



SURVEY ON THE CONSUMPTION IN THE TERTIARY SECTOR BUILDINGS IN FRIULI VENEZIA GIULIA REGION

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SUMMARY

With this survey, the EMILIE project aims to support the growth and innovation of regional SMEs by analyzing the potential for the implementation of energy efficiency and energy saving measures in the buildings of the tertiary or service sector, among the main energy consumers in Italy.

The survey aims to provide a preliminary overview of energy consumption levels and requirements of tertiary sector buildings (offices, commercial business premises, hotels and other accommodation facilities, school buildings, hospitals and retirement homes) in the Friuli Venezia Giulia region.

Furthermore, it helps define a prospective regional scenario and set strategies for the tertiary sector, defining effective proposals to submit to regional stakeholders, thus fostering sustainable development to the benefit of small and medium enterprises and local authorities operating in the field of energy efficiency.

Therefore the first step of the analysis of the energy savings potential in this sector is to know the characteristics of the tertiary sector building stock and then trying to locate the buildings, the activities, plants on which it is easier, more urgent or more convenient to intervene in order to obtain a conspicuous reduction of fuel consumption and CO2 emissions.

The survey data collection brought to light the lack of regional statistical data to describe tertiary sector buildings' energy consumption levels. A decision was thus made to carry out a detailed technical analysis on the energy consumption of 17 regional buildings, specifically selected as a representative sample of regional tertiary sector properties.

The survey highlighted how many service providers operate in buildings showing high potential for a significant increase in their energy efficiency (for instance, through replacement of doors and windows, improvements in plumbing and fittings, introduction of renewable energy systems), which should preferably take place alongside with other extraordinary building maintenance operations.

The survey also pointed out how building restrictions (as, for instance, those affecting buildings of historic/architectonic interest) often limit significantly available options for the implementation of energy efficiency measures, particularly as concerns the more common ones, an interesting area to be explored to come up with innovative solutions

In conclusion, the Emilie project hopes that, with effective regulatory and financial support from political decision makers, SMEs established in regional manufacturing districts will be able to benefit from the opportunities offered by tertiary sector buildings and improve currently available products and technologies through new investments for innovation to support energy efficiency.



1 SOURCES

1.1 Modes of acquiring information

Were used as sources for the following publications:

- [1] " type buildings , benchmark indices of consumption by type of building for hotel use , application of innovative technologies in different italian climates ," Arch. Belicini Lorenzo , Francesco Toso , Search Electric System Research Department CRESME SpA - ENEA, September 2010
- [2] " Energy Characterization of the hotel industry in Italy," Marcello April Search Electric System, Polytechnic of Milan - ENEA, March 2009
- [3] " Statistical Analysis of the park non-residential building and development of simple calculation models," Marco Citterio Search Electric System, ENEA, May 2009
- [4] " Evaluation of consumption in existing and benchmarks using simplified codes: analysis of hospital buildings ", RSE/2009/117 Report, March 2009
- [5] " The location of production activities in Friuli Venezia Giulia - Archive Asia 2008 ", Chiara Donati, Ilaria Silvestri, April 2011
- [6] " The domestic trade in Friuli Venezia Giulia", Ilaria Silvestri, May 2012
- [7] "The innovation efficiency in buildings - Onre Report 2013", organized by Legambiente and CRESME RESEARCH SpA, February 2013

1.2 Available sources on energy data

In order to achieve the objective of this survey, the following individuals and organizations/ structures established in the region of Friuli Venezia Giulia were interviewed:

- Friuli Venezia Giulia Region
- Private Nursing Homes (retirement homes)
- Commercial structures
- Hospitals

In some cases, the collection of data has presented several doubts and sometimes it has not been possible to obtain complete information on the energy consumption of buildings and in the statistics presented.

Currently there is no land registry for regional energy and therefore the buildings of the tertiary sector are not mapped at regional statistical level and therefore no data are available on time as the total area, power consumption, volume and so on.

In Italy there is no obligation to monitor the consumption in the tertiary sector. In addition, in most of the buildings there are no gauges able to count the electricity used exclusively for heating and cooling.



Useful data for this study were obtained from the following sources:

- [8] Terna S.p.A. - <http://www.terna.it>

Terna S.p.A. is an operator that performs the management, development, transmission and dispatching of electricity on high-voltage grid throughout the Italian territory. With reference to the tertiary sector, were analyzed and compared the power consumption available (2010 and 2011) at the national, regional (Friuli Venezia Giulia) and provincial (Udine, Pordenone, Gorizia, Trieste). http://www.terna.it/default/Home/SISTEMA_ELETTRICO/statistiche/consumi_settore_mercato_logico.aspx

- [9] ARES- Regional Agency for Sustainable Building s.r.l. - <http://www.aresfvg.it>

ARES aims to promote sustainability and eco-friendly buildings and its quality improvement and has the following responsibilities related to the certification procedure VEA energy environmental sustainability of buildings: a) disclosure, b) education, c) accreditation d) receipt of declarations of conformity , e) advice to public bodies , f) management of the land registry for energy; g) any other activities assigned by the regional Board, to achieve the purposes of LR 23/2005.

- [10] CRESME - Center for Economic Research Social Market for Construction and Land - <http://www.cresme.it>
- [11] ENEA – National Agency for New Technologies, Energy and Sustainable Economic Development - <http://www.enea.it>
- [12] ISTAT – National Institute of Statistics - <http://www.istat.it>

1.3 Software used for the simulations

For the development of this survey, we have used the following software to perform simulations of energy with the aim to identify the performance characteristics of different types of plants or energy efficiency measures.

The software used for the simulations are the following:

- MC4 Software Suite 2012
- Thermus (Acca Software)
- Odesse (ENEA)
- Polysun v 4.0

The results of the simulations performed with the software Odesse, available at ENEA, have not produced useful results and are not consistent with the analysis carried out. In particular, it was found a failure to complete the operation of the software for the analysis of the building.



The simulations carried out with the software Polysun were exclusively used to simulate the behavior of the buildings and the possibility of installation of "solar cooling" in some type buildings.

1.4 Regulations on energy efficiency and use of renewable energy in buildings

The most significant boost to innovation in energy and environmental building must be Europe. In fact, since 2002, a perspective of change in the construction sector has been defining and articulating, which is considered strategic in the fight against climate change and to reduce overall energy expenditure. Energy efficiency in buildings is a piece of the energy and climate policy that has on it is horizon the goals to be achieved by 2020 in terms of reducing CO2 emissions and contribution of renewables to energy consumption, introduced by Directive 2009/28 / EC .

To better understand the future of the construction industry in Europe it is necessary to refer to the European Directive 31/2010, published June 18, 2010 and entered into force in February 2012, repealing the previous Directive 91/2002. Such Directive promotes the improvement of the energy performance buildings, taking into account outdoor climatic and local conditions as well as the provisions relating to indoor climate and effectiveness in terms of costs.

From the point of view of the energy performance, a great importance is given to the recent European Regulation 244/2012 which is integrating the Directive 2010/31 on the energy performance of buildings, thus providing a methodology for calculating optimal cost levels of minimum performance requirements for efficiency of buildings and building elements.

Directive 31/2010 provides that from 1 January 2021 all new buildings are "near-zero-energy buildings" where the energy needs to be so low, or zero, it can be covered to a very significant extent by energy from renewable sources, including that produced on site or nearby.

Lastly, the entry into force December 5, 2012, the new European Directive 2012/27 on energy efficiency. It is stipulated that each Member State must comply with the new obligations of reduction of energy consumption of public housing. In particular, art. 5 also provides the initiation of plans to upgrade energy efficiency of public buildings: from 2014 each Member State shall ensure that the 3 % of the total floor area of heated and/or cooled buildings owned and occupied by its central government is renovated each year to meet at least the minimum energy performance requirements

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The European Reference Framework is the following:

- Directive 31/2010/CE, Directive on the energy performance of buildings;
- Directive 2012/27/UE Directive on energy efficiency;

As regards, however, **the National Framework**, we have:

- Decreto Legislativo 19 agosto 2005, n. 192, Legislative Decree of 19 August 2005, n. 192, "Implementation of Directive 2002/91/EC on the energy performance of buildings";



- DPR 59/09, Legislative Decree of 29 December 2006 no. 311, "Corrective and additions to Legislative Decree 19 August 2005, no. 192, implementing Directive 2002/91/EC on the energy performance of buildings."
- Legislative Decree of 29 December 2006 no. 311, "Corrective and additions to Legislative Decree 19 August 2005, no. 192, implementing Directive 2002/91/EC on the energy performance of buildings"
- Legislative Decree 115/ 08, "Implementation of Directive 2006/32/EC on energy end-use efficiency and energy services and repealing Directive 93/76/EEC";
- Ministerial Decree 26/06/2009, "National guidelines for energy certification of buildings."
- Legislative Decree of 3 March 2011 n. 28, "Implementation of Directive 2009/28/EC on the promotion of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC."
- Law of 4 June 2013, n. 63 "Urgent provisions for the implementation of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings for the definition of infringement proceedings by the European Commission, as well as other provisions for social cohesion"

As regards the regional aspect, the intervention by the individual regions has led to a breakdown of the regulatory framework and, in some cases, significant changes in the way we design and build, through the introduction of precise indications for use of renewable energy, water conservation and for the thermal insulation of buildings. In other cases it has instead followed the route of Guidelines on Green Building indicative only as a reference for new construction, and in others has adopted the regulations that simply promote sustainable construction.

In Friuli Venezia Giulia regulations of the primary reference on the energy performance of buildings are:

- Regional Law 11 November 2009, n. 19, "Regional Code of Building"
- DGR September 24, 2009, n. 2117, "Regulations on procedures for the certification of VEA energy environmental sustainability of buildings."

The following table presents finally the main technical standards that are used in the field of energy efficiency:

NORMA TECNICA	DESCRIZIONE
UNI EN ISO 13790:2008	calculation of energy use
UNI/TS 11300-1:2008	determination of the thermal energy demand of the building for air conditioning in



	summer and winter
UNI/TS 11300-2:2008	determination of the primary energy demand and yields for winter heating and for the production of domestic hot water.
UNI/TS 11300-4:2012	energy performance of buildings, use of renewable energy and other methods of generation for space heating and domestic hot water production
UNI EN ISO 6946:2007	components and building elements - Thermal resistance and thermal transmittance
UNI EN ISO 13370:2008	exchange of energy between the land and building
UNI EN ISO 14683:2008	thermal bridges in building construction - transmission coefficient per unit length
UNI EN ISO 13789:2008	less coefficient for transmission and ventilation
UNI EN ISO 13788:2003	Hygrothermal performance of components and building elements - Internal surface temperature to avoid critical surface humidity and interstitial condensation - Calculation method
UNI EN ISO 13786:2008	Thermal performance of building components - Dynamic thermal characteristics - Calculation methods
UNI EN ISO 10077	thermal transmittance of the components windowed
UNI 10349	climate data
UNI 10351	thermal conductivity and vapour permeability of building materials
UNI 10355	walls and floors values of thermal resistance and method of calculation



2 Overview of the buildings in the tertiary sector

2.1 General description of the current state of the buildings

The national non-residential sector is characterized by a very heterogeneous composition (building, plant and intended use). Currently the data on the consistency and quality of the housing stock is not always used for the purpose of the present survey, since the aggregate data does not lend itself to the definition of a cognitive view of the building complex designed for energy efficiency.

At both national and regional levels, there is no specific archive on the construction features and systems of the buildings of the tertiary sector. Therefore, in this chapter, is given the national and, where possible, the regional consistency of the buildings included in the various uses of the tertiary sector by referring to the disaggregated available data.

In general, the number of housing units not at the national level is slightly less than 4.3 million with a breakdown strongly oriented towards the service sector: 3.4 million units (79.8% of the total) refer to this sector and 0.9 million (20.2% of the total) refers to the industrial and craft whose energy consumption is mainly absorbed by the productive activities and insignificant building complex.

In particular, the service sector in Italy is made up of about 1.3 million housing units for commercial use (30.3% of the total), nearly 1.1 million (24.6% of the total) used by "other services" (including transport, communications, credit, insurance, financial, public and private health and other social and health services), 0.6 million (15.1%) for office use, 0.3 million restaurants (6,6%), 73.000 schools and 61.000 hotels.

The first significant fact to be stressed concerning the presence, at the national level, of a huge and fragmented amount of properties that, in the face of an abundance of 4.3 million units, which covers a surface area of more than 1.5 billion square meters of which a large part in the production target (over 0.7 million square meters occupied by industrial sector) and approximately 54% (0.8 million square meters) for commercial. The term of comparison to frame the size of the housing to non-residential use is given by the comparison with the housing stock that is a little over 3 billion square meters.

In Friuli Venezia Giulia the tertiary sector occupies most of the labour force, deployed in enterprises of average size less than those of the industry.



In business the shops are often sole proprietorships, evenly distributed over the territory. In fact, the specialization index reaches values that can be found in manufacturing, and ranges from 1,3 of Tarvisio to 0.5 of Ampezzo. It can therefore be assumed that the realities considered small entities with few employees. Only about twenty local units have more than 100 employees, it is unspecialized large retail outlets (hypermarkets) often located in urban belts (e.g. Tavagnacco and Martignacco).

In total in the region are employed in the trade 72 656 employees, 17% of those detected by ASIA UL.

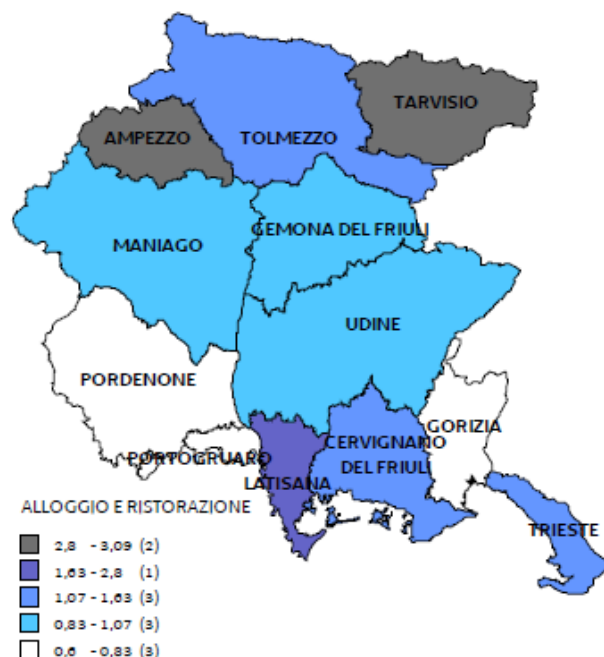


Figure 1 - index of trade specialization in FVG

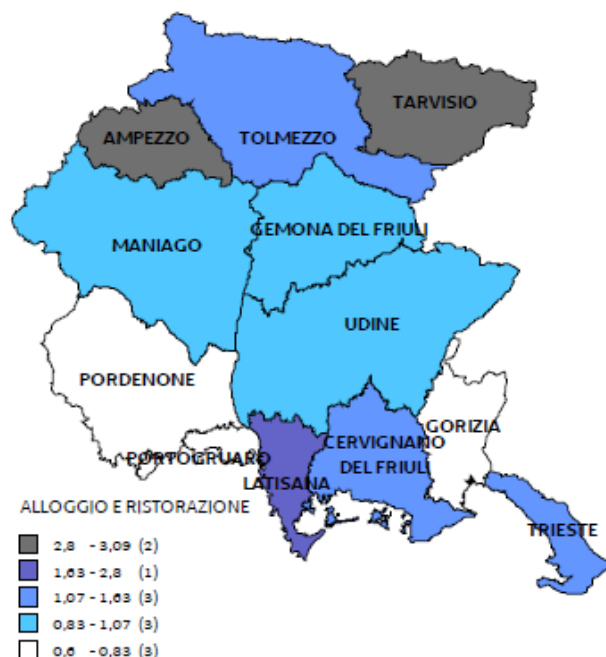


Figure 2 - index of specialization in the field of housing and food in FVG

The economic activities of the hospitality industry and catering, entertainment, culture and sport, can fit ideally in to related tourist economy. For companies operating in the hospitality and catering that is in part what has been said for the trade: the local units are often of small size and evenly distributed throughout the territory.

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The mountainous areas of Friuli Venezia Giulia are distinguished by a greater specialization in this sector: 20 % of employees in the area of Ampezzo and Tarvisio work in these sectors.

The number of workers rises also in the seaside resorts of Grado (more than 1,000 employees in 242 local units) and especially in Lignano (2,242 employees in 427 local units). Also in the cultural field tourist resorts of Friuli Venezia Giulia show high rates of specialization with more than 140 employees to 330 in Lignano and Grado, on a regional total of just under 3,000 people in 1,100 local units.

Finally, within the tertiary sector are encompassed activities of different nature from those professional, information, communication and advertising, information technology and research, education and health care, business and people services and so on.

The following table shows the stock of units divided by the area of the tertiary sector at the national level.



Table: Stock of the year 2012 types of non-residential real estate units

Stock	uffici	negozi	capannoni	istituti di credito	edifici commerciali	alberghi	Totale
Nord est	149.491	412.636	188.373	5.203	48.416	14.515	818.634
Nord Ovest	196.859	629.520	225.729	7.278	64.287	12.327	1.136.000
Centro	138.738	560.481	130.006	4.074	36.463	13.393	883.155
Sud	102.133	670.595	122.165	2.479	45.707	10.895	953.974
Isole	51.490	276.370	50.986	1.453	14.956	5.084	400.339
ITALIA	638.711	2.549.602	717.259	20.487	209.829	56.214	4.192.102

Source: Real Estate Market Report 2012 - Developed by Market Watch Real Estate, Inland Revenue

2.2 Climate of Friuli Venezia Giulia

Friuli Venezia Giulia region is characterized by a geographical location and orography that influence in a decisive way the weather and therefore the climate.

The region is located at mid-latitudes, where there are very marked contrasts between polar and tropical air masses: the contrast frequently generates perturbations of the normal state of the atmosphere. In orographically complex areas, such as Friuli Venezia Giulia, the processes of formation of perturbations and their evolution are strongly influenced by the mountains and their arrangement with respect to the prevailing circulation of air masses. The presence of the Alps in fact induces significant changes in temperature, humidity, and of course the direction of motion of the air masses affecting the region.

Also very important are the local peculiarities of the territory, such as the presence of the Adriatic sea being shallow, and the lagoon is characterized by significant temperature changes. In a nutshell, the climate of the region can be considered as a moderate continental climate with humid connotation.

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Temperature

The humid climate is dictated by the high rainfall of the high plain of Friuli and the foothills of the Alps. This component is the result of the effect is that the findings will have on the flow of moist air from the south, which are forced into vertical motions which result in heavy rain, both the high temporal frequency of the spring and summer. It must not be forgotten that hail is among the phenomena that characterize the summer weather regions.

