EUSALP EU STRATEGY FOR THE ALPINE REGION

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EUSALP Energy Survey 2017

Report

80 million people, 7 countries, 48 regions, mountains and plains addressing together common challenges and opportunities

Interreg Alpine Space

AlpGov

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INTRODUCTORY NOTE

Macro-regional strategies provide a framework for cooperation, coordination and consultation between and within states and regions. They depict an opportunity for greater regional cohesion and a more coordinated implementation of European sectoral policies in transnational territories that are confronted with common challenges and opportunities. The EU Strategy for the Alpine region (EUSALP) is the fourth macro-regional strategy endorsed by the Council in 2015. It covers a territory inhabited by 80 million people and includes 48 regions from seven countries of which five countries are EU member states, namely, Italy, Austria, Germany, France, Slovenia, Switzerland and Liechtenstein. Since 2016, nine thematic Action Groups, composed of regional and national representatives, carry out activities and projects that support the implementation of the EUSALP Action Plan. Action Group 9 has the mission “to make the territory a model region for energy efficiency and renewable energy”. The activities pursued by Action Group 9 shall back the implementation of the Energy Union Package that strives for more energy security, an integrated European energy market, an increase of energy efficiency, decarbonization of the economic sector and support of research, innovation and competitiveness in Europe. The 2020 climate and energy package of the European Union has settled the 20-20-20 goals comprising a 20% reduction of greenhouse gases by 2020 compared to 1990, as well as a 20% increase of energy efficiency and renewable energy sources at European level. By 2030, the reduction of greenhouse gases shall be reduced by 40%, the share of renewable energy consumption shall at least reach 27% and energy savings should account for 27% compared with a business-as-usual scenario. By 2050, the European Union aims to become nearly carbon neutral and to have lowered domestic emissions by 80%.

Reliable energy data are the basis for decision-makers to define, to implement and to monitor the effectiveness of energy policies. In order to implement a well-informed macro regional energy strategy that responds to the needs and challenges of the territory, Action Group 9 developed the EUSALP Energy Survey to collect regional and national energy data aggregating them to macro-regional data as well as medium and long-term policy goals defined by the functional units in the territory. The survey is a first attempt to implement a monitoring system for energy data in the macro-region.

Ulrich Santa and Maren Meyer, EUSALP Action Group 9 coordination team

SUMMARY

The macro-regional Strategy for the Alpine region (EUSALP) was launched by the European Union in 2015, as "*an integrated framework to address common challenges faced by a defined geographical area*". This area includes and surrounds the Alps, embracing five European member states plus Switzerland and Liechtenstein. It covers more than 440.000 km^2 (near 10% of the EU-28 plus Switzerland and Liechtenstein), is densely inhabited and an engine of the economy (about 80 millions of inhabitants that generates 3.100 Trillion € of gross domestic product, respectively corresponding to 15% of the population and 20% of GDP).

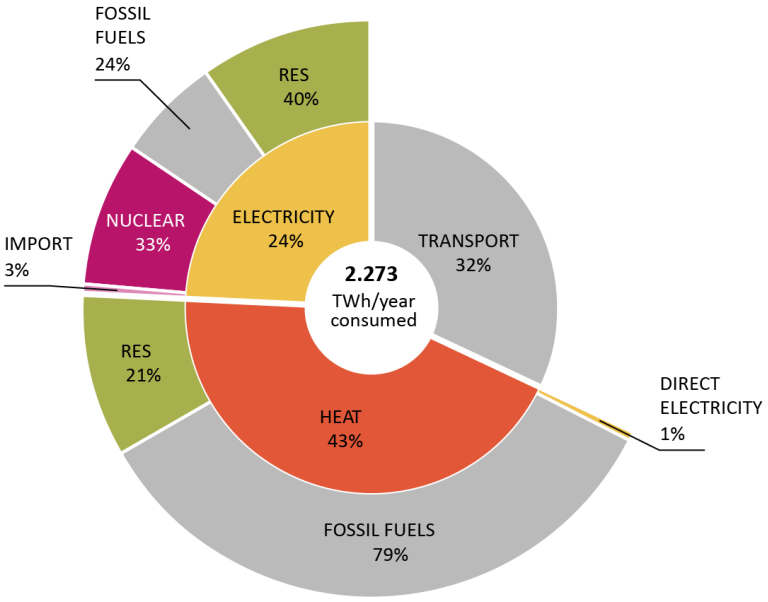
In order to translate the EUSALP strategy into actions, nine Action Groups (AG) are established. Among them, the EUSALP Action Group 9 has the mission to "*make the EUSALP territory a model region for energy efficiency and renewable energy*". For this reason, in 2016, it developed the online EUSALP Energy Survey, meant to be sent to each territory's representative, in order to collect data on the energy production mix, consumption sectors, energy policy strategies and defined energy policy targets. The EUSALP Energy Survey 2017 developed by the EUSALP Action Group 9 is the first attempt to offer a clear and systematic overview of the EUSALP energy data, both on the consumption and production side. Compared to a traditional desk research, it has the great added value of combining quantitative data with qualitative ones, directly provided by the territories.

The present report summarizes the main findings of the activities carried out by Eurac in first collecting and then analyzing provided data, from March to October 2017.

Information provided by respondents has been supplemented by additional data coming from already available databases and compared with other official sources in order to verify the order of magnitude, or to integrate missing data. Even though data comes from very different territorial entities, ranging from entire countries (as Slovenia) to small Swiss cantons, having different competencies, institutional frameworks, and energy balances, it is possible to sum up the main energy figures for the EUSALP territory.

Current yearly energy consumption in the EUSALP amounts to about 2.300 TWh. On average, each EUSALP inhabitant has therefore a per capita consumption of 28 MWh/year, which is slightly above the EU-28 average of energy consumption per capita (25 MWh/year).

The main final energy consumption share is related to satisfy heating needs (43% of total final energy consumption), then to the transport sector (32%) and finally to consumption of electricity (25%). It is notable to mention, that almost 80% of the heating demand is satisfied by non-renewable sources, mostly natural gas and in a smaller extent mineral oil. The remaining 20% of the heating needs in the EUSALP territory is covered by locally generated power from renewable energy sources (RES), mostly coming from biomass and biofuels. Concerning the overall electricity consumption, EUSALP is a slightly net importer as the locally generated power covers 93% of the energy consumption. The share of RES in the local generation is quite high (40%), especially due to a strong and well-rooted hydropower production in the core Alpine territory. Nuclear power plants (33%) and fossil fuel plants (24%) cover the remaining electricity needs. It is worth mentioning that there is a great variety of local energy production and consumption status quo falling under this average figures, both in terms of electricity balance and mix of energy sources. The spatialized information presented through the maps accompanying this report helps



Source: Eurac Research

Figure 1. EUSALP energy consumption.
Data source: EUSALP Energy Survey 2017 and Eurac Research elaboration

better understanding the energy pattern in the EUSALP territory.

The EUSALP Energy Survey 2017 gives evidence about the remaining potentials of RES in the regions and states of the EUSALP. It is worth mentioning that these potentials are qualitatively assessed, based on the respondent's personal feeling and not on modelling activities. Thus, respondents seem to see more opportunities in the electricity sector, rather than in heating, claiming a high potential for photovoltaic (PV) and, quite surprisingly, a medium/high potential for wind. The majority of them refers about an estimated marginal increase in hydropower. Even in heating, the sun seems to show a high potential, followed by geothermal energy and biomass (even though the latter already plays a key role among RES in heating).

Energy strategies seem to be broadly adopted in the EUSALP area, setting various targets (very ambitious in some cases) in their specific territory. As expected, the most recurrent focus areas of the strategies are energy efficiency measures (especially in the building sector), then increasing RES production and setting up a sustainable transport sector. Respondents also recognize the relevant role played by measures that aim at addressing the societal and innovation challenges posed by the energy transition. Not yet widely diffused is the involvement of a third party in supporting the territorial entities in managing the monitoring activities.

Finally, from data collection and control activities, it clearly emerges the need for more harmonized and simplified procedures of energy data sharing, in order to obtain a more precise macro-regional data set, and establish an EUSALP Energy Observatory, to be kept updated and accessible to target groups.

The EUSALP Energy Observatory could assess the effectiveness of adopted measures by executing regular updates of harmonized energy data, in comparison to implemented political and financial frameworks and targets set by local energy strategies.

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INTRODUCTION[1]

The EUSALP Strategy

The EUSALP (2015) is the fourth EU macro-regional strategy, following those for the Baltic Sea region (2009), for the Danube region (2010) and for the Adriatic and Ionian region (2014). The EUSALP concerns 7 Countries, of which 5 EU Member States (Austria, France, Germany, Italy and Slovenia) and 2 non-EU Countries (Liechtenstein and Switzerland), and 48 regions (overall 50 territorial entities, see Fig. 1). The Alpine region is a unique territory, which has an important potential for dynamism but is facing major challenges, such as:

- economic globalization that requires the territory to distinguish itself as competitive and innovative by developing the knowledge and information society;
- demographic trends characterized particularly by the combined effects of aging and new migration phenomena;
- climate change and its foreseeable effects on the environment, biodiversity and on the living conditions of its inhabitants;
- the energy challenge at the European and worldwide scales, which consists of managing and meeting the demand in a sustainable, secure and affordable way;
- its specific geographical position in Europe, as a transit region but also as an area with unique geographical and natural features which set the framework for any future developments.

Macro-regional strategies provide an opportunity to improve cross-border cooperation among the alpine States as well as identify common goals and implement them more effectively through transnational collaboration.

[1] This paragraph is mainly based on contents provided by the official EUSALP website. For any further and more detailed info please refer to https://www.alpine-region.eu/.

Figure 2. EUSALP territory and geographic location. Data source: Eurac Research

The EUSALP Action Groups

On 28th July 2015, the EUSALP Action Plan was adopted, that aims to translate the identified common challenges and potentials of the EUSALP territory into concrete actions. The Action Plan is divided into three thematic policy areas and one cross-cutting policy area (see Table 1) and focuses on 9 actions.

Table 1. EUSALP obejectives

1st Thematic Policy Area: Economic Growth and Innovation	**2nd Thematic Policy Area: Mobility and Connectivity**	**3rd Thematic Policy Area: Environment and Energy**
AG 1 – AG 2 – AG 3	**AG 4 – AG 5**	**AG 6 – AG 7 – AG 8 – AG 9**
OBJECTIVE Fair access to job opportunities, building on the high competitiveness of the region	OBJECTIVE Sustainable internal and external accessibility to all	OBJECTIVE A more inclusive environmental framework for all and renewable and reliable energy solutions for the future
Cross-cutting Policy Area: Governance, including Institutional Capacity		
OBJECTIVE A sound macro-regional governance model for the region (to improve cooperation and the coordination of action)		

1st. Thematic Policy Area: fostering sustainable growth and promoting innovation in the Alps: from theory to practice, from research centers to enterprises

- AG1: to develop an effective research and innovation ecosystem
- AG2: to increase the economic potential of strategic sectors
- AG3: to improve the adequacy of labor market, education, and training in strategic sectors

2nd. Thematic Policy Area. Connectivity for all: in search of a balanced territorial development through environmentally friendly mobility patterns, transports systems and communication services and infrastructures

- AG4: To promote inter-modality and interoperability in passenger and freight transport
- AG5: To connect people electronically and promote accessibility to public services

3rd. Thematic Policy Area: Ensuring sustainability in the Alps: preserving the Alpine heritage and promoting a sustainable use of natural and cultural resources

- AG6: To preserve and valorize natural resources, including water and cultural resources
- AG7: To develop ecological connectivity in the whole EUSALP territory
- AG8: To improve risk management and to better manage climate change, including major natural risks prevention

- AG9: To make the territory a model region for energy efficiency and renewable energy

EUSALP Action Group 9 has the mission to make the territory a “model region for energy efficiency and renewable energy”. The activities carried out by the Action Group that rest on the European energy policy framework that is inter alia provided by the EU’s Energy Efficiency Directives, the European energy and climate package with its targets for 2020 and 2030 as well the Energy Union Package.

THE EUSALP ENERGY SURVEY

In 2016, the members of AG9 started their work to fulfill the mission "*to make the territory a model region for energy efficiency and renewable energy*". In order to depict the "state of the art" of energy policy targets, and energy consumption and production in the EUSALP, the AG9 commissioned the "EUSALP Energy Survey 2017". The Institute for Renewable Energy of Eurac Research (EURAC) carried out the collection and analysis of the relevant data, presenting the main findings in this "EUSALP Energy Report 2017".

The Survey (see Annex 2) consisted of twenty nine open questions organized in 7 sections. Starting from March 2016, the English version of the Survey was made accessible online, by using the tool "Survey Monkey", and an invitation to fill it in was sent all EUSALP territories. Later the Survey was also translated in German (see Annex 3).

EUSALP Energy Survey 2017 data has been elaborated at regional level by drawing local (see Annex 1) as well as aggregated factsheets.

SECTIONS 1, 2 & 3 - BACKGROUND & ENERGY DATA

The first and second sections of the EUSALP Energy Survey 2017 encompass the collection of general data about the respondent and the territory

Territories and contact persons

The list of investigated territories and related contact person details is provided in Annex 4, and comprises 50 entities: 1 EU country (Slovenia), 1 non-EU country (Liechtenstein), 22 EU regions, Provinces or Ländern (9 Austrian, 8 Italian, 3 French and 2 German), and 26 Swiss cantons. Contact details are available only for AG9 communication and research purposes.

General Data

Since the reference years of GDP and population data inserted into the Survey ranged from 2005 to 2016, we decided to use more homogeneous figures, taken from EUROSTAT and referred to 2015 (or the closest year), for further analysis, also including the size and elevation of the territorial units to provide a more exhaustive framework.

The 50 territorial entities included within the EUSALP area are seldom comparable in terms of population and GDP. Concerning the Classification of Territorial Units for Statistics (NUTS), they range from NUTS 0 (Liechtenstein and Slovenia) to NUTS 3 (Swiss cantons). See Table 2 for descriptive statistics.

Table 2. EUSALP general data. Data source: EUROSTAT and Eurac internal database

	Min (Territory)	Max (Territory)	Total	Mean	Std. dev.
Size (km²)[2]	38 (Basel Stadt)	70.580 (Bayern)	467.145	9.343	15.284
Elevation (m)	-12	4.790	-	786	670
Population (inh)[3]	15.854	12.691.568	79.725.926	1.594.519	2. 879.354

[2] Data from EUROSTAT (demo_r_d3area).
[3] Data from EUROSTAT (demo_r_gind3).

Continue

	(Appenzell Innerrhoden)	(Bayern)			
Density (inh/km²)	28 (Graubünden)	5.065 (Basel Stadt)	-	171	929
GDP (Mil. €)[4]	803 (Appenzell Innerrhoden)	550.446 (Bayern)	3.128.258	62.565	112.841
GDP pro capita (€/inh)	18.697 (Slovenia)	150.064 (Liechtenstein)	-	39.237	25.911

This means entities from twelve million inhabitants as Bayern in Germany (more populated than the single country of Slovenia), to 15.000 inhabitants of the small Swiss canton Appenzell Innerrhoden. Interestingly for an Alpine area, the average density of the EUSALP area is 171 inh/km^2: one-and-a-half times the EU figure, due to the presence of several relevant urban areas in the plains surrounding the mountain core area.

As for population, a great variety appears in the GDP data, which fall into a range by factor 1.000 (Mil. € 803 in Appenzell Innerrhoden and Mil. € 550.446 in Bayern). Generally speaking, and in comparison to the broader context (here given by the EU-28 plus Switzerland and Liechtenstein), the EUSALP area covers near 10% of the surface (more than 470.000 km^2), encompasses 16% of the population (about 70 million of EU citizens and 8 Million of non-EU), and generates the equivalent of the 20% (3.100 Trillion €) of the GDP of the EU. Nevertheless, significant differences are evident in the GDP per capita levels: 3% of EUSALP population, that is made up by the population of Slovenia, lies one-third below the EU level (€29.000 instead of €39.000 GDP per capita). Half of the population has an income level comparable to the EU average, while one-third is between the 25% and 50% of the average EU GDP per capita. The GDP per capita of Swiss cantons is often close to the double and even higher in Liechtenstein.

[4] For EUSALP EU regions and Liechtenstein GDP data refers to 2015 and source is EUROSTAT (nama_10r_3gdp). For Swiss cantons GDP data source is the Federal Statistical Office, it refers to 2014 and translated from CHF in € at the time exchange rate (0.8317).

Land use	Surface (km²)	Percentage

Thanks to the data provided by a Eurac internal project, we could include some additional information about land use and morphology (see Table 3). Urban areas cover 6% of the overall surface of the territory of the Alpine macro-region, while 40% is are used for agriculture and 2% are used by the natural resource water.

