TEESCHOOLS

Transferring Energy Efficiency in Mediterranean Schools

PRIORITY AXIS: Fostering Low-carbon strategies and energy efficiency in specific MED territories: cities, islands and remote areas

OBJECTIVE: 2.1 To raise capacity for better management of energy in public buildings at transnational level

DELIVERABLE NUMBER: **4.2.1 Protocol of application of the tool**

TITLE OF DELIVERABLE: WP4 Implementation Strategy
WP n. 4: TRANSFERRING

ACTIVITY n. **4.2 Protocol & model of intervention**

PARTNER IN CHARGE: CMAR PACA

PARTNERS INVOLVED: ALL PARTNERS

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WEB TOOL PRESENTATION AND APPLICATION

TRAININGS

SPLIT 20th SEPTEMBER 2018

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Title of the presentation:

WEB TOOL PRESENTATION AND APPLICATION

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Interreg Mediterranean TEESCHOOLS

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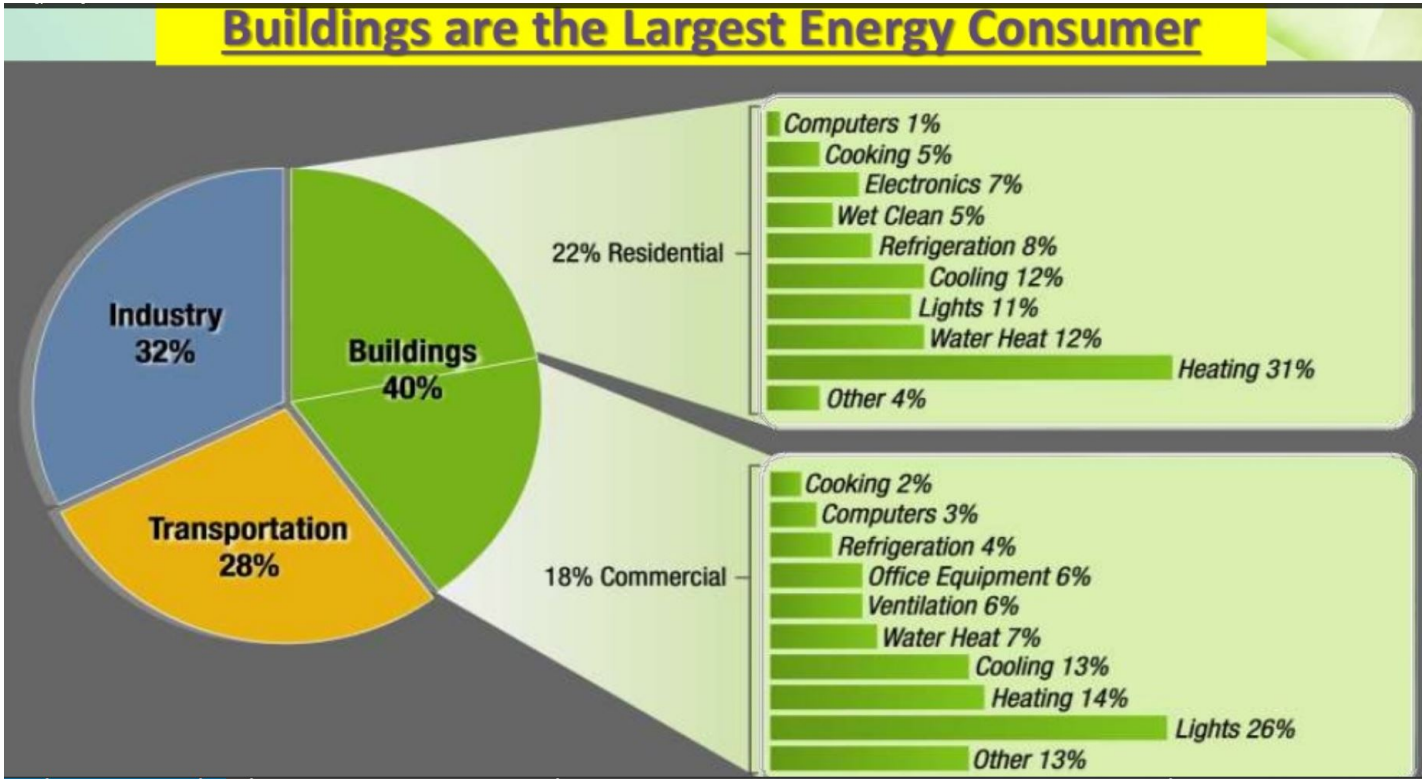
INTRODUCTION

The schools buildings, like all the other buildings, have high energy consumption for heating, for the production of hot domestic water, for lighting and for other services (ventilation, cooling, internal transportation…).



