GovernEE – Good Governance in Energy Efficiency
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WP 3.1.2 POTENTIAL ESTIMATION REGARDING ENERGY EFFICIENCY

CENTRO DI ECOLOGIA TEORICA ED APPLICATA

Summary

1 The municipal building stock

San Vito al Tagliamento is a municipality in the Province of Pordenone in the Italian region Friuli Venezia Giulia, located about 80 km northwest of Trieste and about 20 km southeast of Pordenone. The population reaches about 13.300 unities.

It is a medieval town on the right bank of the Tagliamento river. The main attractions are the three towers of the old medieval walls, one of which houses a small archaeological museum; the Church of San Lorenzo (1479); the Church of Santa Maria dei Battuti, housing works by Pomponio Amalteo and Giovanni Antonio Pilacorte and the Duomo (Cathedral), with a triptych by Bellunello and works by Amalteo, Gaspare Diziani and Padovanino (Figure 1).

Figure 1: "Piazza del Popolo", Municipality of San Vito al Tagliamento

2 Methodology of the potential estimation calculation

The methodology follows the approach of energy auditing. This means that various characteristics of the building envelope including the walls, ceilings, floors, doors, and windows were recorded. Considering the high number of buildings owned by the Municipality of San Vito al Tagliamento some main data about the whole building stock were collected and the energy analysis was carried out referring to a sample of the buildings.

The methodology develops in the following steps:

1. overview of the public building stock,
2. evaluation of retrofitting measures to be applied,
3. assessing energy saving potential in the public building stock.

2.1 Overview of the public building stock

The first step consists of defining the state of the art of the public building stock characteristics. In order to collect data a survey has been carried out.

All public buildings were classified by function, heat consumption and electricity consumption. Yearly energy consumptions for heat generation were gathered for the building stock.

Following the methodological guidelines, public buildings are classified in three main function categories: office, residential, educational. Educational function included also infrastructure used for sport, association and leisure time purposes.

The public building stock is composed of 32 buildings, 8 having office function and 22 educational functions, no public buildings have residential destination[1] (Table 1).

[1] Some buildings are excluded from the list because are schools closed during the last year, or association seats hosted in the same building. In the first case the character is crossed, in the second one the numeration is repeated.

Table 1: Destination of the Municipality buildings and function

	Destination of the Municipality buildings (Italian)	Destination of the Municipality buildings (English)	Function
1	Sede Assoc. Ex-Biblioteca	Association seats	educational
2	Sede Associazioni Via F. Vial	Association seats	educational
3	Via Stazione Rfi Associazioni	Association seats	educational
3	Via Stazione Rfi Associazioni	Association seats	educational
3	Via Stazione Rfi Associazioni	Association seats	educational
4	Sede Progetto Giovani	Association seats	educational
5	Sede Protezione Civile	Association seats - Civil protection	educational
6	Cai Edificio Palestra di Roccia	Association seats - CAI (Italian Alpine Club)	educational
7	Mensa Comunale	Canteen	office
8	Castello – Museo del Territorio	Castle - Museum	educational
9	Centro Civico	Civic centre	educational
10	Ufficio Collocamento	Employment office	office
11	Scuola Materna Prodolone	Kindergarten Prodolone	educational
12	Scuola Materna Capoluogo	Kindergarten S. Vito	educational
13	Asilo Nido	Kindergarten S. Vito	educational
14	Tribunale	Law court	office
15	Uffici Giudice di Pace	Law office	office
16	Biblioteca Comunale	Library	educational
17	Loggia/Teatro Via Marconi	Loggia / Theater	educational
18	Ex Ospedale Dei Battaglieri	Minor buildings	office
19	Palestra Piazza Del Popolo	Palestra and sport facilities	educational
	~~Ex Elementari Gleris~~	Primary school Gleris (ex)	educational
20	Scuola Elementare Ligugnana	Primary school Ligugnana	educational
21	Scuola Elementare Provolone	Primary school Prodolone	educational
22	Scuola Elementare Capoluogo	Primary school S. Vito	educational
	~~Ex Scuola Elem. Savorgnano~~	Primary school Savorgnano (ex)	educational
23	Scuola Media Ex-Amalteo	Secondary school Amalteo	educational
24	Scuola Media Ex-Tommaseo	Secondary school Tommaseo	educational
25	Campo Sport. Via dello Sport	Sports ground	educational
26	Spogliatoi Via dello Sport	Sports ground	educational
27	Campo Sportivo Via Piave	Sports ground	educational
28	Campo Sportivo Savorgnano	Sports ground	educational
28	Piscina Comunale	Swimming pool	educational
29	Parte Nuova Piscina	Swimming pool	educational
30	Uffici Ssb.-Centro Diurno-Attiv.Socio-Ed	Town hall	office
31	Uff. Pubbliche Affissioni	Town hall	office
32	Uff. Tecnico Urbanistico	Town hall	office

Source: CETA elaboration

The energy consumption of the public buildings stock of the Municipality is represented in the

Table 2 and sums to 8.506.701 kWh/year[2]. As shown in the table the Municipality depends mainly on gas and electrical energy supplies. There is not any renewable energy sources furniture guaranteed.