In general, it can be said that the low-lying and coastal region (where there are the 4 regional main cities) falls, as regard to the annual average temperature, between the values 12 and 14 C°, with some minor differences that are mainly due to the greater proximity to the Adriatic Sea and to its arrangement.

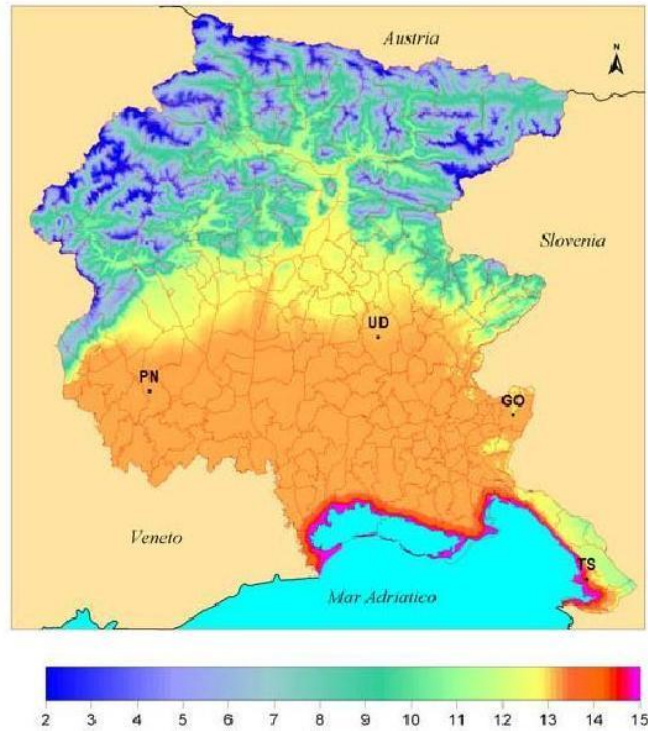


Figure 3 - Friuli Venezia Giulia (ARPA-date Osmer 1997-2006)

In the rest of the hilly and mountainous region, the situation is even more complex, where the temperature is profoundly influenced not only by the altitude, but above all by exposure and orientation of the mountain ranges of the foothills of the Alps and Carnic and Julian Alps, the presence of the plateau of the Carso, the river systems (Adriatic and Black Sea) and river basins (Piave, Livenza, Tagliamento, Isonzo, Drava, Timavo), the shape of the valleys.

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Precipitations

An analysis performed on the data from the OSMER ARPA daily rainfall of the Hydrographic Service of the Ministry of Public Works (1961-2000) led to the drafting of various regional maps of average rainfall. From the study of maps of the annual average rainfall is noted that the region can be, to a large extent, divided into four areas with different rainfall regimes:

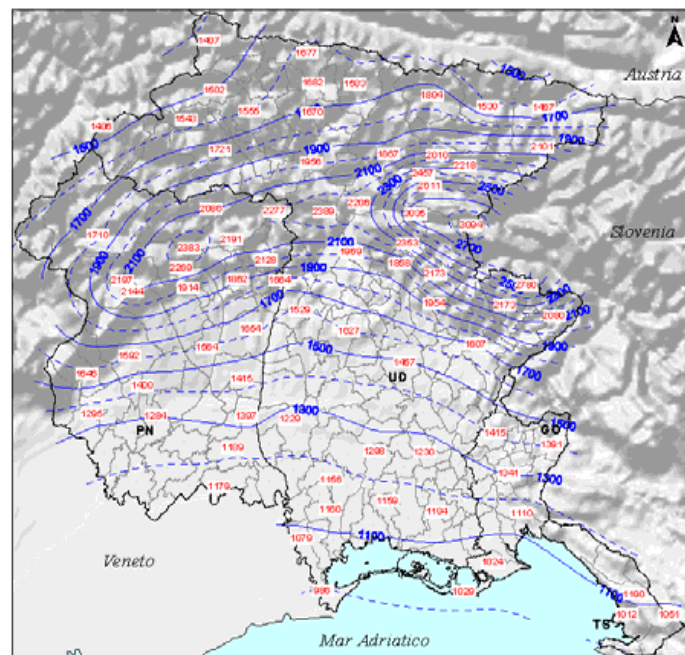


Coastal zone: the area is less rainy in this region; reaching the total annual average, 1,000-1,100 mm, with an increasing trend from the coast towards the interior;

Plains and hills zone: approaching mountains the rainfall increases, the average annual values ranging from 1.200 to 1.800 mm;

Pre-Alps zone: the average annual rainfall reaches values of (from 2,500 to 3,000 millimeters) from European supremacy;

Alpine belt inside zone: north of the Carnic Alps and the Julian returns to the average annual rainfall decreases to values of 1400-1600 mm, very similar to those of the central plains



**Figure 4 - Average annual rainfall in Friuli Venezia Giulia
(Data Service Hydraulics FVG Region 1961-2000)**

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Solar radiation

The OSMER ARPA FVG, thanks to the network of meteorological stations distributed throughout the region, also measures the intensity of the global solar radiation (measured in kJ/m²) and the time of irradiation (measured in minutes). From the data obtained it is clear seasonal trends are common to the different stations: the solar radiation is very diverse and ranges from a minimum of less than 5,000 average daily kJ/m² of December (with about 150 minutes of irradiation) to over 20,000 kJ/m² for the months of June and July (with more than 10 hours, a daily average of sunny weather).



With regard to the various parts of the region, it is evident the higher radiation of the coastal and the plain area compared to the foothills and mountainous one. This situation confirms the climatological evidence according to which the summer period in the region is characterized by frequent rainfall and cloudiness, especially in the afternoons and on the mountains or hilly areas. On the other hand there are mostly clear skies as one descends towards the sea. In addition to the meteorological data, the topography is also fundamentally changing the solar radiation in different parts of the region.

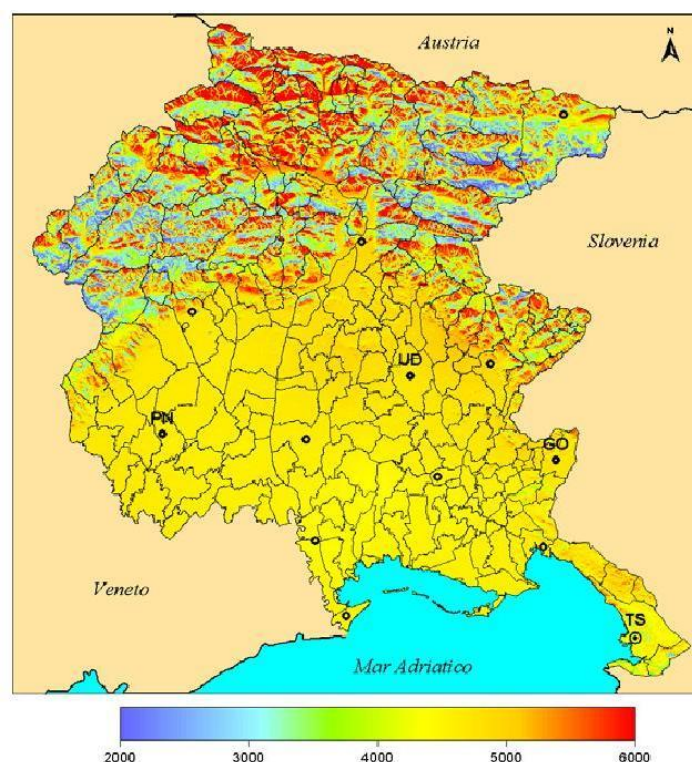


Figure 5- (Average annual temperatures) Figure 5 - Average Annual Global Radiation (MJ/m2)
Data source Osmer ARPA FVG 1995-2005 (Average annual temperatures)

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The figure shows the results of the spatial interpolation of the measured solar radiation data from meteorological stations OSMER-ARPA. This interpolation takes into account the findings of shading and different exposures. The figure shows how the plains annual average insolation is about 4,800 MJ/m², while areas with southern exposure reaching 6000 MJ/m², north-facing slopes in the radiation may be less than 2500 MJ/m².

2.1.2 Heating degree days (HDD)

The Presidential Decree August 26, 1993, n. 412 (GU October 14, 1993, n. 96), as amended regulation that defines a standard design, installation, operation and maintenance of heating systems in buildings in order to control the consumption of energy.



In this decree is the definition of “heating degree days”: Heating degree days are defined as the sum locations, covering all days of an annual period of conventional heating of only the positive differences between the daily temperature, conventionally fixed at 20°C, and the average outdoor temperature daily"

In addition, the decree divides the territory into six climatic zones as a function of heating degree days and regardless of geographical location:

- Zone A: municipalities with a number of “heating degree days” not more than 600;
- Zone B: municipalities presenting a number of “heating degree days” greater than 600 and not more than 900;
- Zone C: municipalities with a number of “heating degree days” greater than 900 and not more than 1.400;
- Zone D: municipalities with a number of “heating degree days” greater than 1,400 and not more than 2.100;
- Zone E: municipalities that have a number of “heating degree days” greater than 2,100 and not more than 3.000;
- Zone F: municipalities presenting a number of “heating degree days” greater than 3,000.

The annex A to the Presidential Decree August 26, 1993, n. 412 is a table, sorted by regions and provinces, which reports for each town in Italy the altitude of the town hall, the “heating degree days” and the climate zone of provenance. It shows, as well, the “heating degree days” and the classification in different climatic zones according to them of the Friuli Venezia Giulia. The processing was carried out by ENEA, an organization to which the decree entrusts the technical expertise in this area.

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Nevertheless, the aforementioned Annex A identifies for each municipality an accumulation of heating degree days and on the basis of this ranking the territory of the whole municipalities in different climatic zones.

It can be assumed that this approach, established by rule, cannot adequately describe the spatial variations of the variable being investigated in municipalities characterized by a complex topography. For this reason, have been recalculated degrees during the days for the Friuli Venezia Giulia on the basis of thermal data recorded by the meteorological network ARPA OSMER.

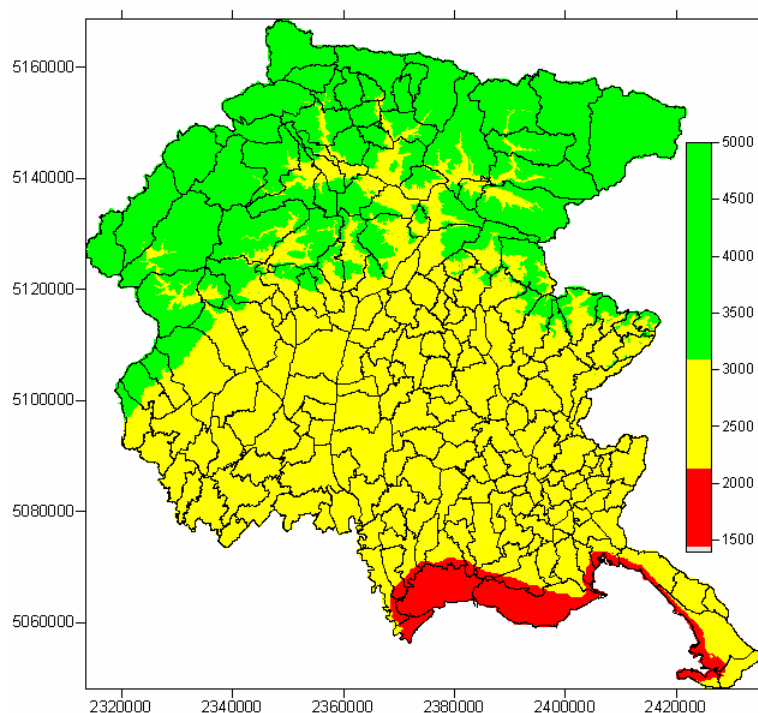


Figure 5 - Breakdown of Friuli Venezia Giulia in different climatic zones (ARPA-OSMER 1997-2006): A red zone, yellow zone and green zone F

It should be noted that compared to the figure above, in the Friuli region there are currently two climatic zones of reference (E and F) following a recent reclassification.

The updated data for the regional main cities are:

CHIEF TOWN	Zone	Daily Degrees	Altitude [msl]
UDINE	E	2323	113
GORIZIA	E	2333	84
PORDENONE	E	2459	24
TRIESTE	E	2105	2



2.3 Characterization of the buildings in the tertiary sector

In the present survey some of the most characteristic areas of the service sector were considered and, depending on the availability of national and regional data, they are described in the following chapters according to their identification parameters and to the following end uses:

- Offices
- Building for commercial use
- Accomodations
- School buildings
- Health facilities / nursing homes (retirement homes)
-

2.4 Characterization of regional office buildings

The largest number of local units used as offices occupy the surface property for mixed use, in mainly buildings constructed for residential use. According to The Land Agency (Land registry) the housing units belonging to the A10 category (office) amounts to 568.577 units. Of these, according to a market survey carried out by the Cresme, 30.5% have interiors at 64.911 buildings used wholly or mainly for office use.

From the data obtained from energy certificates provided by ARES, it appears that most office buildings present in the region of Friuli Venezia Giulia are located inside buildings not newly built (before 1970) or in historical buildings, especially in provincial main cities. The volumes considered are varied and range from a minimum of 300 cubic meters to over 1000 cubic meters.

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Table: Stock year 2012 by region and geographical area: CLASS OFFICES

Area	Regione	Stock	Quota %
Nord Est	Emilia-Romagna	68.619	10,7%
	Friuli-Venezia Giulia	10.144	1,6%
	Veneto	70.728	11,1%
Nord Est		149.491	23,4%

Source: Real Estate Market Report 2012 - Developed by Market Watch Real Estate, Inland Revenue



2.5 Characterization of the regional commercial buildings

The commercial buildings in the region are included in new buildings and, with the exception of some large shopping centers, the heated gross volumes are between 300 and 500 mc.

Table: Stock year 2012 by region and geographical area: DEPARTMENT STORES

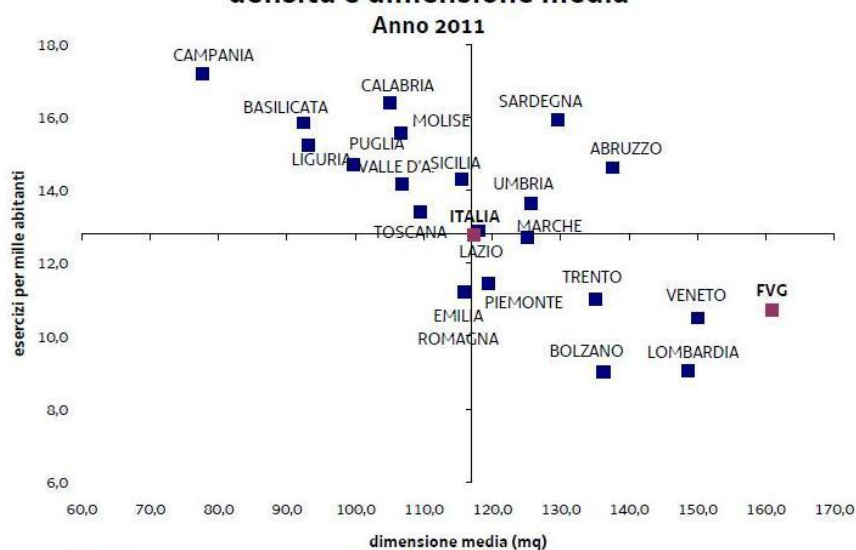
Area	Regione	Stock	Quota %
Nord Est	Emilia-Romagna	178.973	7,0%
	Friuli- Venezia Giulia	28.277	1,1%
	Veneto	205.386	8,1%
Nord Est		412.636	16,2%

Source: Real Estate Market Report 2012 - Developed by Market Watch Real Estate, Inland Revenue

The tables and graphs below represent the density and average size of commercial units in the region compared to the national figure. In particular, the commercial buildings are divided, excluding operations with movable seats (street vendors), in:

- Retail
- Business with fixed location

Esercizi commerciali in sede fissa densità e dimensione media



Fonte: Ministero dello sviluppo economico, Osservatorio nazionale del commercio

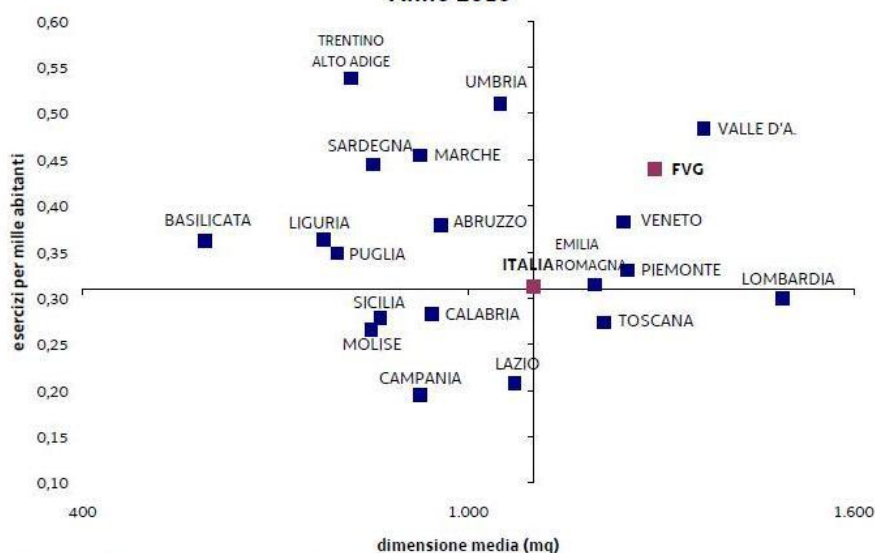


Esercizi commerciali in sede fissa Anno 2011

	sedi	unità locali	totale esercizi	dimensione media (mq)	densità per 1000 ab	var% 2010/2011	var% 2006/2011
PIEMONTE	36.874	14.229	51.103	119,5	11,5	-0,3	-1,3
VALLE D'AOSTA	1.296	523	1.819	106,8	14,2	0,4	-5,2
LOMBARDIA	62.052	28.201	90.253	148,6	9,1	0,3	-0,5
BOLZANO	2.705	1.807	4.592	136,3	9,0	0,2	0,8
TRENTO	3.545	2.303	5.848	135,1	11,0	-0,3	-0,5
VENETO	35.145	16.778	51.923	150,0	10,5	0,0	0,2
FVG	8.824	4.431	13.255	161,0	10,7	-1,1	-5,0
LIGURIA	17.938	6.698	24.636	93,1	15,2	-0,9	-2,5
EMILIA-ROMAGNA	35.545	14.257	49.802	115,9	11,2	0,1	0,6
TOSCANA	35.657	14.685	50.342	109,4	13,4	-0,2	-0,1
UMBRIA	8.806	3.577	12.383	125,6	13,6	0,1	1,3
MARCHE	13.921	5.997	19.918	125,0	12,7	0,6	-0,2
LAZIO	54.882	19.258	74.140	118,0	12,9	0,6	5,8
ABRUZZI	13.945	5.693	19.638	137,6	14,6	0,0	0,9
MOLISE	3.679	1.295	4.974	106,7	15,6	-1,5	-3,7
CAMPANIA	79.920	20.406	100.326	77,7	17,2	-0,2	0,9
PUGLIA	46.797	13.361	60.158	99,7	14,7	0,5	-0,9
BASILICATA	7.025	2.273	9.298	92,4	15,8	0,3	-0,7
CALABRIA	26.018	6.921	32.939	105,0	16,4	0,2	-1,9
SICILIA	56.101	16.039	72.140	115,5	14,3	-0,7	-2,7
SARDEGNA	17.926	8.742	26.668	129,5	15,9	-0,4	-1,8
ITALIA	568.601	207.554	776.155	117,3	12,8	0,0	-0,1

