PISA UNIVERSITY
GRADUATE THESIS/DISSERTATION

UNIVERSITÀ DI PISA

TESTING THE EUROPEAN COMPUTATIONAL MODEL FOR ENERGY CERTIFICATION OF BUILDINGS, ON SOME NON-EUROPEAN BUILDINGS IN UAE

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GIANPAOLO SCATIZZI

STAKEHOLDER

PISA UNIVERSITY: Prof. Fabio Fantozzi *(Supervisor)* - Eng. Gianpaolo Scatizzi *(Supervisor)*
Prof. Giovanni Santi *(Supervisor)*

DUBAI CARBON: Dr. Ivano Iannelli *CEO at Dubai Carbon Centre of Excellence*

SARA CARMASSI: Final year student

AN OUTLINE OF THE ENERGY PERFORMANCE CERTIFICATION IN BUILDINGS HISTORY IN E.U.

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Following EU Directive 2010/31/EU of May 2010, **many European countries have made energy performance certification of buildings mandatory**.

This is the point of the Directive: for each device on the market that consumes energy, the manufacturer has to state its level of consumption. And so for buildings for sale and for the ones to be rented as well.

AN OUTLINE OF THE ENERGY PERFORMANCE CERTIFICATION IN BUILDINGS HISTORY IN E.U.

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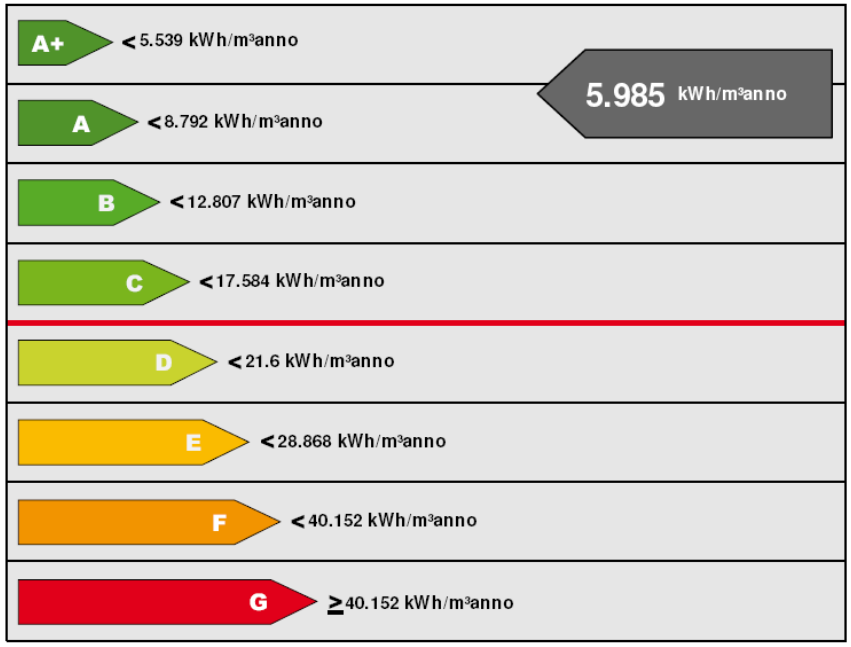
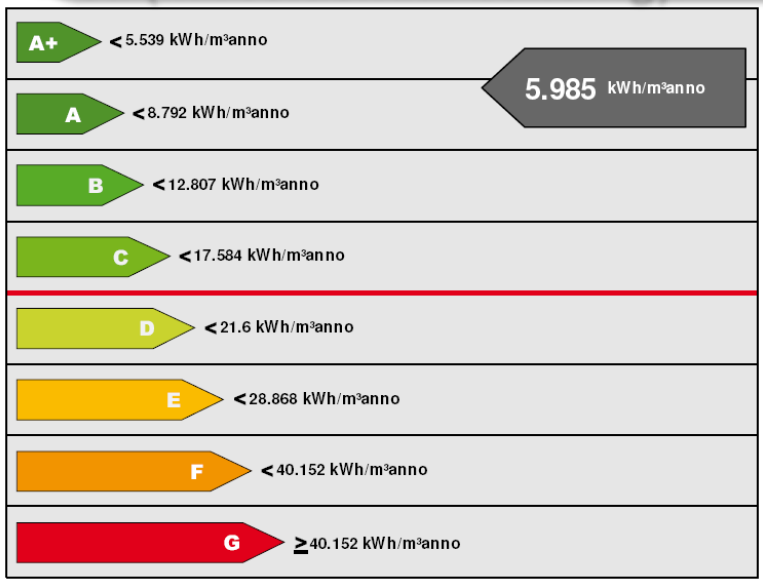
The system **provides a classification of buildings ranging from Class A to Class G.**