Table 2: Energy consumption of the Municipality per source

	Consumption		Distribution
	Tep/year	kWh/year	%
Oil	58	674.424	6
Gas	468	5.441.904	48
Electrical energy	447	2.390.373	46
Renewable energy sources	0	0	0
Total	**973**	**8.506.701**	**100**

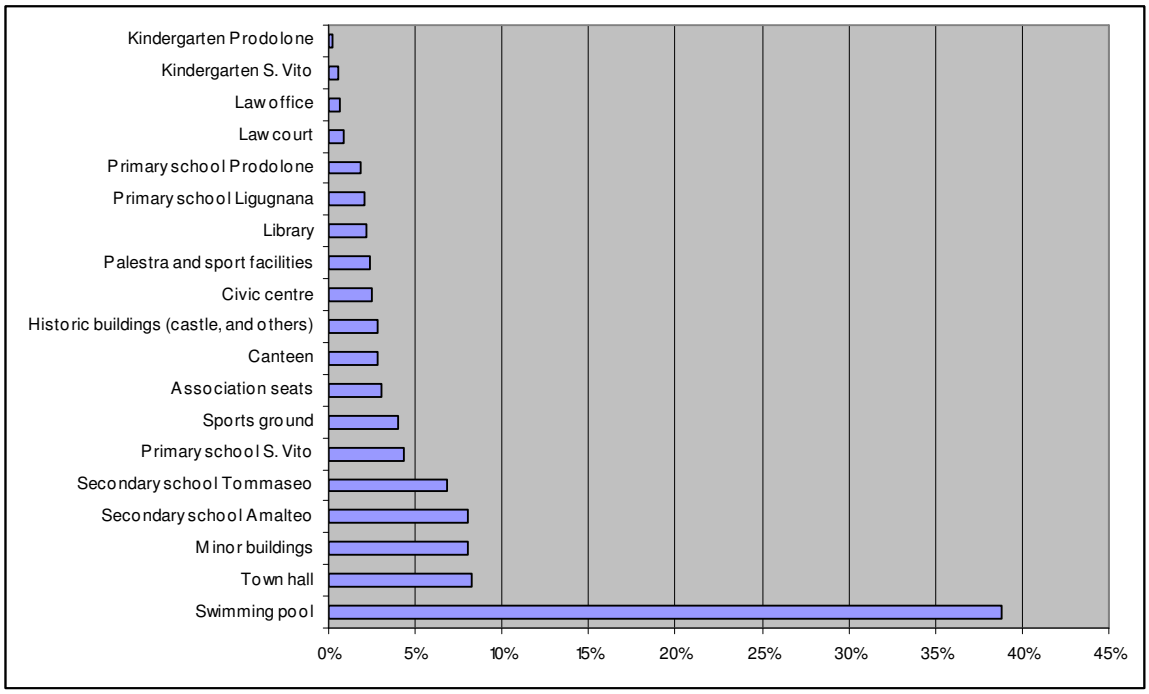
Source: CETA elaboration

Considering the consumption for thermal and electrical purposes the figures are reported in and

[2] 1 tep = 11.628 kWh referring to biofuels (1 tep = 41,860 GJ). 1 tep = 5.347,59 kWh referring to energy (1 kWh = 0,187x10-3 tep).

Table 4.