Fonte: Ministero dello sviluppo economico, Osservatorio nazionale del commercio

Grande distribuzione densità e dimensione media Anno 2010



Fonte: Ministero dello sviluppo economico, Osservatorio nazionale del commercio



Grande distribuzione Anno 2010

	Grandi superfici specializzate	Grandi superfici despecializzate				Totale generale	dimensione media (mq)	densità per 1000 ab
		grandi magazzini	supermercati	minimercati	ipermercati			
PIEMONTE	167	77	736	409	83	1.472	1.248	0,33
VALLE D'AOSTA	10	15	16	19	2	62	1.366	0,48
LOMBARDIA	379	275	1.572	595	153	2.974	1.490	0,30
TRENTINO ALTO ADIGE	37	37	298	178	8	558	818	0,54
VENETO	224	77	1.126	394	68	1.889	1.242	0,38
FVG	69	25	296	131	23	544	1.290	0,44
LIGURIA	40	31	209	298	10	588	775	0,36
EMILIA ROMAGNA	145	74	775	362	40	1.396	1.197	0,31
TOSCANA	79	178	543	200	27	1.027	1.211	0,27
UMBRIA	45	68	228	115	7	463	1.050	0,51
MARCHE	54	83	333	222	20	712	925	0,45
LAZIO	56	153	684	272	26	1.191	1.072	0,21
ABRUZZO	49	44	260	149	7	509	957	0,38
MOLISE	2	7	44	27	5	85	849	0,27
CAMPANIA	86	81	503	448	23	1.141	925	0,20
PUGLIA	68	73	571	692	23	1.427	796	0,35
BASILICATA	1	10	85	114	3	213	590	0,36
CALABRIA	25	86	274	170	15	570	943	0,28
SICILIA	64	127	736	456	27	1.410	863	0,28
SARDEGNA	39	49	366	273	18	745	852	0,44
TOTALE	1.639	1.570	9.655	5.524	588	18.976	1.102	0,31

Fonte: Ministero dello sviluppo economico, Osservatorio nazionale del commercio

As shown above, the Friuli Venezia Giulia region have businesses with highest average in Italy (161 sqm).

In Friuli Venezia Giulia supermarket buildings are very large compared to other regions (average 1,290 square meters. Only Lombardia and Valle d'Aosta have buildings with higher than average areas (albeit slightly).

2.6 Regional characterization of accommodation buildings

As far as hotels go, the study CRESME [1] allows to extract some interesting data related to their consistency both at national and regional level: The following table describes the hotels based on the year of construction:

Numero edifici uso alberghiero per epoca di costruzione

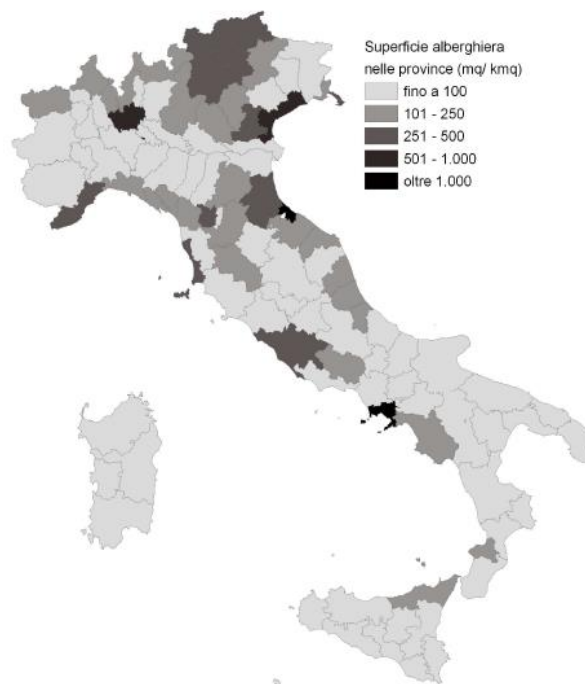
	Numero	%
prima del 1919	5.589	21,6%
Dal 1920 al 1945	1.892	7,3%
Dal 1946 al 1961	4.291	16,6%
Dal 1962 al 1971	5.925	22,9%
Dal 1972 al 1981	3.524	13,6%
Dal 1982 al 1991	2.060	8,0%
Dal 1992 al 2001	1.263	4,9%
Dal 2002 al 2008	1.302	5,0%
TOTALE	25.845	100,0%

Fonte: Elaborazioni Cresme per ENEA - 2010



From the table above it is clear that more than half of the 25,845 hotel facilities considered have been built before 1981. The same distribution can be extended to the region of Friuli Venezia Giulia and therefore, it can be said, that the regional stock of hotel facilities is not made up of recently built structures (they are buildings mainly built between 1946 and 1981).

The following image is an indicator for the density of hotels in the Italian provinces, which it is regarded as the ratio of the total area of the hotel facilities and the region.



Fonte: Elaborazioni Cresme per ENEA – 2010

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From those pictures, it may be noted, that in general, given the configuration of the territory, in the region the area devoted to hotel facilities is low.

From a study carried out in 2009, it follows that in the region there is a high density of hotels, but localized in the coastal / seaside (Lignano, Grado) and in mountain resorts (Tarvisio, Sella Nevea, Carnia).



A phenomenon of particular interest to be monitored in the future is the spread of structures such as B & B, hotels and farmhouse spread, and small facilities spread more evenly throughout the region.

The breakdown by class size has a high prevalence of structures of small size (up to 24 rooms): they determine more than a quarter of the receptive overall in terms of beds (27%). The structures of medium-sized (25 to 99 rooms) make up more than two-thirds of total beds, while larger structures (with 100 rooms and above) are equal to 6% of the overall supply.

Below are two tables showing the number of buildings for hotel use available in the region.

Edifici ad uso alberghiero nel 2009 - Regioni

	NUMERO EDIFICI AD USO ALBERGHIERO	QUOTA SUL TOTALE ITALIA
Piemonte	1.180	4,6%
Valle d'Aosta	314	1,2%
Lombardia	2.190	8,5%
Liguria	1.016	3,9%
Trentino Alto Adige	2.830	10,9%
Veneto	2.555	9,9%
Emilia-Venezia-Giulia	651	2,5%
Emilia Romagna	4.045	15,7%
Toscana	2.561	9,9%
Umbria	571	2,2%
Marche	885	3,4%
Lazio	1.302	5,0%
Abruzzo	667	2,6%
Molise	104	0,4%
Campania	1.449	5,6%
Puglia	845	3,3%
Basilicata	167	0,6%
Calabria	699	2,7%
Sicilia	1.036	4,0%
Sardegna	778	3,0%
Nord - Ovest	4.700	18,2%
Nord - Est	10.081	39,0%
Centro	5.319	20,6%
Sud	3.931	15,2%
Isole	1.814	7,0%
ITALIA	25.845	100,0%

Fonte: elaborazioni e stime Cresme su dati Istat e indagine Cresme 2010



NORD – EST - Edifici ad uso alberghiero nel 2009

		NUMERO EDIFICI AD USO ALBERGHIERO	QUOTA SUL TOTALE ITALIA
Trentino Alto Adige	Bolzano	1.983	7,7%
	Trento	847	3,3%
Veneto	Verona	456	1,8%
	Vicenza	222	0,9%
	Belluno	234	0,9%
	Treviso	152	0,6%
	Venezia	1.152	4,5%
	Padova	287	1,1%
	Rovigo	52	0,2%
Friuli Venezia Giulia	Udine	352	1,4%
	Gorizia	129	0,5%
	Trieste	69	0,3%
	Portogruaro	101	0,4%
Emilia Romagna	Piacenza	66	0,3%
	Parma	247	1,0%
	Reggio Emilia	77	0,3%
	Modena	160	0,6%
	Bologna	223	0,9%
	Ferrara	100	0,4%
	Ravenna	533	2,1%
	Forlì-Cesena	489	1,9%
	Rimini	2.150	8,3%

Fonte: elaborazioni e stime Cresme su dati Istat e indagine Cresme 2010

The study from the CRESME [1] leads to the following conclusions with reference to the northern areas and well represent the reality of the Friuli Venezia Giulia

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- Almost two thirds (65%) of hotel buildings (14,781) are located in the northern regions¹
- Of these, 82% of properties (12,075) falls within climatic zone E. The other climatic zones counted just 2,706 buildings.
- In the area prevailing E, the largest number of buildings (8,710) was made before the '70s, 1,832 additional buildings have sprung up after 1981. About 1,500 belong to the decade '70-'80.
- 60% of the buildings are isolated, with a share in the growth in recent decades.
- The construction system is 64% of reinforced concrete and masonry, while 32% has been declared to be load-bearing masonry, 1,5% AC and glass. Different distribution if you look at the time of construction: before the 70s it was 40% in load-bearing masonry, in recent years a

¹

Piemonte, Valle d'Aosta, Liguria, Lombardia, Veneto, Friuli Venezia Giulia, Emilia Romagna



different focus has shifted towards the concrete cement and glass, the AC and precast panels as cladding and steel and glass (the total of this aggregate is equal to 10.9%).

- The dimensions are uniform in growth in more recent times: in the last twenty years they are 80% larger than 1,000 square meters (accounted for 52% of the buildings constructed before 1970);
- Over half (58%), more of the artifacts made before '70, has only one window per room with wooden frames for 54% of the cases (25% are made of aluminum), but most have double (77.4 %) or triple glazing (6.4%). Most are equipped with external displays (shutters, blinds, etc.).
- Many heating systems are powered by gas (70%), while lower is the use of diesel fuel (21%) and the pipes are inside the walls. In Friuli Venezia Giulia, in particular, the percentage of plants that use gas is higher than the average of the northern regions.
- The issuance of air takes place through both radiators (60%) split (40%) The fan-coil is used by 28% of the hotels, while the air vents in the ceiling represent 18%.
- 89% of the hotels have some circumspection for saving energy. Specifically mentioned are the low energy light bulbs (96%), the timing of the exterior lighting system (55%) control and decommissioning (36%).
- 14% of the hotels have power installations of renewable sources, 12.5% of the buildings built before the 70's.



2.7 Regional characterization of buildings for school use

Most of the schools in the region appear to be built between the early '50s and early '70s.

With the data provided by the Friuli Venezia Giulia Region (Central Directorate for Energy and Environment Policies for Mountain - Energy Service), it was possible to obtain interesting results concerning the size and characteristics of school buildings present in the region; in particular, see the following table:

CHIEF TOWN	NUMBER OF SCHOOLS	YEAR AVERAGE OF CONSTRUCTION	AVERAGE NUMBER OF CLASSROOMS	SURFACE MEDIA [sqm]	AVERAGE VOLUME [mc]
UDINE	525	1960	9	2.230	7.291
PORDENONE	226	1962	10	2.570	8.300
GORIZIA	149	1951	9	1.970	6.630
TRIESTE	123	1931	10	2.817	10.361

2.8 Characterization of regional hospital buildings and other health facilities

The Local Health Agencies are distributed throughout the country amounting 163 in all. In addition to the vast hospital real estate assets they manage, there need to be enclosed all the shelters and private clinics, which provide an additional 25% of beds, for a total of 250,000 beds, distributed in more than 1,500 facilities.

The hospital buildings are particularly varied, with buildings of different eras and diversified healthcare destinations.

The demand for energy in this area is extremely high and needs to be absolutely guaranteed by heating and electrical systems generally operating 24 hours a day, 365 days a year. In particular, energy is used for heating, ventilation and lighting of the environments, the preparation of sanitary hot water, cooling in summer, the production of steam for sterilization and humidification, as well as for kitchens, laundrettes, internal transport, computers, diagnostic and therapeutic devices, etc.

The increase in the complexity of the equipment used and the regulatory compliance in terms of temperature, humidity and air changes leads to further increases in consumption and to a greater difficulty in the management of the facilities.



The different end uses of health facilities require specific technical regulations, but also different patterns of employment and energy use. One must also take into account the company's strategy in terms of hotel comfort for patients and employees, which affects, for example, the percentage of areas that enjoy summer cooling. High consumption can therefore be attributed not only to a low efficiency of the building-plant system, but also to its greater exploitation.

To address a detailed analysis of energy expenditure in hospitals it is essential to try to paint a picture of the national consumption in this sector. Unfortunately, disaggregated data are difficult to find, mainly because the subjects who collected them, usually through assignment of specific contractual tasks, do not intend to disclose them or are required by contract to keep confidential. A further difficulty in the collection of information by health care providers is due to the lack of interest that management usually demonstrates to the problem of energy consumption. In the light of the low incidence of this expenditure within the economic overall health of a company, it may be reluctant to make improvements. In particular, in the overall budget of the National Health System (99 billion euro in 2006), the supply of fuel (excluding for motor transport) and the supply of electricity accounts for about 2%. These two items of expenditure in fact correspond, respectively, to 5% and 2.2% of the share of the budget relating to goods and services, which, in turn, is equal to 27% of total expenditure. The Friuli Venezia Giulia has values that differ slightly.

Regione	Consumi elettrici e termici [kTEP]	Numero di posti letto	Consumi specifici [TEP/p.l.]
Valle d'Aosta	3.57	416	8.58
Piemonte	94.4	6648	14.2
Liguria	17.7	2559	6.92
Lombardia	486	19838	24.5
Veneto	70.1	10772	6.51
Trentino Alto Adige	18.3	840	21.8
Friuli Venezia Giulia	15.0	2261	6.63
Emilia Romagna	59.5	8746	6.80
Toscana	44.1	6903	6.39
Marche	41.1	948	43.4
Lazio	59.8	5906	10.1
Abruzzo	10.9	2283	4.77
Molise	10.0	1843	5.43
Campania	9.36	1259	7.43
Basilicata	82.2	1372	59.9
Puglia	49.7	5858	8.48
Calabria	5.56	642	8.66
Sicilia	39.4	7473	5.27
Sardegna	9.37	2465	3.80
Totale	1126	89032	12.6

Figure 8 - Total Consumption per year (in ktoe) and number of beds of health facilities equipped with Energy Managers. Source: ENEA



There are no statistical data on the surfaces and the distribution of these types of buildings in the region. Hospitals in the region are concentrated in the provincial cities, retirement homes and facilities of a private nature not subject to a general coordination.

On average in Friuli Venezia Giulia representative structures of this class of buildings are historic buildings in load-bearing walls in solid brick and stone, or buildings of the 60s-70s, a type of construction with reinforced concrete walls.



2.9 Energy consumption in buildings of the tertiary sector in the region of Friuli Venezia Giulia

A publication of the Friuli Venezia Giulia Region ("The energy sector 31.12.2011") concludes that 2010 marks the resumption of the production and consumption of electricity in Italy (+3.3%) and in the Friuli Venezia Giulia (+7.9%) as well. In the region the increase in consumption (+8.2%) is mainly due to the industrial sector (+13.6%), which, however, with 5841.9 GWh consumed in 2010, reaches the 2001 level (5877.2 GWh) and is well below the 2007 peak (6471.1 GWh). Fuel consumption in the tertiary sector (+0.02%) are stable while are gradually increasing the domestic ones (+2.2%), which are less affected by the economic cycle.

The following table is an extract from the energy balance of the synthesis of the Region of Friuli Venezia Giulia.

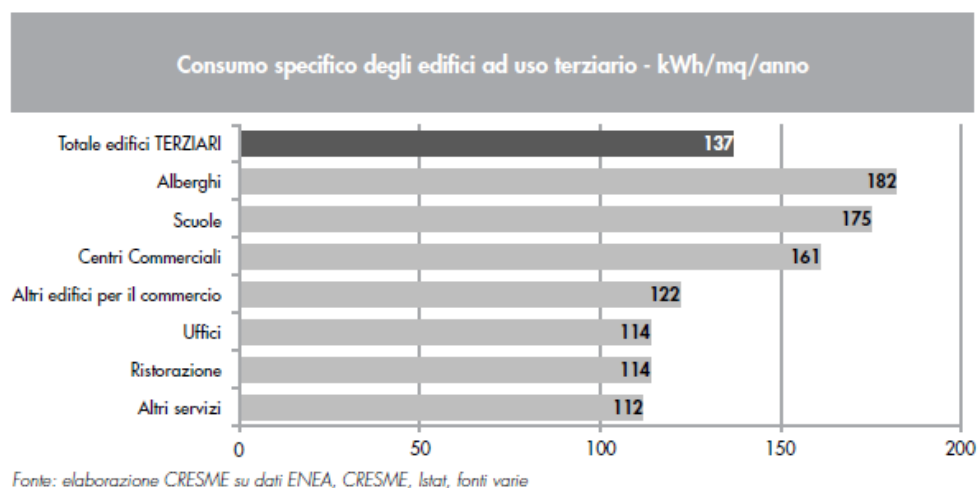
L1 Bilancio Energetico Regionale

L1.1 2008

Idip (migliaia di tonnellate equivalenti di petrolio)							Totale
	Combustibili solidi	Lignite	Petrolio	Gas naturale	Rinnovabili	Energia elettrica	
Produzione interna	-	-	-	-	316	-	316
Saldo in entrata	812	-	1.539	2.248	1	25	4.625
Saldo in uscita	121	-	-	-	2	-	123
Bunkeraggi marittimi	-	-	358	-	-	-	358
Bunkeraggi aerei	-	-	27	-	-	-	27
Variazioni delle scorte	-32	-	-	-	-	-	-32
Risorse interne	722	-	1.164	2.248	316	26	4.486
Ingressi in trasformazione	924	-	178	908	217	-	2.228
Centrali idroelettriche	-	-	-	-	151	-	151
Centrali termoelettriche	530	-	176	908	64	-	1.679
Cokerie	351	-	-	-	-	-	351
Raffinerie	-	-	-	-	-	-	-
Altri impianti	43	-	0	-	1	-	44
Uscite dalla trasformazione	48	-	0	-	1	923	988
Centrali idroelettriche	-	-	-	-	-	151	151
Centrali termoelettriche	-	-	-	-	-	772	772
Cokerie	-	-	-	-	-	-	-
Raffinerie	-	-	-	-	-	-	-
Altri impianti	43	-	0	-	1	-	43
Trasferimenti	-213	-	-84	-485	-170	832	-
Consumi e perdite	61	-	-	10	63	84	188
Disponibilità interna	155	-	878	1.330	46	884	3.352
Uci non energetici	13	-	0	-	-	-	13
Consumi finali	122	-	878	1.330	46	884	3.338
Industria	121	-	144	634	14	525	1.438
Industria manifatturiera di base	119	-	31	464	14	310	939
Metallurgia	119	-	0	59	-	150	367
Minerali non metalliferi	-	-	29	48	14	36	127
Chimica e petrolchimica	0	-	1	67	-	39	107
Carta, grafica ed editoria	-	-	1	261	-	70	335
Industria manifatturiera non di base	2	-	112	170	-	212	495
Alimentari, bevande e tabacco	0	-	7	12	-	21	40
Tessile e calzature	-	-	0	10	-	8	18
Meccanica	1	-	33	86	-	70	199
Altre manifatturieri	-	-	71	62	-	105	239
Trasporti	-	-	692	4	-	14	710
Ferroviani e urbani	-	-	-	-	-	14	14
Stradali	-	-	687	4	-	-	691
Navigazione marittima	-	-	3	-	-	-	3
Navigazione aerea	-	-	2	-	-	-	2
Residenziale	1	-	88	383	30	120	622
Terziario	-	-	20	306	0	184	620
Agricoltura, silvicoltura e pesca	-	-	34	3	-	10	47



The following image represents the specific consumption of buildings for commercial use. This distribution can also be reported at the regional level.



