energy data in the EUSALP territory. The Energy was implemented in 2017 and updated in 2019.

Now, the CERVINO (*Creating an EneRgy data exchange and VIsualizatioN tOol for the alps*) project[2] aims to facilitate energy data exchange within the Alpine territory to support decision-making by setting up a reliable system to collect, manage, update, and use energy data.

This report describes all the activities performed in Activity 1.2 of CERVINO: "Developing a tool allowing for effective management of energy data within the Alpine Strategy".

A1.2 will develop a digital tool - in the form of a user-friendly & open source platform - to improve energy data collection, processing & visualization in the Alpine Space. This will allow for an automated & cost-effective data management for a periodic Energy Survey. Specifically, A1.2 will:

- Structure the data workflow;
- Develop the platform based on the TerriSTORY tool;
- Set up the dashboard to visualise the data.

The report is structured as follow:

- Chapter 1: The Data collection tool (already described in Deliverable D1.1.1)
- Chapter 2: The Data visualization platform based on TerriSTORY® open-source code resulting in existing *Alpine Energy Data Platform*
- Chapter 3: The links between the platforms and some visualisation of indicators

1. https://www.alpine-region.eu/
2. https://www.alpine-space.eu/project/cervino/

Executive Summary

This second report describes the development of the Alpine Energy Data Platform, based on TerriSTORY® source code. It includes modification of existing tool and additional features implemented specifically during CERVINO project.

In Chapter 1, we will briefly reference the web-based platform developped by Activity 1.1 and described in Devlierable D1.1.1.

In Chapter 2, we present the CERVINO's data visualization platform, now known as the *Alpine Energy Data Platform*. We then describe in a second section the existing TerriSTORY® source code, the elements adapted to fulfill CERVINO requirements (geographical levels, translation, new infrastrcture, etc.). The third part of this chapter details the new features developed: a comparison tool in dashboards, customized aggregations, and some specific developments addressing missing data and PDF files generation.

In Chapter 3, the data flow between the data collection tool and the visualization platform is established using an API. We also offer some examples of the indicators available on the platform.

CERVINO project successfully integrated a data collection tool and a data visualization platform. The adaptability of TerriSTORY® and the additional features developed for the *Alpine Energy Data Platform* highlight the feasibility of gathering data on energy throughout EUSALP. It promotes open data between the various regions and will hopefully work towards stronger cooperations between the regions and will contribute building an ambitious Alpine Energy Strategy.

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1 | Data collection tool

In the first period of the project, Eurac Research (EURAC) developed a web-based platform to collect data from the different regions within the Alpine territory. Having a tailor-made application allows to set up a stable and reliable system that can be modified afterwards in the case of further updates of the Energy Survey. This means that the platform has a persistence layer to store energy data, so the participants to the Energy Surveys can add or modify their information at any time. Also, a web-based platform permits to access to the previous, current, and future energy data with any device and with any web browser.

Through a registration in the platform (Fig. Figure), each region can enter their energy data, by category, by year, and related data sources. An in-depth description of the data collection tool is available in Deliverable 1.1.1 for Activity 1.1, edited by EURAC on May 2023.

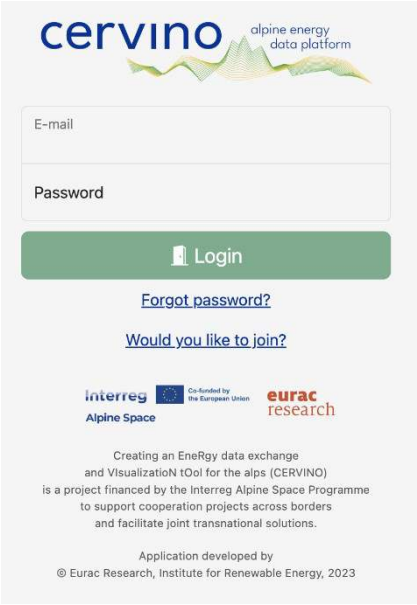


Figure 1: Preview of Login screen of CERVINO Data Collection Platform

2 | Data visualization platform based on TerriSTORY® open-source code

2.1 TerriSTORY® existing platform and how it operates

CERVINO, the Alpine Energy Data Platform is based on TerriSTORY® source code. TerriSTORY® is co-constructed with the French territories as an educational and multi-thematic (energy, climate, economy, etc.) decision-making tool. It was created in 2018, in Auvergne-Rhône-Alpes, at the initiative of the regional agency Auvergne-Rhône-Alpes Énergie Environnement (AURA-EE) and with the support of the Auvergne-Rhône-Alpes Region and the national agency ADEME.

Thanks to a dynamic and interactive visualization interface, the TerriSTORY platform makes it possible to understand one's territory, to identify its potentials and the priority levers of action. Based on this analysis, and in order to build a territorial trajectory that meets the territory's challenges, the tool proposes to simulate prospective scenarios by measuring their socio-economic and environmental impacts.

2.1.1 Existing set of actors

Since 2020, TerriSTORY® is a project led by an open community of public and general-interest actors committed to the climate challenge so that data can be managed as a common good. The signature of a consortium agreement has formalized the partnership between the different members of the TerriSTORY® project. This new governance brings a concrete response to the challenges of harmonization and aggregation of multi-level objectives. It allows the deployment of the TerriSTORY® tool in other regions and favors the mutualization of means for the development of new functionalities and the provision of complementary data for each region.

Today, TerriSTORY® tool is available in six French regions and is used by thousands of users[3]. It receives monthly updates and is interfaced with national databases and other tools. Work is under progress to strengthen those links and enhance TerriSTORY APIs.

3 See TerriSTORY activity report

2.1.2 Architecture

The general principle behind TerriSTORY® is a web application consisting of an API and a front-end. The site itself is made up of several modules based on a single database. These modules provide various services based on quantitative data on the issues mentioned at the beginning of this page, such as historical analysis of consumption, cartographic display of indicators, creation of customized dashboards and simulation of strategic scenarios.

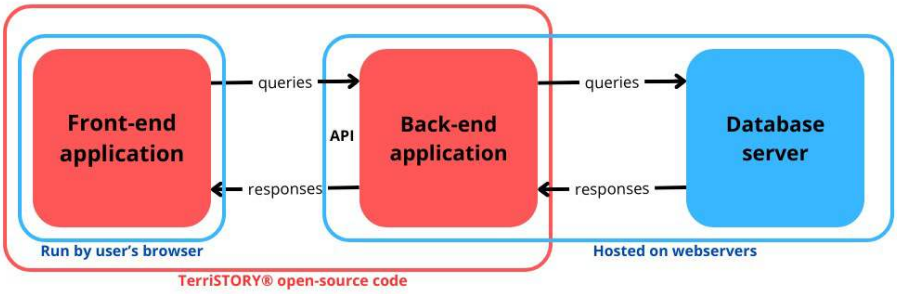


Figure 2: The architecture of TerriSTORY® application.

The Figure 2 presented above describes the architecture of the tool. It consists in two separate applications that communicate through HTTPs queries: one front end, based on ReactJS library, that provides the interface, and one back end, based on Sanic Python framework, that receives and processes the queries, interrogates the database, and produces responses that are read and displayed by the front end. Both applications are open source as detailed in following section. The database is a PostgreSQL/PostGIS engine.

These applications are deployed on a single server of OVH French hosting services and managed using ansible scripts. More details can be found on the project's documentation on https://docs.terristory.fr/ (in French) and specifically on the pages related to the project's architecture.

2.1.3 Current open-source policy

TerriSTORY® is supported by a consortium of regional and national players. As all these actors have a public service or general interest mission, they have decided to make TerriSTORY® open source. The main aim of this open-source approach is to facilitate the development of the tool, so that it can better meet the needs of local authorities in managing their transition trajectory. It also tries to ease any usage of the source code, so any public funded project can use the application as a base for new projects and other cases.

The source code is now available on the GitLab website at https://gitlab.com/terristory/terristory under the aGPL-v3 license available on the git repository[4]. A page, published on every regional version of the TerriSTORY project, details more aspects on how to contribute to the project[5].

4 See here for the license: https://gitlab.com/terristory/terristory/-/blob/master/LICENSE.md.

5 See for example, the page on Auvergne-Rhône-Alpes's regional platform page on open-source elements: https://auvergnerhonealpes.dev.terristory.fr/open_source.

This tool is used by other external projects such as French project TIMS available on GitLab at the following URL: https://gitlab.com/tims-eval/tims/. TIMS's source code is based on TerriSTORY and benefits from TerriSTORY updates.

2.2 Work required to adapt the open-source code to CERVINO project

2.2.1 Deployment on new servers

Deploying the TerriSTORY® platform for a new application required to adapt the architecture. Indeed, current infrastructure was based on a very rigid organization specific to TerriSTORY® French case. We adapted the infrastructure to be able to deploy a specific version of the application on dedicated new servers independent from the original French servers. The new infrastructure is described in Figure 3.

