

POLITECNICO DI TORINO
SECOND SCHOOL OF ARCHITECTURE
Master of Science in Sustainable Architecture
Honors theses

Energy audits of school buildings in the Province of Turin

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The thesis comes from a collaboration with the Province of Turin, particularly with the Department of Management Heating and the Department of Planning installations civil work.

The purpose is to provide the Province not only with an instrument of knowledge and evaluation of its architectural heritage, but also with an action plan that fulfills the objectives of the European Directive 2012/27/UE: renovating 3% of the total useful floor area of public buildings every year.

Thanks to different tools, such as energy audit and energetic signature, we analyzed the consumption of a representative sample of schools, made up of 43 Institutes and 29 High Schools.

The objective was the evaluation of the consumption trends per building of the last three seasons (2009/2010, 2010/2011, 2011/2012) and the comparison among schools.

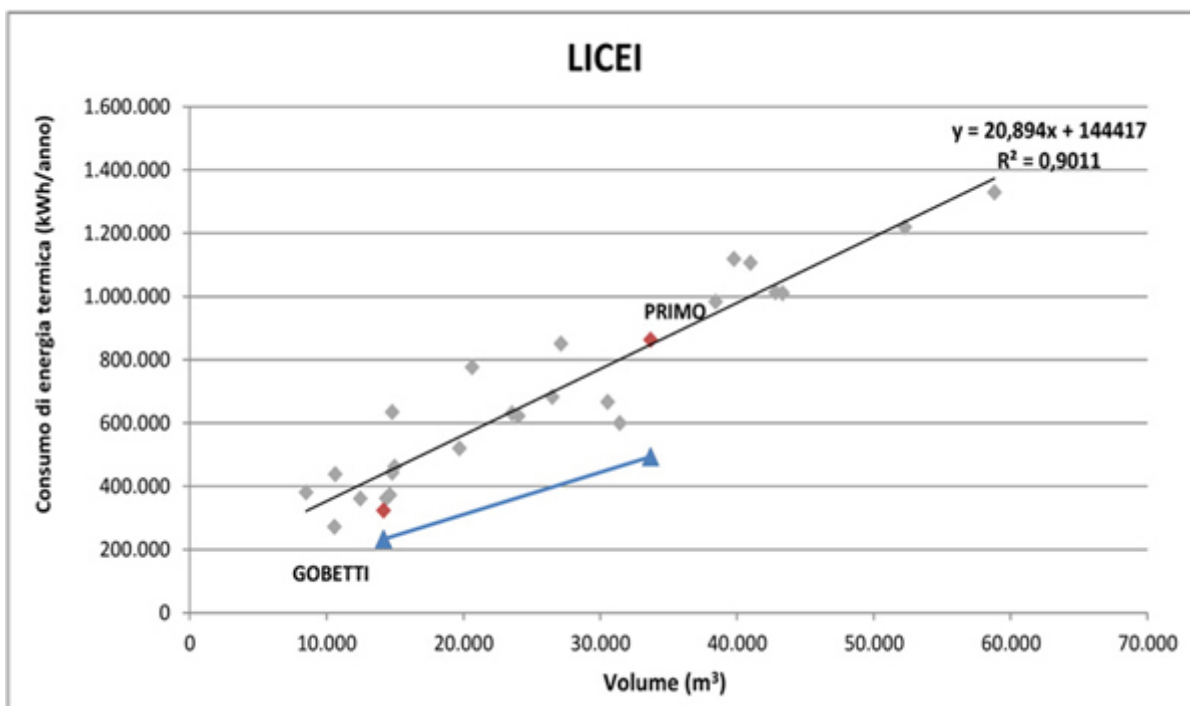
To provide a useful tool for a detailed understanding of the public patrimony and to develop an energy plan, all schools were filed to compose a provincial energy cadastre that includes all relevant information: general, functional and geometric data, type of construction and plant engineering. This tool can be used as an instrument for the evaluation of public building patrimony to be regularly updated by the client.

Afterward, we introduced a possible solution for the redevelopment of the public assets that can/could be adopted by the Province of Turin; it takes into consideration the savings percentage measured on four "standard buildings", previously selected together with the customer according to its specific needs.