	Agricoltura	Industria	Terziario	Domestico	Totale
Piemonte	309,0	13.153,4	6.901,0	5.070,2	25.433,6
Valle d'Aosta	4,4	429,5	334,9	184,0	952,8
Lombardia	840,5	34.279,2	18.717,1	12.044,8	65.881,7
Trentino Alto Adige	232,0	2.489,9	2.594,6	1.261,3	6.577,8
Veneto	618,8	15.447,4	8.059,1	5.621,9	29.747,2
Friuli Venezia Giulia	123,3	5.841,9	2.329,3	1.426,1	9.720,5
Liguria	34,0	1.634,2	2.953,4	1.930,4	6.552,1
Emilia Romagna	924,5	12.163,6	8.939,1	5.283,7	27.310,9
Italia Settentrionale	3.086,5	85.439,0	50.828,8	32.822,3	172.176,6
Toscana	287,1	8.955,1	6.619,1	4.402,0	20.263,2
Umbria	104,0	3.178,8	1.311,8	980,4	5.575,0
Marche	124,8	3.231,7	2.387,5	1.643,7	7.387,6
Lazio	328,2	4.829,7	10.983,7	7.112,3	23.253,8
Italia Centrale	844,0	20.195,3	21.302,1	14.138,3	56.479,7
Abruzzi	83,6	2.988,4	1.949,6	1.323,2	6.344,7
Molise	30,8	698,6	379,9	302,5	1.411,7
Campania	271,3	5.001,7	6.289,7	5.891,3	17.454,0
Puglia	510,8	8.230,6	4.515,5	4.265,3	17.522,2
Basilicata	63,1	1.499,9	598,3	525,4	2.686,6
Calabria	117,9	959,6	2.327,3	2.143,5	5.548,3
Sicilia	404,9	7.157,5	5.676,2	5.848,2	19.086,9
Sardegna	197,5	6.268,7	2.417,1	2.290,5	11.173,8
Italia Meridionale e Insulare	1.679,8	32.805,0	24.153,6	22.589,8	81.228,3
ITALIA	5.610,3	138.439,3	96.284,5	69.550,5	309.884,5

Nota: dati al lordo dei consumi FS per trazione

Fonte: Terna S.p.A.

Figure 9 - Electricity consumption in 2010 in GWh



Moreover, at regional level, the data for electricity consumption in the commodity-related sector is available on the website of Terna SpA, that follows the extracts relating to regional and provincial data in the service sector.

FRIULI VENEZIA GIULIA

Electrical energy consumption by sector – year 2011

	Tipi Attività	2010 mln KWh	2011 mln KWh	Var %
38.	TERTIARY	2.329,3	2.319,5	-0,4
39.	Services salable	1.776,9	1.805,1	1,6
40.	Transport	447,1	462,2	3,4
41.	Communication	73,6	75,9	3,1
42.	Trade	544,9	553,8	1,6
43.	Hotels, Restaurants and Bars	260,9	263,4	1,0
44.	Credit and Insurance	60,8	63,2	3,9
45.	Other Services salable	389,6	386,6	-0,8
46.	Services cannot be sold	552,4	514,4	-6,9
47.	Public administration	114,3	111,2	-2,7
48.	Public lighting	134,2	133,4	-0,6
49.	Other Services not salable	303,9	269,8	-11,2

TRIESTE

Electrical energy consumption by sector – year 2011

	Tipi Attività	2010 mln KWh	2011 mln KWh	Var %
38.	TERTIARY	526,3	508,4	-3,4
39.	Services salable	398,6	389,5	-2,3
40.	Transport	106,7	110,6	3,7
41.	Communication	21,7	23,7	9,2
42.	Trade	94,7	103,9	9,7
43.	Hotels, Restaurants and Bars	50,1	52,7	5,2
44.	Credit and Insurance	21,1	22,4	6,2
45.	Other Services salable	104,3	76,3	-26,8
46.	Services cannot be sold	127,7	118,9	-6,9
47.	Public administration	24,9	25,8	3,6
48.	Public lighting	17,9	20,8	16,2
49.	Other Services not salable	84,9	72,2	-15,0



UDINE

Electrical energy consumption by sector – year 2011

	Tipi Attività	2010 mln KWh	2011 mln KWh	Var %
38.	TERTIARY	969,9	948,2	-2,2
39.	Services salable	779,1	784,8	0,7
40.	Transport	164,8	168,2	2,1
41.	Communication	30,3	30,8	1,7
42.	Trade	257,6	257,5	-0,0
43.	Hotels, Restaurants and Bars	130,9	131,5	0,5
44.	Credit and Insurance	23,9	24,2	1,3
45.	Other Services salable	171,5	172,6	0,6
46.	Services cannot be sold	190,9	163,4	-14,4
47.	Public administration	45,5	44,7	-1,8
48.	Public lighting	67,3	64,2	-4,6
49.	Other Services not salable	78,0	54,5	-30,1

GORIZIA

Electrical energy consumption by sector – year 2011

	Tipi Attività	2010 mln KWh	2011 mln KWh	Var %
38.	TERTIARY	201,9	212,6	5,3
39.	Services salable	147,4	161,8	9,8
40.	Transport	13,3	12,9	-3,0
41.	Communication	5,8	6,0	3,4
42.	Trade	66,7	66,8	0,1
43.	Hotels, Restaurants and Bars	31,5	31,4	-0,3
44.	Credit and Insurance	4,5	5,7	26,7
45.	Other Services salable	25,6	39,1	52,7
46.	Services cannot be sold	54,6	50,8	-7,0
47.	Public administration	19,0	15,6	-17,9
48.	Public lighting	11,5	11,3	-1,7
49.	Other Services not salable	24,0	23,9	-0,4



PORDENONE

Electrical energy consumption by sector – year 2011

	Tipi Attività	2010 mln KWh	2011 mln KWh	Var %
38.	TERTIARY	481,7	493,3	2,4
39.	Services salable	302,4	312,0	3,2
40.	Transport	13,0	13,5	3,8
41.	Communication	15,9	15,4	-3,1
42.	Trade	125,8	125,6	-0,2
43.	Hotels, Restaurants and Bars	48,3	47,9	-0,8
44.	Credit and Insurance	11,3	11,0	-2,7
45.	Other Services salable	88,1	98,6	11,9
46.	Services cannot be sold	179,3	181,3	1,1
47.	Public administration	24,9	25,0	0,4
48.	Public lighting	37,4	37,1	-0,8
49.	Other Services not salable	117,0	119,2	1,9



3 Energetic analysis of building types

Throughout this chapter several buildings particularly representative of the part of the tertiary sector are reviewed. The most relevant data of each building are summarized in special factsheets to allow an immediate reading of the most important energy data for each building.

A fairly representative sample of the properties of the tertiary sector regionally was created, by using available energy data for separate buildings for the following end uses:

- School buildings
- Offices
- Health facilities / retirement homes
- Commercial Buildings
- Accommodations (Hotels)

A fairly representative sample of the properties of the tertiary sector regionally was created.

The structures analyzed were chosen according to the average characteristics of the building for the single end use and to the completeness of the available data.

3.1 Consistency of the monitored buildings

The buildings examined for different categories of buildings within the service sector are those briefly presented in the table below.

CATEGORY	NUMBER OF CASES	NOTES
School buildings	5	Data made available by the municipalities and the province of Gorizia
Offices	5	Data collected by municipalities
Health facilities / retirement homes	3	Data available with difficulty
Commercial Buildings	3	1 small, 2 medium-large
Accommodations (Hotels)	1	Data is often not available or obtainable

The main difficulties encountered in the preparation of an in-depth energy analysis are dictated by the fact that at both national and regional level there is no program of energy audits for buildings of the tertiary sector. Moreover, no energy plan has been foreseen for an energetic improvement of this specific category of buildings.



Note that for certain categories of buildings (mainly for tourist accommodation) it has been very difficult to obtain useful data for the compilation of factsheets. The choice of the historic buildings within the presented analysis was carried out taking into account the particular category of historic buildings adapted for new uses (such as municipal seat), in order to preserve its conservation.

The solutions of public or private offices or banks installed in multi-family apartment buildings are representative of a significant amount of buildings present in the region especially in small urban areas and for this reason it was decided to give particular importance to this type of structure. Another very common type of building within the region and for this reason included within the study, is represented by small businesses included in the urban centers, which are located in apartment buildings, where the business unit is inserted inside a building for commercial ground floor use and residential use on the upper floors.

It would therefore be advisable for all buildings in the regional tertiary sector, and especially for public buildings, the implementation of systems to monitor energy consumption of the plants. To this end, the FVG region is expected for 2014 to comply with the rationalization program of purchases of goods and services by means of CONSIP, the company of the Ministry of Economy. In particular, the agreement relating to the energy sector allows to perform an energy monitoring on regional public buildings.

3.2 Method of analysis of the proposed interventions

The analysis conducted on the sample buildings were based on the following building energetic data:

- Routine exams to view the building
- Routine exams to view the plant system installed
- Energy audit relating to the cost and the type of electrical systems installed
- Analysis of documents such as: energy certification, energy audits, loss calculation rel. art. 28 L10/91, energy signature
- Analysis of consumption (electricity bills and gas / diesel)

In verifications for the calculation of payback on improvements and energy savings with the potential for interventions to be implemented on the buildings you are considering market prices for common facilities proposed.



The following applicable equipment/technologies were examined:

- 1) Replacement of boilers
- 2) Inclusion of climatic control
- 3) Replacement of windows and doors
- 4) Insulation structures dispersants
- 5) Use of biomass boilers
- 6) Mechanical ventilation with heat recovery
- 7) Solar thermal panels for hot water production
- 8) Solar cooling

Replacement of boilers

In this category of intervention it is considered the replacement of the generator of type standard 2 or 3-star hotel with a generator of high efficiency condensing type, this intervention was estimated with an approximate cost of 150€/kW (costs indicative are derived from market analysis carried out on the basis of recent public procurement).

Inclusion of climatic control

In this category of intervention are considered the standard prices "on the body" estimated for the single intervention; since there is a relative proportion adjustment to the cost of the intervention and the power of the plant prices were applied ranging from € 2,500 to € 6,000 for the operation of existing plants without adjustment.

Replacement of windows and doors

In this category of intervention it is considered to be an average price for a window frame with high thermal performance for an estimated price of 500 €/sqm (costs derived from market analysis and regional pricing list).

Insulation structures dispersants

In this category of intervention there are considerations (where possible) for interventions for exterior insulation finishing system (approximate cost € 65 / m²), interventions on the cover (approximate cost € 110/m²) and internal insulation relating to false-internal (approximate cost around 50€/sqm).

Use of biomass boilers

In this category of intervention it is considered the replacement operation for fossil fuel generators with high efficiency generators utilizing woody biomass (wood pellet wood chips). This



intervention was estimated with an approximate cost of 350€/kW (these costs indicative are derived from analyzes of the market).

Mechanical ventilation with heat recovery

For buildings that require the installation of mechanical ventilation it is considered to adopt ventilation systems with heat recovery to improve the efficiency and environmental comfort of the rooms, the costs were estimated for each intervention in the body.

Solar thermal panels for hot water production

For this category of intervention is considered the inclusion of forced circulation solar panels glazed floors and storage systems (boilers) installed in thermal power plant, for such a system is estimated at an average cost of 850€/panel. The sizing of the solar system has been calculated to cover about 40% of the heating requirements for domestic hot water.

Solar cooling

For work related to the inclusion of more complex systems that apply the technology of solar cooling, it was considered the case of inserting a forced circulation solar thermal vacuum and storage systems (boilers) installed in the thermal power plant, combined with a surge in single-effect lithium bromide with efficiency in cooling of 0.75 (in conjunction with cooling tower) and heat output 1.3 (combined with auxiliary boiler).

The insertion of the absorber was evaluated by sizing the absorber on the basis of the cooling capacity currently installed, the thermal energy to be supplied to the absorber by means of solar systems has been estimated assuming a yield of about 250 W/m² of solar panels under optimal operation. For the solar system, an average cost of 1,150€/panel has been estimated: based on the sizes of absorbers commercially available, it was considered a cost of about €95,000 for a 100 kW absorber refrigerators.

Given the small number of interventions that present technologies such as solar cooling and of inserting absorbers made in the region, it is not currently possible to submit standardized costs related to the potential use of such technologies.

Despite the good potential of solar cooling technology , the research here conducted , based on the detailed consumption and costs analysis assessed together with specialists and specialized commercial structures, has highlighted the opportunity, on the basis of cost-benefit analysis of its application only in some particular situations of the tertiary sector. This limitation is mainly due to the high cost of the technology, to the need for large spaces to be allocated to the installation of the various plant components (with particular reference to the surfaces of solar cover) and to a cooling demand of the buildings that focuses only in four months a year.

It has to be said, that buildings that do not have requests for summer cooling (e.g. schools) , have



not been evaluated by the inclusion of types of systems aimed at saving energy for cooling (such as solar cooling) given the absence of such need .

3.3 Incentives for existing interventions aimed at enhancing the efficiency of existing buildings

Currently at the national level there are several incentives aimed at a more energy-efficient performance of existing buildings. These incentives can be summarized in the following list:

- Rate of net metering for PV installations (ARG / elt 74/08)
- Tax deduction of 65% (for private individuals) aimed at the replacement of heating systems with condensing boilers and heat pumps, solar panels installation, construction of the building insulation, replacement windows and doors, upgrades of the building's overall energy (Law: legge 27 dicembre 2006, n. 296, as amended and supplemented)
- Access to the market for white certificates for energy efficiency of buildings (Ministerial Decree: decreto ministeriale del 20 luglio 2004 and subsequent amendments and additions);
- Income thermal energy (DM 28/12/12) within which there are various types of intervention²:
 - 1.A thermal insulation of opaque surfaces bounding the volume air-conditioned;
 - 1.B replacement of transparent enclosures including frames bounding volume air-conditioned;
 - 1.C replacement of air conditioning equipment existing in winter with winter heating systems that use heat-generating condensing;
 - 1.D installation of shielding and / or shading of transparent closures, fixed or mobile, non-transportable.
 - 2.A replacement of air conditioning equipment existing in winter, with winter heating systems with heat pumps, electric or gas, using aerothermal, geothermal or hydrothermal energy;
 - 2.B replacement of winter heating systems or heating greenhouses existing in farm buildings with winter heating systems with a heat generator powered by biomass;
 - 2.C installation of solar thermal collectors, also combined with solar cooling systems;
 - 2.D replacement of electric water heaters with heat pump water heaters.

40

² The interventions of Category 1 are encouraged if carried out on existing buildings owned by public authorities; Category 2 interventions involving replacement of existing generators, except for solar collectors (and biomass generators, they provide heat to farms), of which you can install from scratch



3.4 Operations on historic buildings and subject to environmental constraints

Most of the buildings for commercial use are located in historic buildings, secured or protected by the Superintendence according to D. Lg 490/99 and Law 1089 of 1939.

The owner of a protected building is subject to a number of limitations on the use of his property, in particular "the property cannot be changed, demolished or renovated, without the authorization of the Ministry of Cultural and Environmental Heritage, they cannot convert it into something for uses not compatible with its historical-artistic merits or injurious to its preservation or integrity".

The buildings with valuable characteristics such as historic buildings require careful methods of intervention, from the moment that the interventions of the insulation of the walls can be performed only from the inside, while the replacement of windows must be performed by maintaining the shape, material and aesthetics equal to existing. The interventions of the insulation of the roof are allowed only after approval by the Superintendence for the artistic.

With these assumptions, it is clearly impossible to implement interventions for revision of structural building components (such as the insulation of structures outside). Even more obvious is the difficulty of being able to perform the installation of foreign elements in coverage such as solar panels or photovoltaic.

It should not be forgotten the need for space that such plants' equipment require for the housing of all necessary components - spaces inside monumental buildings are often very low. Work on historic buildings must be designed very carefully and always take into account the need not to change the characteristics of the building being the objective of the intervention: it can be insulated from the inside with double wall insulation, replacing the plaster (also external) with thermal insulation plaster.

Acknowledging the particularity of the buildings considered and the characteristics of the construction types related to the time of construction of the building itself, it is important to remember that the actions of internal insulation can create imbalances in the thermo hygrometric characteristics of existing buildings.

The inclusion of plant equipment of high technology inside historic buildings, subjected to environmental constraints, and the implementation of interventions on this type of buildings must always deal not only with the restrictions imposed to protect the building itself, but also with the actual availability of space offered by the buildings at issue for the installation of plant components and with a proper assessment of the behavior of the structure following the completion of the proposed intervention.



3.5 Current energy consumption

3.5.1 School buildings

3.5.1.1 Building public school (primary school)

Year built: 70s or so, plant renovation 2004

Guidance: The plan distribution does not have an optimized orientation of the building, classrooms facing towards all 4 orientations

Volume: 16992mc

Type of building: a building block.

Type of construction: building constructed with framed structure in reinforced concrete, hollow brick infill, cladding in exposed brick and flat roof made of reinforced concrete. The school building has a gym.

Number of users: 280 students.