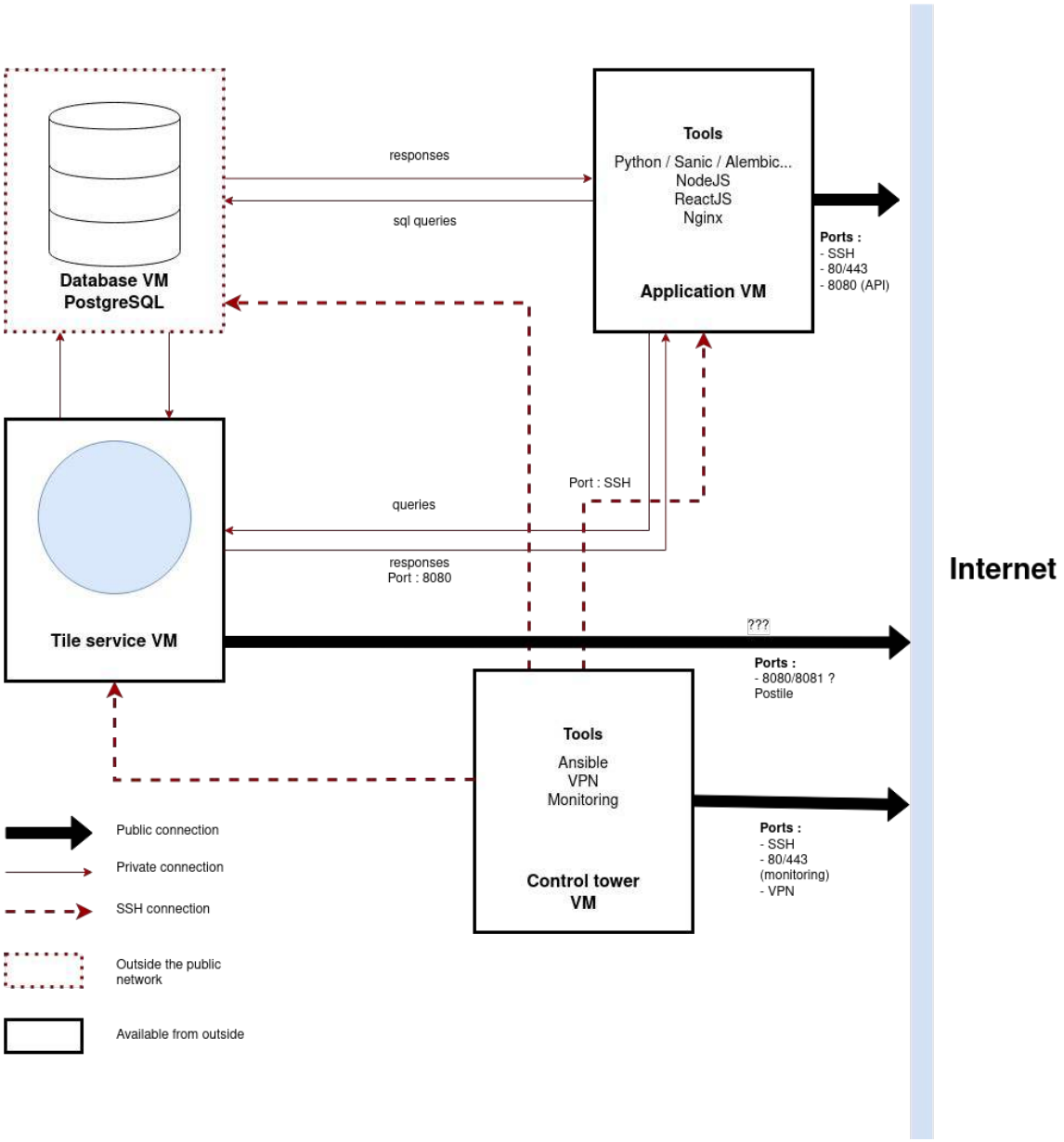


Figure 3: The architecture of the Alpine Energy Data Platform infrastructure deployed.

We had to adapt the deployment process and the tools associated to it in order to create an instance of the CERVINO Alpine Energy Data platform on dedicated servers with a specific domain name. This process is described in the Continuous Integration file available on the GitLab repository[6].

2.2.2 Translation system

TerriSTORY® tool is originally in French without any translation system. We added i18next and react-i18next libraries[7] to the front stack and integrate the translations tools inside the system.

6 See https://gitlab.com/territory/territory/-/blob/cervino/main/.gitlab-ci.yml for this file.
7 See https://www.i18next.com/ and https://react.i18next.com/.

Two files have been created to store the translation tokens, one for original French language and one for English language. These files can be seen here: https://gitlab.com/terristory/terristory/-/tree/cervino/main/front/src/translations. These files could be shared through a Translation Management software to translate the tool and reach more languages[8].

The error messages were also translated, and the system was changed in order to feed the front with translations tokens instead of direct messages.

2.2.3 Generalization of geographical levels

The Nomenclature of Territorial Units for Statistics (NUTS) division system was defined by the European Union to propose a geocode standard over the whole European continent of administrative divisions[9]. The level NUTS0 corresponds to the country division, NUTS1 groups regions or states, and NUTS2 corresponds to regions. TerriSTORY® tool works at municipal level in France and has never worked at a different minimal geographical level. We adapted the source code for the CERVINO project so it can work at a more suited level, the level of European NUTS2 regions..

This minimal regional level applies many constraints to the application as it is involved in:

- data structure,
- queries performed,
- geographical aggregations.

We updated the structure to have a data layout at NUTS2 level and we changed the queries performed on the database to be able to apply to any minimal regional level defined in the application. This generalization succeeded in providing queries efficient and adapted to NUTS2 minimal level. However, we performed some manual specific changes for:

- Switzerland, which is included as a single region, even if it normally gathers 7 different NUTS2 regions. Data could not be collected for each single NUTS2 region and was only collected at NUTS0 country level.
- The same issue occurred for Slovenia, one single region is displayed instead of the 2 available NUTS2 region.
- French and German data were collected at NUTS1 level because the data were more easily available at the NUTS1 level, the NUTS2 level being less used in terms of administrative organization.

More details can be found on this topic in Deliverable D1.3.1 regarding the way the survey was conducted in the regions.

8 For example, http://zanata.org/ could be used.

9 More details at https://en.wikipedia.org/wiki/Nomenclature_of_Territorial_Units_for_Statistics.

The final distribution of the NUTS2 regions is displayed in the following table.

Table 1: List of all regions displayed in the Alpine Energy Data Platform.

Country	Code	Name	Country	Code	Name
AT	AT11	Burgenland	FR	FR43	Bourgogne-Franche-Comté
AT	AT12	Niederösterreich	FR	FR71	Auvergne-Rhône-Alpes
AT	AT13	Wien	FR	FR82	Provence-Alpes-Côte d'Azur
AT	AT21	Kärnten	FR	FRF	Grand Est
AT	AT22	Steiermark	IT	ITC1	Piemonte
AT	AT31	Oberösterreich	IT	ITC2	Valle d'Aosta/Vallée d'Aoste
AT	AT32	Salzburg	IT	ITC3	Liguria
AT	AT33	Tirol	IT	ITC4	Lombardia
AT	AT34	Vorarlberg	IT	ITH1	Provincia Autonoma di Bolzano/Bozen
CH	CH0	Switzerland	IT	ITH2	Provincia Autonoma di Trento
DE	DE1	Baden-Württemberg	IT	ITH3	Veneto
DE	DE2	Bayern	IT	ITH4	Friuli-Venezia Giulia
LI	LI00	Liechtenstein	SI	SI	Slovenija

The perimeters available on the Alpine Energy Data Platform are the following:

1. EUSALP aggregated as a single macro-region;
2. All regions (see Table 1);
3. All countries (it corresponds to the aggregation by country of regions presented above – all German regions together, all Austrian regions together, etc.);
4. A single region;
5. A single country (defined as previously stated).

2.3 Main additional contributions specific to CERVINO project

2.3.1 Comparison tool in dashboards

To allow regions to know better their territory and understand the main levers for action and barriers, TerriSTORY® provides territorial indicators showcased in customizable dashboards. This functionality is also available in the CERVINO platform, with an additional option, which is the comparison among territories.

Dashboards allow users to select:

- the territory,
- the indicators (e.g., electricity capacity installed),
- the year(s),
- the visual representation preferred (circular diagram, stack chart, map, etc.).

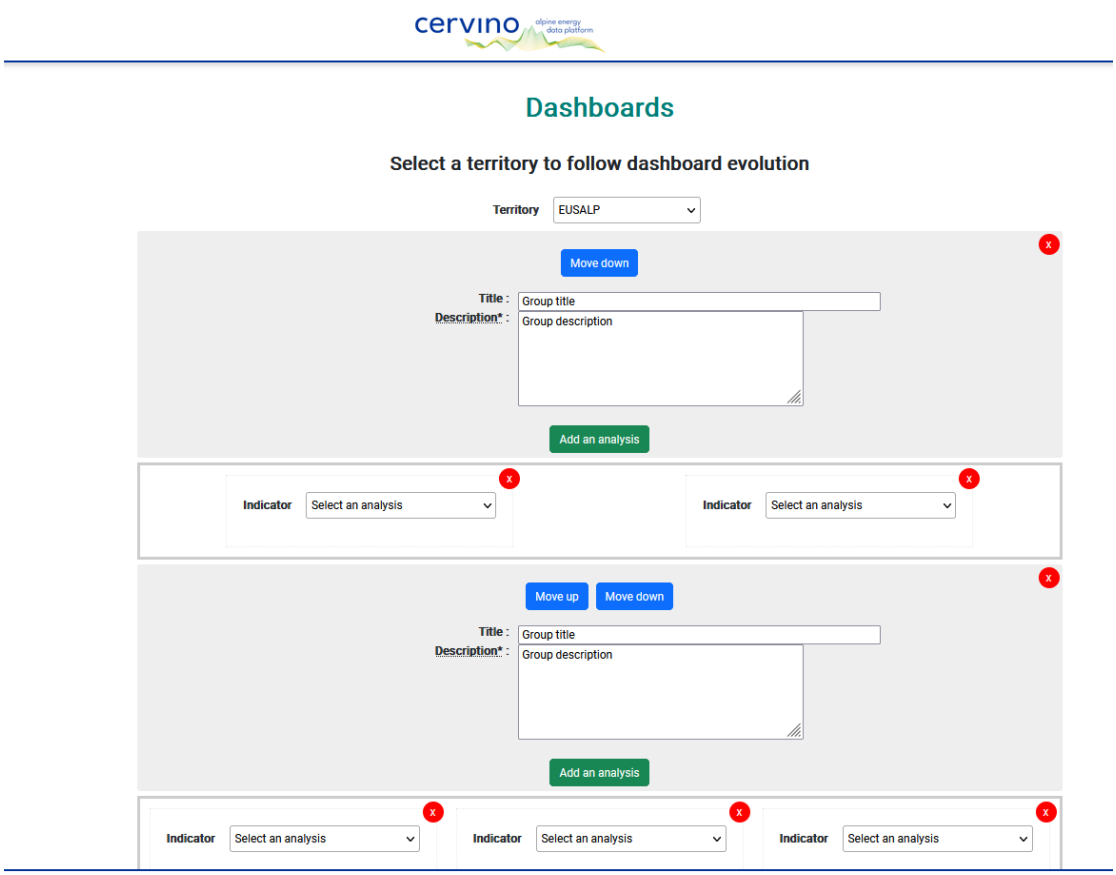


Figure 4: Editing a dashboard.