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INTRODUCTION

Sometimes energy used isn't the most appropriate for the final service, in other cases the system for the production and distribution of energy have low performances or the energy use doesn't take place in the best way (high heat losses in distribution net, overheating, high energy losses through winwows…).

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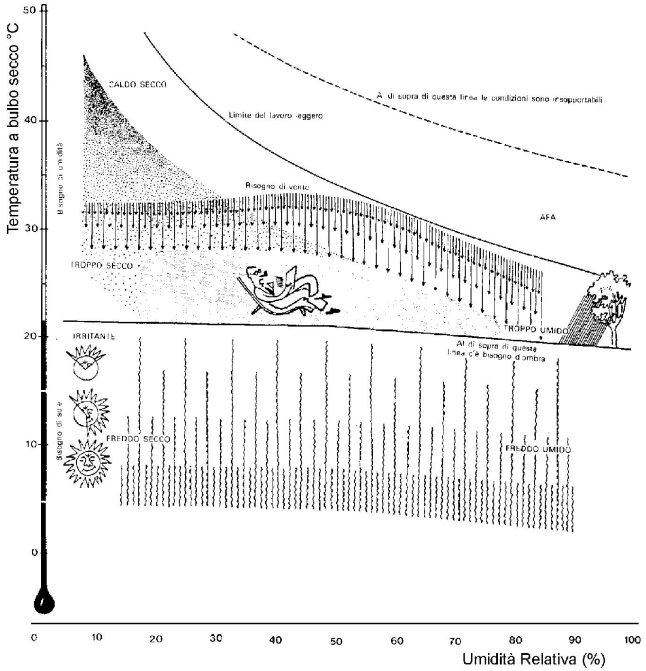
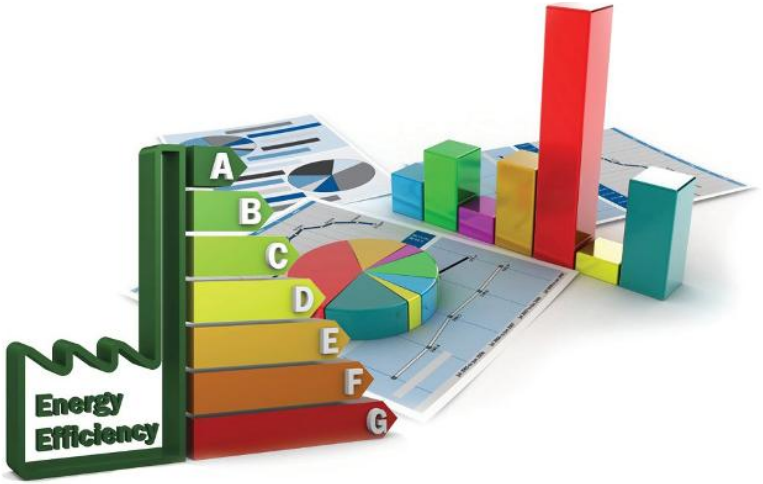
INTRODUCTION

In all these cases there is a greater use of resources than necessary, with negative effects both on the users comfort and on the waste of money.

To help stakeholders interested in school buildings, a web tool has been developed with the aim to simplify the analysis of the actual state of a school building and the implementation of energy improvement actions.





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WEB TOOL

One of the most important aim of TEESCHOOLS Project is developing a simplified web tool to allow stakeholders, involved in school buildings, to make evaluations on the savings achievable through energy improvement actions.

It is important to remember that the tool is not a design tool. The design of improvement actions must be entrusted to professionals (engineers, architects, energy expert…) choose by the school manager.