Heated area of the building (m²) **3152**

Energy consumption of the building

Electricity (MWh)/yr		92473kwh			
Fuel, district heating, renewable sources (MWh)/yr.		Natural Gas 22,30 MWh/yr (1926€/yr)			
TOTAL (MWh)		114,77MWh			
Emission of CO2		4,52Tons CO2/yr			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	80	0	5	15	-

Observation data quality: from energy certification

Brief description of the energy

Housing:

Building perimeter	transmittance media 2,8 W/mq*k
Ground floor	transmittance media 1,7 W/mq*k
Cover made of insulated brick	transmittance media 0,4 W/mq*k
Aluminum windows with double glazing	transmittance media 3,0 W/mq*k



<p>Systems of heating, ventilation and air conditioning:</p> <p>The system of production of thermal energy is a thermal power station with 1 heat generator with natural gas, the distribution system is controlled by one circuit and the heaters are radiators. 1 boiler power 470kW Riello standard (year 1990)</p> <p>Emission system:</p> <p>100% radiators</p> <p>Hours of use:</p> <p>7am – 4pm temperature 20°C</p> <p>The gym also has 2 openings until 8 pm (gym temperature 18°C)</p> <p>period of use of the building from September to June</p> <p><i>Adjustment:</i> climate of central thermostatic valves for each environment.</p>
<p>Cooling:</p> <p>There is not any cooling system installed</p>
<p>In local classrooms and corridors are installed air exchange units with heat recovery.</p>
<p>Domestic Hot Water:</p> <p>The domestic hot water is heated by boilers supplied by accumulator tank capacity 250lt. Tank insulation 8cm polystyrene.</p>
<p>Lighting system:</p> <p>General plant construction year 1980 (approximately) and later adapted and modified</p> <p>All lamps are made with fluorescent tubes of various types</p> <p>Lighting estimated average</p> <p>200LUX corridors</p> <p>300lux classrooms</p> <p>100lux gym</p> <p>There are not systems of automatic adjustment of lighting.</p>
<p>Other systems:</p> <p>In the school building are installed approximately:</p> <ul style="list-style-type: none"> ✦ 15 computers (200W) ✦ 2 copiers (500W) ✦ 1 refrigerator (500W) ✦ 2 televisions (500W)
<p>Building energy management:</p> <p>During the occupation the guaranteed temperature is 20°C. No cooling system is foreseen for summer periods.</p>



Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other (biomass)
MEDIUM	HIGH	HIGH	LOW	LOW	MEDIUM

The buildings of this type of construction and management require, for the purpose of energy saving, significant insulation of the building, replacement of existing windows with high-performance windows and doors, replacement of existing generators with heat generators with high efficiency.

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
not applicable	very applicable	very applicable	not applicable

List of task in order of priority:

- ✦ replacement of the boiler
- ✦ achieve insulation to coat structures to limit the dispersion of the building
- ✦ replace the windows and doors
- ✦ use of biomass boilers
- ✦ installation of electricity production (PV)
- ✦ replacement of lighting bodies
- ✦ use of solar panels to cover part of the production of domestic hot water



Potential investment:

The school building in question is broadly representative of the regional school buildings. It is noted that school buildings have very little energy needs related to:

- ⌄ cooling system
- ⌄ domestic hot water
- ⌄ lighting and electricity.

Thus, turn out to be convenient and therefore primary the investments for the replacement of the boiler and for the insulation of the structure. Other interventions are difficult to propose because of the high return periods.

The plant systems that use renewable sources such as insertion of boilers to biomass are interesting but have times of high return on investment.

The intervention on the solar cooling is not convenient because the school building is not energy consuming due to cooling systems.

	% risparmio	energia post intervento kWh	Energia risparmiata kWh/yr	mancate emissioni CO2 kg/yr	costo stimato intervento €	risparmio economico €	tempo di ammortamento yr	note
sostituzione generatori di calore		20512,32	1783,68	362	18000	146	122,91	Sostituzione caldaia
regolazione climatica								intervento eseguito
sostituzione serramenti		16722	5574	1132	38000	458	83,03	
isolazione delle strutture disperdenti		13377,6	8918,4	1810	40000	732	54,63	
utilizzo di caldaie a biomassa		22296	0	4526	50000	513	97,44	
ventilazione meccanica con recupero di calore		non previsto						già eseguito
pannelli solari termici (ACS)		non previsto						NP
solar cooling		non previsto	104479	21209		8578		NP

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable

Solar Thermal: not applicable

Biomass: probably applicable

Heat pump: not applicable

There is not enough hot water use to justify investments for the production of hot water from renewable energy sources.

As already mentioned solar cooling is not feasible for this type of building. The PV has a reasonable chance of exploitation, given the government incentives, the low cost of the operation and the availability of good surface coverage.



System to monitor the consumption by the user

There is no system to monitor the consumption by the user.

The plant is managed by an energy service contract but consumption data are not provided to the user. It should be noted that there is no regular issue of the gas bills: the bills are paid on the basis of presumed consumption and later adjusted. From a brief analysis it should be noted that the adjustments are carried out in winter (maximum cost of the service).



3.5.1.2 Upper secondary school (technical school)

Year of construction: 1966 (building has not undergone substantial changes and restructuring since the year of construction).

Guidance: The plan distribution does not have an optimized orientation of the building, classrooms facing towards all 4 orientations.

Volume: 43 699 cubic meters

Type of construction: building consists of several buildings (classrooms, workshops, gym). The body of classrooms is a tower building with 5 floors while the other bodies develop on one or two floors, creating an internal courtyard.

Type of construction: building constructed with a framed structure in reinforced concrete, infill masonry brick, and flat roof with structure in brick and bitumen coating. The frames are made of aluminum without thermal break.

N. Users: 700 students



Heated area of the building (m²) **11.336**

Energy consumption of the building

Electricity (MWh)/yr		data not available				
Fuel, district heating, renewable sources (MWh)/yr		1.809				
TOTAL (MWh)		data not available				
Specific energy consumption for the Heat. (kWh/m ²)		160				
Specific consumption of electrical energy (kWh/m ²)		data not available				
Energy consumption divided by [%] - estimated	Heating	Cooling (VAC)	Hot water	Lighting	Other	
Energy consumption of the building	70	5	5	5	15	

Observation data quality: from energy certification

Brief description of the energy



Housing: Structure in reinforced concrete estimated transmittance $U= 1,980$ W/m^2K Steel frames with double glazing estimated transmittance $U= 3,500$ W/m^2K Intermediate slab with ceiling bricks and reinforced concrete Ground floor not insulated Roof slab with ceiling bricks and reinforced concrete			
Systems of heating, ventilation and air conditioning: Heating: 2 standard boiler + 1 condensing boiler with total power of 2052 kW Other systems: data not available			
Building energy management: During the occupation the guaranteed temperature is 20°C, while in summer the school is closed.			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other (biomass)
HIGH	HIGH	MEDIUM	LOW	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
not applicable	very applicable	very applicable	not applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable
 Solar thermal: probably applicable
 Biomass: probably applicable
 Heat pump: probably applicable



3.5.1.3 Upper secondary school (vocational school)

Year Built: 1965 (the building has not undergone substantial restructuring interventions since the year of construction).

Orientation: The building plan distribution does not have an optimal orientation.

Volume: 20 811 cubic meters

Type of construction: the school consists of three buildings (classrooms, workshops and gym).

Type of construction: building a framed structure made of reinforced concrete and masonry infill brick. The covers appear to be different in different buildings: masonry load-bearing structure, flat (classrooms) and barrel (gym) coated with bitumen, incline covered with tiles (workshops). The frames are available in aluminum without thermal break.

N. Users: 350 students



Heated area of the building (m²) **5.473**

Energy consumption of the building

Electricity (MWh)		data not available			
Fuel, district heating, renewable sources (MWh)		623			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat. (kWh/m ²)		114			
Specific consumption of electrical energy kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	70	5	5	5	15

Observation on the quality of the data: coming from energy audits

Brief description of the energy



Housing: Structure in reinforced concrete estimated transmittance $U= 1,980$ W/m^2K Steel frames with double glazing estimated transmittance $U= 3,500$ W/m^2K Intermediate slab with ceiling bricks and reinforced concrete Ground floor not insulated Roof slab with ceiling bricks and reinforced concrete			
Systems of heating, ventilation and air conditioning: Heating: 1 standard boiler + 1 condensing boiler total power of 560 kW Other systems: data not available			
Building energy management: During the occupation the guaranteed temperature is 20°C, while in summer the school is closed.			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
HIGH	HIGH	MEDIUM	LOW	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
not applicable	very applicable	very applicable	not applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable
 Solar thermal: probably applicable
 Biomass: probably applicable
 Heat Pump: probably applicable



3.5.1.4 Upper secondary school of small dimension (vocational school)

Year Built: 1980 (the building has not undergone substantial restructuring interventions since the year of construction).

Orientation: The building plan distribution does not have an optimal orientation.

Volume: 9,869 cubic meters

Type of construction: building consists of two buildings (classrooms, workshops, gym). The body of classrooms is a tower building with 2 floors while the other bodies are developed on one floor and constitute the service area and gym.

Type of construction: prefabricated building structure with precast reinforced concrete infill panels and insulated concrete weakly. The floors of the flat roof and soffit are made from prefabricated reinforced concrete structure and covered with bitumen. The frames are made of aluminum with double glazing without thermal break.

N. Users: 250 students



Heated area of the building (m²) **2.672**

Energy consumption of the building

Electricity (MWh)		data not available			
Fuel, district heating, renewable sources (MWh)		305			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat. (kWh/m ²)		114			
Specific consumption of electrical energy (kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	70	5	5	5	15

Observation on the quality of the data: coming from energy audits

Brief description of the energy



Housing:			
Structure in reinforced concrete		estimated transmittance $U= 1,980$	
W/m^2K			
Steel frames with double glazing		estimated transmittance $U= 3,500$	
W/m^2K			
Intermediate slab with ceiling bricks and reinforced concrete			
Ground floor not insulated			
Roof slab with ceiling bricks and reinforced concrete			
<i>Systems of heating, ventilation and air conditioning:</i>			
Heating:1 oil boiler and wood chip total power of 300 kW			
Other systems: data not available			
Building energy management:			
During the occupation the guaranteed temperature is 20 ° C, while in summer the school is closed.			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
HIGH	HIGH	MEDIUM	LOW	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
not applicable	very applicable	very applicable	not applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable
 Solar thermal: probably applicable
 Biomass: probably applicable
 Heat Pump: probably applicable



3.5.1.5 Upper secondary school of small dimension (Hotel Management School)

Year Built: 1964 (the building has not undergone substantial restructuring interventions since the year of construction).

Orientation: The building plan distribution does not have an optimal orientation.

Volume: 6.880 cbm

Type of construction: tower building with four floors above ground, rectangular with a compact volume. The building is part of a larger school (middle school), while the upper school building was separated (1998) from the functional point of view and energy from the primary school.

Type of construction: building with reinforced concrete framed structure with infill brick masonry. The intermediate floors are in brick like the cover that has a coating of bitumen.

The frames are made of aluminum without thermal break.

N. Users: 120 students



Heated area of the building (m²) **1.658**

Energy consumption of the building

Electricity (MWh)		data not available			
Fuel, district heating, renewable sources (MWh)		316			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat (kWh/m ²)		190			
Specific consumption of electrical energy (kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	70	5	5	5	15

Observation on the quality of the data: coming from energy audits

Brief description of the energy



<i>Housing:</i>			
Structure in reinforced concrete		estimated transmittance $U= 1,980$	
W/m^2K			
Steel frames with double glazing		estimated transmittance $U= 3,500$	
W/m^2K			
Intermediate slab with ceiling bricks and reinforced concrete			
Ground floor not insulated			
Roof slab with ceiling bricks and reinforced concrete			
<i>Systems of heating, ventilation and air conditioning:</i>			
Heating: 1 standard boiler of total power of 425 kW			
Other systems: data not available			
<i>Building energy management:</i>			
During the occupation the guaranteed temperature is 20°C, while in summer the school is closed.			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
HIGH	HIGH	MEDIUM	LOW	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
not applicable	very applicable	very applicable	not applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable
 Solar thermal: probably applicable
 Biomass: probably applicable
 Heat Pump: probably applicable



3.5.2 Offices

3.5.2.1 Public building used for offices (Town hall))

Year of construction: building 600, went through profound changes during the eighteenth century. The building was renovated for office use in the late eighties.
Orientation: main facade orientated to the West

Volume: data not available

Building type: historical building

Type of construction: Perimeter structures made of mixed stone-brick with wooden roof and wooden windows with double glazing.

Number of users: 15 employees.



Heated area of the building (m²) **1161**

Energy consumption of the building

Electricity (MWh)/yr.		Electricity 25,68 MWh/yr. (4622€/yr.)			
Fuel, district heating, renewable sources (MWh)/yr.		Natural gas 46,26 MWh/yr. (4207€/yr.)			
TOTAL (MWh)		71,94 MWh/yr.			
Emission of CO2		21,45Tons CO2/yr.			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	56	0	5	36	-

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Observation data quality: from energy certification

Brief description of the energy

<i>Housing:</i>	
Building perimeter	average transmittance 1,7 W/mq*k
Ground floor	average transmittance 0,8 W/mq*k
Cover made of insulated brick	average transmittance
3,2W/mq*k	
Wooden framed windows with double glazing	average transmittance 2,8
W/mq*k	



Systems of heating, ventilation and air conditioning:

The production system of the thermal energy is a thermal power plant equipped with one heat generator to methane gas.

The distribution system is controlled by one circuit and the heating sources are radiators.

Climatic control of the central thermostatic valves for each environment.

1 brand ICI BOILERS Boiler type B with $P_n = 93 \text{ kW}$ and $P_f = 103 \text{ kW}$ (standard 2 stars)

2 brand FERROLI advanced Boiler type B in 1991 with $P_n = P_f = 87.20 \text{ kW}$ and 96.90 kW (standard 2 stars)

Emission system:

100% radiators

Hours of use:

8am – 5pm temperature 20°C

period of use of the building: all year round

Cooling:

It has not installed any cooling system.

There are installed mechanical ventilation systems with heat recovery in all classrooms and corridors.

Domestic Hot Water:

The domestic hot water is provided by a central boiler for DHW production from 150lt insulated with fiberglass 6cm.

Lighting system:

General plant construction year 1990 (approximately)

All lamps are made with fluorescent tubes of various types

Lighting estimated average

200 LUX corridors

300 LUX offices

there are not systems of automatic adjustment of lighting.

Other systems:

In the school building are installed approximately:

- ✦ 15 computers (200W)
- ✦ 3 copiers (500W)
- ✦ 1 refrigerator (500W)
- ✦ 1 television (500W)
- ✦ 2 portable air conditioners (1200W)

Building energy management:

During the occupation the guaranteed temperature is 20°C . No cooling system is foreseen for summer periods.



Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	OCCASSIONAL	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other Biomass
MEDIUM	HIGH	HIGH	LOW	LOW	MEDIUM

The buildings of this type of construction and management require, for the purpose of energy saving, significant insulation of the building, replacement of existing windows with high-performance windows and doors, replacement of existing generators with heat generators with high efficiency.

The buildings with valuable features such as historic buildings require careful methods of intervention: insulation of the walls can be performed only from the inside, the replacement of windows and doors must be conducted by respecting the existing aesthetics and forms. Moreover, the interventions of the insulation of the roof are allowed only after approval by the Superintendence for the artistic.

The plant systems that use renewable energy sources that are acceptable payback times are heat production by biomass.

There is no justifiable hot water use to merit investments for the production of hot water from renewable energy sources.

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
not applicable	very applicable	very applicable	not applicable

List of task in order of priority:

- ⬆ replacement of the boiler
- ⬆ replace the windows and doors
- ⬆ achieve insulation to coat structures to limit the dispersion of the building
- ⬆ use of biomass boilers
- ⬆ replacement of lighting bodies



Potential investment:

The municipal building in question is a historic building. Many municipal buildings in the region have the same characteristics, and many of the historic buildings within the regional urban centers have been renovated and reused in order to obtain municipal and public offices.

Buildings used for municipal offices have very little energy needs related to:

- ⤴ domestic hot water

They also have relatively modest energy consumption needs to:

- ⤴ lighting and electricity

Turn out to be convenient and priority the investments for the replacement of the heat generator and for providing insulation, while other interventions are difficult to propose because of the high return periods.

The intervention on the solar cooling has not been convenient, since the building is not equipped with a cooling system. Thanks to the considerable thermal inertia in fact, this type of building does not require high energy requirements for cooling.

	energia post intervento	Energia risparmiata	mancate emissioni CO2	costo stimato intervento	risparmio economico	tempo di ammortamento	note
	kWh	kWh/yr	kg/yr	€	€	yr	
sostituzione generatori di calore	35398	4827	980	12000	396	30,28	Sostituzione caldaia
regolazione climatica	39420,5	804,5	188	2500	66	37,85	
sostituzione serramenti	30168,75	10056,25	2041	22400	826	27,13	
isolazione delle strutture disperdenti (tetto)	26146,25	14078,75	2858	39000	1156	33,74	
utilizzo di caldaie a biomassa	40225	0	8166	35000	1830	19,12	
ventilazione meccanica con recupero di calore	non previsto						NP
pannelli solari termici (ACS)	non previsto						NP

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Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: probably applicable

Solar Thermal: not applicable

Biomass: probably applicable

Heat pump: probably applicable



Consistent with the architectural constraints of the historic buildings, the installation of a photovoltaic system has a reasonable chance of exploitation given the presence of incentives. On the contrary, the exploitation of solar energy for heating and domestic hot water does not have the potential for this type of use. The replacement of existing boilers with boilers for biomass is feasible with acceptable payback times, but the intervention is difficult to apply for space to devote technological intervention.

System to monitor the consumption by the user

There is no system to monitor the consumption by the user; the consumption are verified according to monthly reports of the distribution companies and the plant is managed directly by the tenant.

In the FVG region the energy audit program for the buildings of the tertiary sector is not available.

No energy plan has been implemented for the energetic improvement of buildings.

It's a priority for all buildings in the tertiary regional sector to implement the systems for the monitoring of the energy consumption of the plant.



3.5.2.2 Public building used for offices (provincial headquarters offices)

Year of construction: 1876 - 1930s underwent renovation and expansion of a factory; renovated in the 80's; currently under preservative restoration.

Orientation: South-West orientation of the main facade.

Volume: 15,438 m³

Type of construction: building consists of three buildings respectively the palace of the province (historic building), board room (compact body, rectangular annex), and offices (building line).

Type of construction: the three buildings are characterized by different types of construction.

Historic building: masonry load-bearing brick and stone and wooden floors, the roof slab made of wood.

Council hall: structure in the reinforced concrete and infill masonry.

Office block: masonry structure and cover in brick.