Urban	26.510	6%
Agricultural	176.427	40%
Forest and rocks	232.089	52.4%
Water	7.300	1.6%

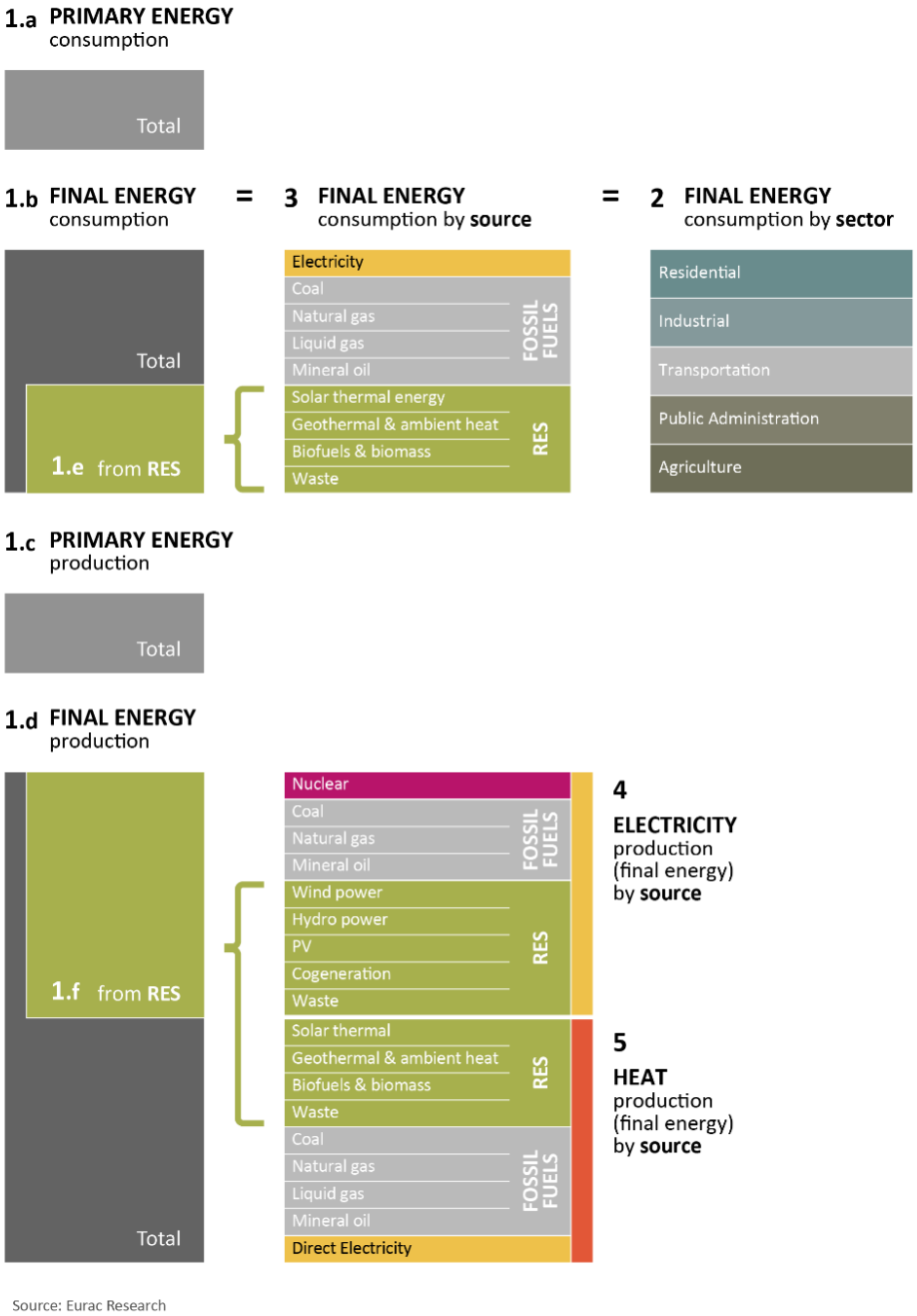
Table 3. EUSALP land use. Data source: Eurac internal database – Corine land cover

Beside intensely built-up areas, one should bear in mind that the EUSALP territory includes one of the most relevant European mountain systems; 52% of the area is covered by forest or rocks and the elevation of EUSALP ranges from slightly below the sea level to more than 4.700 meters, with an average of about 760 meters. Finally, 16% of the EUSALP area is included in the environmental network "Natura 2000", hosting a huge variety of protected species, fragile ecosystems, unique landscapes, and sparsely populated areas[5]. Thus, once again, there are much more alternate situations, than a representative average density.

[5] Statistic elaboration about EUSALP territory are provided by a Eurac internal project SetAlps (2016).

Energy data collection

After collecting general background data, the EUSALP Energy Survey 2017 focuses on questions related to energy production and consumption. A graphical representation of these questions is given in Figure 3 to stress how some of them are related, and they offer the possibility to double-check the data (and conversely pose doubts if divergences arise).



Source: Eurac Research

Figure 3. EUSALP Energy Survey 2017 conceptual structure of the energy data section (section 3)

Generally speaking, values provided by respondents cover near 90% of the overall calculation of energy consumption and 75% of the overall calculation of energy production from renewable sources.

Primary energy production and consumption data were required, but not subjected to further investigation. Final energy production and consumption data were asked, including the amount related to renewable energy sources (RES). Final energy consumption figures was investigated both regarding sources[6] and sectors, while more detail was required about the final energy production, distinguishing between heat and electricity production. See Table 4 for descriptive statistics.

Energy data have been first harmonized by unit of measurement (we decided to use GWh and its multiples) instead of GJ, Toe, etc.), and then checked for consistency, by comparing single values with the expected sum (e.g. "final energy consumption from RES" and single renewable sources under "final energy consumption by source").

Table 4. EUSALP main energy data. Data source: EUSALP Energy Survey 2017

	Min (Territory)	Max (Territory)	Total	Mean	Std. dev.
Final energy consumption (TWh/year)	1.04 (Nidwalden)	386.2 (Bayern)	2270.1	48.3	84.2
Final energy consumption pro capita (MWh/year/inh)	18.7 (Liguria)	45.8 (Graubünden)	-	30.2	6.3
Electricity consumption (TWh/year)	0.23 (Obwalden)	77.6 (Bayern)	552.7	11.8	20.3
Heating consumption (TWh/year)	0.39 (Nidwalden)	187.4 (Bayern)	987.5	21.1	39.1
Transport sector consumption (TWh/year)	0.39 (Glarus)	123.6 (Bayern)	730.2	14.5	25.5
Share of RES in electricity consumption	5% (Zug,Liguria)	100% (Alpine NUTS)	38%	48%	37%
Share of RES in heating consumption	1% (Lombardia)	61% (Kärnten)	18%	21%	16%

[6] Cogeneration is always assumed as a RES, unless otherwise specified by respondents.

On the basis of available[7] data it was possible to provide an estimation of the final energy consumption figures in the EUSALP area, distinguishing thermal energy from electricity and transport. Later, the share of RES in heat and electricity was calculated, as well as the amount of exported and imported electricity.

To obtain these figures, some assumptions were made: (i) heat consumption is assumed to be equal to the difference between final energy consumption and electricity consumption plus the consumption of the transport sector. If consumption data by sectors were missing, we assumed the heat consumption to be equal to the heat production; (ii) to calculate the electricity export inland electricity need is assumed to be satisfied first by energy production from the local RES, then from fossil fuel plants or nuclear plants[8]. In some cases, we found reliable values, in some others results seem to be affected by accountancy divergences or errors in data entry[9]. Thus, next to each local energy chart, its relative level of confidence/completeness (good, medium or low) is presented, judging both the overall completion of the sections and the accordance of data. These data confidence level labels consist of personal perceptions of Eurac researchers.

No further elaborations about consumption sectors and sources have been done, due to different accountancy systems and the high number of annotation and comments inserted by respondents.

Energy data validation

EUSALP Energy Survey 2017 data provided by respondents have been compared with available statistical databases of each EUSALP country. This was needed on the one hand to probe the accuracy of data collection, to fill some data gaps, and to avoid misunderstanding in the interpretation of the definitions[10].

In the following chart, blue bars show data coming from the EUSALP Energy Survey 2017, provided by respondents, while red bars show the “gross final energy consumption” data calculated from national statistical data source (Austria, Italy, Slovenia, and Land Bayern[11]) and from EUROSTAT data at national level, redistributed by the number of inhabitants to NUTS 2 and 3 level (France, Switzerland, Baden-

[7] Not all administrative areas completed the EUSALP Energy Survey 2017 by the time this Report was published.
[8] Where relevant, an alternative option is provided, assuming that the mix of locally consumed electricity is equal to the one exported.
[9] For example: the inclusion, exclusion or suspected double counting of electricity directly used for space heating purposes (consumed as heat source); the value attached to “cogeneration”, that was often interpreted by respondents as only dealing with RES.
[10] See the section “Discussion” of this chapter for more info about the methodology.
[11] For Land Bayern we computed the gross final energy consumption according to the Directive 2009/28/EC.

Württemberg)[12]. The labels show the difference in percentage between the calculated value and EUSALP survey data.

The result of the validation returns some errors exceeding the 10%, and a few cases of major differences around 20-25%. The lack of blue bars highlights still not answered questionnaires (or not properly answered). Nevertheless, the values provided by respondents cover near 90% of the overall calculation, and their sum, integrated with estimated data, only differs by 3% from the estimated gross final energy consumption of the whole EUSALP region. It is also worth mentioning that the reference year chosen by respondents ranges from 2008 to 2016, while validation data refer to 2014 or 2015.

[12] The comparison with national data redistributed by the number of inhabitants (those marked with *) provide of course less robust results, due to basic assumption of equal consumption in different territories of the same country. Similarly, the comparison between the data at the country level with aggregated territorial data (those marked with **) is possible only by filling the missing value with estimates obtained with the method previously described and having the same limitations.

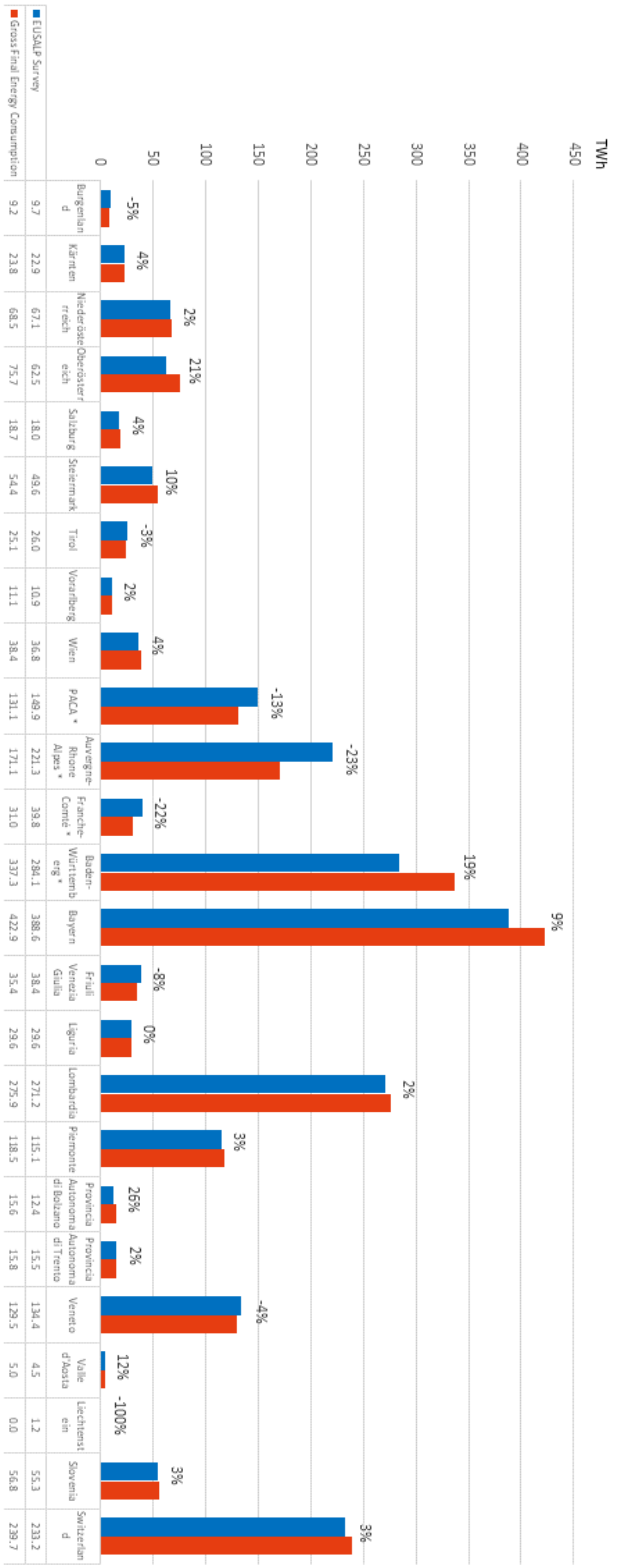


Figure 4. Double check of final energy consumption figures declared by respondents.
Data source: EUSALP Energy Survey 2017 and Eurac Research internal project

Electricity in the EUSALP territory

Electricity consumption	Electricity production	Electricity Import	From RES	From fossil fuels	From nuclear	Electricity production				
						PV	Hydro power	Wind power	Cogeneration	Waste
553 TWh	537 TWh	22TWh	220 TWh	134 TWh	182 TWh	22 TWh	176 TWh	6 TWh	11 TWh	3 TWh
		3%	37%	22%	20%	10%	80%	3%	5%	1.5%

Table 5. Electricity balance and RES production mix. Data source: EUSALP Energy Survey 2017

The section concerning electricity production was often exhaustively compiled by respondents. On the basis of collected data (see Table 5), it seems that there is a small imbalance in the EUSALP region between the annual final electricity consumption and production: the former is about 550 TWh, the latter 530 TWh, thus a 3% lower[13]. Electricity production from RES is about 37%, the remaining energy comes from nuclear plants (20%) and from fossil fuel plants (22%). Among RES, hydropower plants production is outstanding (80%), a long way down lies PV (10%). Power from wind and cogeneration is even lower (around 4% each one), and waste contribution only slightly above 1%.

It clearly appears that in the EUSALP area coexist opposite situations: about half of the territories need to import electricity (among those the less self-sufficient are PACA, Franche-Comté, Liechtenstein and some Swiss cantons, importing near 80% of electricity locally consumed), while others are net exporter (those having the stacked column exceeding the red dot in Figure 5).

Among exporters, Auvergne-Rhone Alpes has the most outstanding figure: 60 TWh of exported power (50% of the production), mainly coming from the nuclear plant. Similar source and export rate characterize Aargau, even though the figure is much smaller (9.5 TWh of export). Valais, Graubünden, and Provincia Autonoma di Bolzano/Autonome Provinz Bozen export amounts to about 6 TWh of renewable electricity each, almost completely coming from hydropower plants.

[13] Please note that the reference year of collected data range from 2008 to 2015. Besides, the electricity production figure can be overestimated due to the fact that electricity production figure is gross energy, while electricity consumption figure is final energy.

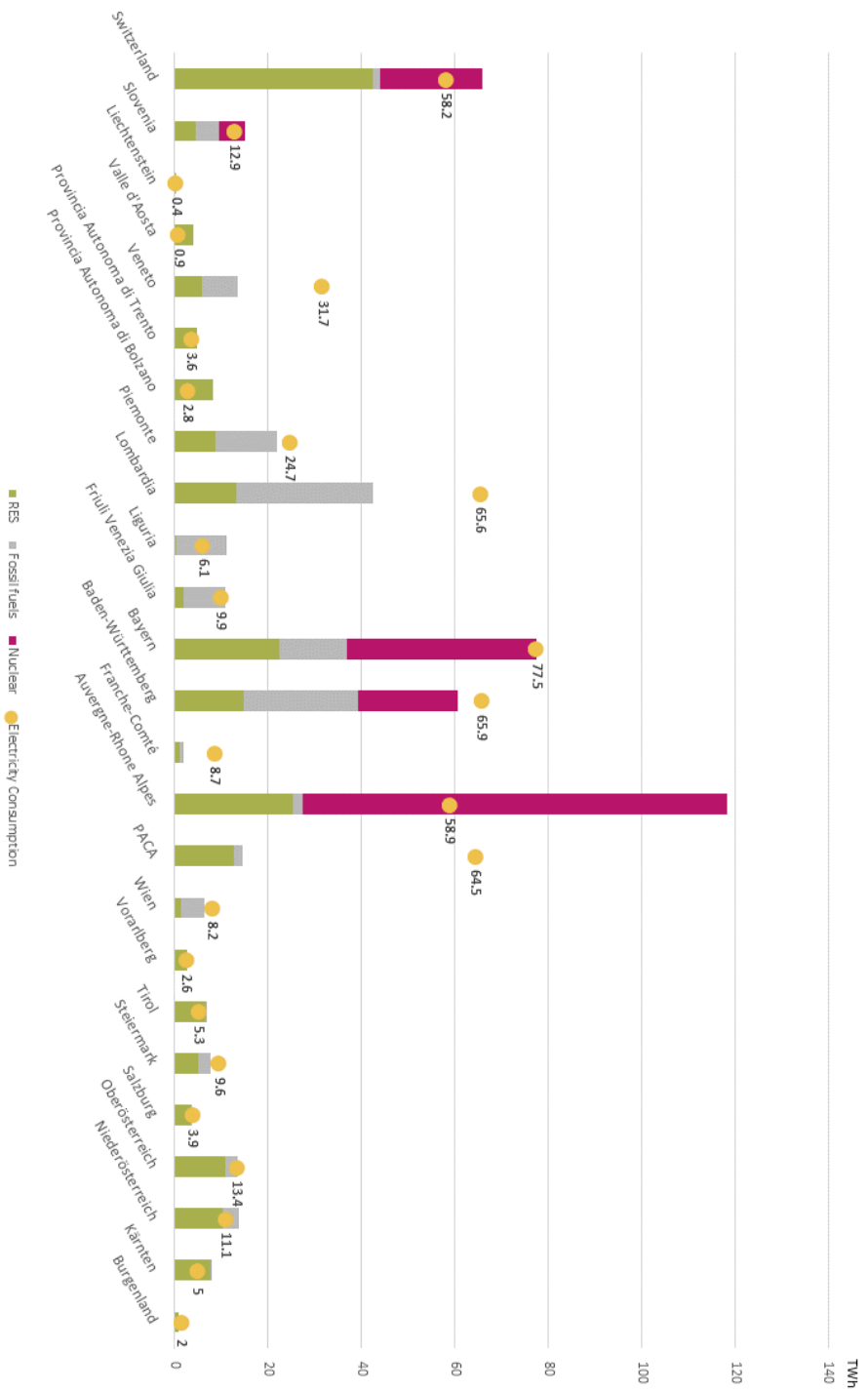


Figure 5. Electricity production by source and local consumption. Data source: EUSALP Energy Survey 2017 and Eurac Research elaborations

Liguria also exports 5 TWh (45% of its electricity production), almost completely produced from fossil fuels. Slovenia presents a modest export (15% of its production), with a production mix of 15 TWh made of nuclear, fossil and RES in similar proportion. Electricity production from fossil fuel in Switzerland seems to be close to zero.