The tool, however, furnishes the possibility to evaluate if it is the case to proceed with a deepened energy audit and then it allows to evaluate what is the intervention that can give the greatest savings.

In fact the tool allows to appraise the weight of every single action in comparison to the total saving.

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WEB TOOL: STATE OF THE ART

The developed web tool allows knowing the energy quality of the schools building, evaluated with respect to the average value of the national school consumption.

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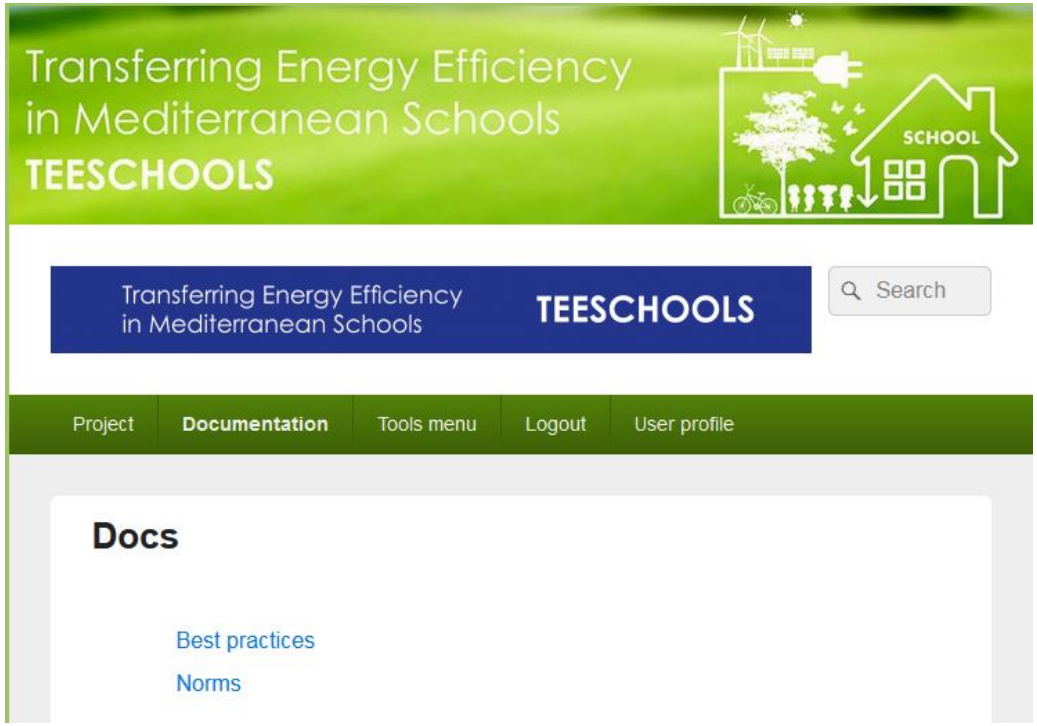
WEB TOOL: IMPROVEMENT ACTIONS



It also allows to identify the simplest interventions to improve the energy quality of the school buildings and to evaluate the opportunity of carrying out, through an energy specialists, more in-depth energy audits.

In the website you can also find other materials:

- Project information
- Norms and local Regulation
- Collection of Best practises