N. users: 60 employees



Heated area of the building (m²) **3.929**

Energy consumption of the building

Electricity (MWh)/yr.		data not available			
Fuel, district heating, renewable sources (MWh)/yr.		363			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat. (kWh/m ²)		93			
Specific consumption of electrical energy (kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other



Energy consumption divided by [%] - estimated	40	35	5	5	15
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Observation data quality: from energy certification

Brief description of the energy

Housing: Load-bearing masonry structure (stone) estimated transmittance $U = 1,980 \text{ W/m}^2\text{K}$ Wooden doors and windows with single glazing estimated transmittance $U = 3,500 \text{ W/m}^2\text{K}$ Intermediate slab with wood structure <i>Ground floor not insulated</i> Roof slab with wood structure			
Systems of heating, ventilation and air conditioning: Heating: 2 standard boilers of total power of 570 kW Other systems: data not available			
Building energy management: During the occupation the guaranteed temperature is 20°C. No cooling system is foreseen for summer periods.			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
LOW	HIGH	HIGH	HIGH	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
probably applicable	very applicable	very applicable	not applicable



Potential introduction of renewable energy sources (FER7) in buildings

Photovoltaic:	probably applicable
Solar thermal	probably applicable
Biomass:	probably applicable
Heat Pump:	probably applicable



3.5.2.3 Building for use by public offices (office small entity)

Year built: 1500 - renovated and converted

for office use in the 1990s

Orientation: There are no optimizations.

Volume: 1.811 cbm

Building type: historical building block,
compact volume with a rectangular plan.

Construction type: historical building made of
stone and brick masonry bearing and wooden
floors, roofing with wooden frame and roof
tiles and wooden window frames with double
glazing.

The building was renovated and converted for
office use in order to preserve a historic
building.

N. Users: 8 employees

Heated area of the building (m²) **549**



Energy consumption of the building

Electricity (MWh)		data not available			
Fuel, district heating, renewable sources (MWh)		43			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat.(kWh/m ²)		77			
Specific consumption of electrical energy (kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	40	35	5	5	15

Observation on the quality of the data: coming from energy audits

Brief description of the energy



Housing: Load-bearing masonry structure (stone) estimated transmittance $U= 1,980 \text{ W/m}^2\text{K}$ Wooden windows with double glass estimated transmittance $U= 3,000 \text{ W/m}^2\text{K}$ Intermediate slab with wood structure <i>Ground floor not insulated</i> Roof slab with wood structure			
Systems of heating, ventilation and air conditioning: Heating: 2 standard boilers of total power of 92 kW Other systems: data not available			
Building energy management: During the occupation the guaranteed temperature is 20°C. No cooling system is foreseen for summer periods.			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
LOW	HIGH	HIGH	HIGH	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
probably applicable	very applicable	very applicable	not applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable
Solar thermal: probably applicable
Biomass: probably applicable
Heat Pump: probably applicable



3.5.2.4 Office building public

Year built: 1980s

Orientation: not relevant

Volume: 6,952 cubic meters

Type of construction: building a vocation trade / industrial isolated, compact rectangular plan

Type of construction: prefabricated building with load-bearing structure consists of beams and columns in cap with infill panels, concrete masonry units anchored outside the frames and floors in cap and flat roof covered with bitumen.

This type of buildings appears to be a low cost of implementation with low energy performance and with a very poor aesthetic impact.

N. users: 15 employees



Heated area of the building (m²) **1.656**

Energy consumption of the building

Electricity (MWh)		data not available			
Fuel, district heating, renewable sources (MWh)		364			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat (kWh/m ²)		220			
Specific consumption of electrical energy (kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	40	35	5	5	15

Observation on the quality of the data: coming from energy audits

Brief description of the energy



Housing:			
Reinforced concrete structure		estimated transmittance $U= 1,980$	
W/m^2K			
Steel frames / aluminum with double glass		estimated transmittance $U= 3,000 W/m^2K$	
Intermediate slab with reinforced concrete			
<i>Ground floor not insulated</i>			
Roof slab with reinforced concrete			
<i>Systems of heating, ventilation and air conditioning:</i>			
Heating boiler standard total power of 420 kW			
Other systems: data not available			
Building energy management:			
During the occupation the guaranteed temperature is 20°C. No cooling system is foreseen for summer periods.			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
HIGH	HIGH	HIGH	HIGH	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
very applicable	very applicable	very applicable	probably applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable
 Solar thermal: probably applicable
 Biomass: very applicable
 Heat Pump: very applicable



3.5.2.5 Public building (door to the public)

Year of construction: 1970s

Orientation: not relevant

Volume: 788 cubic meters

Type of building: Office inserted in condominium building. The units used for offices are located on the ground floor of the tower building, compact, rectangular in shape. Construction type: structure in reinforced concrete with infill brick masonry floors, aluminum window frames and doors without thermal break.

Building from poor energy performance.

n. rating: 4 employees



Heated area of the building (m²) **212**

Energy consumption of the building

Electricity (MWh)		data not available			
Fuel, district heating, renewable sources (MWh)		14			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat (kWh/m ²)		67			
Specific consumption of electrical energy (kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	40	35	5	5	15

Observation on the quality of the data: coming from energy audits

Brief description of the energy

Housing:

Structure in reinforced concrete

estimated transmittance $U = 1,980 \text{ W/m}^2\text{K}$

Steel frames / aluminum with double glass

estimated transmittance $U = 3,000 \text{ W/m}^2\text{K}$

Intermediate slab with reinforced concrete

Ground floor not insulated



Systems of heating, ventilation and air conditioning: Heating boiler standard total power of 28 kW Other systems: data not available			
Building energy management: During the occupation the guaranteed temperature is 20°C. No cooling system is foreseen for summer periods.			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
MEDIUM	HIGH	HIGH	HIGH	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
very applicable	very applicable	very applicable	probably applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable
Solar thermal: probably applicable
Biomass: very applicable
Heat Pump: very applicable



3.5.3 Hospital, retirement homes

3.5.3.1 Hospital located in historic building

Year of construction: building dating back to 1800, restored for hospital use in the 1970s, the current configuration dates back to the 1990s.

Orientation: various non-optimized.

Volume: 18490 mc

Type of building: a building block.

Construction type: reinforced concrete framed structure with infill brick on the ground floor which is not insulated, brick-concrete floors, new window frames in existing aluminum and wood with double glazed.

The ground floor is used as the administrative offices while the first floor is used as a hospital and day hospital.

Number of users: 65 Offices - 50 patients

Heated area of the building (m²) **8.785**



Energy consumption of the building

Electricity (MWh)		(Conditioning) 75,6MWh/yr. (15100€/yr.)			
Fuel, district heating, renewable sources (MWh)		Natural gas 725,059MWh/yr. (61057€/yr.)			
TOTAL (MWh)		800,659MWh/yr.			
Emission of CO ₂		105Tons CO2/yr.			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	65	8	14	13	-

Observation on the quality of the data: coming from energy audits

Brief description of the energy



Housing:

Load-bearing masonry structure	estimated transmittance $U = 1,790 \text{ W/m}^2\text{K}$
On the ground floor uninsulated	estimated transmittance $U = 2,150 \text{ W/m}^2\text{K}$
Aluminum doors and windows	estimated transmittance $U = 2,050 \text{ W/m}^2\text{K}$
Wooden window frames with double glazing	estimated transmittance $U = 3,190 \text{ W/m}^2\text{K}$
Intermediate slab with reinforced concrete	

Systems of heating, ventilation and air conditioning:

Heating: 2 heat generators with natural gas (standard boilers)

1 boiler power 930kW brand Sile mod. P88AR 1989

2 boiler power 340kW brand Unical mod. ELL340 2003

Emission system:

60% Aermec Fan coils FCX 1990

30% Ferroli mod. BTP wall year 2012

10% radiators in the bathrooms

Hours of use:

Ground floor (offices) from 8am to 6pm the temperature reaches 20°C - first floor (hospitalization) h24 temperature 22°C

Adjustment: single environment.

Cooling system: chiller with 276 kW (2 circuits)

In the meeting rooms and in the others rooms (15%) of the non-windowed rooms are fitted with air exchange units to single stream without heat recovery

The cooling system is made up of fan coils (the same used for heating) the cold fluid is provided by chiller power supply brand Ferroli mod. RLA the power of 276kW

Cooling times of use:

Ground floor (office) from 8am to 6pm temperature 27°C

First floor (hospitalization) 24 h daytime temperature 27°C – nighttime 28°C

Adjustment: single environment.

Domestic hot water: The hot water is supplied by rechargeable battery brand ACV boilers heated by 600lt. capacity.

Tank insulation 8cm polystyrene.

Lighting system: general plant construction 1990

All lamps are made with fluorescent tubes 4x18 recessed in the ceiling.

Lighting estimated average

300LUX (part of offices)

200LUX inpatient rooms

There are systems of automatic adjustment of lighting.



Other systems:

On the ground floor (offices) are installed approximately:

- ⬆ 50 computers (200W)
- ⬆ 10 copiers (500W)
- ⬆ 2 refrigerators (500W)

In the first floor (wards) are installed approximately:

- ⬆ 10 computers (200W)
- ⬆ 3 copiers (500W)
- ⬆ 4 refrigerators (500W)

20 medical devices (1500W)

Building energy management:

During the occupation the guaranteed temperature is 20°C. In summer there are cooling temperatures from 8am to 6pm for the office area of 27°C while in the patient area there is day and night temperature 27-28°C .

Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
data not available	ALWAYS	data not available	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
HIGH	HIGH	HIGH	HIGH	LOW	-

The buildings of this type of construction and management require, for the purpose of energy saving, significant insulation of the building, replacement of existing windows with high-performance windows and doors, replacement of existing generators with heat generators with high efficiency heat generators with simultaneous development of the distribution.

The introduction of plant systems that use renewable energy should also be carefully evaluated.

The plant systems that have acceptable payback times are the heat production through the use of biomass and the solar thermal systems for buildings with high requirements of domestic hot water (DHW).

Solar cooling has very high running costs and given the temperate climate of the region there is not an acceptable timeframe for payback.

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)



Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
probably applicable	very applicable	very applicable	not applicable

List of interventions in order of priority:

- ✧ replace boilers (old and inefficient)
- ✧ achieve insulation to coat structures to limit the dispersion of the building
- ✧ replace the wooden window frames which have more than 20 years
- ✧ enter a system of climate control system
- ✧ replace the mechanical ventilation system of the building system with heat recovery
- ✧ use of solar panels to cover part of the production of domestic hot water
- ✧ installation of electricity production (PV)
- ✧ use of biomass boilers
- ✧ replacement of lighting bodies
- ✧ solar cooling

Potential investment:

Turn out to be convenient and also priority the investments for the replacement of heat generators and for providing insulation and replacement windows. See the table below.

The intervention on the solar cooling is not very convenient and is very complex to implement, because the solar surface which affects the intervention is very high (approximately 600sqm).

	% risparmio	energia post intervento kWh	Energia risparmiata kWh/yr	mancate emissioni CO2 kg/yr	costo stimato intervento €	risparmio economico €	tempo di ammortamento yr
sostituzione generatori di calore		500422	98209	19936	45000	8063	5,58
regolazione climatica	1,50%		8979,47		6000	737	8,14
sostituzione serramenti		531675	66956	13592	85000	5497	15,46
isolazione delle strutture disperdenti		383952	214679	43580	224589	17626	12,74
utilizzo di caldaie a biomassa		598631	0	182719	120000	13777	8,71
ventilazione meccanica con recupero di calore	5,55%		33224,02	6744	65000	2728	23,83
pannelli solari termici (ACS)	27,00%		34135,29	6929	18000	2803	6,42
solar cooling			121978	24762		10015	
			75600	35532		15876	
				60293,53	465000	25891	17,96



Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable

Solar thermal: probably applicable

Biomass: probably applicable

Heat Pump: probably applicable

The exploitation of solar energy for heating and domestic hot water has potential, although probably the exploitation of solar thermal systems for domestic hot water production does not generate significant fuel savings and hence the cost savings resulting from the application of these technologies are not considered to be significant.

The exploitation of solar thermal absorber utilizing solar cooling systems turns out to be difficult to apply to the characteristics of a highly invasive intervention and the high cost of installation. The solar PV has a high chance of exploitation also seeing government incentives and intervention costs which are very low.

It is possible to envisage an operation to replace the existing boilers with natural gas boilers for biomass, but it is necessary to consider the fact that the intervention is problematic for the needs of high-tech space to devote to the system.

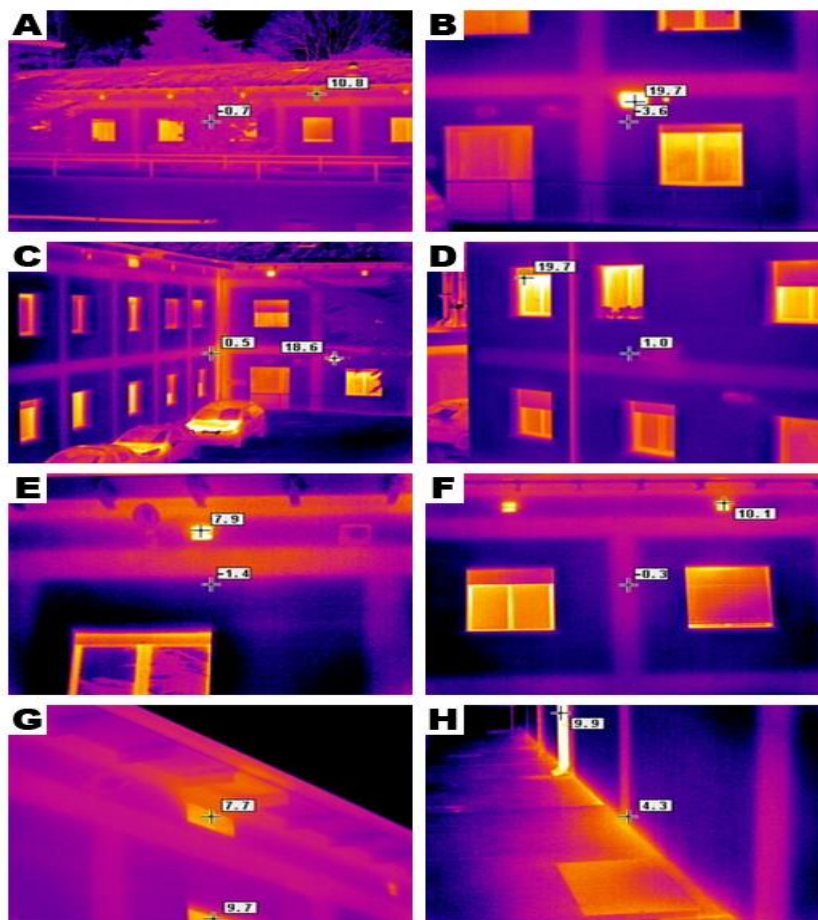
System to monitor the consumption by the user

There is no regional system to monitor consumption by the user.



Thermography

In the analysis of the property in question in order to know exactly the weak points of the structure and characteristics of the housing thermographic analysis was carried out of the building. Below are some pictures related to the thermal analysis carried out on date 20.02.2013. The choice of the winter period to accomplish this examination is essential in order to make a proper assessment of the behavior of the structure, noting in particular the most critical points and the sources of major losses. In the present analysis are shown the different compositions of the masonry, the presence and the conformation of thermal bridges, the critical points of the structure from the point of view of energy. Thermography is not supplied by numerical results on energy dispersed by the various structural elements, but provides a qualitative indication of the state of the housing.



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In the images above we can see that the concrete structure (built in the 70s) is a significant dispersion component of the building. In addition, it can be seen in Figure D, the large difference in thermal performance of new windows and non-substituted (lighter colours indicate a high heat flux).



3.5.3.2 Historic building used as a public retirement homes)

Year built: 1700 for the historical block (block A) 1963 (block B) enlarged portion of the building

Orientation: Not determined

Volume: data not available

Type of building: a building block.

Construction type: Original renovated historic building.

A body is made up of mixed stone brick structure, on the ground floor, floors made of reinforced concrete, wooden roof with insulation and wooden windows with double glazing, while the body B consists of reinforced concrete framed structure with brick infill and intermediate insulation, on the ground floor, floors made of reinforced concrete, reinforced concrete roof is not insulated, aluminum doors and windows with double glazing.

Number of users: 112 patients (beds).

Heated area of the building (m²) **3165**



Energy consumption of the building

Electricity (MWh)		(Conditioning) 42MWh/yr. (8820€/yr.)			
Fuel, district heating, renewable sources (MWh)		Natural gas 567,72 MWh/yr. (46613€/yr.)			
TOTAL (MWh)		609,72 kWh/yr.			
Emission of CO ₂		134Tons CO2/yr.			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	15	6	22	15	-

Observation on the quality of the data: coming from energy audits

Brief description of the energy



Block A housing:

Structure in mixed stone and brick walls	average transmittance 2,1 W/mq*k
Ground floor	average transmittance 1,9 W/mq*k
Last roof slab with ceiling bricks and reinforced concrete	average transmittance 1,5 W/mq*k
Roof slab with wood structure	average transmittance 0,6 W/mq*k
Doors and windows framed in wood with insulating glass	average transmittance 2,5 W/mq*k

Block B housing:

Structure with reinforced concrete and Intermediate insulation	average transmittance 0,85 W/mq*k
Ground floor	average transmittance 1,8 W/mq*k
Last roof slab with ceiling bricks and reinforced concrete	average transmittance 1,5 W/mq*k
roof slab with ceiling bricks and reinforced concrete	average transmittance 2,0 W/mq*k
Aluminum doors and windows framed with insulating glass	average transmittance 1,8 W/mq*k

Systems of heating, ventilation and air conditioning:

The system of production of thermal energy is a thermal power station with 2 heat generators with natural gas; the distribution system is divided into 3 circuits and the heaters are radiators and fan coil units

- 1 boiler power 290kW Biasi brand hack. TN 2AR 250 years 1988 (standard) body A
- 2 boiler power 370kW Viessmann brand mod. Vitocrossal 2006 (condensing) body B

Emission system:

- 60% Fan Coil Eurapo 2004
- 40% of radiators in the bathrooms and in some of the building blocks

hours of use:

24 h temperature 22°C

There are mechanical ventilation systems installed with heat recovery only in certain parts of the building.

Adjustment: single environment.



Cooling:

For summer cooling it is used as a chiller to supply energy.

In rooms without windows are installed in the units of air exchange with heat recovery, some portions of the building (Block B) are equipped with air exchange made with 3 UTA with heat recovery.

The cooling system is made up of fan coils (the same used for heating) the cold fluid is provided by two chiller power supply brand Aermec mod. ANL the power kW55kw (Block A) and 60kW (Block B)

cooling times of use:

(inpatient) 24 h daytime temperature 27°C - 28° night

Adjustment: single environment.