By spatially comparing the data of electricity production and consumption, it can be seen that the share of renewables is higher in the Alpine core area where, thanks to the availability of natural sources, the electricity production is significant. In mountain areas, the electricity production completely satisfies the electricity consumption and the surplus is exported to other regions (see Figure 6).

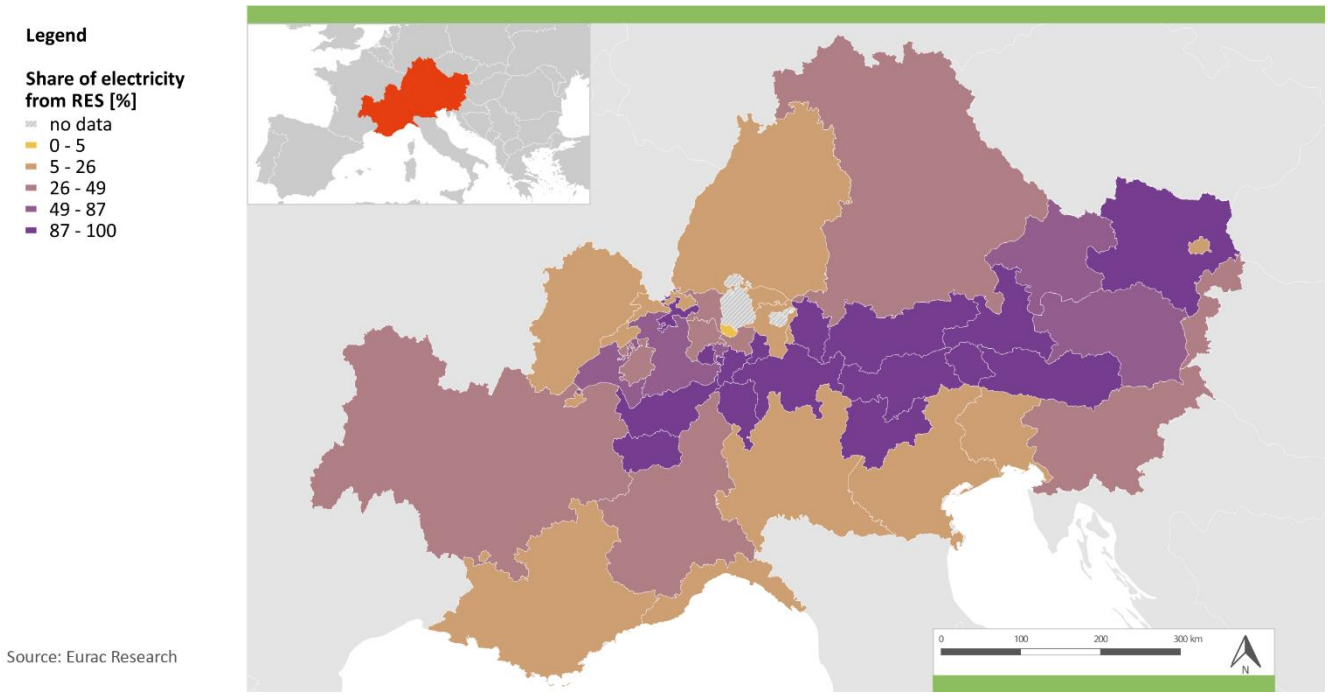


Figure 6. Share of electricity from renewable sources.
Data source: EUSALP Energy Survey 2017

On the other hand, electricity consumption is higher in the more industrialized and densely populated regions where the share of electricity from renewables is usually lower. Energy consumption data normalized by the surface (see Figure 7) or population (see Figure 8) returns quite different results, as predictable.

In the first case (Figure 7), the lower consumption goes to a broad group of territories located in the central east-west band of EUSALP, while the highest to the small entities of Wien (AT) and Liechtenstein, followed by Lombardia (IT).

Looking at per capita consumption (Figure 8), PACA (F), Liechtenstein, Oberösterreich (AT), Kärnten (AT), and Friuli Venezia Giulia (IT) move on the top, while Piemonte (IT), Provincia Autonoma di Bolzano/Autonome Provinz Bozen (IT), and Burgenland (AT) still keep the lowest consumption.

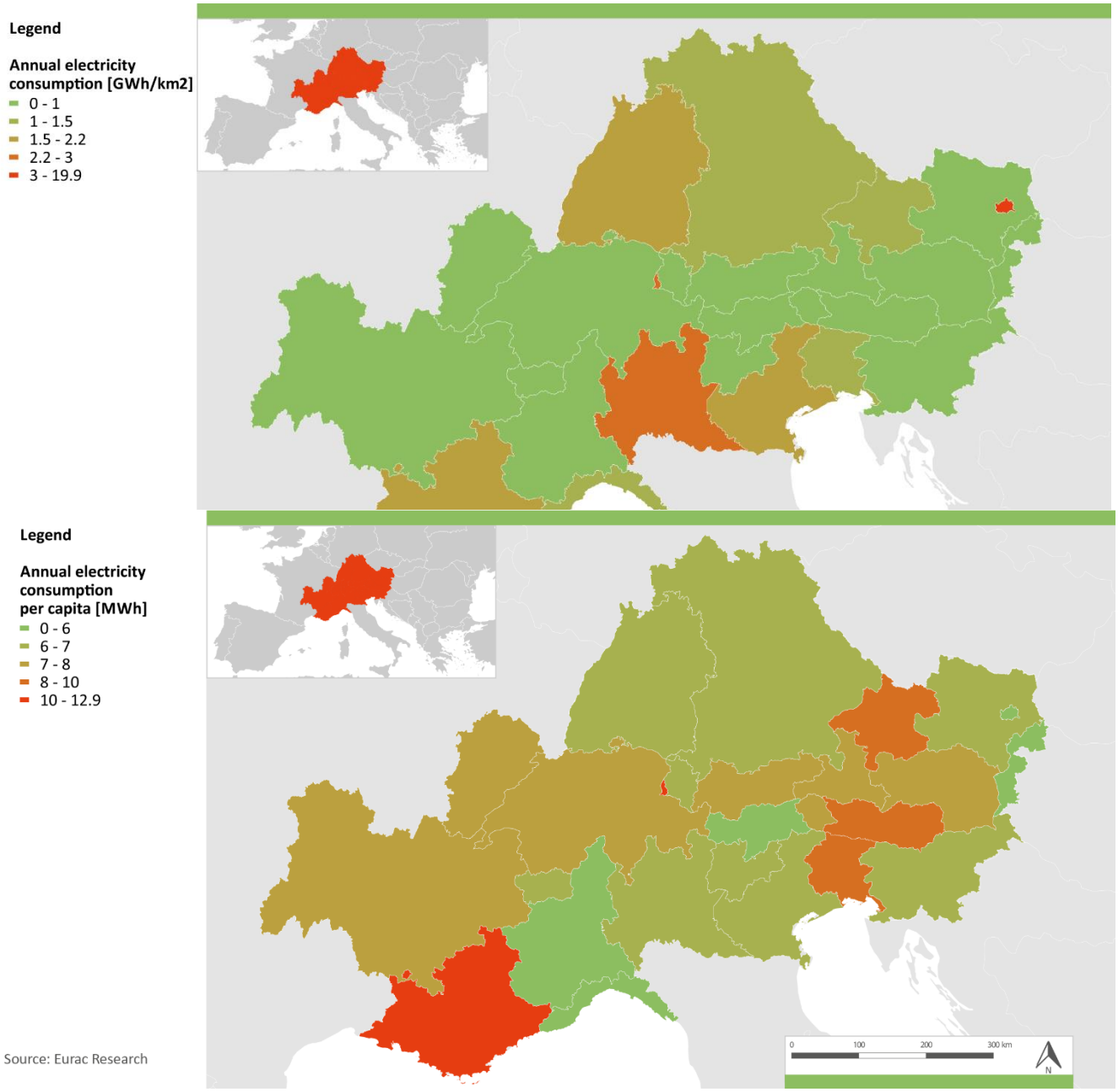


Figure 8. Yearly electricity consumption per capita. Data source: EUSALP Energy Survey 2017

Thermal energy in the EUSALP

Heat production	From RES	From fossil fuels	From direct electricity	Heath production			
				Solar thermal energy	Geothermal energy and ambient heat	Biofuels and biomass	Waste
987 TWh	203 TWh	777 TWh	7 TWh	7 TWh	12 TWh	154 TWh	17 TWh
	21%	79 %	1%	4%	6%	81%	9%

Table 6. Heating needs and RES production mix. Data source: EUSALP Energy Survey 2017 and Eurac Research

Thermal energy needs seem to account for about 43% of the overall final energy consumption in the EUSALP area, corresponding to about 990 TWh per year14 (see Table 6). Heat production from RES, on the basis of collected data, is about 21%15. Among RES, biomasses and biofuels (not further distinguished) play a prominent role (about 80%), while solar thermal and geothermal account for around 5% respectively and waste for near 10%. Natural gas is the most used source of thermal energy (50% of overall production and 64% of fossil fuels). Still, 8% of heat in the EUSALP area comes from coal. Among thermal energy sources, the survey includes electricity directly used for heating purposes; figures provided by respondents built overall a 1%. Notice that the energy balances often do not account for the final use of the energy. Consequently, electricity used for heating purposes is considered as electricity consumption and this value cannot easily be estimated. The EUSALP Energy Survey 2017 was not precisely asking about fossil fuel supply; one can, however, assume that in general they are not locally available (or just marginally). Similarly, heat is assumed to be generated and consumed locally, and not exchanged as electricity between territories.

The section concerning heat production was not always answered by respondents, and in some cases the impression was that figures were related only to the RES side or partially missed some data. Thus, in the majority of cases the sum given by the energy sources was lower than the estimated needs obtained by subtracting from the final energy the electricity and the transport sector consumption. Figure 9 shows the local heating needs by energy sources obtained after a refinement process of inserted data.

[14] Please note that the reference year of collected data ranges from 2008 to 2015.
[15] The sum of energy sources declared by respondents only covers 60% of expected thermal needs, thus the overall percentage could be different.

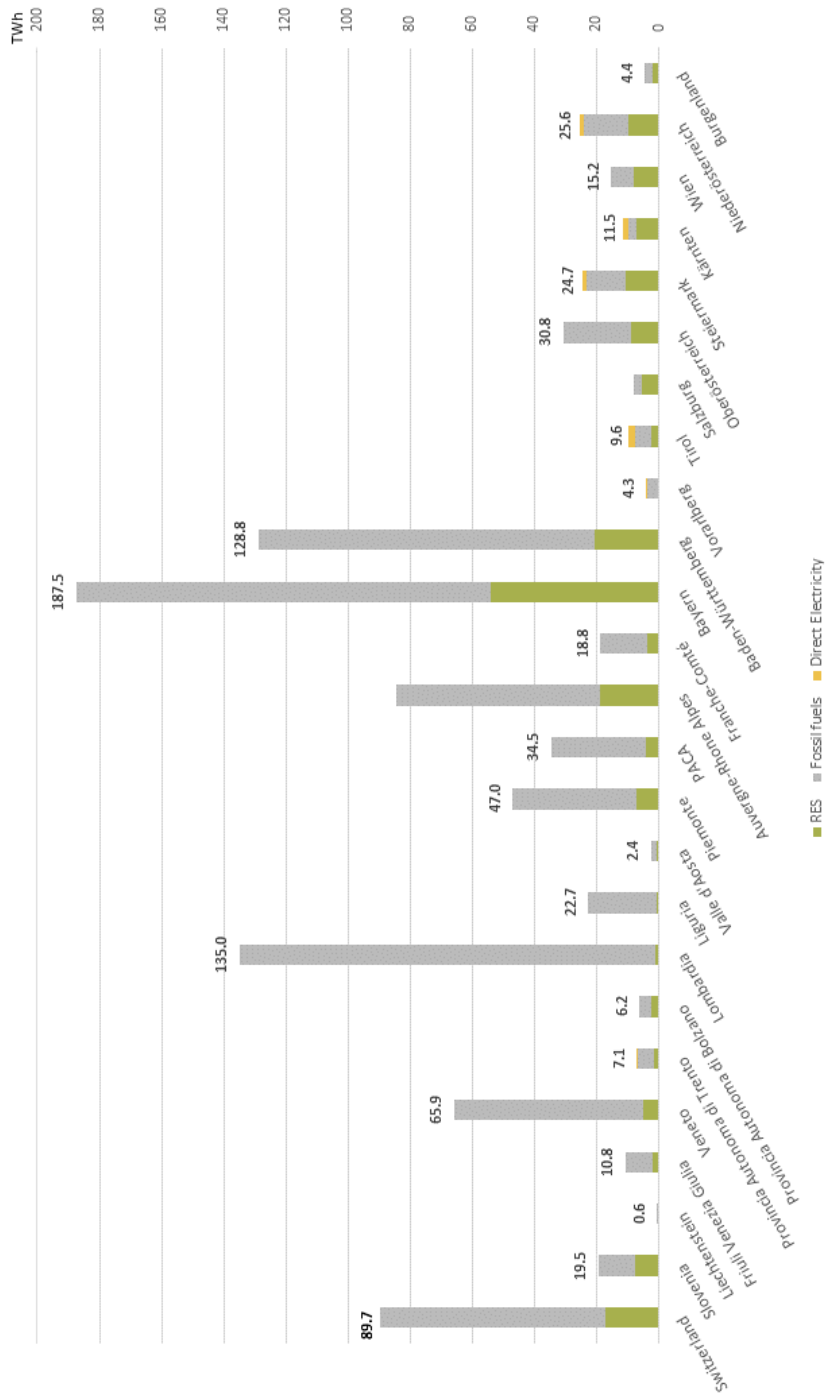


Figure 9. Thermal energy consumption by energy source. Data source: EUSALP Energy Survey 2017 and Eurac research elaborations

The spatial distribution of RES in heat consumption (see Figure 10) shows some different patterns in comparison to previously reported electricity consumption (Figure 6). Territorial entities performing better are Salzburg (AT) und Kärnten (AT), and in general those in the eastern side. At the opposite of the chart are Lombardia (IT), Liguria (IT), and Zug (CH) with a small contribution from RES.

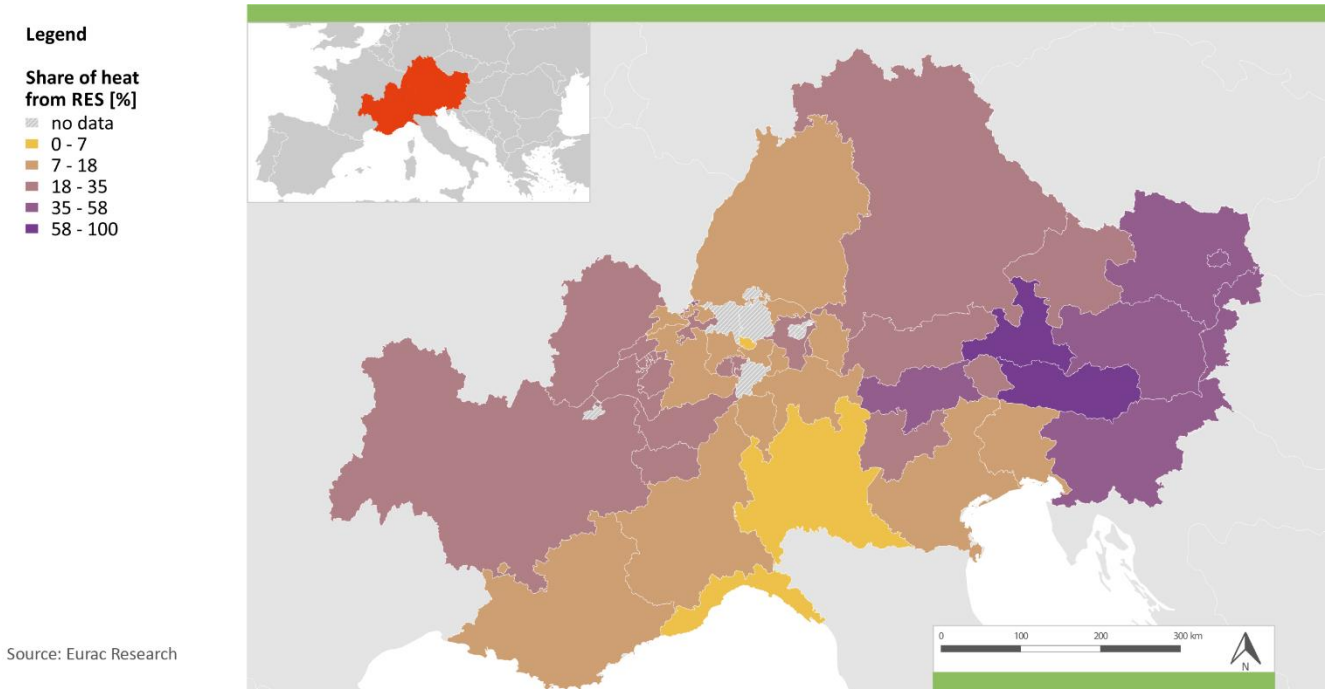


Figure 10. Share of heat from renewable energy sources.
Data source: EUSALP Energy Survey 2017 and Eurac research elaborations

Heat consumption level normalized on territorial surface (see Figure 11) or inhabitants (see Figure 12) also offer interesting results. In the first case (Figure 11), Wien (AT) and Lombardia (IT) are again the highest (as for the electricity branch), while the better are the core Alpine territories of Provincia Autonoma di Bolzano/Autonome Provinz Bozen (IT), Tirol (AT) and Valle d'Aosta (IT).