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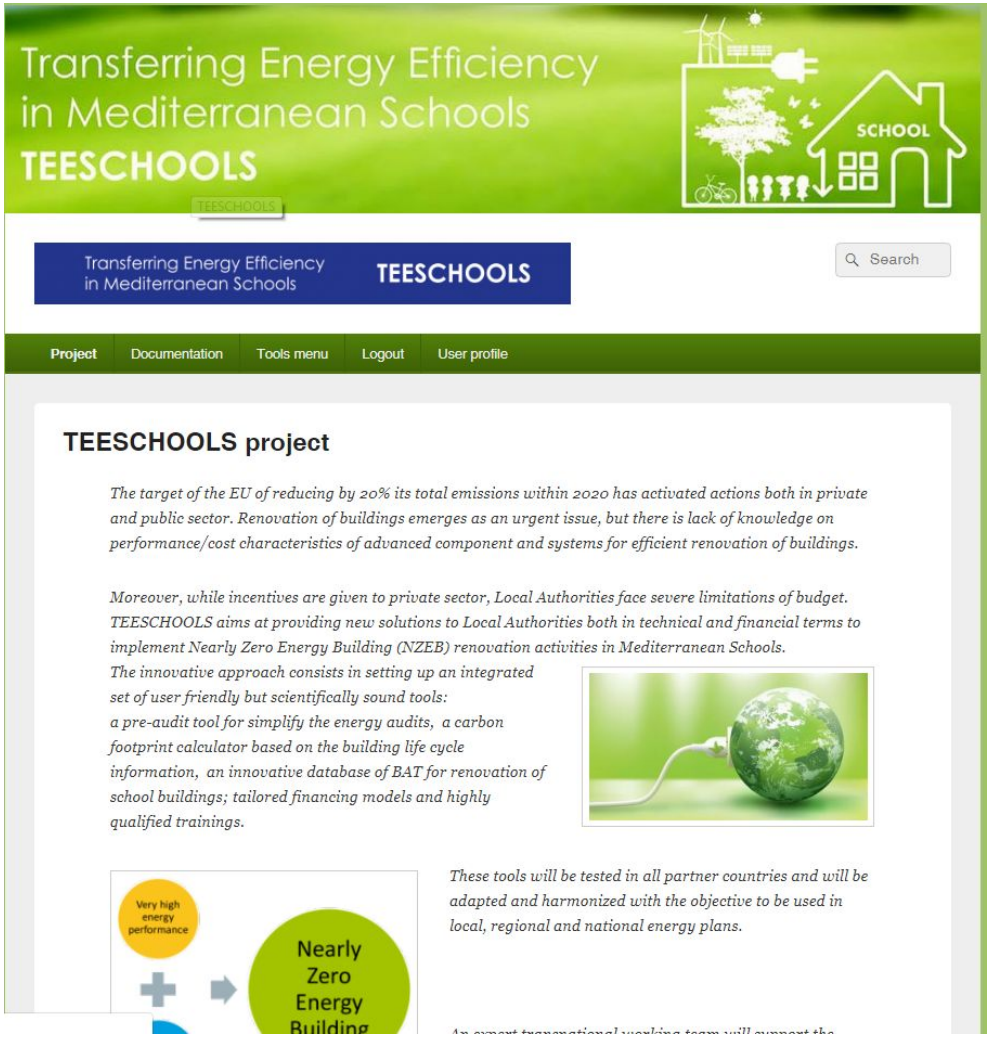
WEB TOOL

The evaluation of energy quality of the school building takes place through the comparison with a representative sample of similar schools. The examples used for the comparison were originate from a series of complex energy audits performed in different European countries (TEESCHOOLS project partners).

In the picture it is shown the home page of the web tool.



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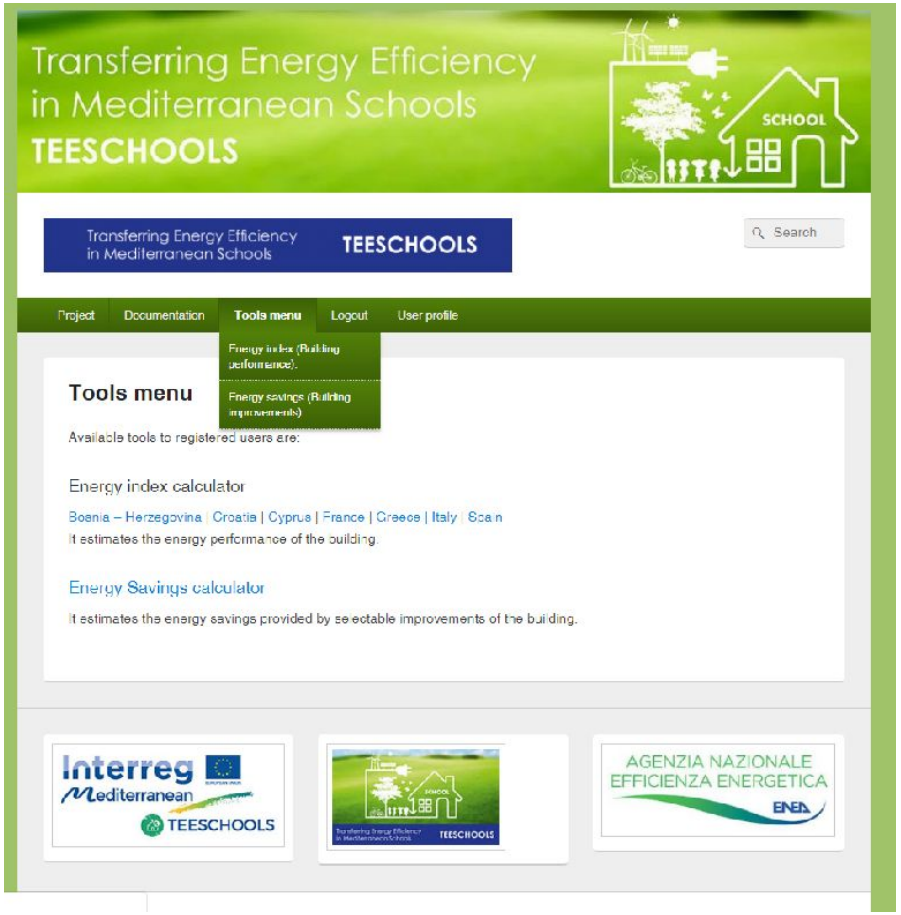
WEB TOOL