Domestic Hot Water:

The domestic hot water is heated by boilers supplied by accumulator tank capacity 1500lt. Sile brand. Tank insulation 8cm polystyrene.

Lighting system:

General plant construction year 1980 (approximately) and later adapted and modified

All lamps are made with fluorescent tubes of various types

Lighting estimated average

150LUX (room)

200LUX meeting rooms

There are not systems of automatic adjustment of lighting.

Other systems:

In the body of the ground floor (offices) are installed approximately:

- ✦ 3 computers (200W)
- ✦ 1 copiers (500W)
- ✦ 3 refrigerators (500W)
- ✦ 20 televisions (500W)
- ✦ 10 medical devices (1500W)

In the block B on the ground floor (offices) are installed approximately:

- ✦ 10 computers (200W)
- ✦ 2 copiers (500W)
- ✦ 4 refrigerators (500W)
- ✦ 20 medical devices (1500W)

Building energy management:

During the occupation the guaranteed temperature is 20°C. In summer there are cooling temperatures from 8am to 6pm for the office area of 27°C while in the patient area there is day and night temperature 27-28°C .



Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other (Biomass)
MEDIUM	MEDIUM	HIGH	LOW	LOW	MEDIUM

The buildings of this type of construction and management for the purpose of energy saving interventions require insulation of the building, replacement of existing windows with high-performance windows and doors, replacement of existing generators with heat generators with high efficiency.

The plant systems based on renewable energy sources that have an acceptable payback time are the heat production through the use of biomass and the solar thermal systems for buildings with high requirements of DHW.

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
probably applicable	very applicable	very applicable	not applicable

List of interventions in order of priority:

- ✦ replacement of the boiler body A
- ✦ achieve insulation to coat structures to limit the dispersion of the building block A
- ✦ insulate the roof or ceiling of the block B
- ✦ implement the entire structure with a mechanical ventilation system with heat recovery (to improve the comfort of indoor air)
- ✦ use of solar panels to cover part of the production of domestic hot water
- ✦ installation of electricity production (PV)
- ✦ use of biomass boilers
- ✦ replacement of lighting bodies
- ✦ solar cooling



Potential investment:

Turn out to be convenient and therefore priority the investments for the replacement of the heat generator and for the production method of isolations; it is not present the adoption of solar system for the production of sanitary hot water. The intervention on the solar cooling is not cheap and is very complex to implement, because the surface of the sun is very high (approximately 500sqm). See the table below:

	% risparmio	energia post intervento kWh	Energia risparmiata kWh/yr	mancate emissioni CO2 kg/yr	costo stimato intervento €	risparmio economico €	tempo di ammortamento yr	note
sostituzione generatori di calore		391894,86	20626,05	4187	20000	1694	11,81	Sostituzione 1 caldaia
regolazione climatica								intervento eseguito
sostituzione serramenti								intervento eseguito
isolazione delle strutture disperdenti		430164,53	137560,92	27925	180000	11294	15,94	
utilizzo di caldaie a biomassa		412520,9	0	134988	90000	9494	9,48	
ventilazione meccanica con recupero di calore	2,00%		8250,42	1675	65000	677	95,95	comfort ambientale
pannelli solari termici (ACS)	38,00%		58977,73	11972	23750	4842	4,9	
solar cooling			104479	21209		8578		
			42000	19740		8820		
				40949,24	261500	17398	15,03	

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable

Solar Thermal: very applicable

Biomass: probably applicable

Heat pump: not applicable

The exploitation of solar energy for hot water has considerable potential for this type of building, in view of the high consumption of hot water.

The exploitation of the solar thermal absorber with the implementation of solar cooling systems turns out to be difficult to apply with the characteristics of highly invasive interventions and the high cost of installation.

The PV has a good chance of exploitation also seeing government incentives, low cost of operation and the discrete summer consumption of electricity due to the system of cooling. The replacement of existing boilers with boilers for biomass is feasible with acceptable recovery times, but the intervention results in difficult application in the view of the scarcity of suitable technological spaces to devote to the intervention.



System to monitor the consumption by the user

There is no system to monitor the consumption by the user. The plant is managed by a contract but heat consumption data are not provided to the user. There is no energy audit program for the buildings of the tertiary sector the FVG region. No energy plan for the energetic improvement of building has ever been created. It is a priority for all buildings in the tertiary sector to implement regional systems to monitor the energy consumption of the plant.



3.5.3.3 Historic building for use by retirement homes

Year built: 1900 renovated historic building in the 1980s with the preservation of the outer perimeter structure.

Volume: 2891.74 mc

Building type: apartment house in the historic building.

Type of construction: load-bearing masonry structure with solid bricks, wooden roof and wooden windows with double glazing.

Number of users: 35 patients (beds).



Heated area of the building (m²) **662,21**

Energy consumption of the building

Electricity (MWh)/yr.		data not available			
Fuel, district heating, renewable sources (MWh)/yr.		data not available			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat. (kWh/m ²)		23,71			
Specific consumption of electrical energy (kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	40	35	5	5	15

Observation data quality: from energy certification

Brief description of the energy

Housing:

Load-bearing masonry structure

estimated transmittance $U = 1,980 \text{ W/m}^2\text{K}$

Wooden doors and windows

estimated transmittance $U = 3,000 \text{ W/m}^2\text{K}$

Intermediate slab in wood



Systems of heating, ventilation and air conditioning: Central Heating Systems : standard boiler power of 316 kW (diesel) Domestic Hot Water: No. 4 electric water heaters from 4.8 kW Other systems: data not available			
Building energy management: During the occupation the guaranteed temperature is 20°C. In summer a cooling system is foreseen but the data are not available.			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
MEDIUM	HIGH	HIGH	HIGH	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
not applicable	very applicable	very applicable	probably applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: probably applicable

Solar thermal: probably applicable

Biomass: probably applicable

Heat Pump: very applicable



3.5.4 Commercial buildings

3.5.4.1 Building for commercial use (supermarket)

Year Built: late 1980s - internally renovated in 2010.

Volume: 19142.40mc

Building type: shed for commercial use

Type of construction: The building, commercial structure built in the late 1980s, has undergone a major restructuring of the plant in 2010. The property is spread over one floor above ground, with a flat roof, closed on all sides except the main front, which has a closing window with thermal break aluminum windows with double glazing.

Number of employees present: average 20-25 people (65 employees tot).



Heated area of the building (m²) **2991**

Energy consumption of the building

Electricity (MWh)		1541,8 MWh			
Fuel, district heating, renewable sources (MWh)		390,5MWh			
TOTAL (MWh)		1932,3 MWh			
Specific energy consumption for the Heat (kWh/m ²)		130 kWh/mq			
Specific consumption of electrical energy (kWh/m ²)		513 kWh/mq			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] – estimated	20,00%	6,00%	1,00%	6,00%	67,00%

Observation on the quality of the data: coming from energy certification

Brief description of the energy



<i>Housing:</i>	
industrial building structure	average transmittance 0,90
W/mq*k	
ground floor	average transmittance 1,90
W/mq*k	
insulated roof	average transmittance 1,20
W/mq*k	
thermophan steel/aluminum framed windows double glazing	average transmittance 2,00
W/mq*k	
Systems of heating, ventilation and air conditioning:	
The system of production of thermal energy is a thermal power station equipped with 4 heat generators with natural gas distribution in air	
Boilers Baxi brand power 87,20 kW mod. Luna HT res. 1850 (x4).	
Emission system:	
air distribution	
hours of use:	
temperature 18°C	
employees (2 shifts): 6am to 9pm	
public: 8:30am to 8pm (Mon-Sat), 9am to 7:30pm (Sun).	
It is a unit of the present climatic control.	
Control: remote management.	
Cooling:	
For summer cooling it uses two air-cooled water chillers with a cooling capacity respectively of 328.00 kW and 178.0 kW.	
Hours of use:	
temperature 26°C	
employees (2 shifts): 6am to 9pm	
public: 8:30am to 8pm (Mon-Sat), 9pm to 7:30pm (Sun).	
It is a unit of the present climatic control.	
Control: remote management.	
Domestic Hot Water:	
The domestic hot water is heated by boilers supplied by accumulator tank capacity 800lt.	
Lighting system:	
The lighting system is made up of different types of lighting, including fluorescent lamps with the pans of reflection, neon headlights, directional lamps and interior lamps for refrigerators.	
It is estimated there are about 600 light fixtures.	
There are no automatic lighting control systems.	



Other systems:

Inside the building are installed approximately:

- 1 cell BT
- 2 refrigerated counters BT (frozen)
- 2 frozen central exhibitor
- 3 refrigerated counters
- 7 industrial freezers
- 1 refrigerated fish freezer
- 1 freezer cell for vegetables
- 2 large cells TN
- 2 small cells TN
- 1 small cell for waste
- 1 counter for hot meat
- 2 ovens
- 2 bread ovens
- 2 fryers

The showcases are controlled by the external management, it is currently being carried out of the heat recovery chillers.

Building energy management:

During the occupation the guaranteed temperature is 18°C, during the summer there is a cooling temperature from 6am to 9pm to 26°C.

Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
ALWAYS	ALWAYS	ALWAYS	ALWAYS

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Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other Solar cooling
HIGH	LOW	LOW	LOW	MEDIUM	MEDIUM



The buildings of this type of construction and management for the purpose of energy saving interventions mainly require insulation of the building.

There is not enough hot water uses to justify investments for the production of hot water from renewable energy sources.

You currently already have a system of heat recovery by the heat of condensation of water chillers for food storage.

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
probably applicable	very applicable	very applicable	Not applicable

List of tasks in order of priority:

- ⬆ achieve insulation to coat structures to limit the dispersion of the building
- ⬆ insulated cover
- ⬆ installation of electricity production (PV)
- ⬆ replacement of lighting bodies
- ⬆ solar cooling
- ⬆ use of biomass boilers

Potential investment:

Turn out to be convenient and priority investments for providing insulation and improving the structure of the building dispersant.

	energia post intervento	Energia risparmiata	mancate emissioni CO2	costo stimato intervento	risparmio economico	tempo di ammortamento	note
	kWh	kWh/yr	kg/yr	€	€	yr	
sostituzione generatori di calore	366121,17	11323,34	2299	40000	930	43,02	cladaia già a condensazione
regolazione climatica							intervento non necessario
sostituzione serramenti	483173,01	14943,5	3034	50000	1227	40,75	intervento non prioritario
isolazione delle strutture disperdenti (tetto)	252887,82	124556,69	25285	241500	10227	23,61	intervento prioritario
utilizzo di caldaie a biomassa	377444,5	0	76621	50000	8364	5,98	non facilmente attuabile
ventilazione meccanica con recupero di calore	non previsto						NP
pannelli solari termici (ACS)	8139,98	4989,02	1013	9000	410	21,97	non conveniente
solar cooling	en. Termica	64794,78	13153		5320		NP
	en. elettrica	120672	56716		25341		
			69869,18	736667	30661	24,03	non facilmente attuabile

Potential introduction of renewable energy sources (FER) in buildings

- Photovoltaic: very applicable
- Solar thermal rarely applicable
- Biomass: not applicable
- Heat Pump: probably applicable



3.5.4.2 Medium-sized commercial building

Year Built: 2005 (new construction)

Volume: 6,009

Building type: single building block.

Construction type: reinforced concrete framed structure with brick infill thermal, intermediate floors and masonry, roofing and masonry, aluminum framed windows with thermal break and double glazing.

Fairly insulated building recently built (within the limits prescribed by the L10/91).



Heated area of the building (m²) **1.455**

Energy consumption of the building

Electricity (MWh)		data not available			
Fuel, district heating, renewable sources (MWh)		data not available			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat. (kWh/m ²)		19,38			
Specific consumption of electrical energy (kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	65	10	5	5	15

Observation on the quality of the data: coming from energy audits

Brief description of the energy

<i>Housing:</i>	
Concrete Structure	n.a.
Ground floor	n.a.
Doors and windows	n.a.



Systems of heating, ventilation and air conditioning: Heating boiler standard total power of 206 kW Domestic Hot Water: Electric heater 1.2 kW Cooling: data not available Other systems: data not available			
Building energy management: data not available			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
HIGH	HIGH	HIGH	HIGH	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
probably applicable	very applicable	very applicable	probably applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: very applicable
 Solar thermal: probably applicable
 Biomass: very applicable
 Heat pump: very applicable



3.5.4.3 Small commercial building

Year Built: 2007 (new building)

Volume: 513

Building type: apartment house with 4 floors above ground.

Construction type: reinforced concrete framed structure with brick infill thermal, intermediate floors and masonry, roofing and masonry, aluminum windows with thermal break and double glazing.

Fairly well insulated building recently built (within the limits prescribed by the L10/91).



Heated area of the building (m²) **103**

Energy consumption of the building

Electricity (MWh)		data not available			
Fuel, district heating, renewable sources (MWh)		data not available			
TOTAL (MWh)		data not available			
Specific energy consumption for the Heat. (kWh/m ²)		21,80			
Specific consumption of electrical energy (kWh/m ²)		data not available			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	65	10	5	5	15

Observation on the quality of the data: coming from energy audits

Brief description of the energy

<i>Housing:</i>	
Concrete Structure	n.d.
Ground floor	n.d.
Doors and windows	n.d.
Systems of heating, ventilation and air conditioning:	
Heating and hot water: boiler air blown total power not available	
Cooling: data not available	
Other systems: data not available	



Building energy management: data not available			
Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other
HIGH	HIGH	HIGH	HIGH	LOW	-

Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
probably applicable	very applicable	very applicable	probably applicable

Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: probably applicable

Solar thermal: not applicable

Biomass: probably applicable

Heat pump: very applicable



3.5.5 Accommodations (Hotels)

3.5.5.1 Building uses as hotel (Sea location)

Year Built: 2004 (new building)

Orientation: /

Volume: 1636 cubic meters

Building type: apartment house.

Construction type: reinforced concrete framed structure, the perimeter structures are made from poroton (thermo bricks), the cover is made from wood frame and insulated doors and windows are made of aluminum with thermal break.

Number of users: 14 rooms (28 beds).

Hotelier use building



Heated area of the building (m²) **891,1**

Energy consumption of the building

Electricity (MWh)/yr		Electricity 54,73 MWh/yr (9852€/yr)			
Fuel, district heating, renewable sources (MWh)		Natural gas 55,38MWh/yr (5829mc 4472€/yr)			
TOTAL (MWh)		110,11 MWh/yr			
Emission of CO ₂		11,24Tons CO ₂ /yr			
	Heating	Cooling (VAC)	Hot water	Lighting	Other
Energy consumption divided by [%] - estimated	46	13	5	36	-

Observation on the quality of the data: coming from energy audits

Brief description of the energy



Housing:

Outer perimeter structure	average transmittance 0,58
W/mq*k	
ground floor plan	average transmittance 0,83
W/mq*k	
cover with insulation	average transmittance
0,55W/mq*k	
thermal break aluminum window frames with double glazing	average transmittance 1,4
W/mq*k	

Systems of heating, ventilation and air conditioning:

The system of production of thermal energy is a thermal power station with 1 generator heat with natural gas, the distribution system is governed by two bodies which are circuit and fan coils and radiators in the bathrooms.

1 power boiler 62kW year 2004 (condensation)

emission system:

80% fan

20% towel radiators (in the bathrooms)

hours of use:

24 hours a day during the winter months the temperature is 20°C

WINTER 30% occupancy of the premises

SUMMER 100% occupancy of the premises

It's installed a climatic control of central thermostatic valves for each environment.

Cooling:

The building is equipped with a cooling system, the cold fluid is supplied by a generator chiller condensing in the air.

Mechanical ventilation systems with heat recovery are not installed

Domestic Hot Water:

The domestic hot water is provided by a central boiler for DHW production volume 2000lt, production is ensured by a combined boiler with solar panels. 18 solar panels are installed with a total area of 40sqm.



Lighting system:

General plant construction 2004

All lamps are made with fluorescent tubes of various types

Lighting estimated average

- ⤴ 200 lux corridors
- ⤴ 300 lux public areas
- ⤴ 200 lux rooms

There are not systems of automatic adjustment of lighting.

Other systems:

In the building are installed approximately:

- ⤴ 5 computers (200W)
- ⤴ 3 copiers (500W)
- ⤴ 6 refrigerators (500W)
- ⤴ 21 televisions (500W)
- ⤴ 3 split air conditioners (1200W)

Building energy management:

data not available

Qualified energy managers employed in the management of the building	Regular collection of energy consumption and costs (bills)	Analysis of consumption (the calculation of benefits, goals, etc.)	Telemanagement system installed (counters, and data collection of line)
not provided	ALWAYS	not provided	not provided

Potential for energy savings / renovation

(Note: HIGH, MEDIUM, LOW)

Housing insulation	Replacement windows and doors	Heating	Cooling system (VAC)	Lighting	Other Solar cooling
LOW	LOW	HIGH	HIGH	LOW	LOW

The buildings of this type of construction and management require, for the purpose of energy saving, significant insulation of the building, replacement of existing windows with high-performance windows and doors, replacement of existing generators with heat generators with high efficiency heat generators with simultaneous development of the distribution.

Building systems that use renewable energy should also be carefully assessed. The plant systems that have acceptable payback times are the heat production through the use of biomass and the solar thermal systems for buildings with high requirements of DHW.

Solar cooling has very high running costs and given the temperate climate of the region there is not an acceptable timeframe for payback.



Potential application of the technologies proposed by the pilot project EMILIE

(Note: very applicable, probably applicable and not applicable)

Solar heating and cooling	Optimization of heating, ventilation, cooling	Energy management	PCM
very applicable	very applicable	very applicable	probably applicable

List of tasks in order of priority:

- ✧ insulation structures
- ✧ replace windows and doors
- ✧ replacement of lighting bodies
- ✧ solar cooling



Potential investment:

The building is mainly in height and is broadly representative of the class of the tertiary sector, since the facilities for accommodation use the main tourist areas in this region have average size.

The buildings for hotel use have a regional mainly seasonal use (summer) and have modest energy needs in relation to consumption of:

- lighting and electricity
- heating

These turn out to be convenient and priority investments for providing insulation, the implementation of solar systems for the production of domestic hot water (in this case it exists) and interventions targeted to reduce power consumption due to cooling. The prevailing problem of this type of building for the implementation of systems such as solar cooling is to not have large areas of coverage available, because these buildings are built vertically: solar cooling instead need to cover large areas of suitably oriented to dedicate to the installation of solar panels.

Interventions such as installation of biomass boilers are not to be proposed in these type of buildings because there is the presence of suitable technological spaces in order to install the systems.