Looking at the per capita heat consumption (Figure 12), the territories on the central-east side, as Oberösterreich (AT), Kärnten (AT), and Steiermark (AT) are the most energy-intense consumers (similarly as for electricity), while the lower per capita heating needs are in PACA (FR), Liguria (IT) and Friuli Venezia Giulia (IT).

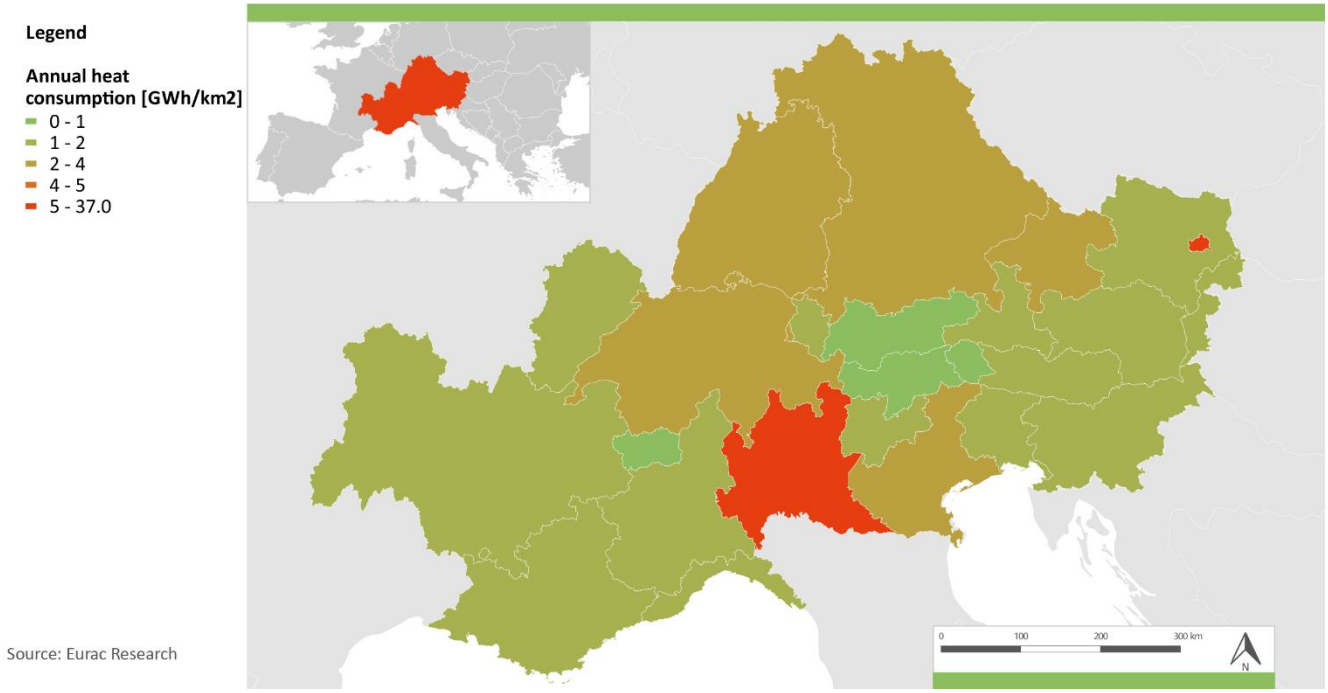


Figure 11. Yearly heat consumption per area. Data source: EUSALP Energy Survey 2017

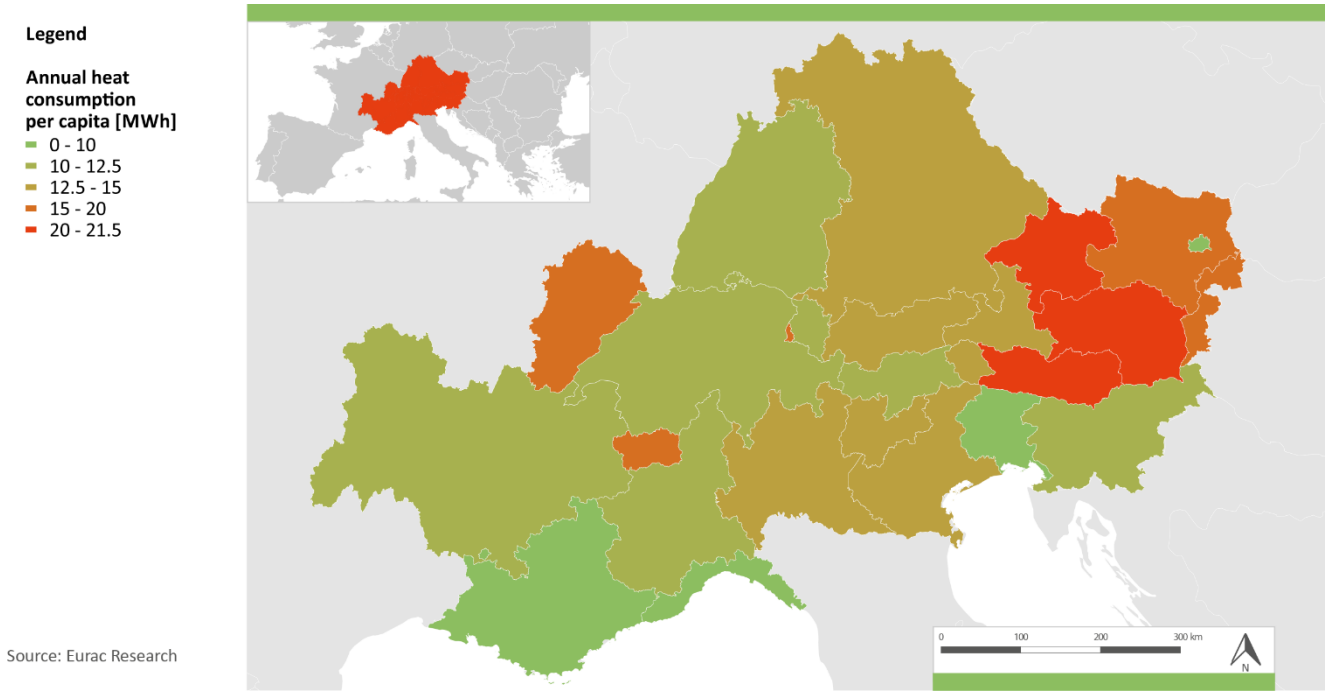
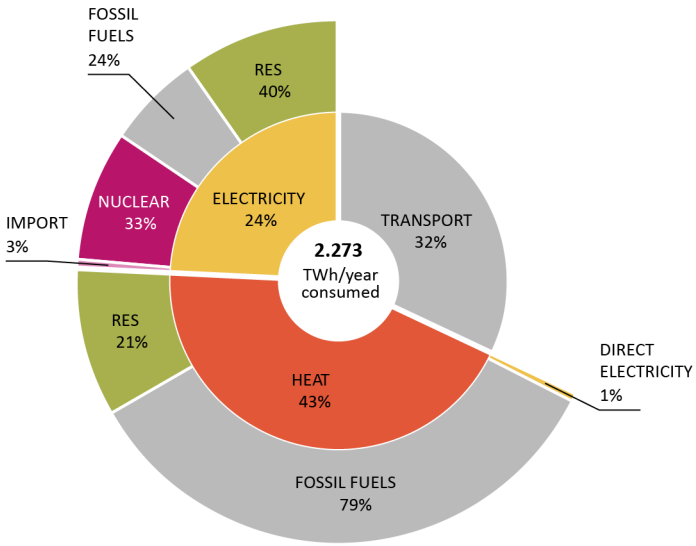


Figure 12. Yearly heat consumption per capita. Data source: EUSALP Energy Survey 2017

Discussing results

On the basis of the collected data, it is possible to generate some general energy figures for the EUSALP area. Yearly energy consumption is approximately 2.300 TWh, mainly related to heating needs (43% of



Source: Eurac Research

Figure 13. EUSALP energy consumption and share of RES.
Data source: EUSALP Energy Survey 2017 and Eurac Research elaborations

total final energy consumption), then transport (32%) and electricity (25%) (see Figure 13).

Energy consumption shares vary widely among the territories: for example, in Tirol (A) the main share relates to transport (42%), while in PACA (F) to electricity consumption (43%).

Electricity balance depicts the EUSALP area as a slightly net importer[16] because generated power is only 97% of local consumption. The share of RES in the local generation is generally quite high (37%), especially due to a strong hydropower production in the core Alpine area. In Baden-Württemberg (D), Bayern (D), and Thurgau (CH) the PV also makes an important contribution, around 40% of renewable electricity generation. Wind as a source for electricity production is quite relevant in Niederösterreich (A), and electricity from Burgenland (A) totally comes from PV and wind.

[16] Energy imported figure could be slightly underestimated due to the fact that electricity production values are gross energy production, while energy consumption figures is in final units.

In some core Alpine territories – Kärnten (A), Tirol (A), Provincia Autonoma di Bolzano/Autonome Provinz Bozen (I), Provincia Autonoma di Trento (I), Valle d'Aosta (I), Glarus (CH), Graubünden (CH) – local hydropower production exceeds the local energy needs. In a few cases, electricity exports are mainly related to the presence of nuclear power plants – Bayern (D), Auvergne-Rhone Alpes (F), Aargau (CH), Bern (CH) and some other Swiss cantons –, fossil fuel plants – Liguria (I) and Friuli Venezia Giulia(I) – or both as in Slovenia. A remaining 3% of the electricity demand is covered by imported power, whose composition is unknown (it assumed to be the same in every national energy mix).

The 78% of the heat demand is satisfied by non-renewable sources, mostly natural gas, in a smaller extent mineral oil. Remaining 21% of heating need is covered by locally generated power from RES, mostly from biomass/biofuels. Kärnten (A) und Steiermark (A) stand out of the crowd, with a renewable heat production above 40%, due to the contribution of biomasses.

The only information we get from the survey about the transport sector is a percentage value of the total consumption, on average 32%, with a few extremes ranging from near 20% – Basel-Stadt (CH) – to 40% – Geneve (CH). It is worth mentioning that there are some divergences in the energy accountancy systems: some territories explicitly include in transport only the fossil fuels, because electric-powered transports (e.g. for rail system) are already counted in the electricity consumption figure, while in other cases the methodology is not clear. Reasonably, due to the low penetration of clean fuels in the transport sector, one may argue that almost all consumption is related to fossil fuels.

As already said, these figures are obtained by the aggregation of data referred to various years and accounted differently. Thus, they only describe the complexity of the EUSALP area in broad terms. Moreover, it is interesting to see the variety of distribution of the percentage of the territorial entities (Figure 14), as well as the differences in RES contribution in electricity and heat consumptions.

For example, a small detail that needs further clarification is the meaning (and related account methods) of "direct electricity use" for heat production, which might turn to be relevant in the near future, shifting from gas boiler to heat pumps for domestic ambient heating purposes.

Moving from the general perspective to the pro capita figures, we obtain that on average each EUSALP inhabitant has a per capita consumption of 28 MWh/year, slightly above the EU28 figure (25 MWh/year). Liguria (I) and Graubünden (CH), respectively 19 and 45 MWh/year, represent the two extremes.

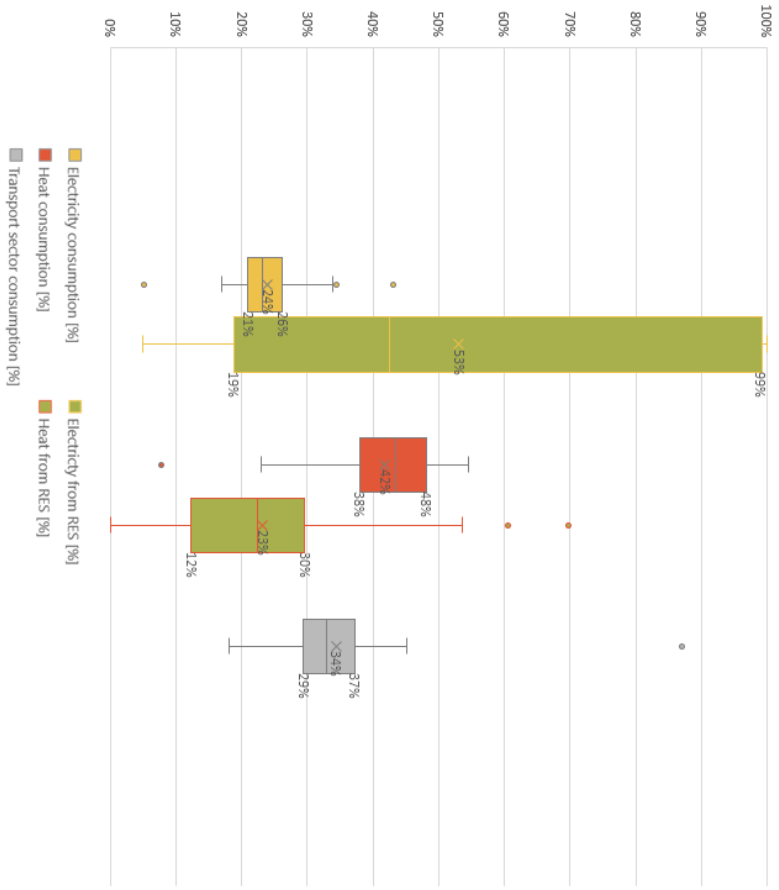


Figure 14. Statistic distribution of energy consumptions in the EUSALP.
Data source: EUSALP Energy Survey 2017 and Eurac Research elaborations

By mixing economic and energy data, differences also emerge in the energy intensity[17] of local economies (see Table 7).

A high energy intensity indicates a high price or cost of converting energy into GDP, and within the EUSALP region the upper and lower values vary by a factor of seven. This indicates how the energy and economic systems of each territorial entity are difficult to be identified by a unique way.

Table 7. EUSALP energy intensity. Data source: EUSALP Energy Survey 2017 and Eurac Research internal database

	Min (Territory)	Max (Territory)	EUSALP	Std. dev.
Energy intensity (Gross Final Energy consumption/GDP)	0,21 (Basel Stadt)	1,47 (Slovenia)	0,76	0,29

Concerning the data verification, despite the relevant work done to discover data entry mistakes or missing information, we had the feeling that also assuming different definitions of "energy consumption" and "energy production" could have lead respondents to provide different data in filling the survey's questions, thus introducing biases. Usually one can distinguish among recurrent definitions:

- energy consumption in primary units: Final energy when energy carriers are counted according to the energy consumption needed to deliver them to the end users[18];
- energy consumption in final units: Final energy when energy carriers are counted according to their content[19];
- gross inland energy consumption: the energy commodities[20] delivered for energy purposes including the consumption of electricity and heat by the energy branch for electricity and heat production and including losses of electricity and heat in distribution and transmission losses of electricity and heat in transformation[21];

[17] Energy intensity is a measure of the energy efficiency of a territory's economy. Here it is calculated as units of energy (kWh) per unit of GDP (€): high energy intensities indicate a high price or cost of converting energy into GDP, while low energy intensity indicates a lower price or cost of converting energy into GDP.
[18] ISO 17742:2015 Energy efficiency and savings calculation for countries, regions and cities.
[19] ISO 17742:2015 Energy efficiency and savings calculation for countries, regions and cities.
[20] Among them the transport sector.
[21] EUROSTAT.

- gross final energy consumption: the energy commodities delivered for energy purposes including the consumption of electricity and heat by the energy branch for electricity and heat production and including losses of electricity and heat in distribution and transmission[22].

To double-check the data, Eurac researchers used as reference value the "gross final energy consumption" as it is defined in the Directive 2009/28/EC on renewable sources, in order to compute the share of renewable energy and compare the results with European data.

[22] Directive 2009/28/EC.

SECTION 4 – REMAINING POTENTIAL OF RENEWABLES

The fourth section of the EUSALP Energy Survey 2017 focuses on the qualitative assessment of both electric and thermal energy production from renewable sources:

Q1. Please rank the remaining potentials of RES in electricity production.

Q2. Please rank the remaining potentials of RES in heat production in your Region/Canton/Province/State.