For a better readability of the dashboards, users can create groups of indicators and naming them (e.g., electricity production; electricity consumption, etc.).

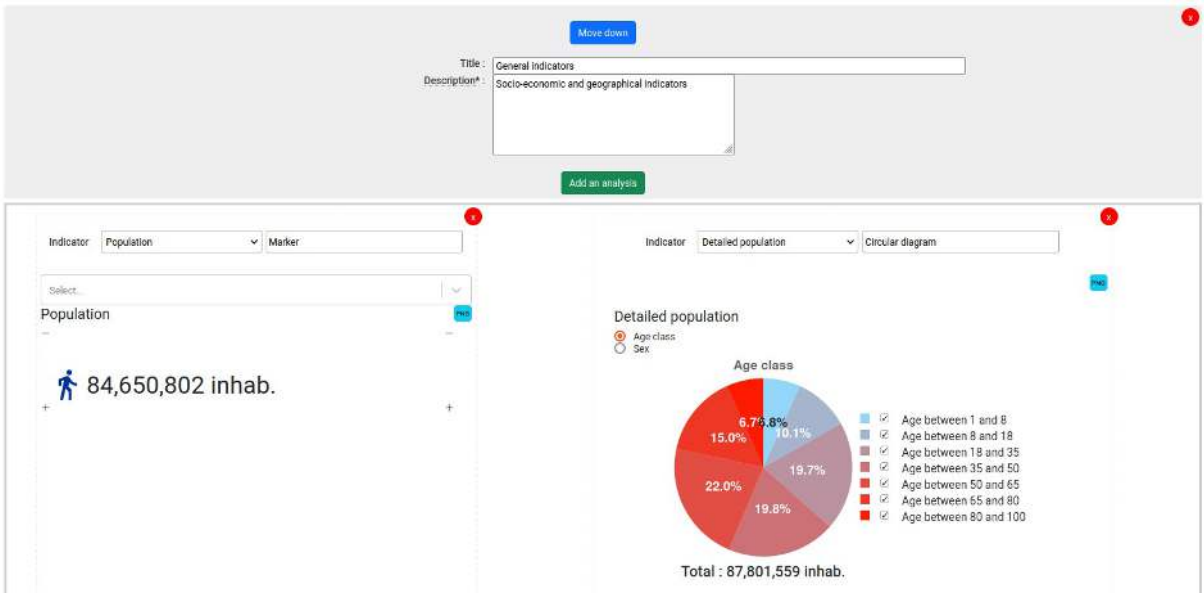


Figure 5: Creating a group of indicators in the Dashboard edition screen.

In Figure 5, the first group has been filled with two indicators using different representations. Various representations are available depending on the kind of representation: *circular diagram*, *radar diagram*, *bar chart*, *stacked curves*, *single total value*, or *map display*.

Once created, the dashboard can be displayed on any territory and will give a quick overview of the indicators chosen for any territory (NUTS2 regions or whole EUSALP for example), as shown in Figure 6.

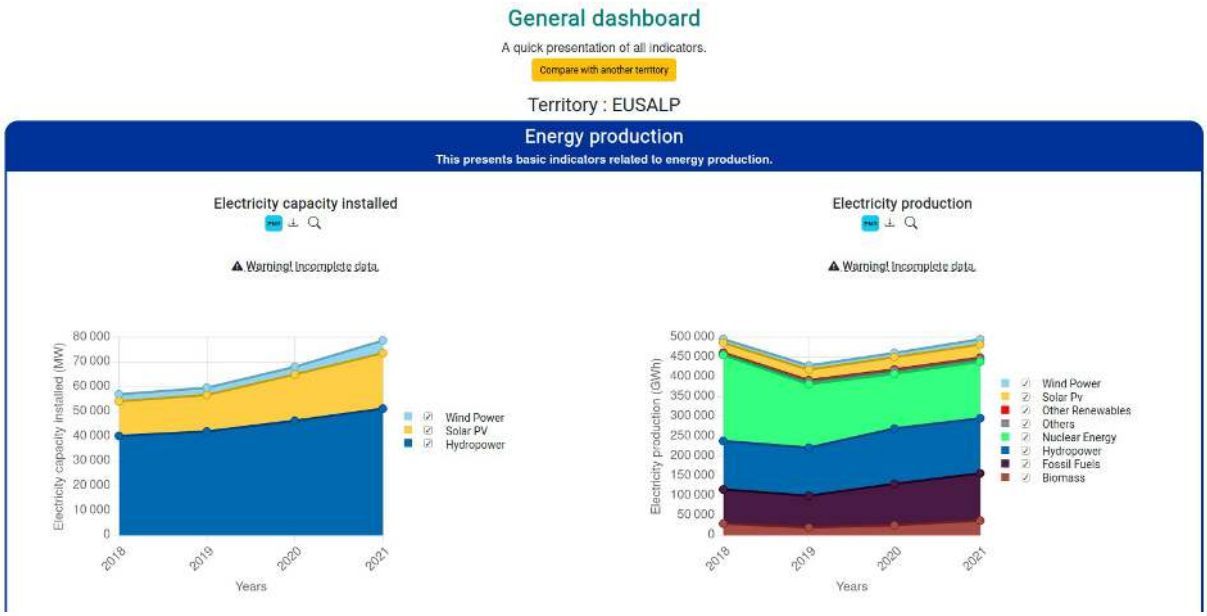


Figure 6: The General Dashboard displayed on a single region.

A feature was specifically developed for CERVINO project: the comparison tool. It allows any user to display a dashboard and compare it with another region. The feature works as follow:

1. First, the user must select one territory to add to the comparison;
2. Then, the territory will be added and every indicator will be duplicated to allow for comparison between both territories selected. This comparison page can be shared with anyone.

Another territory can be added to have three territories side by side. Such added territories can be removed at any time.

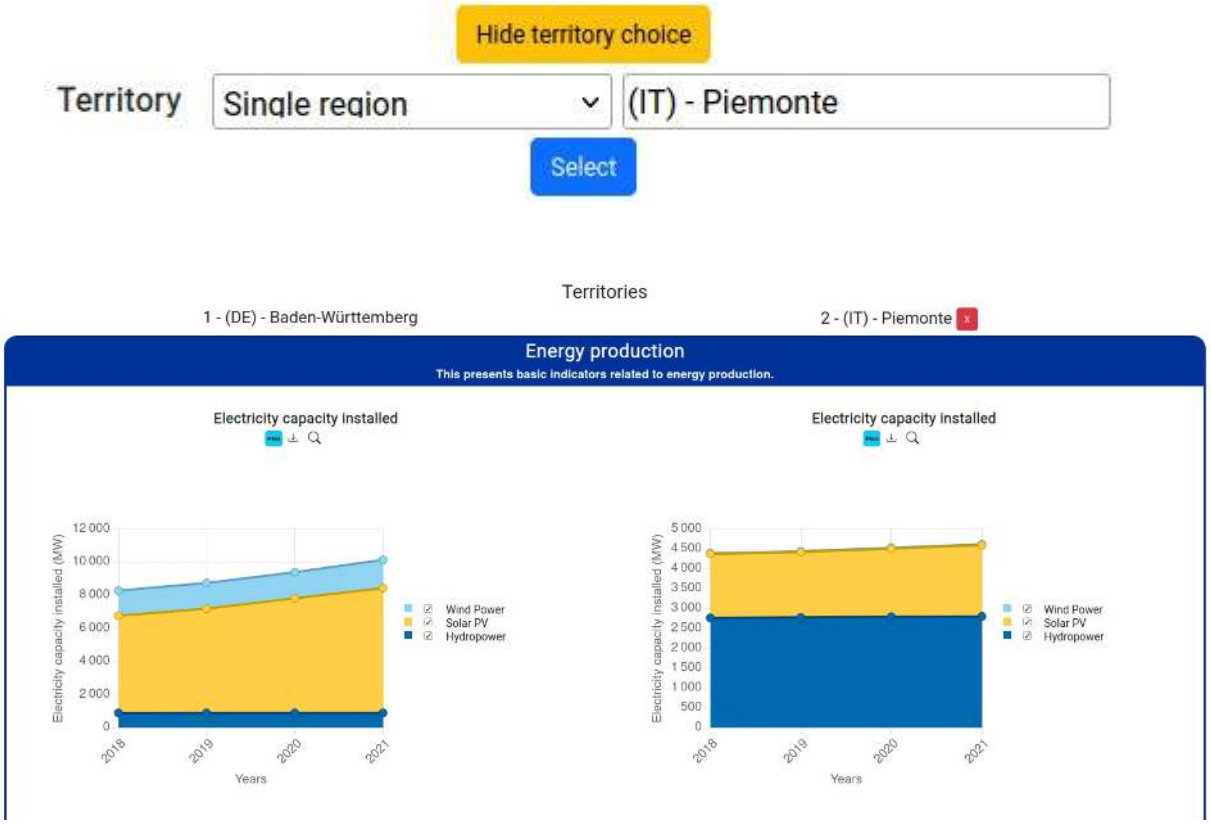


Figure 7: Example of the comparison tool applied to a dashboard.