In the link bar you can choose the action for your evaluation:

- Building performances (state of art)
- Building improvement

And you can choose your Country.



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WEB TOOL

Characteristics of schools and areas of application

The web tool evaluation can be applied to different type of school buildings:

- Preschool
- Primary
- Secondary

Other data are:

- School name
- Municipality (this data defines your climatic condition)
- Address

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WEB TOOL

Calculation method for specific energy consumption in the schools

To determine the energy indicators the single phases below indicated must be follow:

1. **CONSUMPTION EVALUATION**
2. **GROSS HEATED VOLUME, GROSS AREA OF THE FLOORS AND DISPERSING SURFACE OF BUILDINGS COLLECTION**
3. **DEGREES DAYS (K_D) OF THE CITY IN WHICH IS LOCATED THE SCHOOL**
4. **HEATING CONSUMPTION NORMALIZATION FACTOR, DEPENDING ON THE SHAPE OF THE BUILDINGS**
5. **THE OPERATING TIME NORMALIZATION FACTOR FH**
6. **NORMALIZED ENERGY INDICATORS CALCULATION**

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WEB TOOL

Type	Year (0)	Year (-1)	Year (-2)	Average	
Methane gas	0	0	0	0.00 m^3	x 9.59 = 0.00 kWh_t
Diesel fuel	0	0	0	0.00 l	x 11.86 = 0.00 kWh_t
Fuel Oil	0	0	0	0.00 l	x 11.40 = 0.00 kWh_t
L P G	0	0	0	0.00 l	x 12.79 = 0.00 kWh_t
Firewood	0	0	0	0.00 kg	x 4.77 = 0.00 kWh_t
Coal	0	0	0	0.00 kg	x 8.15 = 0.00 kWh_t
Electric Energy	0	0	0	0.00 kWh	kWh_t

STEP 1 – CONSUMPTION EVALUATION

As a firts step, the energy consumption for heating per year detected by the bills relating to the previous 3 years will be collected.

The fuel consumption of three years is added together and divided by 3 obtaining the annual average fuel consumption.

The same will be done for electricity.

The data of annual consumption of fuel and electricity, should be registered in specific tables as shown in the picture.

Contract ID	Year (0)	Year (-1)	Year (-2)	Average
Electric Contra	kWh	kWh	kWh	0.00 kWh
Electric Contra	kWh	kWh	kWh	0.00 kWh
Electric Contra	kWh	kWh	kWh	0.00 kWh