The answering format is a five-range scale measuring the remaining potential as high, medium/high, medium, medium/low, low[23]. Four categories are listed under electricity production, namely: photovoltaic (PV), hydropower, wind power, and cogeneration. While heat production encompasses five sources:

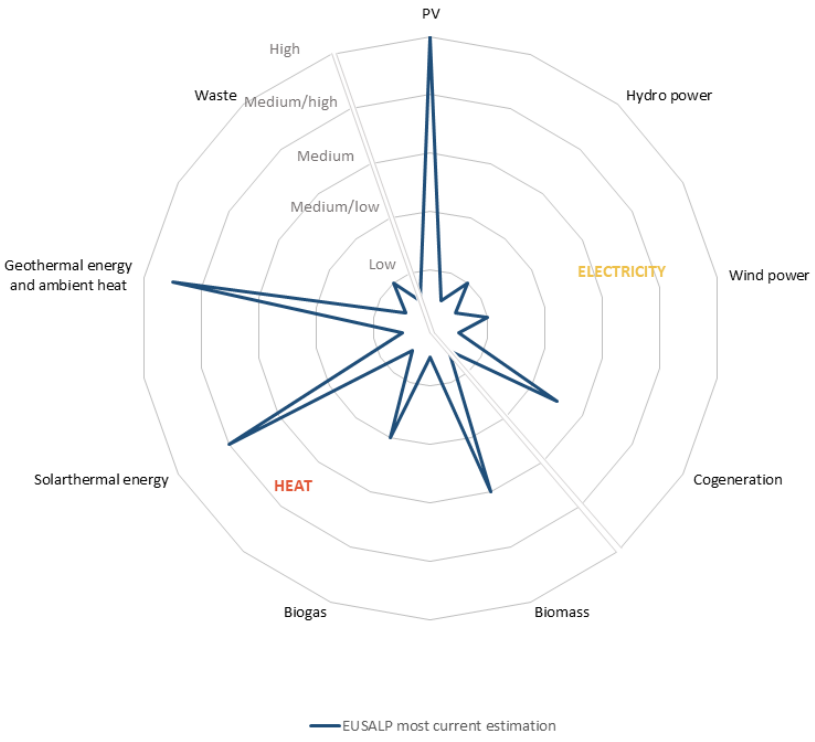


Figure 15. Self assessed remaining potentials of RES (most recurrent judgements). Data source: EUSALP Energy Survey 2017

[23] In the following description high, medium/high, are considered positive statement about remaining potential, while medium/low and low negative. Medium is the central, thus a neutral value.

biomass, biogas, solar thermal energy, geothermal energy and ambient heart, and waste.

Figure 15 shows the most recurrent judgments given by respondents in the EUSALP area, electricity production lies on the right side, heat on the left. The photovoltaic (PV) ranks on top, as the most promising energy source to be further exploited in electricity production, followed by cogeneration. The same about solar thermal and geothermal in the heating sector. Given the absence of further explanations, it is not possible to say if respondents considered such qualitative assessment as related to the actual penetration of the source in the local mix, or on an absolute scale. Even more interesting than the absolute values, is the variation of answers provided by respondents. The most recurrent answers in the electricity sector are “medium” (21%), while “medium” or “medium/low” (respectively 22% and 20%) dominate the heating branch (see Figure 16 and Figure 17). The number of unanswered questions concerning heat production from RES (20%) is wider than in electricity (12%) and covers one-fifth of the branch.

Remaining potential of electricity from renewables

As Figure 16 shows, the 64% of answers about PV remaining potential are very positive, while in most of the territories there is a low expectation of additional production from hydropower (52%). A positive remaining potential is attached to wind in the majority of cases (42%), even though once excluded the unanswered questionnaires and the central values, the overall amount of less optimistic judgments over-

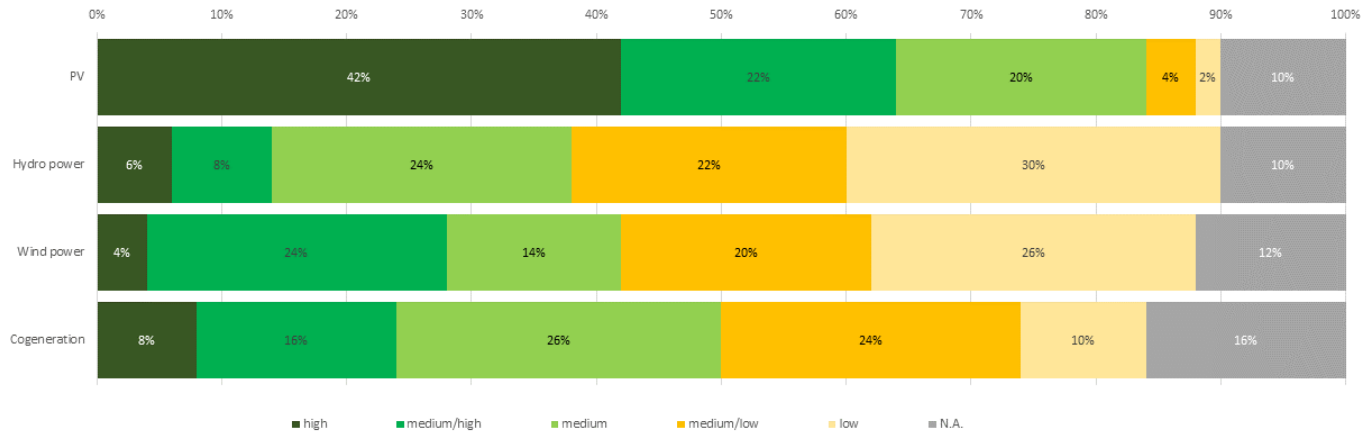


Figure 16. Self assessed remaining potentials of RES in electricity production. Data source: EUSALP Energy Survey 2017

comes the positive (26%).

Concerning cogeneration, answers are quite equally distributed in all the segments of the evaluation scale, (26% and 24% respectively).

Remaining potentials of heat from renewables

Figure 17 shows how in heating, as for electricity before, the sun is seen as the clean energy source receiving the higher percentage of positive answers about its potential (44%). Interestingly, it is also the most mentioned as the one having a "medium potential" (34%) among heating RES. The majority of respondents considers geothermal energy and biomass (42% and 30% respectively) as presenting interesting developments. About biogas potential, the most recurrent judgments are negative (50%), as

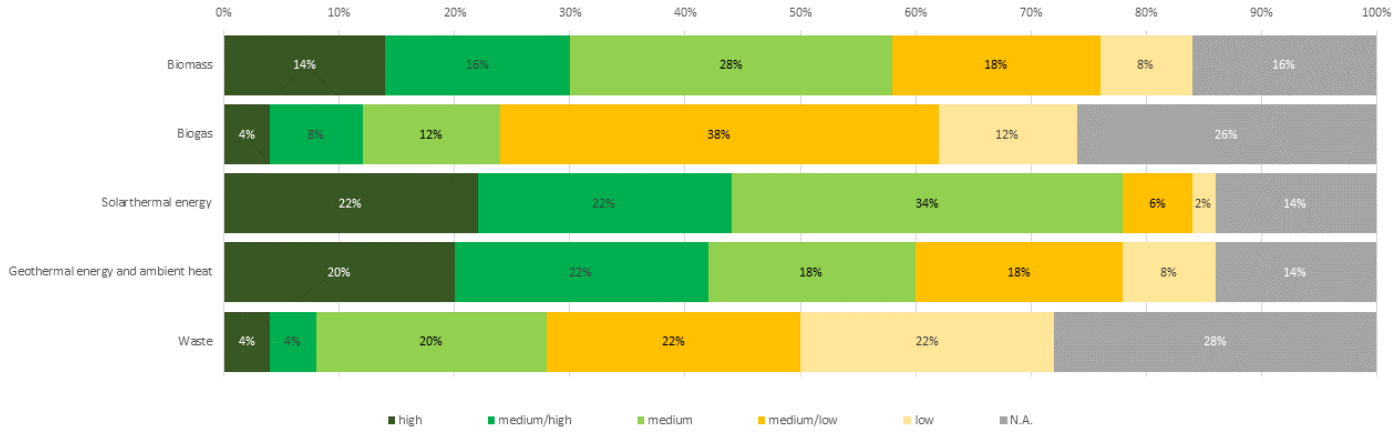


Figure 17. Self assessed remaining potentials of RES in heat production. Data source: EUSALP Energy Survey 2017

showed by a high percentage of unanswered questionnaires (26%). Similarly, the energy potential of waste is often considered poor (44%), and several questionnaires concerning this source have been left blank (28%).

Table 8 shows the links to feasibilities studies for RES in the electricity and heating sectors given by respondents to the EUSALP Energy Survey 2017.

	EUSALP TERRITORY	Links to feasibility studies and mappings for RES in electricity	Links to feasibility studies for RES in the heating sector
AUSTRIA	Burgenland	Energiestrategie Burgenland 2020	Energiestrategie Burgenland 2020
	Niederösterreich	http://www.noe.gv.at/Umwelt/Energie/Windkraft.html	
	Oberösterreich	http://www.energiesparverband.at/fileadmin/redakteure/ESV/Info_und_Service/Energie_in_OOe/Energie-Zukunft_2030/Potentiale_Energieszenarien_2030.pdf http://www.land-oberoester-reich.gv.at/files/publikationen/AUWR_Wasserkraftpotentialanalyse.pdf	http://www.energiesparverband.at/fileadmin/redakteure/ESV/Info_und_Service/Energie_in_OOe/Energie-Zukunft_2030/Potentiale_Energieszenarien_2030.pdf
	Salzburg	www.salzburg.gv.at/themen/energie/energiedatenfakten , www.umweltbundesamt.at , Statistik Austria	
	Tirol	Potenzialanalyse Wasserkraft, Solarkataster Tirol, Kriterienkatalog Wind (unveröffentlicht), Biomasseversorgungskonzept, Kriterienkatalog Wasserkraft, Regionalplan Oberland	Abwärmekataster Tirol 2009, Sinfonia Innsbruck, Fernwärmeschiene Wattens-Innsbruck, iverse wärmestrategische Konzepte
	Wien	https://www.wien.gv.at/umweltgut/public/	
FRANCE	Auvergne-Rhone Alpes	http://rhone-alpes.ademe.fr/sites/default/files/files/partenariats_reseaux/reseaux/14e-rencontre/schema-regional-raccordement-reseau-energies-renouvelables.pdf	
	Franche-Comté	Wind power plan in the "SRE" http://www.franche-comte.developpement-durable.gouv.fr/schema-regional-eolien-sre-r693.html	Geothermal energy: www.brgm.fr/projet/atlas-geothermique-franche-comte
GERMANY	Baden-Württemberg	Energy Atlas (Energieatlas): http://rips-app.lubw.baden-wuerttemberg.de/maps/?lang=de&app=potenzialatlas	Energy Atlas (Energieatlas): http://rips-app.lubw.baden-wuerttemberg.de/maps/?lang=de&app=potenzialatlas
	Bayern	www.energieatlas.bayern.de	www.energieatlas.bayern.de
ITALY	Provincia Autonoma di Bolzano	Interreg-Projekt SOLAR TIROL; Solarpotenziale im Land Tirol und der Provinz Bozen	
	Provincia Autonoma di Trento		Biomass Action Plan
	Veneto	http://bur.regione.veneto.it/BurvServices/pubblica/DettaglioDcr.aspx?id=340227	http://bur.regione.veneto.it/BurvServices/pubblica/DettaglioDcr.aspx?id=340227

Table 8. Links to feasibility studies for RES in electricity and heating sectors. Data source: EUSALP Energy Survey 2017

LIECHTENSTEIN	Liech-tenstein	Energiestrategie 2020 www.energiebündel.li	www.energiebündel.li

Continue

SLOVENIA	Slovenia	http://www.energetika-portal.si/dokumenti/strateski-razvojni-dokumenti/akcijski-nacrt-za-obnovljivo-energijo/	
SWITZERLAND	Aargau	solar: https://www.ag.ch/app/agisviewer4/v1/agi-sviewer.html?xmin=2571900&ymin=1203410&xmax=2763900&ymax=1294510&basemap=base_ortho2016&thema=420; wind: https://www.ag.ch/app/agisviewer4/v1/agisvie-wer.html?xmin=2448750&ymin=1134110&xmax=2928750&ymax=1361860&basemap=base_leer&thema=443; geothermal energy: https://www.ag.ch/app/agisviewer4/v1/agisview-er.html?xmin=2448750&ymin=1134110&xmax=2928750&ymax=1361860&basemap=base_ortho2016&thema=72	https://www.google.ch/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwjV6bL2qavUAhVCY1AKHYfFAnYQFggrMAE&url=https%3A%2F%2Fwww.ag.ch%2Fmedia%2Fkanton_aargau%2Fbvu%2Fdokumente_2%2Fumwelt__natur___landschaft%2Fumweltschutzmassnahmen_1%2Fabwasserreinigung_1%2Fafu_bericht_abwasserwaermenutzung.pdf&usg=AFQjCNGVRU71CJ7XhKzs4eTt0uxPMpYJoA; www.sonnendach.ch
	Basel-Landschaft	www.geoview.bl.ch (solar kataster)	
	Bern	http://www.map.apps.be.ch/pub/synserver?project=a42pub_komrpe&userprofile=geo&language=de ; http://www.apps.be.ch/geo/index.php?tmpl=index&option=com_easysdi_catalog&Itemid=46&context=geocatalog&toolbar=1&task=showMetadata&type=complete&id=a5031ed6-0c0a-4219-b76f-459d1f6f4638&lang=de ; http://www.bve.be.ch/bve/de/index/wasser/wasser/wasserkraft.html ;	http://www.gr.be.ch/etc/designs/gr/media.cdwsbinary.DOKUMENTE.acq/f7001b3833364a7582f9ba8e1c51d152-332/2/PDF/2015.RRGR.802-Beilage-D-116549.pdf ; http://www.bve.be.ch/bve/de/index/direktion/ueber-die-direk-tion/downloads_publikationen.assetref/dam/documents/BVE/AUE/de/pub/aue_en_ev_eig_analyse_heizanlagenbestand_be_schlussbericht_d.pdf
	Fribourg	Plan sectoriel de l'énergie (parution automne 2017)	

	Graubünden	http://map.geo.gr.ch/gr_webmaps/wsgi/theme/Globalstrahlung?lang=de ; http://www.bfe-gis.admin.ch/sonnendach/?lang=de ; https://www.gr.ch/DE/institutionen/verwaltung/bvfd/aev/dokumentation/AmtDokumente/Studie_AEV.pdf	https://www.gr.ch/DE/Medien/Mitteilungen/MMStaka/2016/Documents/160201_PotenzialstudieGRSG_Kurzfassung_V3.pdf ; http://www.gr.ch/DE/institutionen/verwaltung/bvfd/aev/dokumentation/AmtDokumente/Energieholzpotenzial_GR.pdf ; http://map.gis.gr.ch/gr_webmaps/wsgi/theme/Erdwaermenutzung; http://map.gis.gr.ch/gr_webmaps/wsgi/theme/Förderberechtigung%20für%20Luft-Wasser-Wärmepumpen
	Jura	Conception cantonale de l'énergie: http://www.jura.ch/DEN/SDT/Energie/Politique-energetique-du-Canton-du-Jura/Politique-energetique-du-Canton-du-Jura.html	https://www.jura.ch/DEN/SDT/Energie/Politique-energetique-du-Canton-du-Jura/Politique-energetique-du-Canton-du-Jura.html

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SWITZERLAND	Lucerne	http://www.geo.lu.ch/map/solarpotential/ ; www.sonnendach.ch; http://www.sonnenfassade.ch/	http://www.geo.lu.ch/map/solarpotential/; www.sonnendach.ch; http://www.sonnenfassade.ch/
	Neuchatel	http://www.ne.ch/autorites/DDTE/SENE/energie/Pages/efficacite-energies-renouvelables.aspx	http://www.ne.ch/autorites/DDTE/SENE/energie/Pages/efficacite-energies-renouvelables.aspx
	Nidwalden	http://www.nw.ch/dl.php/de/20080114100448/potenzial_energitraeger_nw.pdf	http://www.nw.ch/dl.php/de/20080114100448/potenzial_energitraeger_nw.pdf
	Schwyz	https://map.geo.sz.ch Energie, Solarkataster	
	Ticino	http://www4.ti.ch/fileadmin/GENERALE/piano_energetico_cantonale/documenti/PEC_Piano_azione_2013.pdf	http://www4.ti.ch/fileadmin/GENERALE/piano_energetico_cantonale/documenti/PEC_Piano_azione_2013.pdf
	Uri	www.sonnendach.ch	Wärmenutzungskonzept in Überarbeitung
	Valais	https://www.vs.ch/documents/87616/178920/Teilstrategie+Photovoltaik/d55e3796-b280-4a1a-baf0-0bb367b454a5 ; https://www.vs.ch/documents/87616/178920/Teilstrategie+Windenergie/05199edf-e7b2-4069-83cc-94c4c51bb224	https://www.vs.ch/documents/87616/178920/Synthese+Strategie+EEV/45b0472a-23e4-4d78-926b-11f30e2f68b6?t=1499868163764

Discussing results

Not surprisingly, the second section of the EUSALP Energy Survey returns a great variety of judgments about the remaining potentials of different RES. Remaining potentials differ from several reasons, dealing both with the absolute presence or scarcity of a certain resource in a given territory, as well as with the already achieved exploitation level and local strategies of further development. Respondents declared different interpretation of the “remaining potential” concept: in some cases, they were referring to the overall remaining availability of the resource, while in some others to the gap between the actual use

and the target set by strategies and political decisions. Again, it is not possible to say if respondents considered such qualitative assessment as related to the actual penetration of the source in the local mix, or on an absolute scale.