This feature is useful to compare various regions between each other (see Figure 7) or to compare a specific region with the whole EUSALP or the aggregation of all regions of the same country (one French region compared with all French regions in EUSALP perimeter, one Italian region with all Italian regions in EUSALP perimeter, etc.).

2.3.2 Customized aggregations

We also added a dynamic territorial aggregation tool. This tool, available to any registered user, allow to create custom aggregations to monitor indicators on a specific perimeter different from the perimeters available in the Alpine Energy Data Platform as described before.

A user can access this tool by clicking on *Aggregations* menu on the top right navbar once logged in. The main screen shows custom aggregations already created by the user as displayed on Figure 8.

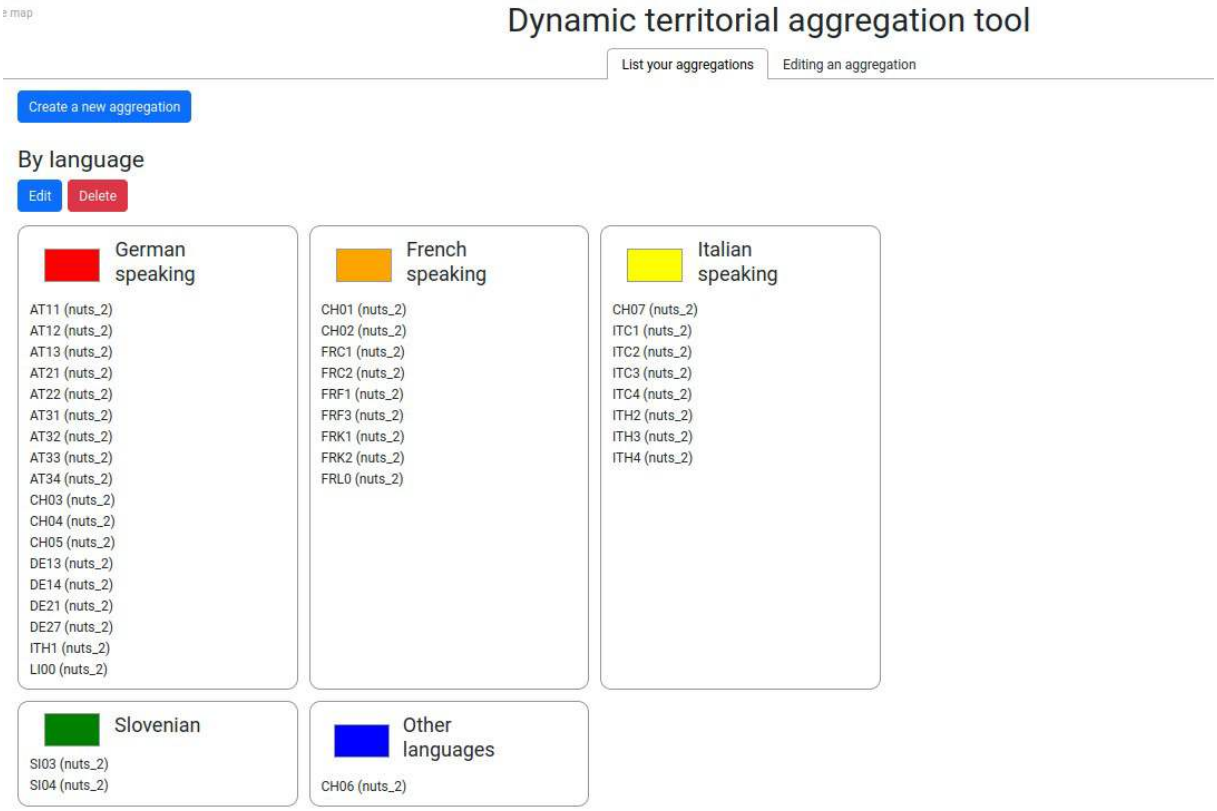


Figure 8: List of user's custom aggregations available on Aggregations page.

When creating an aggregation, the user can create a various number of custom groups. It depends whether the user wants to use this custom aggregation on the map (multiple groups will be displayed) or in dashboards (a single group would be better).

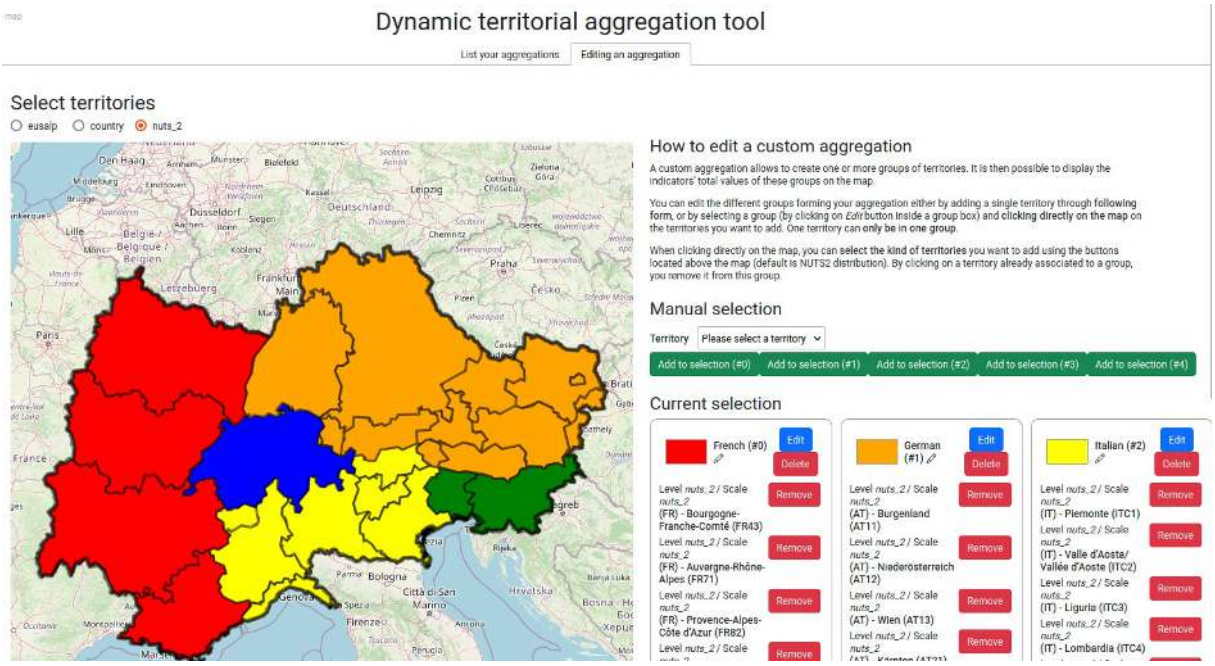


Figure 9: Edit a custom aggregation screen.

To fill in a group, the user must select the group in edition mode (*Edit* button), and then select any region by clicking on the map. Clicking on a region associated will remove it from the group.

Once created, the custom aggregations are available inside the Territory selection menu and can be used to display any indicator on the map.

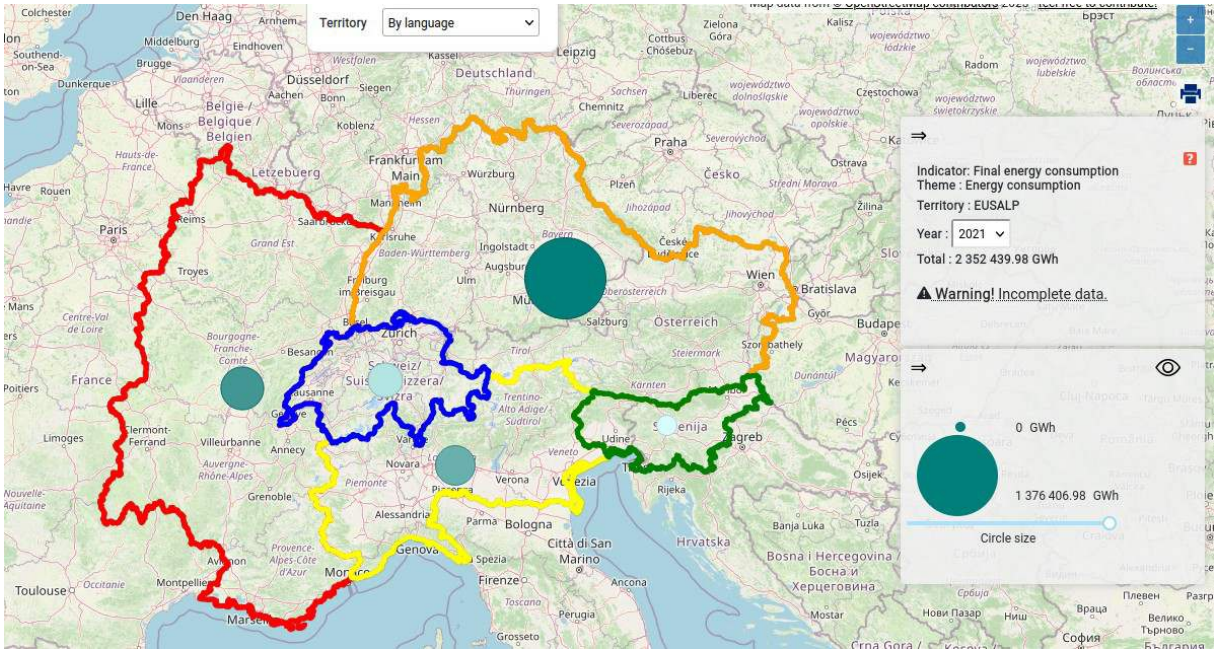


Figure 10: An indicator displayed on a custom aggregation gathering all regions by language mostly spoken by population.