Electricity average total = 0.00 kWh_t

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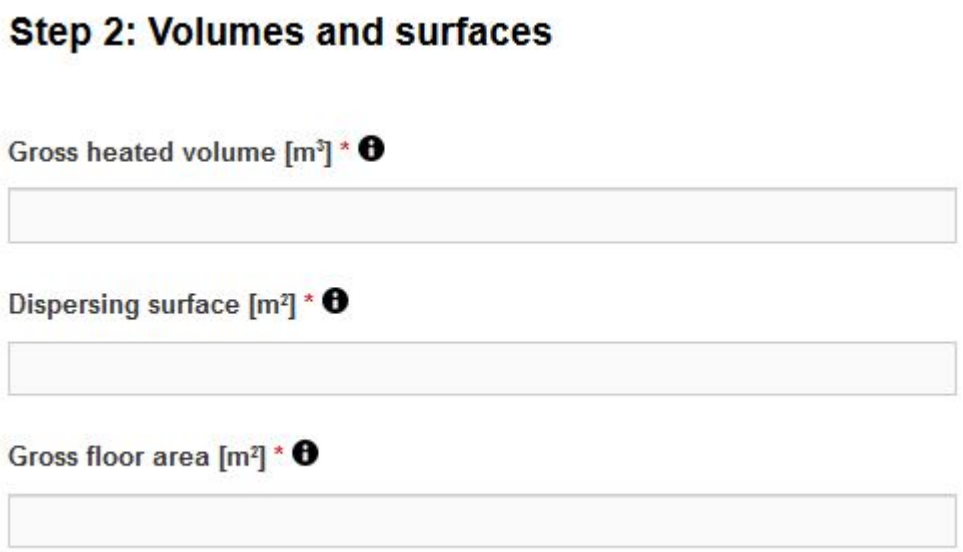
WEB TOOL

STEP 2 – COMPILATION OF SPECIFIC BUIDING DATA: GROSS HEATED VOLUME, GROSS AREA OF THE FLOORS AND DISPERSING SURFACE

The gross heated volume

It is obtained from the drawings, if they are available, or the building can be measured from the outside. In the gross heated volume, the external walls must be included and the not heated parts of the buildings must be excluded (undergrounds, attics, stores, garage...).

If the school building consists of several buildings, Volume will be the sum of the volumes of the individual building.



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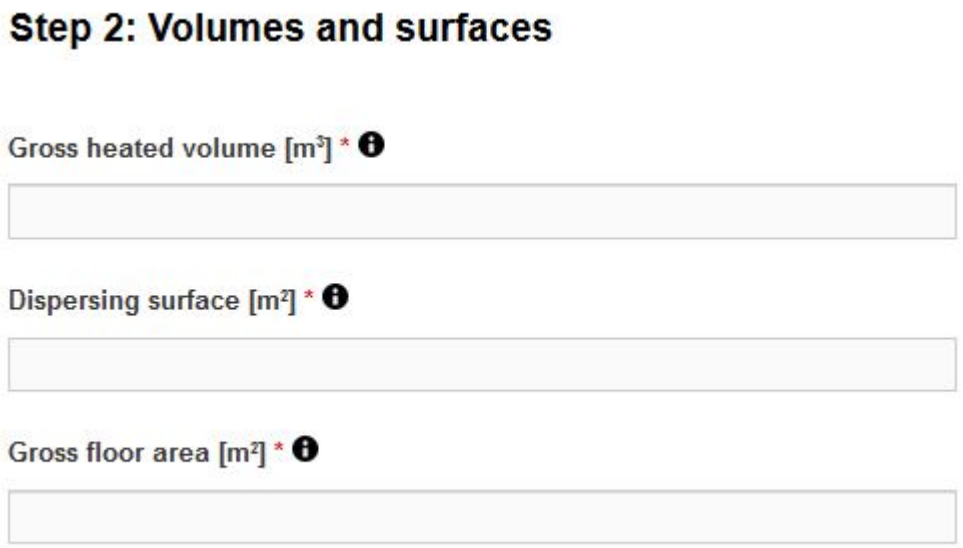
The gross floor Area

It is obtained from the drawings, if they are available, or the building is measured from the outside. In the gross heated volume, the external walls must be included and the not heated parts of the buildings must be excluded (undergrounds, attics, stores, garage...).
If the school building consists of several buildings, Volume will be the sum of the volumes of the individual building.