Planning different scenarios for "standard buildings" through the calculation software Termolog, allowed to determine how much the consumption will decrease as a result of the above mentioned improvements and to define the relative economic feasibility study as well. We then estimated the real costs of individual interventions using the thermal energy bill, which indicates a cost of intervention for incentives of 40%, up to a maximum of € 250,000 per year, always respecting the values imposed by the Italian legislative decree 28/12/12.

The outcome/result is a useful evaluation tool for ranking/classifying in order of priority the interventions needed in the whole building area.

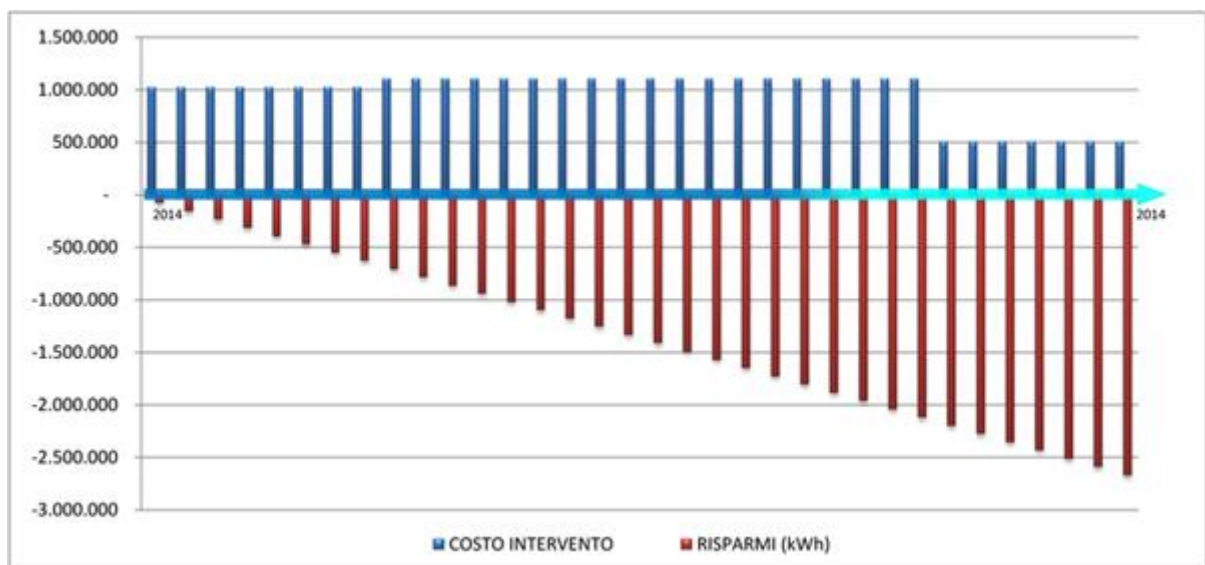
Moreover, an analysis of the consumption distribution in kWh, based on different volumes, was carried out to demonstrate the improvements obtained: as a result of the energy renovation, remarkable changes in consumer spending were registered. The graph below shows an example of the thermal consumption of High schools with underlined the buildings type on which the calculation of the savings is simulated after a complete requalification: red indicates the real consumption of the analyzed buildings, while blue shows those measured after the intervention.



Relationship between consumption and savings with respect to High Schools only

Particularly, through the simulation done with Termolog, buildings belonging to the period 1950 -1980 recorded an improvement of 54%, that goes down to 38% for more recent buildings.

Since 93% of the edifices of the Province taken into account uses methane as fuel, we estimated an annual consumption of 58.579.000 kWh per building with a total expense equal to 5.096.373 € every year. Therefore, the Province has to renovate 3% of its building patrimony to meet at least the minimum energy performance requirements that was set in application of Article 4 of Directive 2012/27/UE. This corresponds to 63.900 m³, approximately three schools, resulting in an annual expense of 1.100.616 €. If the Province re-qualified the required volumetry every year, only considering the sample analyzed, it would certainly cover its requalification costs by 2047.



Costs and Savings of the Interventions, expressed in kWh

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