It is also possible to show any dashboard on the custom aggregation. For example, figures 9 and 10 show a custom aggregation for same language speaking regions in the edition screen and on the main map, while Figure 11 displays the general dashboard on a custom group.

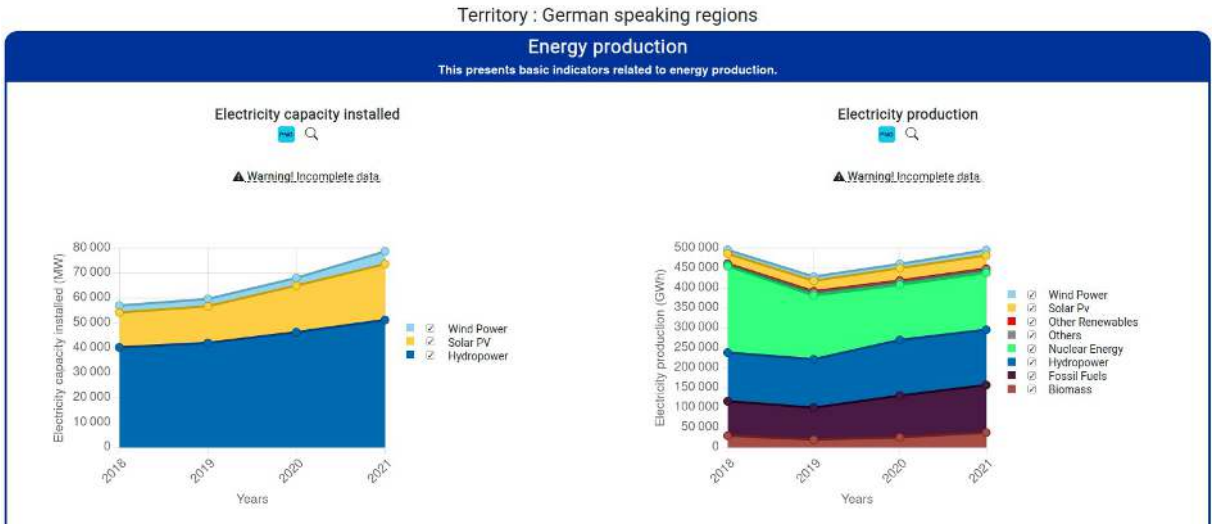


Figure 11: The General Dashboard displayed on a custom aggregation gathering all German speaking regions.

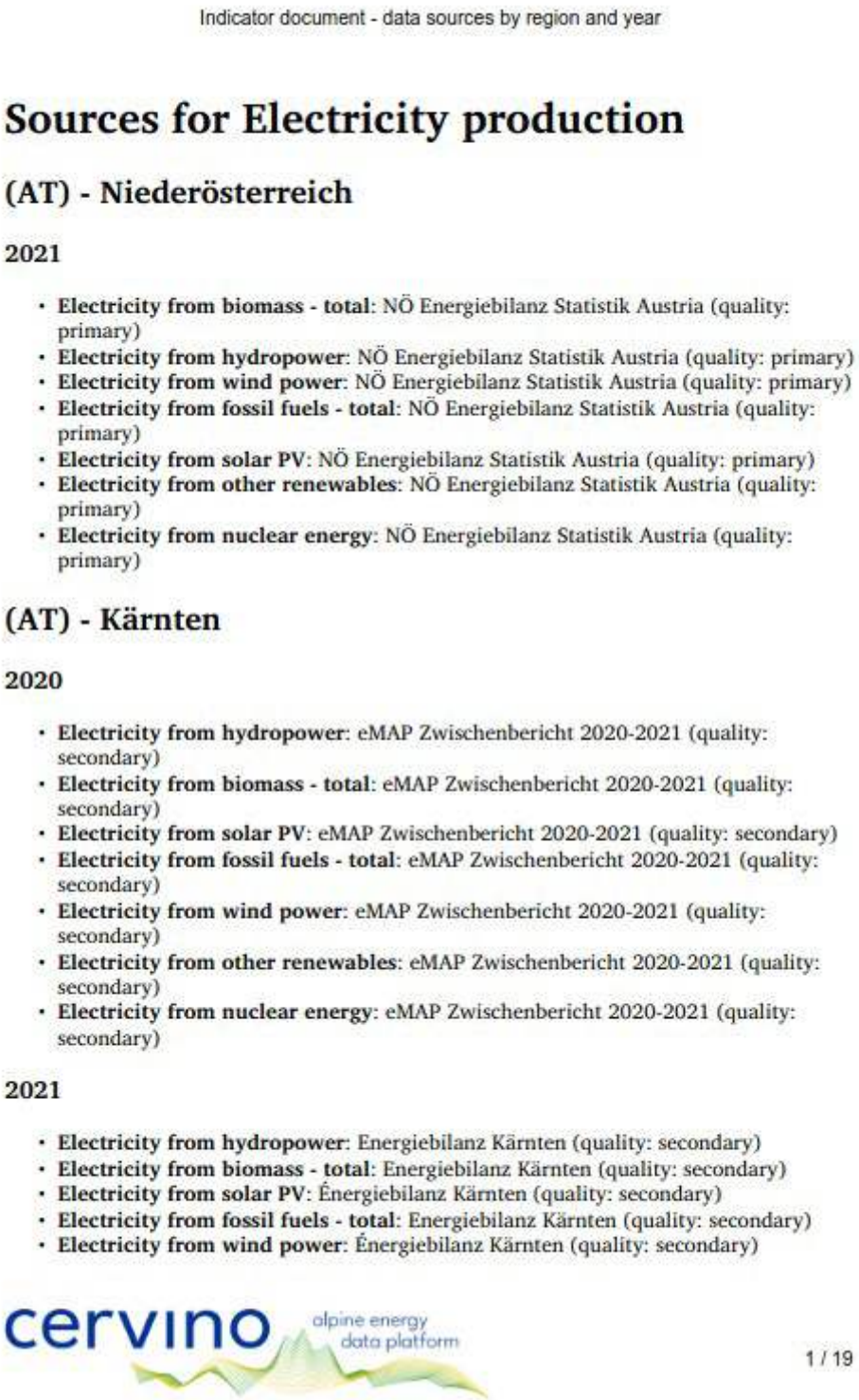
2.3.3 Other developments

Other functionalities were developed for the Alpine Data Energy Platform in order to respond to its specific needs: (*i*) generating PDF files containing the data sources, (*ii*) adapting the management of missing values and, (*iii*) displaying a warning when data are not exhaustive over the geographical units.

The first point consists in automatically generating a PDF file that contains, for each region and each year, the sources indicated in the data collection platform. An example of such file is provided in Figure 12.

The second point is due to a difference in terms of data exhaustivity between the original TerriSTORY tool and the Alpine Energy Data Platform: in the last case, unfortunately it is common to have missing values for some indicators because some regions did not answer the survey or answered only partially (not all four years, not all sectors, etc.). We had to adapt the way the platform handles such missing data as it was causing some unexpected bugs.

To enhance the user experience and be transparent on the data displayed, we also added a warning message concerning the missing data. This warning explains that the data are not exhaustive and that some regions do not have data available for the indicator displayed. This warning is available on both the map and the dashboards. Examples are provided in the next pages.



Indicator document - data sources by region and year

Sources for Electricity production

(AT) - Niederösterreich

2021

- **Electricity from biomass - total**: NÖ Energiebilanz Statistik Austria (quality: primary)
- **Electricity from hydropower**: NÖ Energiebilanz Statistik Austria (quality: primary)
- **Electricity from wind power**: NÖ Energiebilanz Statistik Austria (quality: primary)
- **Electricity from fossil fuels - total**: NÖ Energiebilanz Statistik Austria (quality: primary)
- **Electricity from solar PV**: NÖ Energiebilanz Statistik Austria (quality: primary)
- **Electricity from other renewables**: NÖ Energiebilanz Statistik Austria (quality: primary)
- **Electricity from nuclear energy**: NÖ Energiebilanz Statistik Austria (quality: primary)

(AT) - Kärnten

2020

- **Electricity from hydropower**: eMAP Zwischenbericht 2020-2021 (quality: secondary)
- **Electricity from biomass - total**: eMAP Zwischenbericht 2020-2021 (quality: secondary)
- **Electricity from solar PV**: eMAP Zwischenbericht 2020-2021 (quality: secondary)
- **Electricity from fossil fuels - total**: eMAP Zwischenbericht 2020-2021 (quality: secondary)
- **Electricity from wind power**: eMAP Zwischenbericht 2020-2021 (quality: secondary)
- **Electricity from other renewables**: eMAP Zwischenbericht 2020-2021 (quality: secondary)
- **Electricity from nuclear energy**: eMAP Zwischenbericht 2020-2021 (quality: secondary)