This in order to inform users about the energy efficiency of the building, and especially about the interventions required to reach an higher efficiency level, for example from E to A.

WHAT ABOUT THE CALCULATION MODEL ?

The calculation model for the energy performance certification in buildings is based on a European technical standard UNI EN ISO 13790:2008 and on a set of rules at national level, like the UNI TS 11300. **The model provide a data output of energy consumption per year in kWh per square meters of usable floor area (in residential building).**



SOME INITIALS

-UNI Italian Organization for Technical Rules.

- EN refers to the CEN, the European Committee for Standardization.

- ISO International Organization for Standardization.

This is one the main point; the energy consumption outputted by the model is COMPERABLE with the real consumption of the building.

THE CALCUTION CONSUMPTION IS COMPARABLE WITH THE REAL ONE

WHAT DOES THIS MEANS FOR THE EXISTING BUILDINGS ?

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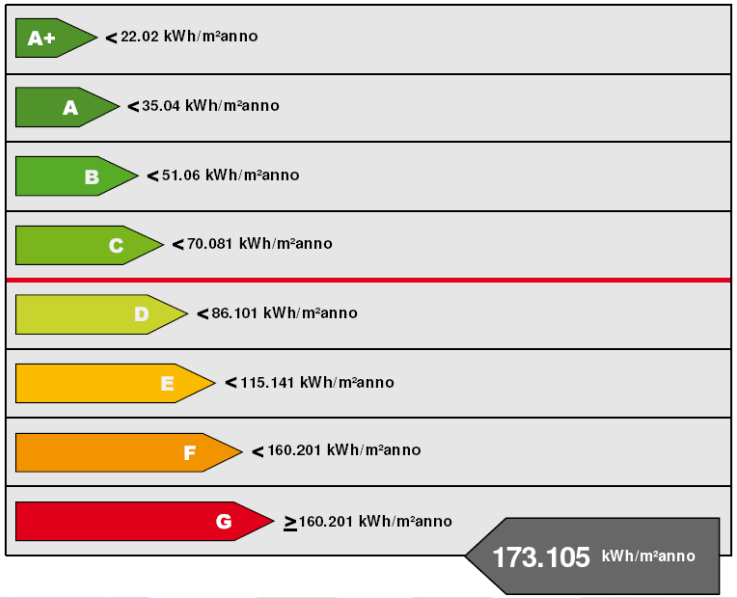
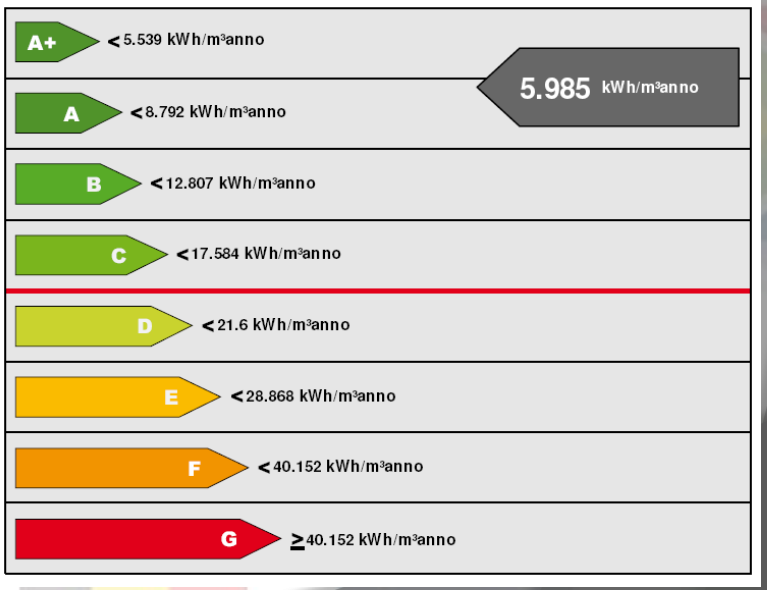
It means that for the first time we have a model that **allows to calculate with good accuracy the savings obtainable as a result of an energy restructuring**. For e.g. this is the current status (class G) of a building; by restructuring I can reach an higher class, f.e.g, class A.