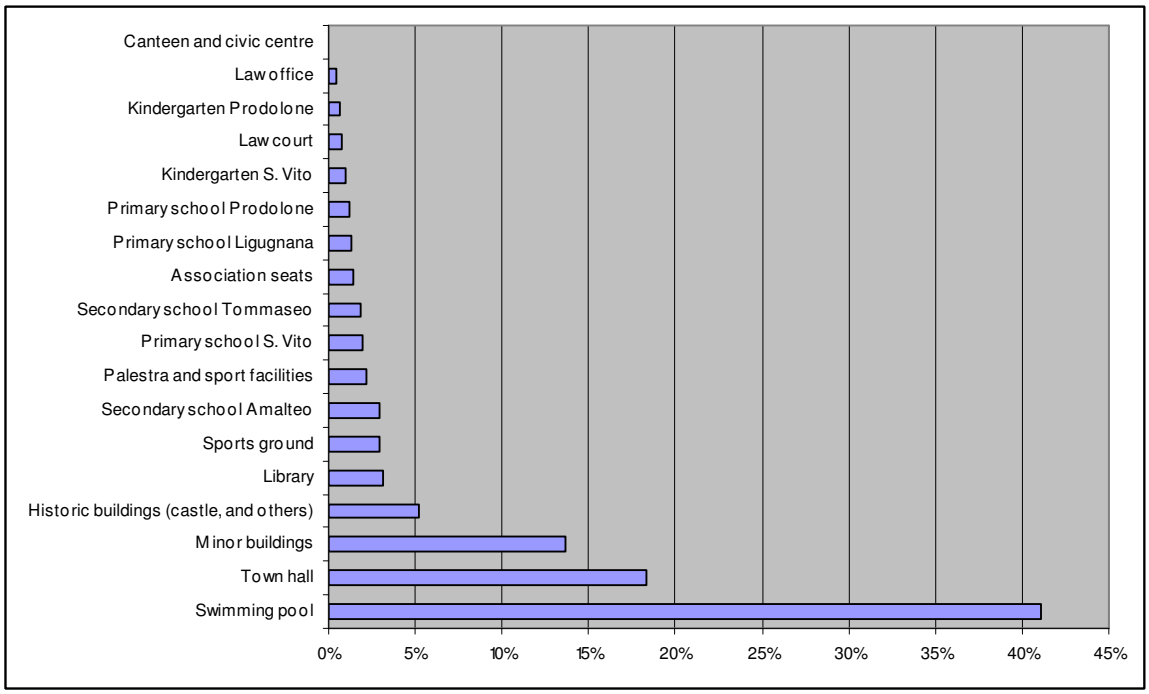
Table 3: Energy gas consumption of the public building stock (percentage)



Source: CETA elaboration

In general terms the most thermal energy consuming building are the swimming pool, the town hall, some minor buildings and the educational buildings, especially the secondary schools. The “Minor buildings” category includes some facilities such as the cemetery, the post office, the park place, the pharmacy, the municipal store and many lifting apparatus. Regards the electrical energy consumptions, the swimming pool and the town hall are the most energy consuming buildings.

Table 4: Electrical energy consumption of the public building stock (percentage)



Source: CETA elaboration

2.2 Evaluation of retrofitting measures to be applied

Referring both to energy analysis and literature data, the percentage reachable respect to each kind of improvement on the envelope and plants was assessed.

As previously explained energy analyses were developed regards a sample of buildings representing eight of the most significant one in the town: 1 kindergarten, 2 elementary schools, 2 secondary schools, 1 library, 1 court of law and 1 sports hall.

The sampled buildings were classified by function, heat/water and heat consumption, heating plant characteristics, building characteristics, previous renovation, renewable sources feasibility on building, electricity consumption, useful area, gross volume. Some of these data are reported in Table 5 and the main figures of the building stock and the sampled buildings are shown in Table 6.

Table 5: Function, area, volume and energy consumption of the sampled buildings

		Elementary school	Secondary school	Court law	Library	Kinder garten	Elementary school	Secondary school	Sport hall	Total
Function		Educational	Educational	Office	Educational	Educational	Educational	Educational	Educational	
Useful floor area	m^2	2.247	2.242	369	1463	617	1.474	5.551	3.826	17.789
Gross volume	m^3	12.305	10.986	1749	6114	2342	5.975	28.320	31.839	99.630
Energy consumption	kWh/m^3/ year	15,06	17,55	19,30	14,16	22,71	23,30	16,14	35,32	22,81

Source: CETA elaboration

Table 6: Main figures of the building stock and the sample

	Public buildings	**Sampled public buildings**
Number	32	8
Energy consumption (kWh/year)	8.506.701	1.147.937

Source: CETA elaboration

On the base of the general overview of the building stock, and the analysis done focusing on 8 representative buildings, some energy efficiency improvements have been suggested. The percentage that could be reachable by enhancing energy efficiency respect to improvement affecting the envelope, floor, windows, plants and integration with renewable energy sources are indicated in Table 7.

Table 7: Energy saving potential percentage of the building sample

Building	Envelope	Floor toward the roof	Windows	Plants	Photovoltaic panels
Primary school	11%	30%	13%	23%	60%
Secondary school	18%	9%	33%	15%	70%
Court of law	51%	13%	6%	-	-
Library	48%	20%	6%	20%	-
Kindergarten	21%	32%	14%	17%	-
Elementary school	9%	40%	22%	17%	-
Secondary school	16%	10%	35%	29%	40%
Sport hall	9%	17%	7%	37%	35%
Average	**23%**	**21%**	**17%**	**23%**	**51%**

Source: CETA elaboration

2.3 Assessing energy saving potential in the public building stock

Considering that the percentage is the simplest way for expressing a number, the energy saving potential is transformed in a final percentage. This figure is calculated as weighed average.

Applying the lowest and the highest percentage assessed in Table 7, the energy saving potential has been estimated as shown in Table 8. Depending on the measures adopted the Municipality can gain energy saving performance between 8% applying the worsen measures and 43% applying the best available measures.