An interesting point raised by the answers is the possible development of energy systems in the near future. Are we going towards more individual and self-organized electricity microgrids (maybe based on small-scale PV distributed plants), and centralized heating systems (e.g. district heating networks based on biomass centralized boilers)? Most of the respondents guess that PV has a high potential, while hydropower, the resource, seems room for signifi- conversely bio- RES in heating, large potential.

Other questions (from Q12 to ples of regulation ern the expansion es and studies as main obstacles in

OPEN QUESTIONS

Judgements provided by respondents have been compared with results obtained from modeling activities developed by Eurac Research within an internal project, aiming to estimate the theoretical potential of RES in the alpine region. In some cases discrepancies arise, this can be seen as the mismatch between theoretical potential and the already exploited resources, or as the intention to support/stern the further use of a certain source.

already most used to have no additional cant development; mass, the most used still seem to have a

posed in this section Q17) provide exam- instruments that gov- of RES, best practic- well as some of the raising the potentials

of RES. Respondents often provided such info in their own language. Among the barriers in electricity RES exploitation, social and political acceptance, as well as market distortions (e.g. not including environmental costs or subsidies in fossil fuel generated energy) are the most mentioned. The heat generation branch seems to suffer low prices of fossil vectors (gas and mineral oil), and concerns about biomass combustion problems (e.g. increasing air pollution).

SECTION 5 – ENERGY STRATEGIES

The fifth section of the EUSALP Energy Survey investigates the climate-energy strategies adopted by the administrative territories, with a special focus on measures, targets and monitoring systems.

Q18. REGULATIONS AND ROADMAPS. Please name the energy strategy and related Regional/national regulations of your Region/Canton/Province/State. Shortly resume its contents and provide a direct link to the documents if available.

Q19. FOCUS AREAS. Please indicate the focus areas of the energy strategy of your Region/Canton/Province/State (energy production, renewable energies, energy distribution and storage, energy efficiency of buildings and in industry, etc.).

Q20. GOOD PRACTICES. In your opinion, in which focus area(s) your Region/Canton/Province/State has been particularly successful in implementing the energy strategy and explain why.

Q21. MEDIUM TERM TARGETS OF THE ENERGY STRATEGY. Please indicate the medium term targets (by 2020) defined by the energy strategy.

Q22. LONG TERM TARGETS OF THE ENERGY STRATEGY. Please indicate the long-term targets (e.g. by 2050) defined by the energy strategy.

Q23. MEASURES. Which measures (e.g. regulatory, programmes, subsidies and incentives) has the Region/Canton/Province/State put in place in order to achieve the defined targets? Please provide links to the documents if available.

Q24. MONITORING AND ASSESSMENT. Has your Region/Canton/Province/State put a monitoring system into place in order to observe the implementation of the measures? If so, please briefly explain how the monitoring functions. (e.g. use of Regional data tools for decision making and data dissemination about energy and climate, energy efficiency and sustainable mobility etc.)

Q25. Are third/independent parties involved in monitoring/reporting?

Energy strategies and targets

Fourteen out of fifty entities did not provide any information about the existence of local strategies or similar documents (one from Italy and two from Austria, eleven from Switzerland). One (Piemonte), could only anticipate that the regional energy strategy will be presented in the near future, however giving some insights on it. Table 9 gives a glance at the status quo (Q18), and the presence or lack of medium/long-term targets (see columns Target M / Target L) in increasing the share of RES in the energy mix, as stated by respondents in the EUSALP Energy Survey 2017.

Some of the respondents also mentioned as additional information the existence of sectorial plans/strategies or laws related to specific renewable energy sources (e.g. wind, geothermal energy), national frameworks, or air quality protection acts. In most of the cases, single strategies embrace both energy and climate issues, aiming at reducing consumption needs and fossil fuel use, respectively by increasing efficiency and the share of renewable energy.

NUTS code	Territory	Document name	Link	Targets M	Targets L
AT11	Burgenland	Energiestrategie Burgenland 2020	http://www.tobgld.at/index.php?id=1874&CSS=0&L=3%5C%5C%5C%5C%5C%5C%27	Yes	Yes
AT21	Kärnten	Energiemasterplan (emap)	http://www.energie.ktn.gv.at/283394_DE		
AT12	Niederösterreich	NÖ Klima- und Energieprogramm	http://www.noe.gv.at/Umwelt/Klima/Klima-Energieprogramm/KlimaEnergieprogramm.html	Yes	
AT31	Oberösterreich	Ooe. Energiestrategie "Energiezukunft 2030"	http://www.energiesparverband.at/english/energy-in-upper-austria/energy-strategy-energy-future-2030.html		
AT33	Tirol	Tirol 2050 energieautonom als energiestrategischer Fahrplan	http://www.tirol2050.at/	Yes	Yes
AT34	Vorarlberg	Energieautonomie Vorarlberg	www.energieautonomie-vorarlberg.at	Yes	
AT13	Wien	Smart City Wien - Frameworkstrategy	https://www.wien.gv.at/stadtentwicklung/studien/b008380.html	Yes	Yes
FR82	PACA	Regional scheme for Energy, Climate and Air	http://www.paca.developpement-durable.gouv.fr/le-schema-Regional-climat-air-energie-a5380.html	Yes	Yes
FR71	Auvergne-Rhone Alpes	Schema Regional climat air Energie-Objectifs	http://oreges.rhonealpes.fr/fileadmin/user_upload/mediatheque/oreges/Publications/SRCAE/3_SRCAE_Objectifs_Avril_2014.pdf	Yes	
FR43	Franche-Comté	SRCAE	http://www.franche-comte.developpement-	Yes	Yes

Continue

NUTS code	Territory	Document name	Link	Targets M	Targets L
			durable.gouv.fr/IMG/pdf/SRCAE_vv_cle589444.pdf		
DE1	Baden-Württemberg	Integrated Energy and Climate Concept	https://um.baden-wuerttemberg.de/de/service/publikation/did/integriertes-energie-und-klimaschutzkonzept-baden-wuerttemberg-iekk/	Yes	Yes
DE2	Bayern	Bayerisches Energieprogramm	https://www.stmwi.bayern.de/fileadmin/user_upload/stmwi/Publikationen/2015/2015-21-10-Bayerisches_Energieprogramm.pdf	Yes	
ITH4	Friuli Venezia Giulia	Piano energetico Regionale	http://www.Regione.fvg.it/rafvg/export/sites/default/RAFVG/ambiente-territorio/energia/FOGLIA111/allegati/PIANO_ENERGETICO_REGIONALE_ALLEGATO1.pdf	Yes	
ITC3	Liguria	Regional Energy and Environmental Plan 2014-2020	www.ambienteliguria.it	Yes	
ITC1	Piemonte	Piano Energetico Regionale	It will be presented on 30/10/2017		
ITH1	Provincia Autonoma di Bolzano	Klimaplan Energie-Südtirol 2050	http://umwelt.provinz.bz.it/publikationen.asp?publ_action=4&publ_article_id=214424	Yes	Yes
ITH2	Provincia Autonoma di Trento	Provincial Energy Environmental Plan 2013-2020	http://www.energia.provincia.tn.it/peap/	Yes	Yes
ITH3	Veneto	PERFER: Regional Energy Plan	http://bur.Regione.veneto.it/BurvServices/pubblica/DettaglioDcr.aspx?id=340227	Yes	
ITC2	Valle d'Aosta	Piano Energetico Ambientale Regionale della valle d'Aosta	www.regione.vda.it/energia/pianificazione_energetica/default_i.aspx	Yes	
LI	Liechtenstein	Energiestrategie 2020 aus dem Jahre 2012 und Zwischenstandsbericht aus dem Jahre 2017	www.energiebündel.li	Yes	
SI	Slovenia	AN OVE	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/an_ove/an-ove_eng.pdf	Yes	
CH0	Switzerland	Aktionsplan "Erneubare Energien"; Energiestrategie 2050	http://www.bfe.admin.ch/themen/00490/index.html?lang=de; http://www.bfe.admin.ch/energiestrategie2050/index.html?lang=de	Yes	
CH033	Aargau	energieAARGAU	https://www.ag.ch/media/kanton_aargau/bvu/dokumente_2/energie/strategie__konzepte_1/energieaargau_1/energieAARGAU_Energiestrategie.pdf		Yes
CH054	Appenzell Innerrhoden	Strategie Energie Appenzell Innerrhoden	Richtplan 2015 Energie Grundlagenbericht.pdf		
CH032	Basel-Landschaft	Energiestrategie 2012	https://www.baselland.ch/politik-und-behorden/direktionen/bau-und-umweltschutzdirektion/medienmitteilun	Yes	

NUTS code	Territory	Document name	Link	Targets M	Targets L
			gen/neue-energiestrategie-2012-verabschiedet		
CH021	Bern	Kanton Bern Energiestrategie 2006	http://www.bve.be.ch/bve/de/index/direktion/ueber-die-direktion/downloads_publikationen.assetref/dam/documents/BVE/GS/de/gs_energiestrategie_d.pdf	Yes	
CH022	Fribourg	Stratégie énergétique 2050 de la Suisse	http://www.bfe.admin.ch/energiestrategie2050/index.html?lang=fr		Continue
CH013	Geneve	Projet de conception generale de l'energie 2013	http://ge.ch/grandconseil/data/texte/RD00986.pdf		
CH051	Glarus	Energiekonzept Kanton Glarus	http://www.gl.ch/documents/20120618_Energiekonzept_Glarus_Juli12.pdf		
CH056	Graubünden	Energiegesetz Kanton Graubünden	http://www.gr-lex.gr.ch/frontend/versions/2280		
CH025	Jura	Loi fédérale sur l'énergie LEne	https://www.admin.ch/opc/fr/classified-compilation/19983485/index.html	Yes	Yes
CH061	Lucerne	Planungsbericht Energie 2006 B151	https://uwe.lu.ch/themen/energie/planungsbericht_energie		
CH024	Neuchatel	Conception directrice de l'énergie du canton de Neuchâtel - Rapport d'experts	http://www.ne.ch/medias/Documents/16/05/Conception%20directrice_Rapport%20experts_final_complet.pdf	Yes	Yes
CH064	Obwalden	Energiekonzept 2009	http://www.ow.ch/dl.php/de/0crz8-6outun/Energiekonzept.pdf	Yes	
CH052	Schaffhausen	Grundlagen für die Leitlinien und Massnahmen der kantonalen Energiepolitik 2008 - 2017	http://www.sh.ch/fileadmin/Redaktoren/Dokumente_nicht_im_Formularpool/Energiefachstelle/8_Publikationen-und-Berechnungsprogramme/820_be_GrundlagenEnergieSH_defAG4.pdf		
CH063	Schwyz	Energiestrategie 2013 – 2020	https://www.sz.ch/public/upload/assets/18707/energiestrategie_bericht1416489184835.pdf	Yes	
CH023	Solothurn	Energiekonzept Kanton Solothurn	http://www.econcept.ch/uploads/media/Schlussbericht_02.pdf	Yes	Yes
CH057	Thurgau	Konzept zurt verstärkten Förderung erneuerbarer Energien und der Energieeffizienz	Internetseite Energiefachstelle	Yes	
CH070	Ticino	Piano Energetico Cantonale (PEC)	http://www.oasi.ti.ch/web/energia/monitoraggio-pec.html; PEC_Piano_Azione_2013.pdf		
CH012	Valais	Strategie Effizienz und Energieversorgung Kanton Wallis	https://www.vs.ch/documents/87616/178920/Strategie+Effizienz+und+Energieversorgung/12cda898-fcd1-4d04-86fa-2673880b7bf5		
CH011	Vaud	Conception cantonale de l'énergie			
CH066	Zug	Energieleitbild (vom 29.1.2008)	https://www.zg.ch/behoerden/regierungsrat/aktuell/energie-im-kanton-zug-	Yes	

NUTS code	Territory	Document name	Link	Targets M	Targets L
			leitbild-des-regierungsrates/downloads/energie-im-kanton-zug-leitbild-des-regierungsrates/at_download/file		
CH040	Zürich	N.A	N.A.	N.A	N.A.

Focus areas of the energy strategies

The survey was asking the respondent to state the focus areas (Q19) of the above-mentioned documents, and they often provided the information in their own language, supported by concise comments. In fact, the answering format was free text. Even though an in-depth investigation was out of the scope of this report, some interesting generalizations can be drawn for future research, by grouping answers under recurrent concepts or keywords. It emerges how energy efficiency (especially in buildings and industry) backed up by a general reference to RES development are the most common statements (see Figure 18 areas are listed clockwise by the frequency of occurrence from largest to smallest). Social aspects, as citizen involvement and awareness increase, as well as innovation and technology transfer, are also frequently mentioned.

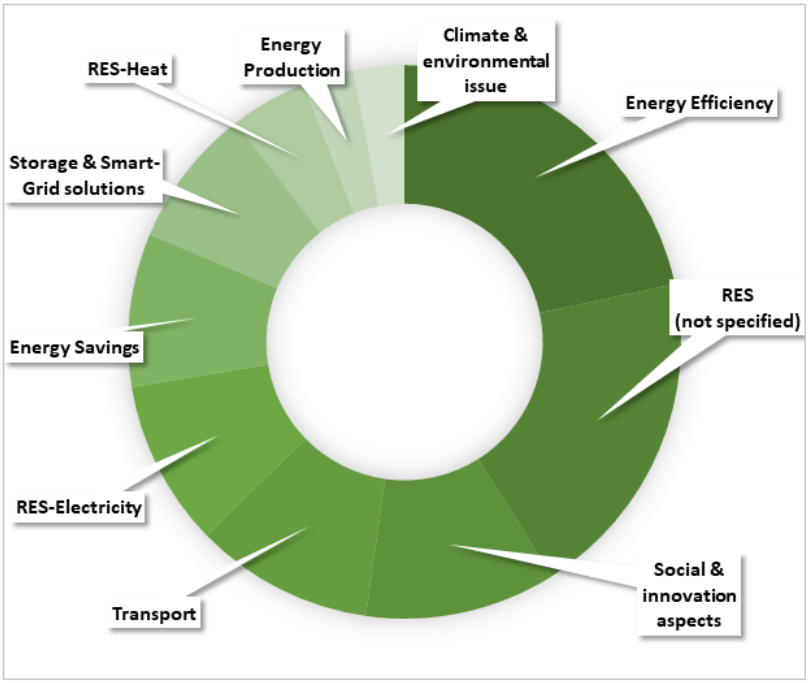


Figure 18. Focus areas of energy strategies in the EUSALP area. Data source: EUSALP Energy Survey 2017

Similarly, sustainable mobility issues and increased exploitation of RES in the electricity sector often occur. A little bit less mentioned by respondents, as priority topics, are the concepts related to energy savings, energy storage, smart-grids, and energy management. Focus areas explicitly referring to RES in the thermal sector, climate and pollution, and energy production are scarcer.

Good practices and measures

Concerning the “good practices” (i.e. focus areas in which they feel to have been particularly successful in implementing the energy strategy) (Q20), the answering format was again free text. Also here the most recurrent answer deals with the building sector, more specifically with the deployment of initiatives related to refurbishment campaigns, energy performance certification, and efficiency of heating systems. Then come the examples of successful involvement of local municipalities in international networks of sustainable cities (e.g. Covenant of Majors, European energy award, etc.) or establishment of participatory approaches with citizens on energy-related issues.

About “measures” (e.g. regulatory, programmes, subsidies, and incentives) (Q23) put in place by territories in order to achieve defined targets, the survey identifies 14 thematic areas (see Figure 19, measures are listed clockwise by the frequency of occurrence from largest to smallest).

Respondents often provided such info in their own language, sometimes only referring to a web link or external source – e.g. the extensive document “Schritt für Schritt zur Energieautonomie in Vorarlberg. 101 enkeltaugliche Maßnahmen” mentioned by Vorarlberg (A) in all thematic areas. Thus, a thematic classification by keywords is not feasible, unless going into a detailed analysis and translation of all the linked documents. Also the typology of measures widely differ, ranging from specific actions, limited in time and scope – e.g. “Developing crowd funding for PV” mentioned by PACA (F) to more generic categories of actions – e.g. “awareness raising measures, support of projects, changing programs for appliances, ex post subsidies” mentioned by Burgenland (A). Despite this heterogeneity in the information provided, it emerges how the most often mentioned measures (by more than half of territories) are those supporting the expansion of RES in heat and electricity production, as well as those for energy efficiency improvement of existing buildings. Slightly below are measures dedicated to address energy efficiency of new buildings and to sensitize citizen and increase awareness. At the opposite side of the chart lie

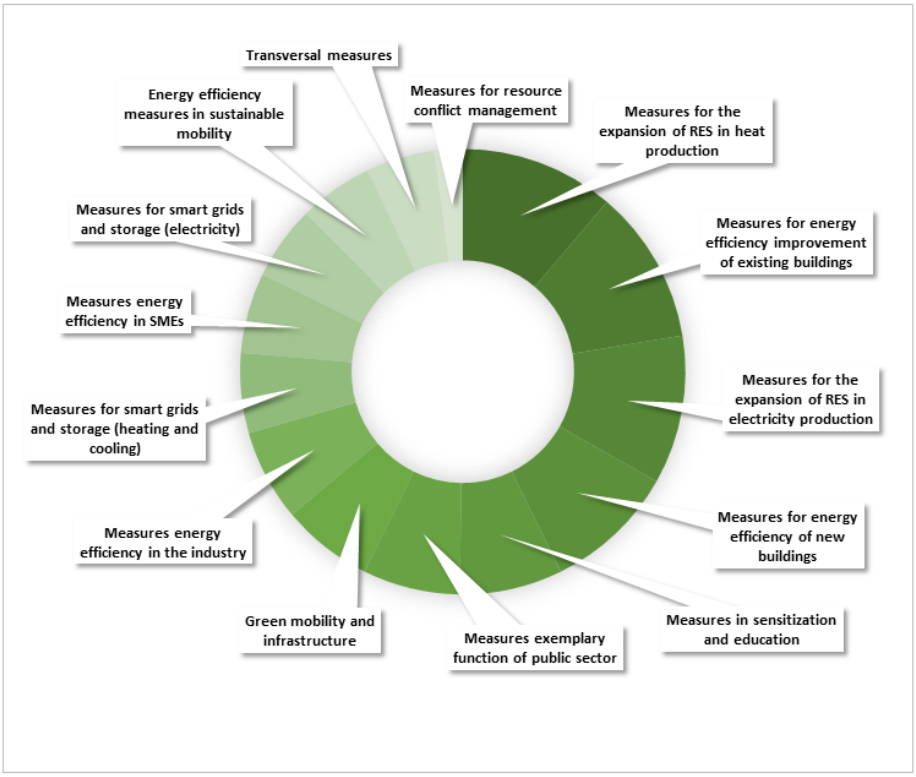


Figure 19. Measures in place to achieve the local energy targets. Data source: EUSALP Energy Survey 2017

measures related to “resource conflict management” (mentioned only by five territories).