For analysis of possible interventions, see table below.

	energia post intervento	Energia risparmiata	mancate emissioni CO2	costo stimato intervento	risparmio economico	tempo di ammortamento	note
	kWh	kWh/yr	kg/yr	€	€	yr	
sostituzione generatori di calore	48338,88	2014,12	409	12000	165	72,56	cladaia già a condensazione
regolazione climatica							intervento non necessario
sostituzione serramenti	60477,9	4552,1	924	14000	374	37,46	
isolazione delle strutture disperdenti (tetto)	40282,4	10070,6	2044	40000	827	48,38	
utilizzo di caldaie a biomassa	50353	0	10222	25000	1232	20,3	non facilmente attuabile
ventilazione meccanica con recupero di calore	non previsto						NP
pannelli solari termici (ACS)	non previsto						NP

solar cooling	en. Termica	9583,65	1945		787		NP
	en. elettrica	14677	6898		3082		
			8843,67	113333	3869	29,29	non facilmente attuabile



Potential introduction of renewable energy sources (FER) in buildings

Photovoltaic: Very applicable

Solar thermal: Very applicable (already done)

Biomass: Less applicable

Heat pump: Very applicable

The exploitation of solar energy for hot water has considerable potential for this type of building, in view of the high consumption of hot water: in the building in question is to be installed a solar thermal system for domestic hot water production, to the satisfaction of the holder of the property.

The exploitation of solar thermal absorber with using solar cooling systems turns out to be difficult to apply to the characteristics of highly invasive interventions and the high cost of installation.

The installation of a solar PV system has a high chance of exploitation also seen the incentives and the low cost of the plant.

The replacement of existing boilers with biomass boilers for intervention is difficult to apply in this category of buildings.

System to monitor the consumption by the user

There is no system to monitor the consumption by the user. The consumption is verified by means of monthly reports of the distribution companies and the plant is managed directly by the tenant.

In the FVG region an energy audit program for the buildings of the tertiary sector is not available.

An energy plan for improving energy efficiency of the building has never been made. *It is a priority for all buildings in the tertiary sector to implement regional systems to monitor the energy consumption of the plant.*



3.6 Evaluation of the effects of different technologies on the supply chain

In Italy, out of a total of 4.425.950 active businesses, have settled 943.520 in the North East, of which 86.773 in Friuli Venezia Giulia.

The following table presents the data from the latest ISTAT census carried out in 2011 with reference to the region of Friuli Venezia Giulia on the number of companies active in the sector. With regard to the field of construction, there are 12.014 companies, including 1.405 dedicated to the installation of electrical systems and 1.555 involved the installation of plumbing, heating and air conditioning system.

Total	86773
agriculture, forestry and fishing	807
ore mining and quarrying	35
manufacturing activities	8525
supply of electricity, gas, steam and air conditioning	108
water supply sewerage, waste management and remediation activities	153
construction	12014
installation of electrical, plumbing and other construction and installation	3280
installation of electrical	1405
installation of plumbing, heating and air conditioning	1555
Wholesale and retail trade repair of motor vehicles and motorcycles	20413
Transport and storage	2559
activities of accommodation services and catering	6996
information services and communication	1958
Financial and insurance activities	1663
real estate activities	4665
professional, scientific and technical	13622
rental, travel agencies, business support services	2422
education	574
Health and social care	5030
artistic activities, sports, entertainment and recreation	1084
other service activities	4145

Source, CensStat - ISTAT

The economic crisis of recent years has also been heavily involved in the construction sector by limiting the opportunity for local businesses to increase interventions in the areas of energy efficiency in spite of national incentives in terms of tax deduction.

The production structure of Friuli Venezia Giulia, in terms of local units of enterprises, it is very similar to the national, the regional distribution of employment, however, is more concentrated in industry excluding construction. This distribution is related to the increased size of the local units of manufacturing firms in Friuli Venezia Giulia with respect to the local units in the rest of the industry in Italy: the average number of employees per location is in fact equal to 11.8 in the region, to 10.5 in the macro-area North-East and 8.7 in Italy.



According to a study commissioned by the Region of Friuli Venezia Giulia ("Innovation in enterprises in Friuli Venezia Giulia" - June 2013) , companies in the Friuli Venezia Giulia region have introduced innovations primarily to provide products and services of better quality (91% of little more than 89% at the national level) , to increase its market share and its ability to penetrate new markets (78% , compared with 68 % in the Italian) and to expand the range of products and services offered to customers (77 % versus 81 % nationally). Two out of three companies consider important to innovate in order to increase production capacity and 62% to improve the health and safety at work.

The companies of the industry, compared to other macro -sectors, recognize greater importance to the objectives of increasing its market share (84% of companies closely tied to the industry, compared to 56% of the building) and the cost reduction, both at work (50%) and of the materials and energy used in the production process (39%).

The interventions described as innovation aimed at reducing environmental impact are broken down in percentage as follows:

- 59% - construction industry
- 43% - industry
- 39% - services sector

Interventions aimed at improving health and safety at work are broken down as follows:

- 73% - construction industry
- 66% - industry
- 48% - services sector

Firms in the service sector point more than any other innovation in the diversification of supply (83% of them) and to the increase in flexibility in the production of services (64%). The largest regional firms have attributed a greater importance to the objectives of access to new markets or increase their market share and limiting the environmental impact, while smaller companies have innovated mainly to improve the quality of products and services and to increase the number of products and services offered to customers.

Therefore, there is, in the industrial and craft districts present in Friuli Venezia Giulia, the potential and momentum necessary for the realization of investment by companies in the sector in order to produce and improve the currently available technologies. In the following table is shown a qualitative assessment of the development potential of the different categories of intervention on the basis of the considerations made in the fact sheets presented in the previous chapter.



Type of intervention / technology	Current development in FVG	Potential for evolution in FVG
Thermal insulation coating	HIGH	STABLE
Doors and windows	HIGH	STABLE
Solar thermal	HIGH	MEDIUM
Solar cooling	MEDIUM	LOW
Biomass	VERY LOW	HIGH
Photovoltaics	MEDIUM-HIGH	STABLE

The technology of solar cooling is much more appropriate to the climates of the southern regions of Italy who have less need for heating, a higher specific power of solar radiation, and a period of increased demand for cooling³.

³ It should be noted that the difference between the values of “heating degree day” between the cities of the south and the north of Italy are notable, such as Palermo has 751 “heating degree day” while Napoli 1034 has Udine in 2323.



3.7 Evaluation of the effects of the different technologies in terms of energy savings and environmental impact

According to the considerations made with regard to the application of different types of intervention within the fact sheets presented, it is believed that in the region of Friuli Venezia Giulia there may be diverse energy-saving potential. In particular, the energy savings achievable by means of technologies available in the region are estimated as follows:

Type of intervention / technology	saving
Thermal insulation coating	20% fuel
Doors and windows	7% fuel
Solar thermal	50% of the production of domestic hot water
Solar cooling	unavailable
Biomass	40% cost savings compared to fossil fuels
Photovoltaics	15% electricity consumption of the building

The above data were derived and estimated from the documents examined and ARES data provided by the banks, and in particular according to the improvements shown in the energy certificates.

In the following chapters will be presented the considerations and comments from analyzes carried out on the sample buildings representative of the regional park in the various categories of the service sector taken as a reference.

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3.7.1 SCHOOL BUILDINGS

The buildings of this type of construction and management require, for the purpose of energy saving, significant insulation of the building, replacement of existing windows with high-performance windows and doors, replacement of existing generators with heat generators with high efficiency. The plant system based on the use renewable energy sources that have an acceptable payback time is the heat production by biomass.

The school buildings are considered broadly representative of the existing school buildings in the region. School constructions in the region are mainly located in historic buildings or buildings in the years 1960s and 1970s, while there are very few new buildings or completely renovated ones.



Precisely because of the overall age of the school building such buildings are particularly energy-intensive: the priority actions should be related to the improvement of the housing.

Potential investments in the category

The analysis of the school buildings taken into consideration, highlights the scarce energy needs related to:

- ✧ Cooling
- ✧ Hot water
- ✧ Lighting and electricity

Turn out to be convenient and priority the investments for the replacement of the heat generator and for providing insulation. Other interventions on school buildings are difficult to propose because of the high return periods and methods of use (for example, the intervention relative to the solar cooling is not feasible because school buildings have no need for cooling).

The use of solar PV system has a reasonable chance of exploitation in view of the large areas of coverage available, the low cost of the technology and also the incentives.

Another intervention that may have developments for school buildings and for public institutions is the creation of small district heating networks that can serve for example all public buildings in a given area, such interventions are optimal for the installation of centralized systems biomass and cogeneration.

3.7.2 OFFICES

The buildings in this category are often located in historic buildings, restored and adapted for office use.

Such buildings for the purpose of energy saving interventions require insulation of the building, replacement of existing windows with high-performance windows and replacement of existing generators with heat generators with high efficiency.

It must be remembered, however, that the actions of historical buildings and monuments are very problematic especially for the architectural constraints present.

For example it is impossible to think of revision interventions of structural building components (insulation of structures outside), and it is also difficult to imagine the installation of foreign elements in coverage (solar panels), without considering the fact that the technological spaces in building's monuments are very low.

Work on historic buildings must be designed very carefully: it is possible to run from the inside with double wall insulation, replace the plaster (also external) with thermal insulation plaster, insulate the roof. The interventions of internal insulation, however, can create imbalances in thermo hygrometric characteristics of existing buildings, due to the presence of significant thermal bridges that cannot be canceled. Moreover, to avoid the formation of condensation it is necessary



to equip the buildings of internal insulation of mechanical ventilation system to ensure an appropriate rate of renewal of the air within the premises.

Potential investments in the category

As a representative sample it was considered a historic building, since many municipal buildings in the region have the same characteristics.

Buildings used for municipal offices have very little energy needs related to:

- ⤴ Hot water

They also have modest energy needs in relation to the consumption of

- ⤴ Lighting and electricity

Thus turn out to be convenient and priority the investments for the replacement of the heat generator and for providing insulation, other interventions are difficult to propose because of high return periods.

There is not enough hot water uses to justify investments for the production of hot water from renewable energy (solar panels) it is also very difficult to get the go-ahead by the Superintendence for the installation of foreign bodies in coverage.

The intervention on the solar cooling is not feasible since the historical buildings have little need for cooling and it is almost impossible to find a location for complex technological systems. Consistent with the architectural constraints of the historic buildings and fittings, the installation of a photovoltaic system represents a reasonable chance of exploitation given the presence of government incentives.

The replacement of boilers with boilers for biomass is feasible with acceptable recovery times, but the intervention is difficult to enforce given the frequent lack of space to devote to technological intervention.

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3.7.3 HOSPITAL AND RETIREMENT HOMES

The buildings for hospital and retirement home use in the region have different architectural styles and are mostly settled in existing buildings. The hospital building has grown from the 1960s to the 1980s, while retirement homes are mostly settled in historic buildings or buildings with some architectural merit.

These types of construction are affected by the age of the building systems, and for the purpose of energy saving interventions require insulation of the building, replacement of existing windows with high-performance windows and replacement of existing generators with high efficiency heat generators with simultaneous development distribution. It should also be carefully evaluated the introduction of plant systems that use renewable energy.



The plant systems that have acceptable payback times are heat production through the use of biomass and solar thermal systems for buildings with high requirements of DHW. Solar cooling has very high costs of implementation, requires the availability of wide spaces for the technology implementation and given the temperate climate of the region it does not provide an acceptable timeframe for the payback.

Potential investments in the category

Turn out to be convenient and priority the investments for the replacement of heat generators and for providing insulation and replacement windows.

The intervention on the solar cooling is not particularly convenient as it is very complex to implement, because the solar surface to affect the intervention is very high (600 square meters of solar surface about to be committed).

Potential introduction of renewable energy sources

The exploitation of solar energy for heating and domestic hot water has the potential though probably the exploitation of domestic hot water does not generate significant fuel savings of energy because the amount of energy devoted to the water heater is not particularly worthy of note.

The exploitation of a solar thermal absorber with using solar cooling systems turns out to be difficult to apply to the characteristics of a highly invasive intervention, and the high cost of installation.

The solar PV has a high chance of exploitation also seeing government incentives and intervention costs are very low.

It is possible to envisage an operation to replace the existing boilers with natural gas boilers for biomass, even if the intervention is problematic because of objective difficulties in having suitable space to be allocated to the technological components needed.

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3.7.4 COMMERCIAL BUILDINGS

The analysis of the energy certificates obtained from the ARES has emerged that the buildings of this type of construction are varied and can be grouped into three broad categories:

- small commercial spaces (100 to 300 square meters) inserted in condominium buildings (category which happens to be the standard type of commercial buildings in the region);
- supermarkets settled in prefabricated buildings, industrial buildings;
- Big shopping centers or business parks (although in this region it has seen tremendous growth over the past 10 years, these settlements have not been possible to obtain any data on).



It should be noted that the systems installed in structures belonging to the last category, "big malls or retail parks", appear to be difficult to change as they are designed specifically for each individual complex, because they often work with heat pumps independent of water rings, or with heat pumps in variable refrigerant volume and direct expansion, thus resulting in closed systems and not implementable.

In fact, the energy distribution of a large supermarket has as its main component (about 60%) the electrical energy for the maintenance of refrigerated counters, cold rooms, warming benches and exhibitors, therefore, part of a strategy to increase efficiency of this type of building, this should be the point on which we base a priority intervention. The buildings analyzed as supermarkets and small commercial buildings have shown that for the purpose of energy-saving, the type of intervention which is more achievable is the insulation of the building casing. There is not enough hot water use to justify investments for the production of hot water from renewable energy sources. In some cases there is the presence of a plant for heat recovery by the heat of condensation of the refrigeration units of food preservation which produces a considerable energy saving on the heating of buildings.

Potential investments in the category

These turn out to be convenient and priority investments for providing insulation and improving the structure of the building dispersant.

Potential introduction of renewable energy sources

The exploitation of solar energy for heating and domestic hot water does not have the potential for this type of use.

The PV has high potential for exploitation due to the high power consumption of commercial buildings examined, the presence of government incentives, the low cost of the intervention and the relative ease of operation. It is impossible to manage a biomass plant in this type of building. Solar heating with solar cooling may have applications in such buildings as the cooling demands are significant.

In particular, it is interesting for the potential application of solar cooling with ammonia absorbers capable of producing cooling necessary for cold storage, even if such intervention is to be very invasive with very high costs. An intervention with this technology requires a total revamping of the commercial space or the building a new facility and is a technology still under study and development. In FVG region there is a regional company that produces these types of systems.



3.7.5 ACCOMODATION BUILDINGS (HOTELS)

For this category of buildings of the tertiary sector it has been hard to find energy data. Such buildings are managed by individuals who often do not have organized structures to follow the energy aspect of the business.

The hotel industry in the region is mainly developed in the coastal strip and is concentrated mainly in the two seaside resorts of the region, Grado and Lignano. In these places, buildings for hotel use have an average size of about 30 rooms and family rooms and there are also a few large hotels. The buildings of this type of construction and management require, for the purpose of energy saving, significant insulation of the building, replacement of existing windows with high-performance windows and doors, replacement of existing generators with heat generators with high efficiency heat generators with simultaneous development of the distribution.

Building systems that use renewable energy should also be carefully assessed as well. The plant systems that have an acceptable payback period is the use of solar thermal systems for DHW production, while the solar cooling has a very high running cost and requires plenty of technological spaces for its installation.

Potential investments in the category

The buildings for hotel use have a regional mainly seasonal use (summer) and have also modest energy needs in relation to the consumption of:

- lighting and electricity
- heating

Therefore turn out to be convenient and priority the investments for providing insulation, the implementation of solar systems for the production of domestic hot water (in this case it exists) and the implementation of measures targeted to reduce power consumption due to cooling.

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Potential introduction of renewable energy sources

The exploitation of solar energy for hot water has considerable potential for this type of building, in view of the high consumption of hot water.

The exploitation of solar thermal absorber using solar cooling systems turns out to be difficult to apply to the characteristics of highly invasive interventions and the high cost of installation.

The prevailing problem of these type of buildings in the application of systems such as solar cooling is to not have large areas of coverage in order to install solar panels.

The PV has high potential for exploitation, given the high consumption of electricity during summer due to the cooling, in the presence of government incentives and acknowledged the low cost of the plant.

The replacement of existing boilers with biomass boilers is difficult to apply in this category of buildings, since there is no enough space for the installation of such facilities.



3.8 FINAL EVALUATION

The previous chapters and, in particular, the analysis report fact sheets, clearly state that the buildings of the tertiary sector are located in building structures that have the following common problems:

- ✧ bad building “housing” for thermal insulation
- ✧ obsolete plants with boilers with on average more than 20 years of operation
- ✧ poor use of systems with renewable energy sources
- ✧ impossibility of monitoring and control of energy consumption by users
- ✧ scarce presence of mechanical ventilation systems to improve environmental comfort
- ✧ architectural constraints very restrictive for its historic buildings and monuments.

In coherence with the analysis carried out and considering the results obtained in the simulations, it is considered that for each type of buildings considered, priority and qualifying actions can be summarized, as follows:

School buildings	<ul style="list-style-type: none"> • Replacement of boilers with condensing boilers and implementation of systems optimization and control • insulation of the building casing • replacement of windows • Replacement of heat generators with heat generators utilizing woody biomass • insertion of controlled mechanical ventilation systems for the improvement of the conditions of environmental comfort of the users • implementation of the monitoring system of consumption by the user
Office buildings (historic buildings)	<ul style="list-style-type: none"> • Replacement of boilers with condensing boilers and implementation of systems optimization and control • insulation of the building casing using techniques of insulation from the inside • Replacement of doors and windows • Insertion of controlled mechanical ventilation systems for the improvement of the conditions of environmental comfort of the users • Implementation of the monitoring system of consumption by the user • inclusion of photovoltaic systems for the reduction of electricity consumption
Hospitals and retirement homes	<ul style="list-style-type: none"> • Replacement of boilers with condensing boilers and implementation of systems optimization and control • insulation of the building casing • replacement of windows and doors • insertion of controlled mechanical ventilation systems with heat recovery to improve the living comfort of the users • introduction of systems for the production of domestic hot water through solar thermal • inclusion of photovoltaic systems for the reduction of electricity



	<p>consumption</p> <ul style="list-style-type: none"> • inclusion of systems using new technologies such as solar cooling
Commercial buildings	<ul style="list-style-type: none"> • Replacement of boilers with condensing boilers and implementation of systems optimization and control • insulation of the building casing • for supermarkets insertion of systems using solar cooling for the production of cooling energy to devote to the storage of food
Accommodations	<ul style="list-style-type: none"> • Replacement of boilers with condensing boilers and implementation of systems optimization and control • introduction of systems for the production of domestic hot water using solar thermal • insulation of the building casing • replacement of windows • inclusion of photovoltaic systems for the reduction of electricity consumption