The result of this analysis represents the total energy saving potential ranging between 189.354 kWh/year and 976.516 kWh/year.

Table 8: Energy saving potential

	Consumption	Energy saving	
	kWh/year	Lo west percentage kWh/year	Highest percentage kWh/year
Primary school	185.313	20.384	111.188
Secondary school	192.804	17.352	134.963
Court of law	33.756	2.025	17.215
Library	86.574	5.194	41.556
Kindergarten	53.187	7.446	17.020
Elementary school	139.218	12.530	55.687
Secondary school	457.085	45.708	159.980
Sport hall	1.124.467	78.713	416.053
Total	2.272.404	189.354	976.516
Saving potential		**8%**	**43%**

Source: CETA elaboration

3 Summary

Table 9 summarizes the main data about energy consumption, area, volume and saving potential of the Municipality of San Vito al Tagliamento.

The figures describe in a synthetic manner the main characteristics of the sampled buildings as shown and commented in the previous pages and especially regards:

- Total number of public buildings,
- Total heating energy consumption,
- Total average heating energy consumption,
- Total floor area of the buildings,
- Average floor area of the buildings,
- Average specific heating energy consumption,
- Total estimated heating energy saving potential – Renovation,
- Total estimated heating energy saving potential - Changing users habits.

The table reports the estimated heating energy saving potential that the Municipality can gain adopting retrofitting measures. As shown in Table 8 two different scenarios have been developed: one applying the worsen and one the better technologies. For prudential purposes the lowest estimation was considered meaning that the Municipality could gain at least that result.

Regards the estimated heating energy saving potential through changes in the users habits the common factor of 3,5% has been used.

Considering both:

- Total estimated heating energy saving potential – Renovation,
- Total estimated heating energy saving potential - Changing users habits,

the total energy saving potential of the Municipality is about kWh/year 229.532.

Table 9: San Vito al Tagliamento data about energy consumption, area, volume and saving potential

Total number of public buildings	**number of the buildings**	8
Number of public educational buildings	number of the buildings	7
Number of public office buildings	number of the buildings	1
Number of public residential buildings	number of the buildings	0
Number of other public buildings	number of the buildings	0
Total heating energy consumption	**kWh/year**	1.147.937

Total heating energy consumption - Educational	kWh/year educational buildings	1.114.181
Total heating energy consumption - Office	kWh/year office buildings	33.756
Total heating energy consumption - Residential	kWh/year residential buildings	-
Total heating energy consumption - other public buildings	kWh/year public buildings	-
Total average heating energy consumption	**kWh/year average public building**	192.925
Average heating energy consumption - Educational	kWh/year average educational building	159.169
Average heating energy consumption - Office	kWh/year average office building	33.756
Average heating energy consumption - Residential	kWh/year average residential building	-
Average heating energy consumption - Other	kWh/year average other building	-
Total floor area of the buildings	**m^2**	17.789
Floor area of the educational buildings	m^2 educational	17.420
Floor area of the office buildings	m^2 office	369
Floor area of the residential buildings	m^2 residential	-
Floor area of the other buildings	m^2 other	-
Average floor area of the buildings	**m^2/average public building**	2.858
Average floor area of the buildings - Educational	m^2/average educational building	2.489
Average floor area of the buildings - Office	m^2/average office building	369
Average floor area of the buildings - Residential	m^2/average residential building	-
Average floor area of the buildings - Other	m^2/average other building	-
Average specific heating energy consumption	**kWh/(m^2/year) average public building**	155
Average specific heating energy consumption - Educational	kWh/(m^2/year) average educational building	64
Average specific heating energy consumption - Office	kWh/(m^2/year) average office building	91
Average specific heating energy consumption - Residential	kWh/(m^2/year) average residential building	-
Average specific heating energy consumption - Other	kWh/(m^2/year) average other building	-
Total estimated heating energy saving potential - Renovation	**kWh/year public buildings**	189.354
Estimated heating energy saving potential - Renovation - Educational	kWh/year educational buildings	187.328
Estimated heating energy saving potential - Renovation - Office	kWh/year office buildings	2.025
Estimated heating energy saving potential - Renovation - Residential	kWh/year residential buildings	-
Estimated heating energy saving potential - Renovation - Other	kWh/year other buildings	-
Total estimated heating energy saving potential - Changing users habits	**kWh/year public buildings**	40.178

Estimated heating energy saving potential - Changing users habits - Educational	kWh/year educational buildings	38.996
Estimated heating energy saving potential - Changing users habits - Office	kWh/year office buildings	1.181
Estimated heating energy saving potential - Changing users habits - Residential	kWh/year residential buildings	-
Estimated heating energy saving potential - Changing users habits - Other	kWh/year other buildings	-

Source: CETA elaboration