2021

- **Electricity from hydropower**: Energiebilanz Kärnten (quality: secondary)
- **Electricity from biomass - total**: Energiebilanz Kärnten (quality: secondary)
- **Electricity from solar PV**: Énergiebilanz Kärnten (quality: secondary)
- **Electricity from fossil fuels - total**: Energiebilanz Kärnten (quality: secondary)
- **Electricity from wind power**: Énergiebilanz Kärnten (quality: secondary)

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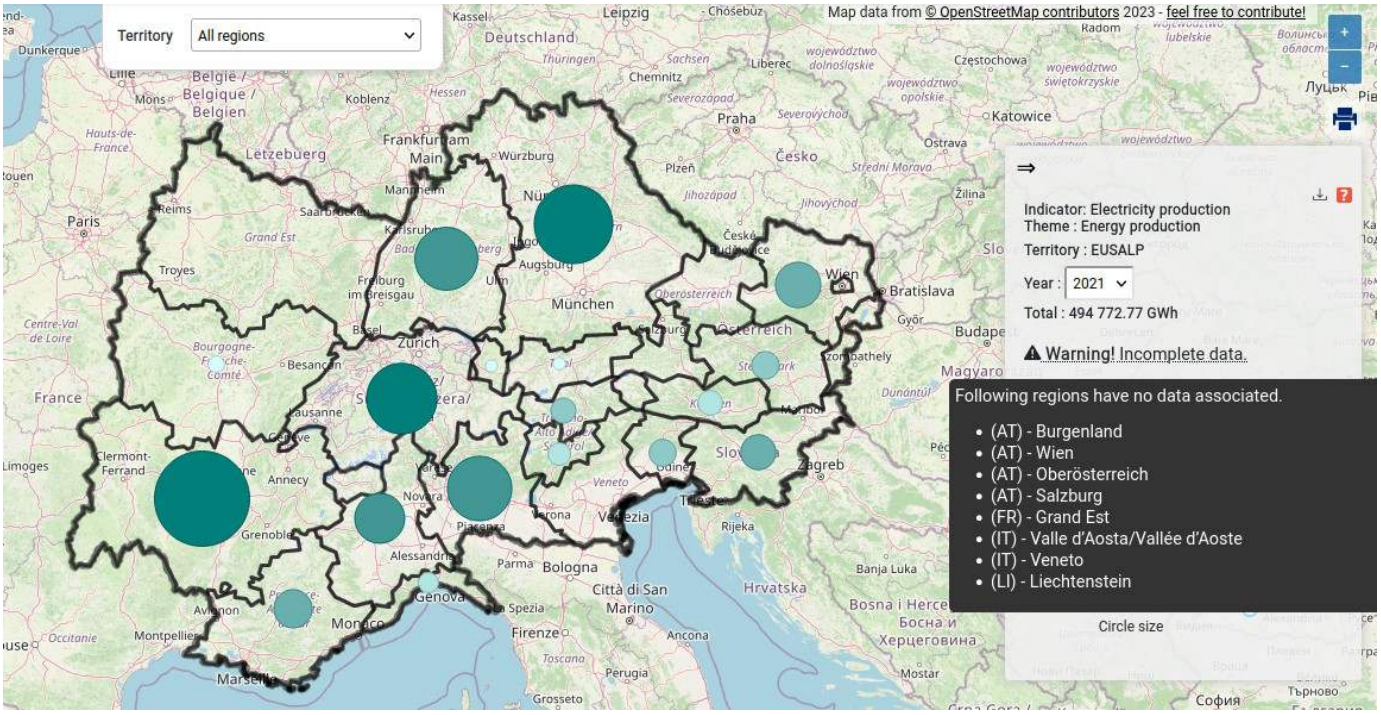
Figure 12: Example of PDF file displaying the sources used to fill in the data as provided by the regional actors when answering the Energy Survey 2023.



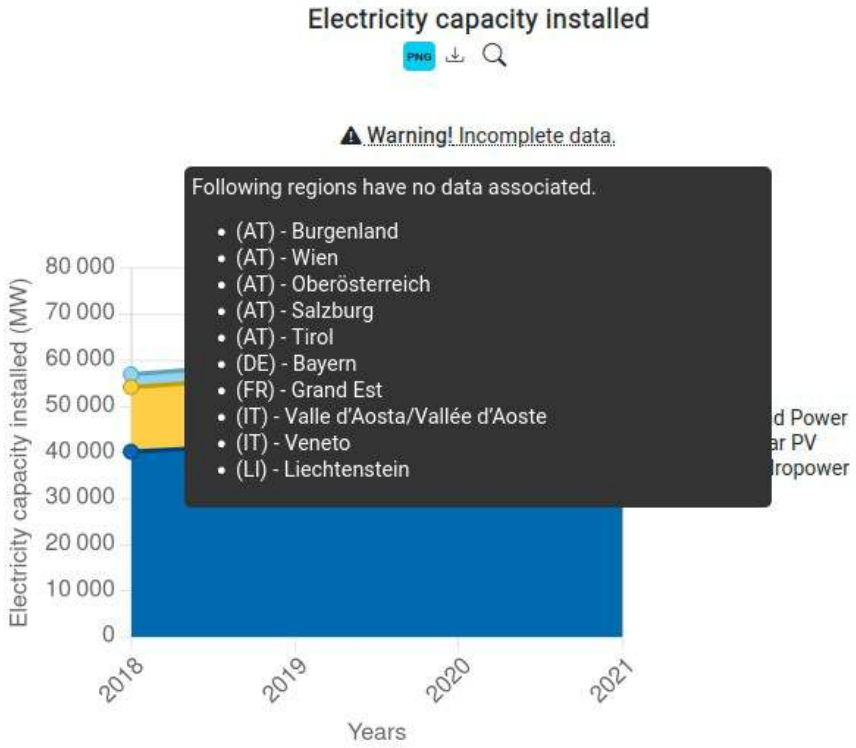


Figure 14: The warning message displayed on one of the indicators in a dashboard when some regions have no data associated. It makes it easier to grasp what the total displayed actually represents.

3 | Link between the platforms and visualisation of indicators

3.1 Data flow between the platforms

3.1.1 Possible links studied

Three potential links have been studied between the data collection tool and the data visualization platform:

1. the data collection tool pushes new data when it is updated (or frequently) and the Alpine Energy Data Platform, based on TerriSTORY, receives the data sent and reloads its indicators.
2. the data visualization platform pulls data from the data collection tool by using an API or an entry point.

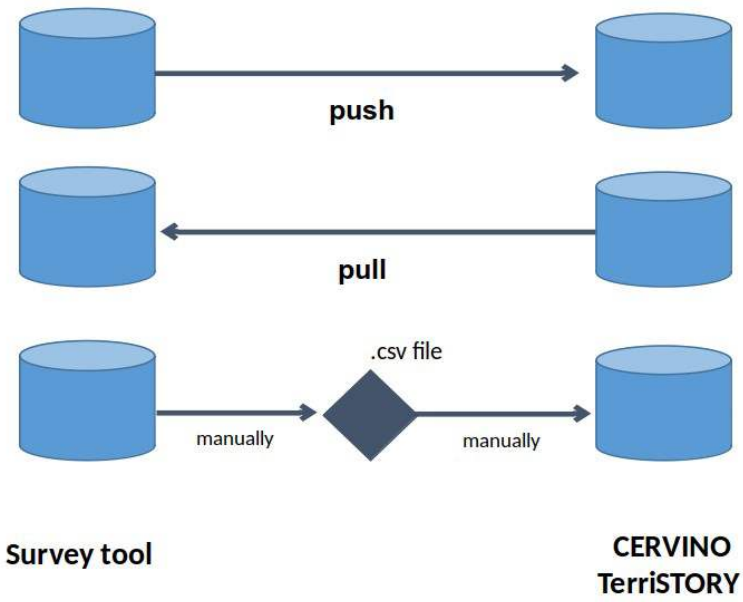


Figure 15: Possible connections between the two tools.

3. the data collection tool produces static files (for example, csv files) which are later manually uploaded on the data visualization platform.

3.1.2 Standard adopted

The solution developed is based on the second principle described above for the following reasons:

- It is more secured since it does not give any external writing access to the Alpine Energy Data Platform, avoiding any security leak from this point of view. In case 1, the risk is that the

authentication tokens could be intercepted, compromising the data displayed. Case 3 proposes the same level of security as only admin users have access to upload panel;

- It is automated (case 1 could be automated as well);
- It can be run automatically frequently (case 1 could be as well);
- The Data Collection Tool already had an entry point that provided data.

A screen was developed inside the admin panel of the Alpine Energy Data Platform which allows the admin user to perform the following operations:

1. Retrieve the data from the Data Collection Platform using its API (producing a csv or a json file) or upload a local csv file;
2. Define the indicators based on the aggregation of the various data collected;
3. Create the final indicators from the indicators definitions and the data retrieved (results of points 1 and 2).

The following screen captures (see figures 16 and 17) present this admin panel and the possibilities described above.