Medium and long-term targets

Concerning the existence and range of RES targets in the local strategies (at medium as well as at long-term), a great variety emerges (Q21 and Q22). This is obviously related to multiple factors. Above all is the starting point of each territory, in terms of the actual share of RES. In the following charts (see Figure 20 and Figure 21) the average level of the EUSALP area is identified by the three lines, respectively describing the overall share (18%) and the level of electricity (41%) and heat production (21%). EUSALP share values could also be compared to EU28 figures: in 2015, the European overall share of RES[24] was 16.7%, in electricity was 28.8% and in heating the 18.6%. Vertical bars depict the local status quo, while the circular and rectangular markers represent respectively medium term and long-term targets: the former are usually set at 2020, while the latter at 2050. Different reference years are specified in the callouts. European RES penetration target is 20% in the short-medium term (2020 – dashed lines) and 27% in the medium-long term (2030 – dashed line). European target for the share of RES in electricity is set on 45% by 2030.

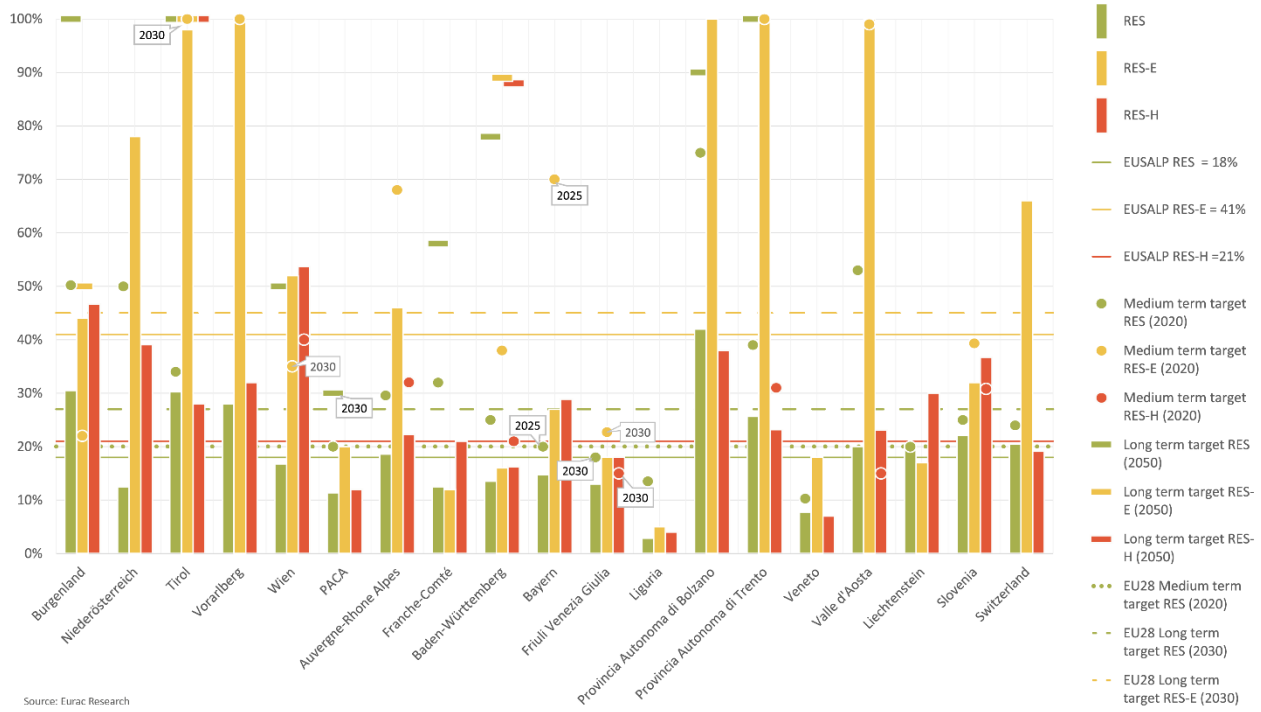
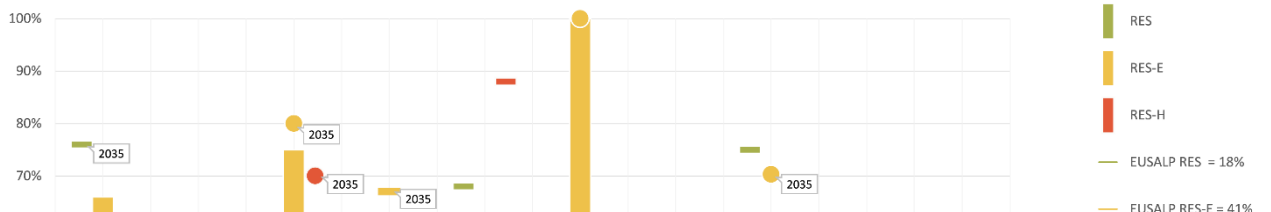


Figure 20. Status quo and future targets of RES penetration in the EUSALP area. Data source: EUSALP Energy Survey 2017



Some medium-term targets are defined (or at least explicitly mentioned in the filled questionnaires) by the majority of territories, while long-term ones only by few (in particular in collected data are missing those of several Swiss cantons). Only Baden-Württemberg (D) identifies the complete set of six targets (i.e. three at medium and three at long-term, respectively related to the overall energy mix, electricity and heating), and only a minority of strategies identifies the targets related to RES in the heating sector. Usually, for the long term, only the overall RES penetration is defined, without further specification of the role played by the different energy vectors. In some cases, the targets seem to be already achieved (especially where the clean electricity production is particularly high), while thermal goals seem more challenging. Small mismatches appear (i.e. targets lower than actual share), probably related to the definition of different baseline years (sometimes strategies go back to the early 2000s), divergence in accountancy, data entry mistakes.

Energy strategies also define savings goals (see Figure 22 and Figure 23). European energy efficiency targets are 20% in 2020, shown by a dotted line, and 30% in 2030, dashed line. In the majority of cases,

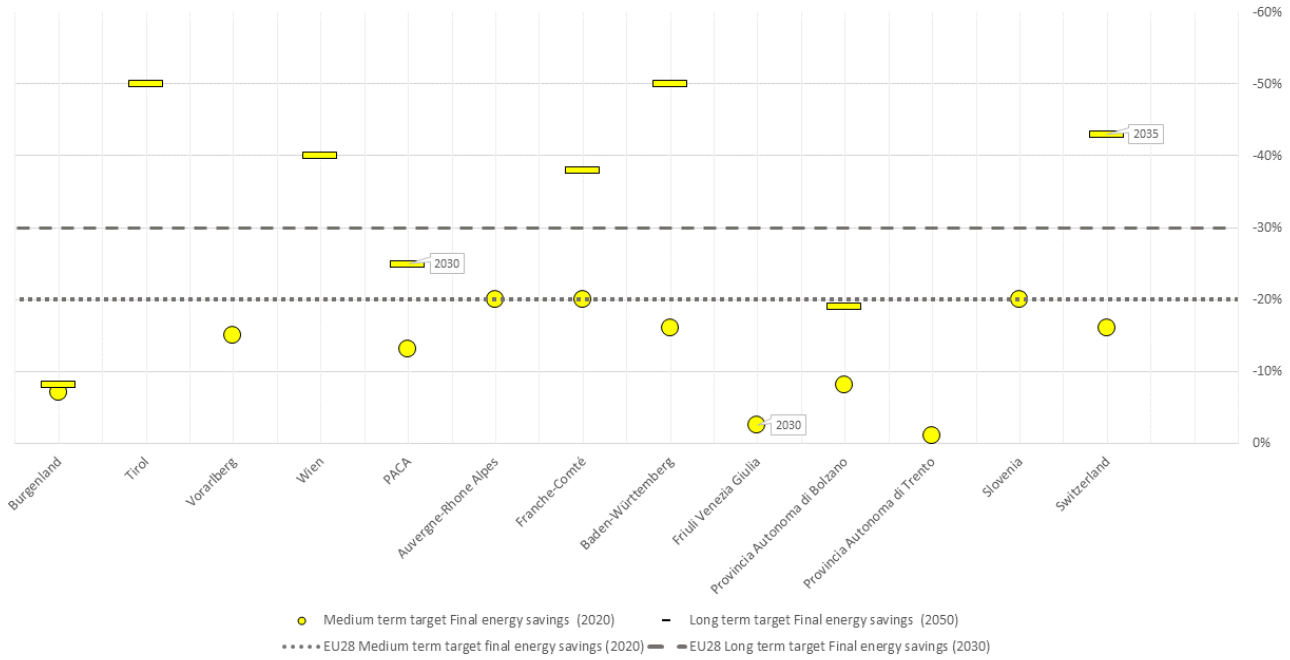


Figure 22. Energy savings targets in the EUSALP area. Data source: EUSALP Energy Survey 2017

those at medium-term lie between -10% and -20%, except in Switzerland, where a few of them are closer to -40% (even though referred to 2035 instead of 2020). Some long-term targets are even more ambi-

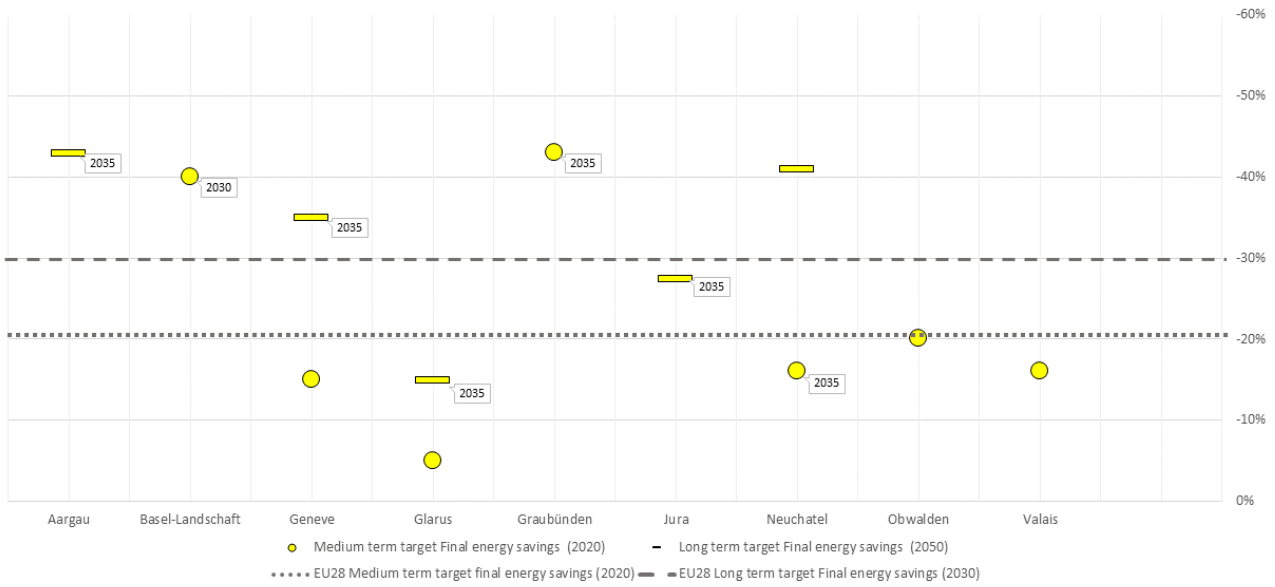


Figure 23. Energy savings targets in the Swiss cantons. Data source: EUSALP Energy Survey 2017

tious, aiming to reach up to -50% in 2050. Unfortunately, they are referring to different baseline years, thus difficult to compare in a rigorous way. In any case, this section concerning the targets was filled only by a minority of territories (about one third), as the recurrence of empty cells in the charts show.

Monitoring systems

The question about the existence of monitoring systems (Q24) was positively answered by nearly half of the EUSALP territories (23 out of 50, corresponding to 46%, see Figure 24); among these, a few also declared a yearly or five-yearly update period (four and two respectively).

Other four are actually working on the establishment of such systems. Assuming that also blank answers have a negative meaning (no monitoring system in place), we inferred that 46% of the EUSALP territo-

ries are not keeping track of measures implementation. About the presence of third/independent parties involved in monitoring/reporting activities (Q25), only eleven territories (22%) answered positively[25].

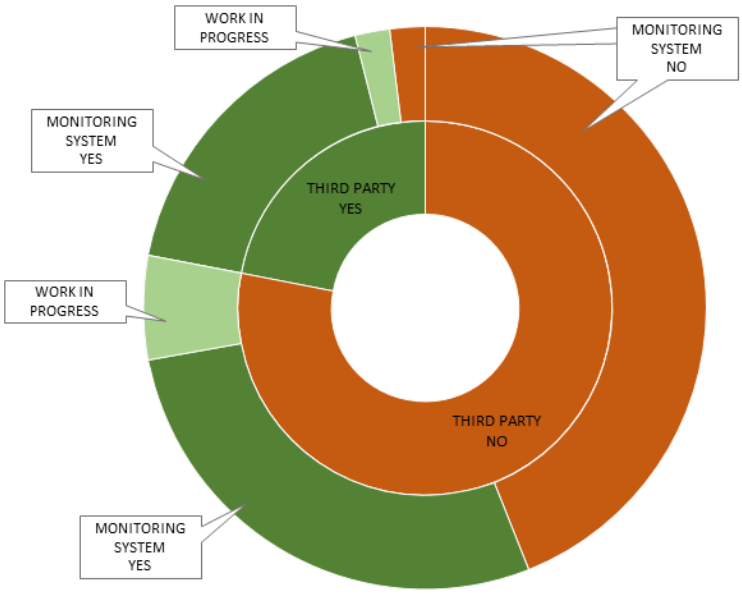


Figure 24. Monitoring systems and third parties involvement. Data source: EUSALP Energy Survey 2017

Discussing the results

The third Section of the EUSALP Energy Survey returns a great variety of targets concerning the share of RES and energy savings in the energy strategies of the regions and states in the EUSALP area.

By comparing the frequency of appearance of "focus areas of the energy strategy" and "measures put in place to achieve the defined targets", there is an accordance with categories such as the development of RES in electricity and heat production, or energy efficiency improvement of existing buildings, because they are the most mentioned issues in both questions. At first sight, a different situation seems to happen on the mobility side, which ranks quite high among "focus areas", and on the bottom of "measures". This can be explained looking more into detail into the thematic categories of measures. In fact, the survey differentiates among "green mobility and infrastructure" and "energy efficiency measures in sustainable mobility": by summing them, we highlight the expected strategic role of the transport sector in achieving

[25] Among them, we have two answers difficult to interpret, because one correspond to a "blank" answer about monitoring, and the other to a "work in progress".

the climate-energy targets. The issue of “resource conflict management” presents room for improvement: as so far it seems to be quite neglected by measures already in place, whereas it plays a strategic role in a smooth transition of energy systems toward a clean production based on RES, and a smart grid architecture of the distribution systems. Similarly, the presence of a third/independent party involved in the monitoring/reporting activities seems to be not so common in the EUSALP area. Moreover, its role could be further investigated: is it acting as an external evaluator of activities internally done by the public authority or is it an advisor, working together in collecting and assessing data? Finally, for a better understanding and knowledge deepening about the correspondence between focus areas and measures already in place, a common glossary (specific for EUSALP) could facilitate the comparison among local and national strategies. For this scope, a glossary used at international level could be used as reference, e.g. the databases and definitions provided by the International Energy Agency[26].

[26] http://www.iea.org/policiesandmeasures/energyefficiency or http://www.iea.org/policiesandmeasures/renewableenergy.

SECTION 6 & 7 – GOVERNANCE & FEEDBACK FOR EUSALP

The sixth Section of the EUSALP Energy Survey investigates the governance and institutional framework in force in the territories, with a special focus on the participatory approach:

Q18. How does your administration collaborate with local authorities on sustainable energy issues?

Q19. Please give a brief overview over the local, regional and national administrative bodies that have competences in the policy field of energy.

Q20. How does your administration assure stakeholder involvement?