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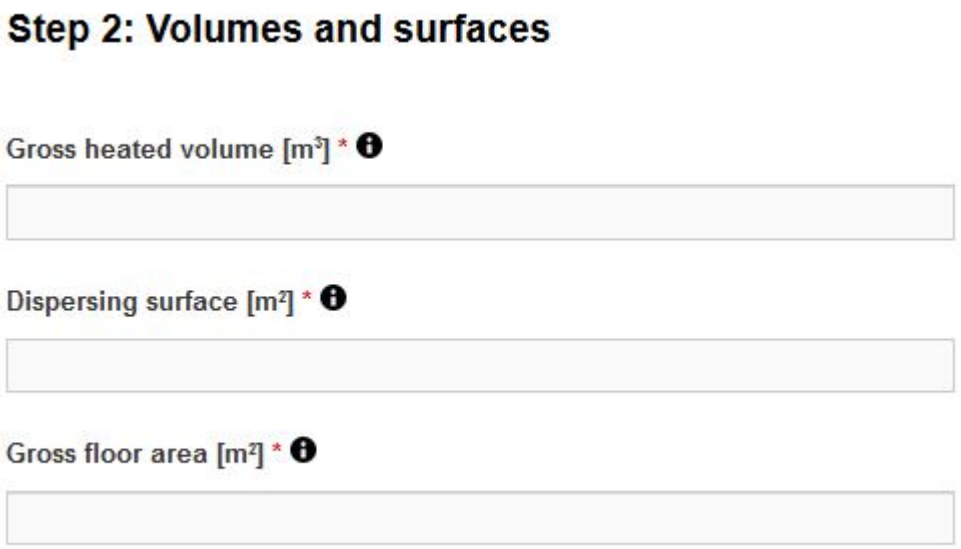
WEB TOOL

The dispersing surface

The dispersing surface is obtained from the sum of the individual surface of the gross heated volume V (walls, roofs, ground floor slabs).

Is not considered as a dispersing surface all walls or slabs that are connected to other heated buildings. If the school consists of several buildings S will be the sum of the dispersing surfaces of the individual buildings.



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WEB TOOL

STEP 3 - DEGREE DAYS OF THE PLACE IN WHICH IS LOCATED THE SCHOOL

To compare heating consumption, it is necessary to consider the climatic differences in the Country and the Municipality in which the school buildings are located. According to this issue, consumption is released from climatic differences through the use of degrees day (DD). is obtained as the sum of the positive differences between the internal comfort temperature and the outdoor daily average temperature.
The summation is extended to all the heating days of the winter season.

Step 3: Degree days (DD)

For the selected municipality Bologna you have 2,259.00 DD

Location ……

DD……..

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WEB TOOL

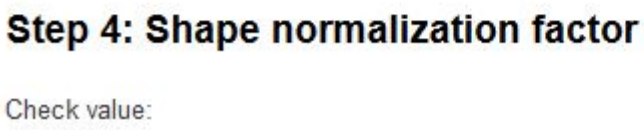
PHASE 4 - HEATING CONSUMPTION NORMALIZATION FACTOR

The specific consumption of schools buildings must be normalized with a factor depending on shape.

It is expressed by the ratio between the buildings dispersing surface and its heated volume (S/V).

The normalization factor Fe is obtained from the following value:

V = …… m^3
S = …… m^2
S/V = …… m^2/m^3



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WEB TOOL

SHAPE NORMALIZATION FACTOR

Kindergarten

S/V m^2/m^3	Fe
up to 0,25	1,1
0,26 - 0,30	1,0
0,31 - 0,40	0,9
Over 0,40	0,8

Primary

S/V m^2/m^3	Fe
up to 1	1,2
0,41 - 0,50	1,1
0,51 - 0,60	1,0
Over 0,60	0.9

Secondary and High school

S/V m^2/m^3	Fe
up to 0,30	1,2
0,31 - 0,35	1,1
0,36 - 0,40	1,0
0,41 - 0,45	0,9
Over 0,45	0,8

Fe = ……..

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PHASE 5 - THE OPERATING TIME NORMALIZATION FACTOR FH

The normalization factor Fh depends from the operational hours of the school.