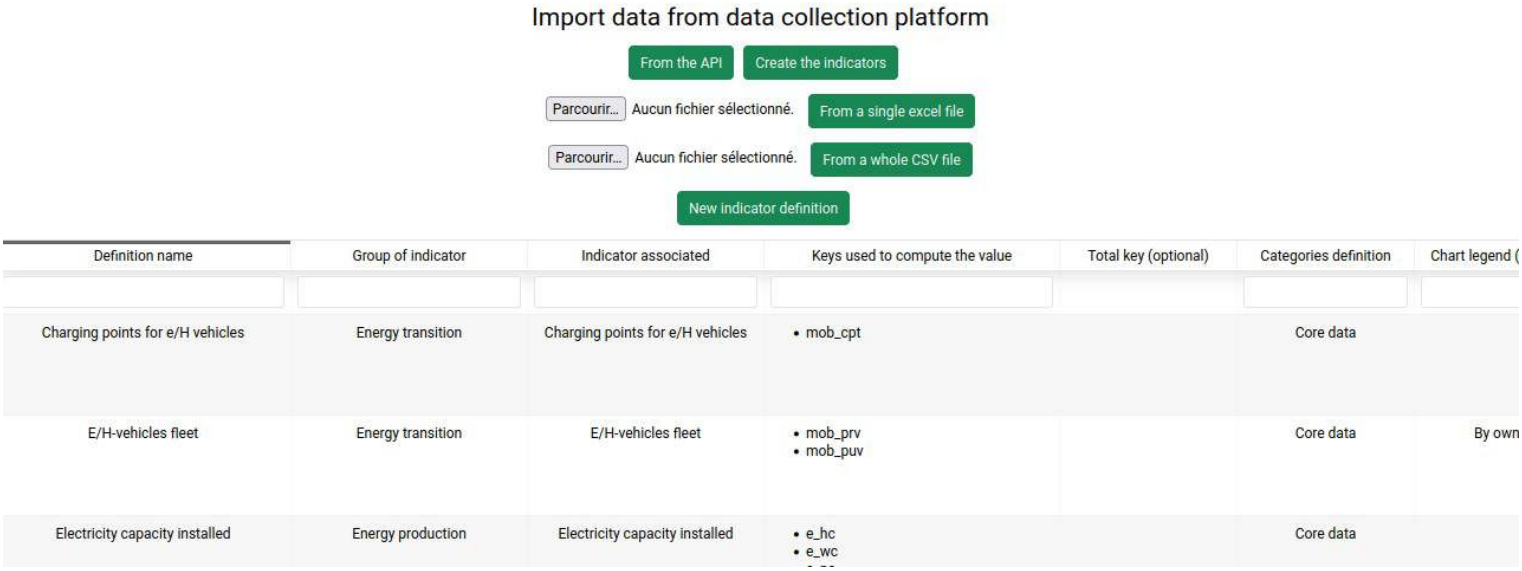


Figure 16: Main admin panel to import data from the Data Collection tool and create associated indicators.

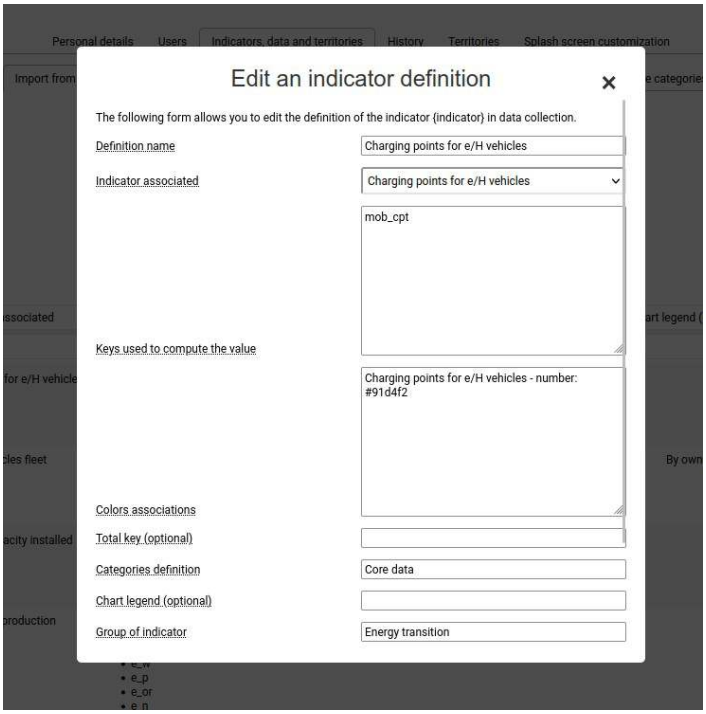


Figure 17: Example of the edition tool for a single indicator which presents the fields associated.

3.2 Results example on some indicators

A few examples are given below. The numbers may vary (a validation process was still undergoing during the writing of this report) and a direct URL is associated to each picture to allow to consult the latest results.

Warning!

Before proceeding, as not all regions filled in the survey, the data displayed below may not reflect the reality of total EUSALP. The CERVINO project does not provide any warranty regarding the data displayed on this Alpine Energy Data Platform. By using the platform and its data, people acknowledge that the data may not be accurate and that using them is at their own sole responsibility.

EUSALP indicators

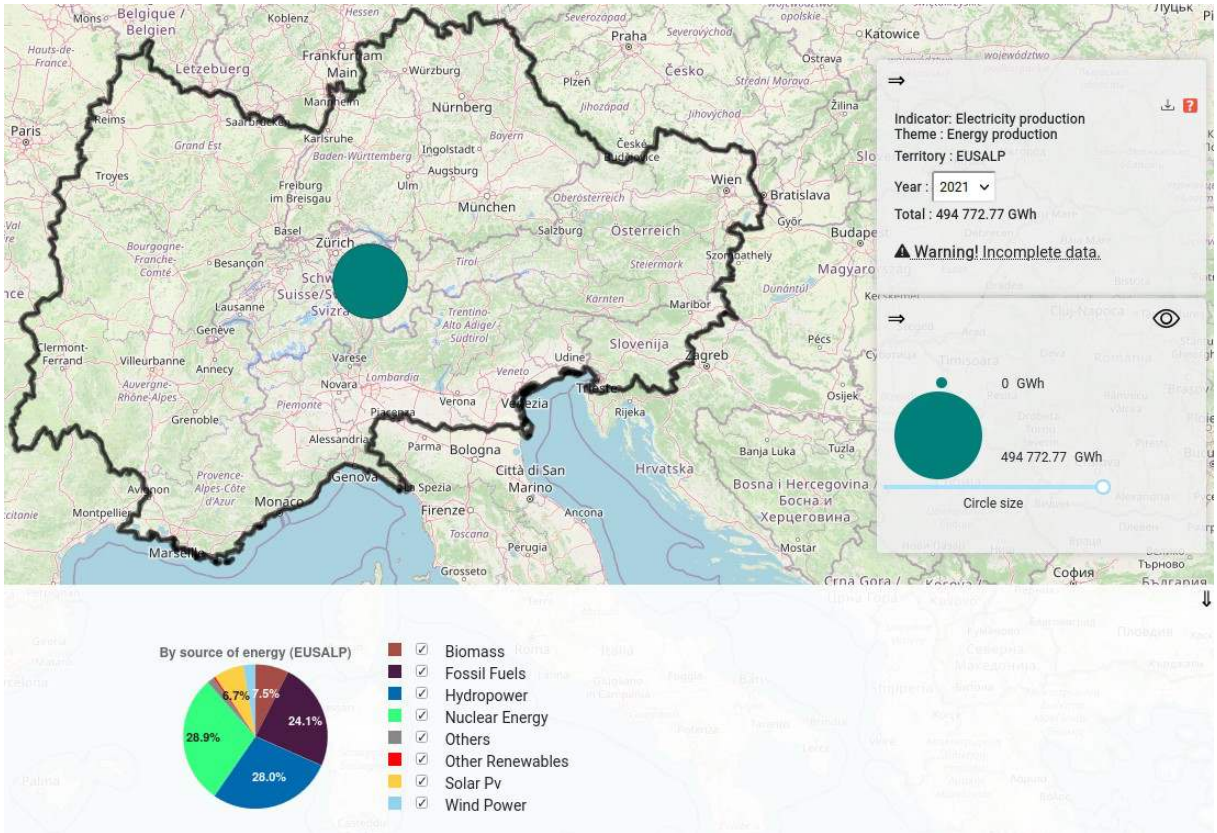


Figure 18: Total electricity production at EUSALP level.

You can go to this page for latest data.[10]

10 Direct link is: https://www.alpine-energy-data.eu/?zone=eusalp&maille=eusalp&zone_id=1&analysis=36197&theme=Energy%20production&nom_territoire=EUSALP