About half of the respondents skipped Section 6, and some of them provided information in their own language. The ways in which they answered the Q26 widely differ, even though there are some recurrent keywords highlighting the main recurrent functions. Among these, we found coordination and steering committee roles, as well as information activities. Answers to Q27 depict a heterogeneous galaxy of administrative bodies dealing with energy issues at different institutional levels, showing once again how complex and country-specific is the institutional framework in this sector.

Working groups, focus groups, public consultation, web-based tools, technical workshop or at least information of stakeholder about the decision-making process are the most common answers to Q28.

Feedback for EUSALP

The seventh and closing session of the EUSALP Energy Survey consists of a single question:

Q18. The EUSALP energy action group concerned with energy issues will tackle various topics to promote energy efficiency and renewable energies in the Alpine territory. Which of the topics are important for your region/Canton/Province/State?

The answering format is a four-range scale: very important, important, less important and not important[27]. The Section was left blank by 40% of respondents.

As Figure 25 shows, it clearly emerges how the number of positive answers far exceed the negative. The topic of energy efficiency in buildings, and thus how to deal with their refurbishment and energy perfor-

[27] In the following description very important and important, are considered a positive declaration of interest, while others judgements as a negative one.

mance improvement, is an outstanding issue for the majority of respondents. Immediately upon, as topic of interest, the same issue concerning the new construction of buildings.

Uncapping the potential of RES in heating and cooling, and the concept of sustainable mobility are often pointed out as relevant topics, while less interest is raised by the topic of transnational grids and the harmonization of the normative frameworks.

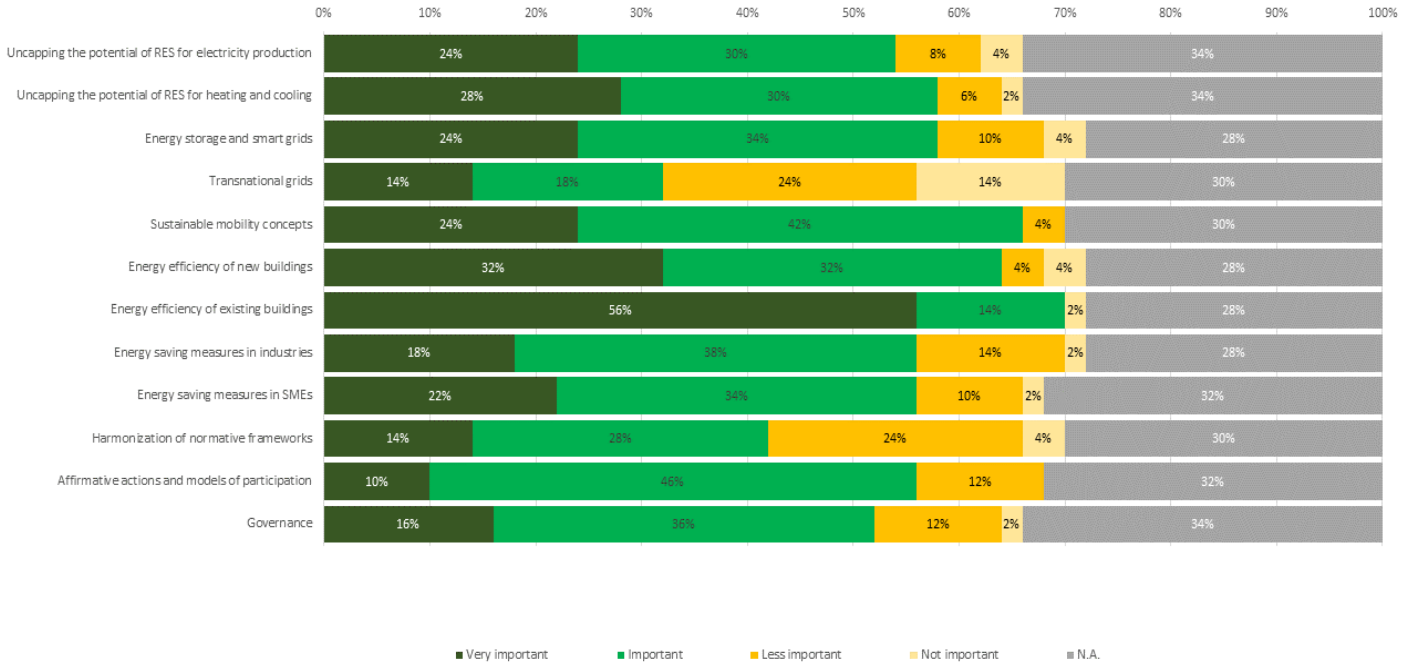


Figure 25. Areas of interest of EUSALP territories. Data source: EUSALP Energy Survey 2017

Discussing the results

The last two sections of the EUSALP Energy Survey returns only a partial image of EUSALP governance systems and attitudes about energy issue, because the amount of blank questionnaire is significant, and the complexity of the topic (especially governance and stakeholders' involvement) is hard to summarize in a few words.

A further investigation of communication tools and participatory approaches in different territories could offer meaningful insights on how to effectively prevent conflicts in natural resource management and making the renewable energy transition smoother, even though this point raised little interest in the last section. It is also quite interesting how the core topics of energy performance in buildings, their retrofit

and a further exploitation of RES in heating and cooling are backed up by the perception that a heterogeneous normative framework is not a limitation to be primarily addressed. On the basis of preliminary results collected by the AG9 leader, four sub-groups have been established within the AG9, namely:

1. energy strategies, coordinated by Patrick Biard (Auvergne-Rhone Alpes), Ulrich Santa and Maren Meyer (AG9 coordinator from South Tyrol);
2. energy efficiency, coordinated by Giovanni Nuvoli (Piemonte);
3. renewable energies, coordinated by Wolfram Sparber (external expert appointed by the Italian Ministry of Environment, Land and Sea);
4. smart grids, coordinated by Peter Obricht (Niederösterreich) and Johann Binder (Burgenland).

Final results could offer the opportunity to involve additional representatives in the thematic sub-groups, on the basis of single interests.

CONCLUSIONS

Achieved results

The EUSALP Energy Survey 2017 developed by the AG9 is the first attempt to offer a clear and systematic overview of the EUSALP energy issues, both on the consumption and production side. In comparison to a traditional desk research, it has the great added value of combining quantitative data with qualitative ones, directly provided by the territories in a bottom-up cooperative approach. Moreover, by directly involving local authorities and responsible bodies in filling in the survey, the positive co-benefit is to make them even more aware of the existence of the EUSALP (and of a specific Action Group on energy – AG9) and to define a comprehensive list of responsible persons in this field.

Globally speaking, and in comparison to the broader context (here given by the EU-28 plus Switzerland and Liechtenstein), we found that the EUSALP area covers near 10% of the surface (more than 470.000 km^2), encompasses 16% of the population (about 70 million of EU citizens and 8 Million of non-EU), and generates 20% of the GDP of the EU, equivalent to 3.100 Trillion €. Far away from preconceived notion related to the core alpine area, EUSALP as a whole is densely inhabited, an engine of the international economy, and therefore for understandable reason energy-demanding.

By aggregating the data from the EUSALP Energy Survey 2017, we reach an estimated gross final energy consumption of about 2.300 TWh, equivalent to the 11% of the broader context, and a share of renewable energy sources (RES) of around 18%. This means that on one hand, the EUSALP area has a per capita consumption of about 28 MWh, which is slightly above the EU average, while on the other hand the share of RES is almost equal than in the rest of the EU[28]. EUSALP is quite "self-sufficient" in covering the electricity needs, only 3% is imported because of a large presence of RES (40% of power production, mainly from hydropower plants). Remaining is provided by nuclear (33%) and fossil fuel plants (24%).

The average energy intensity of the EUSALP area, which measures the energy efficiency of its economy, calculated as units of energy needed per unit of GDP delivered, is about 0.75 kWh/€ (slightly better than 0.87 KWh/€, the reference value of the broader context). In other words, we are facing a territory densely

[28] Even if a small positive difference can be noticed, this could be affected by accountancy bias of the same size. This values are confirmed, at a reasonable interval of confidence, by answers provided by respondents involved in the EUSALP Energy Survey 2017.

populated, economically active, and rich in renewable sources. According to respondents, some of them have been almost completely exploited (as hydropower), while others are expected to increase their contributions (as PV in the electricity production and biomasses in heating branch).

Besides average values, it clearly emerges how the territorial entities making EUSALP widely differ not only from a legal and administrative status (some of them, like Slovenia, are an entire EU Member State, while others are small cantons of a non-EU country) but also in size, population, economic structure and physical environment. Not surprisingly, the energy figures are also heterogeneous.

Table 10 summarizes some relevant data, needed to frame at a glance the wide variety of the fifty territorial entities, which make up the EUSALP region, as well as its mean reference values.

This is just to stress how "average" values could lead to a misleading interpretation of the EUSALP region status quo, trends, and targets.

Table 10. Overview of socio-economic, physical and energy releted data in the EUSALP area. Data source: EUSALP Energy Survey 2017 and Eurac Research internal project

	Min (Territory)	Max (Territory)	EUSALP	Mean	Std. dev.
Size (km^2)	38 (Basel Stadt)	70.580 (Bayern)	467.145	9.343	15.284
Elevation (m)	-12	4,790	-	786	670
Population (inh)	15.854 (Appenzell Innerrhoden)	12.691.568 (Bayern)	79.725.926	1.594.519	2.879.354
Density (inh/km^2)	28 (Graubünden)	5.065 (Basel Stadt)	171	171	929
GDP (Mil. €)	803 (Appenzell Innerrhoden)	550.446 (Bayern)	3.128.258	62.565	112.841
GDP pro capita (€/inh)	18.697 (Slovenia)	150.064 (Liechtenstein)	39.237	39.237	25.911
GDP Energy intensity (kWh/€)	0,21 (Basel Stadt)	1,47 (Slovenia)	0.75	0.75	0.29
Final energy consumption (TWh/year)	1,04 (Nidwalden)	386,2 (Bayern)	2.270,1	48,3	84,2
Final energy consumption pro capita (MWh/year/inh)	18,7 (Liguria)	45,8 (Graubünden)	28	30,2	6,3

Continue

Electricity consumption (TWh/year)	0,23 (Obwalden)	77,6 (Bayern)	552,7	11,8	20,3
Heating consumption (TWh/year)	0,39 (Nidwalden)	174,5 (Bayern)	987,5	21,1	39,1
Transport sector consumption (TWh/year)	0,39 (Glarus)	123,6 (Bayern)	730,2	14,5	25,5
Share of RES in electricity consumption	5% (Zug, Liguria)	100% (Alpine NUTS)	38%	48%	37%
Share of RES in heating consumption	1% (Lombardia)	61% (Kärnten)	18%	21%	16%

Continue

This is an area where extreme values tend to be relevant, peculiarities are very important, and heterogeneity is a main phenomenon, even though some recurrent situations or clusters are recognizable by

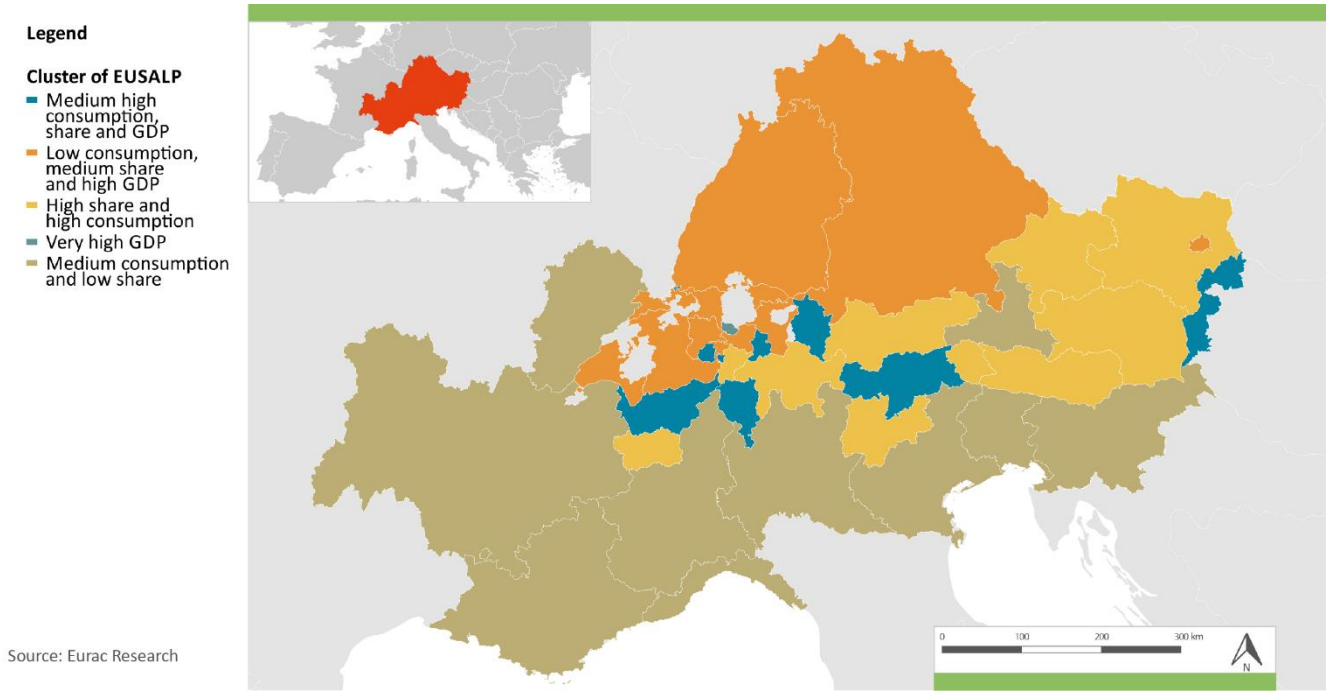


Figure 26. Cluster analysis of socio-economic and energy data.
Data source: EUSALP Energy Survey 2017 and Eurac Research elaborations

spatializing energy-economic data on the map (see Figure 26).

For example, northern EUSALP territories (German Ländern and some Swiss Cantons) show low consumption and a medium share of RES in the energy mix, as well as a high GDP. West and southern territories (France and Italian regions, and Slovenia) are characterized by medium consumption levels and a quite low share of RES in the local energy mix. The majority of Austrian Ländern have on one hand a high share of RES, on the other hand high consumption. Finally, some other core alpine territories have a medium high-energy consumption, although they can count on a high share of RES, and a high GDP levels. Looking at this situation it becomes evident why energy targets set up by territories are quite different and how energy strategies should consider different energy as well as socio-economic systems.
However, the positive fact is that climate-energy strategies are already in place in the majority of cases, and the existence of some monitoring systems is well rooted. The most recurrent focus areas are those dealing with energy efficiency improvement of existing (and new) buildings and development of RES in electricity and heat production. Room for improvement could be reserved to the issue of "resource conflict management", which so far appears to be quite neglected by measures already in place, even though this plays a strategic role in a smooth transition of energy systems toward a clean production based on RES and a smart grid architecture of the distribution systems. Experts and policy makers should also consider how the expected development of distributed PV plants in electricity generation and the increase of biomass contribution in heating production, coupled with storage systems, could lead to a new smart grid infrastructure, and the development of (near) self-sufficient energy communities. This kind of energy systems differs from the traditional ones not only in terms of deployed resources (clean, distributed and discontinuous renewables vs pollutant, centralized and more stable fossil fuels), but also concerning ownership, responsibilities and governance of decision making processes.

Table 11. Data completeness/confidence level in EUSALP territorial factsheets

About the single territorial entities, looking at the data collection process undertaken, verification processes, and results achieved, it is possible to associate different level of completeness/confidence to the territorial factsheets.

Data completeness/confidence level	Number of EUSALP teritories
High	11
Medium/high	4

Medium	17
Medium/Low	9
Low	10

We classified 15 as high-medium/high, 17 as medium and 19 as medium/low-low (see Table 11). Obviously, those defined as “low” particularly need for further investigations and improvements to achieve an adequate level of reliability, and to reduce bias in the EUSALP energy data general pictures.

Further developments

This Report shows the main finding of the analysis of EUSALP Energy Survey 2017 data. Some obstacles emerged during the completion of the EUSALP Energy Survey 2017 and the elaboration of the data. The main ones were the following: the quite long fill-out time needed to provide detailed information was considered unaffordable by some respondents, leading to partially incomplete questionnaires; the lack of a glossary (shared and unique definitions) has led to misinterpretation or misunderstanding of some questions, making data comparison and aggregation less robust; the lack of awareness of EUSALP macro-regional strategy meaning and aim shown by a few territories has led to difficulties in their active commitment. These insights should be taken into consideration when developing a new version of the EUSALP Energy Survey.

Moreover, as already stated, information provided by respondents comes from very different territorial entities, ranging from entire countries (as Slovenia) to small Swiss cantons, having different competencies, institutional frameworks, and energy balances. It clearly emerge that there is a great variety of situation under the EUSALP average energy values. Thus, we recommend further developing the standardization of data collection and management processes, under the oversight of a EUSALP Energy Observatory. Moreover, having the aim to “*make the EUSALP territory a model region for energy efficiency and renewable energy*” (in a broader sense a model region for the low carbon energy transition), we see a deeper investigation on local energy policies and related targets as an important issue. Data collection and analysis should be done at adequate NUTS level (depending from country specific administrative structure and data availability). Regular updates should be executed, in comparison to implemented political and financial framework, to identify the funding schemes and business models maximizing the return on public funds investments.

Such information should be made available and easily accessible to stakeholders, to facilitate an informed decision making process, through the regular publication of a EUSALP energy report.

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