The factor Fh will be subsequently multiplied for the specific heating consumption and for the specific electricity consumption.

hours/ days	Fh
Up to 6	1,2
7	1,1
8 – 9	1,0
10 – 11	0,9
Over 11	0,8

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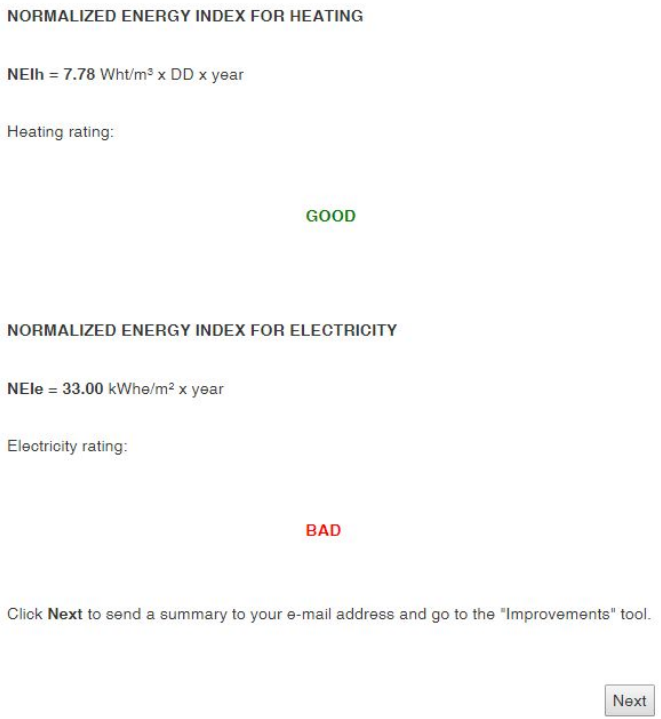
STEP 6 - CALCULATE THE NORMALIZED ENERGY INDICATORS

After the insertion of all previous data we can calculate the two normalized indicators NEIh e NEIe and classifying the building energy performances.



NEI_h = (PHASE 1 x PHASE 4 x PHASE 5 x 1000)/(PHASE 2 x PHASE 3) $\mathbf{Wh_t/m^3*DDx*y}$

NEI_e = (PHASE 1 x PHASE 3)/(PHASE 2) $\mathbf{kWh_e/m^2*y}$

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WEB TOOL

CALCULATE OF SPECIFIC ENERGY CONSUMPTION OF THE SCHOOLS

Reference sample

The evaluation of the specific consumption is carried out by **comparing** the specific consumption data with those from the **reference sample**.

Identification of energy classes

The energy class of the school building is identified according a reference tables that take into account the specific consumption data compared with those from the reference sample. Averge data come from energy audits (pilots of project partner, scientific paper, National studies…)

Evaluation of results

If the NEI value is "sufficient", to the school building is associated an average consumption and it is **advisable** to propose improvement actions

If the NEI value is "good", the school building has efficient systems and good management than **no improvement actions is obliged** but it is advisable to propose improvement actions to reach the nZEB class.

If the NEI value is "insufficient", it is **necessary identify deep interventions** to improve school building energy efficiency.

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WEB TOOL

INTERVENTIONS OF RATIONAL ENERGY USE OF FOR SCHOOLS

The energy efficiency improvement can be obtained, in general, with several actions:

- Improvement actions on the **building envelope** to reduce heat losses
- Improvement actions on **heat production systems** for heating and hot domestic water
- More conscious **behaviour** on energy management of school buildings.
- Adoption of **innovative technological or management systems**

In the second part of TEESCHOOLS web tool you can choose different improvement actions to evaluate savings.

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Elements	U_{old}	U_{new}	Area	Energy Saving	% Saved
☑ Glazing	single glass + woo	Best Insulation	35	7,780.00	3.98 %
☑ Roof	Bricks + concrete r	Best Insulation	350	31,309.74	16.04 %
☑ Walls	Solid masonry wall	Good Insulation	1200	117,757.15	60.31 %
☑ Floor	Bricks + concrete s	Insulation	350	26,565.84	13.61 %

What plants do you want to change?

η_{old} and P_{old} [kW] are the efficiency and the installed power before the renovation, η_{new} and P_{new} [kW] are the efficiency and the installed power after the renovation, while hh are the working hours.

☑ Heat Generator	η_{old} 0.85	η_{new} 0.98		1,272.14	0.65 %
☑ Lights	P_{old} 16	P_{new} 4	hh 880	10,560.00	5.41 %

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Thanks for your attention!

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