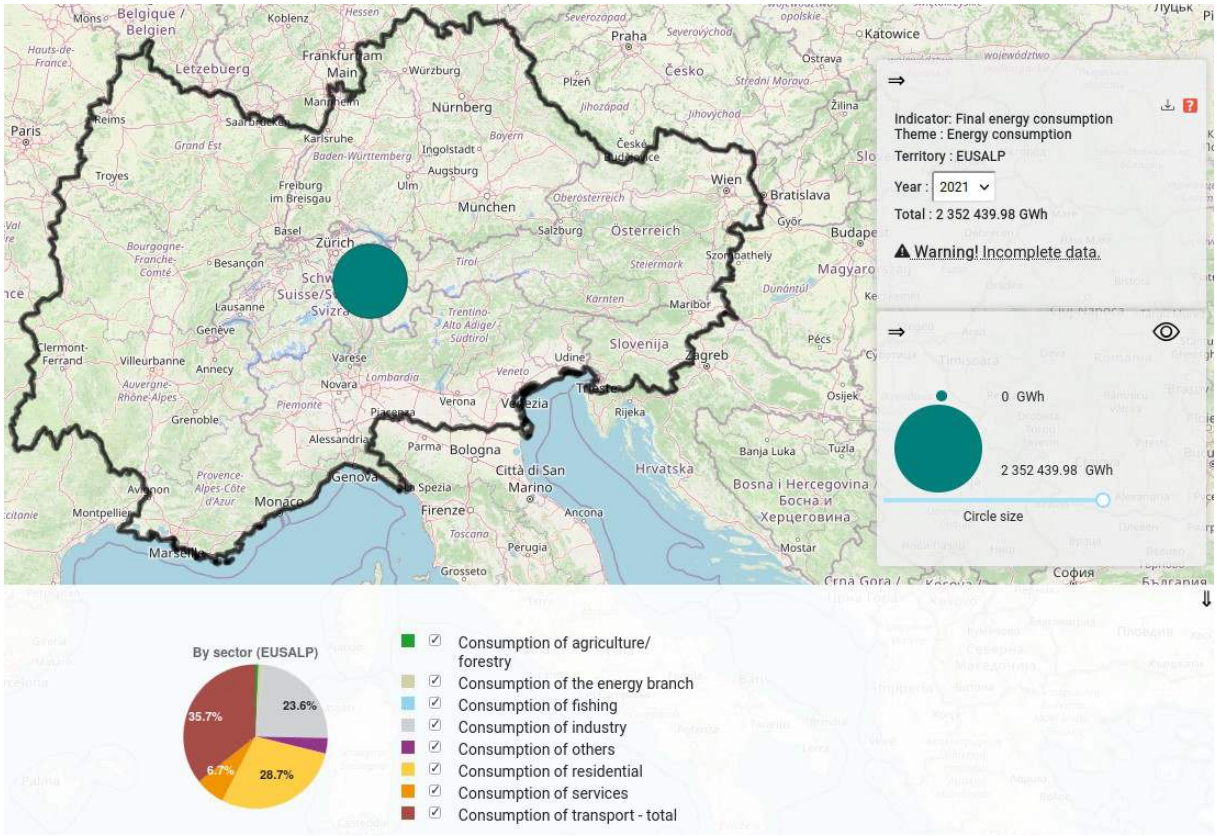


Figure 19: Final energy consumption at EUSALP level.

You can go to this page for latest data.[11]

A full dashboard presenting the main indicators can be shown at following link: https://www.alpine-energy-data.eu/show_dashboard?zone=eusalp&maille=eusalp&zone_id=1&id_tableau=7830&nom_territoire=EUSALP.

11 Direct link is https://www.alpine-energy-data.eu/?zone=eusalp&maille=eusalp&zone_id=1&analysis=36201&theme=Energy%20consumption&nom_territoire=EUSALP

Regional level

You can go to this page for latest data.[12]

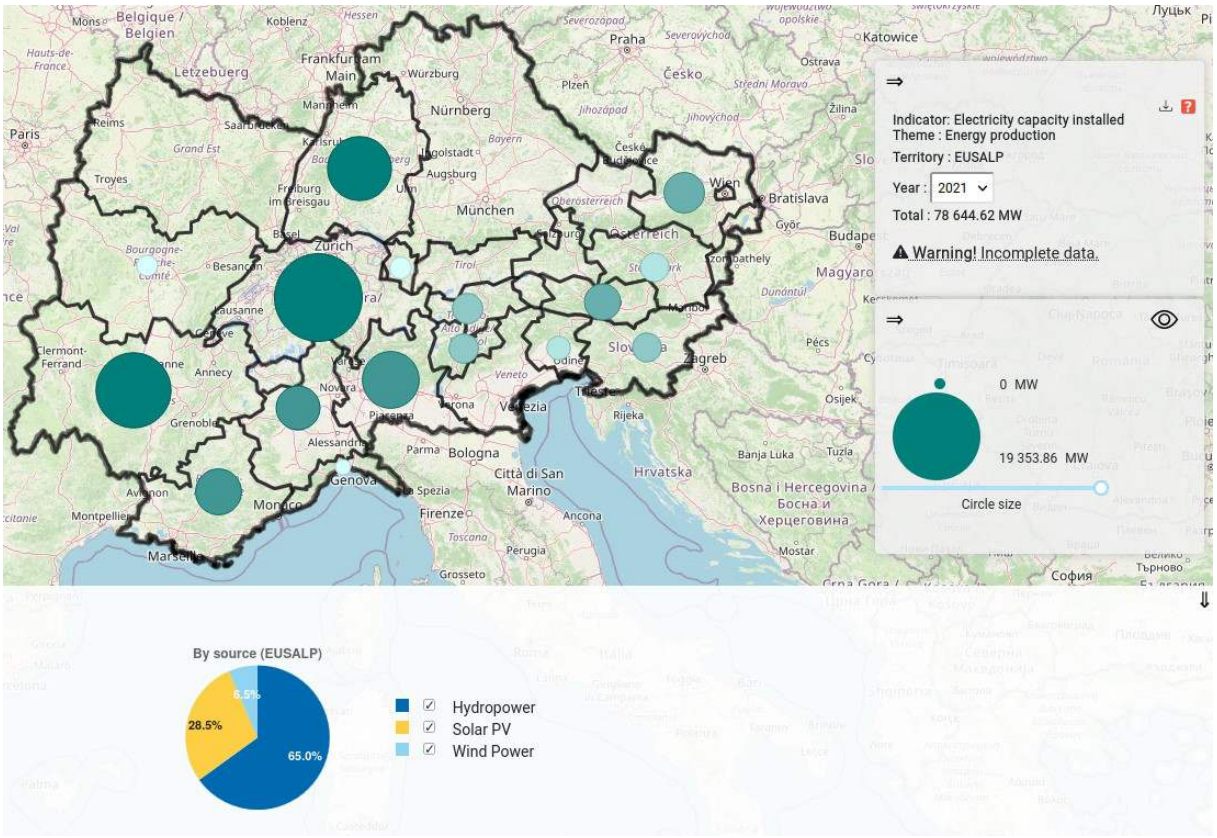


Figure 21: Test

12 Direct link is https://www.alpine-energy-data.eu/?zone=eusalp&maille=nuts_2&zone_id=1&analysis=36196&theme=Energy%20production&nom_territoire=EUSALP

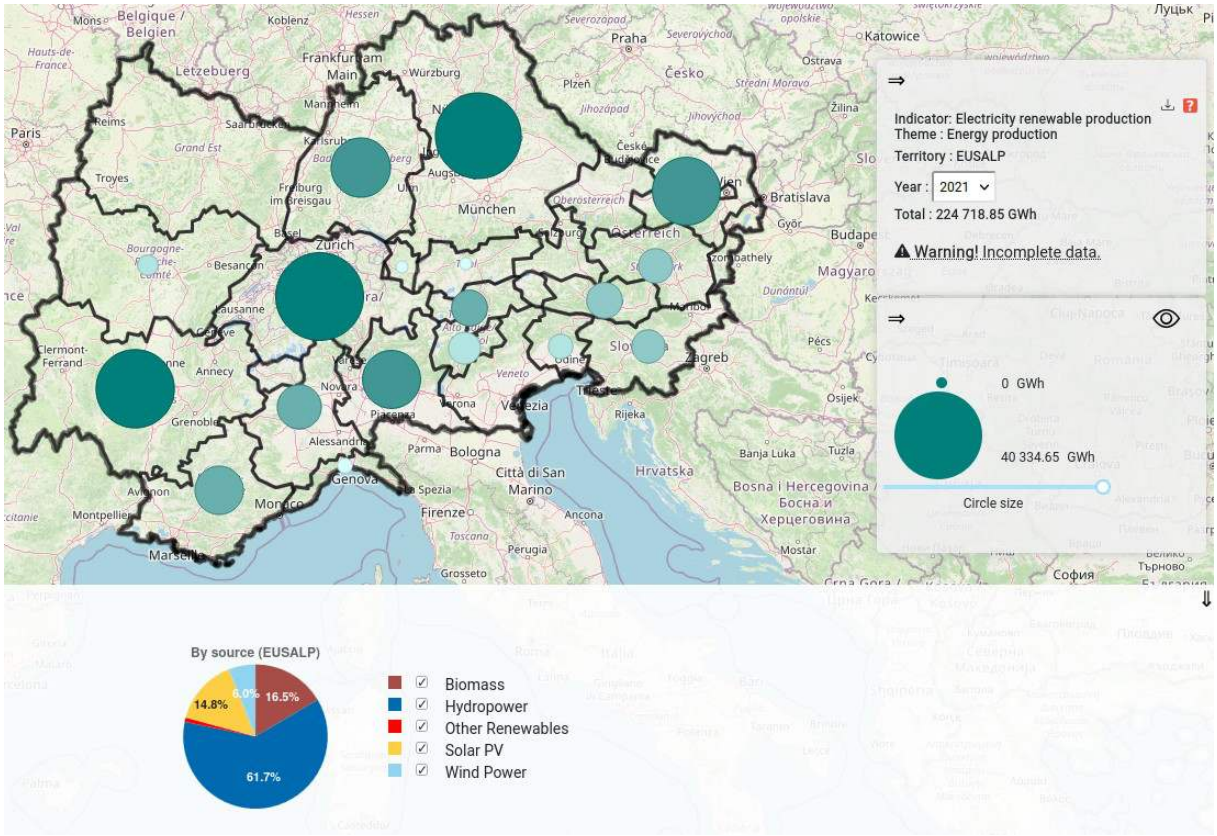


Figure 22: Electricity renewable production of EUSALP regions.

You can go to this page for latest data.[13]

13 Direct link is https://www.alpine-energy-data.eu/?zone=eusalp&maille=nuts_2&zone_id=1&analysis=36198&theme=Energy%20production&nom_territoire=EUSALP

Figures

Tables