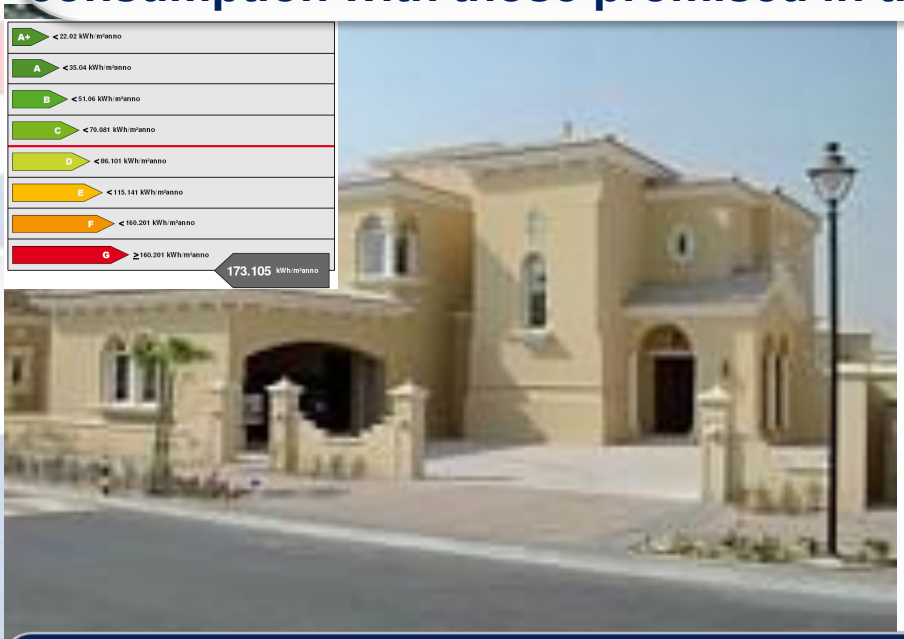


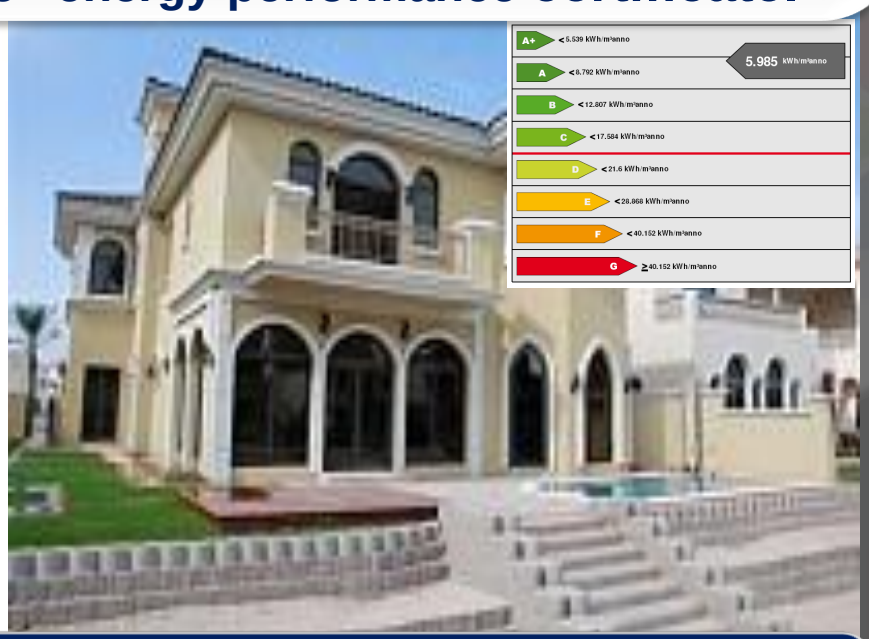
But what will be the new consumption, the new bill cost, and the pay back time ? All these values are calculable and verifiable in any condition.

THE CALCUTION CONSUMPTION IS COMPARABLE WITH THE REAL ONE

WHAT DOES THIS MEANS FOR THE NEW BUILDINGS ?

During the design phase, before the building is constructed, **is already possible to decide which will be the class of energy performance**. In this way the manufacturer **will have the chance to sell at an higher price** the more powerful building. In contrast, **the buyer may compare and verify the real bill consumption with those promised in the energy performance certificate.**





This also means that through this computational model it will be possible to design and to plan the energy-saving.

PLANNING THE ENERGY SAVING: HOW WAS THE STATUS BEFORE ?

To have a good understanding of the potential of the calculation model UNI TS 11300 let's **have a look at what was before** (at least in Europe). I would say that **before this energy model UNI TS 11300** we had a kind of approach to energy planning that was a sort of **"Meddle Ages approach".** If we make a comparison with the structural calculation, let's us ask our self **"what were the criteria for sizing structures in the Middle Ages?"**

There where no analytics criteria for sizing f. e.g. a beam or a pillar. Everything was essentially based on the experience of the master builder.

PLANNING THE ENERGY SAVING: HOW WAS THE STATUS BEFORE ?

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And since now (at least in Europe) **there was a similar approach for the energy saving planning as well**. How engineer or technicians **use to reply** to questions such as: "**How much is the saving if** I replace my old air conditioner or if I insulate the roof ?" *Maybe …30%, or…. I need to consult the manufacturer….*

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But it was not their fault whether the response that followed was very rough. They had no element no criteria no tested calculation model to give appropriate answer.

PLANNING THE ENERGY SAVING: WHAT'S NOW?

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Completing the comparison with the static dimensioning of structure, **for many years no one plans more buildings on the basis of the experience**, but making use of the structural calculation.

Also in the energy field, since some time on, (even if we are still at the dawn), it is possible to design the energy savings, using analytical criteria by the technical rules UNI TS 11300.

PLANNING THE ENERGY SAVING: WHAT'S NEW?

We certainly know **many contest actually related to the design and to a project need:** for e.g. **we know that a project is needed to build up a building**, to design a thermal plant as well as the furnishings . How we can summarize in one sentence what the goal of a project is ? **Is how to do for…..** The calculation model UNI TS 11300 allows the design engineers and the consultant to design not just the building or the thermal plant **but rather the energy-saving** and so **how to do for….. reach an higher efficiency level.**

In this way the energy saving design becomes a new professional discipline. In addition to the designer of the plant, of the structures, we will also have the designer of the energy savings.

WHICH GOAL THE DISSERTION IS GOING TO TARGET

Testing the European computational model for energy certification of buildings, on some non-European buildings in the UAE **we aim to**:

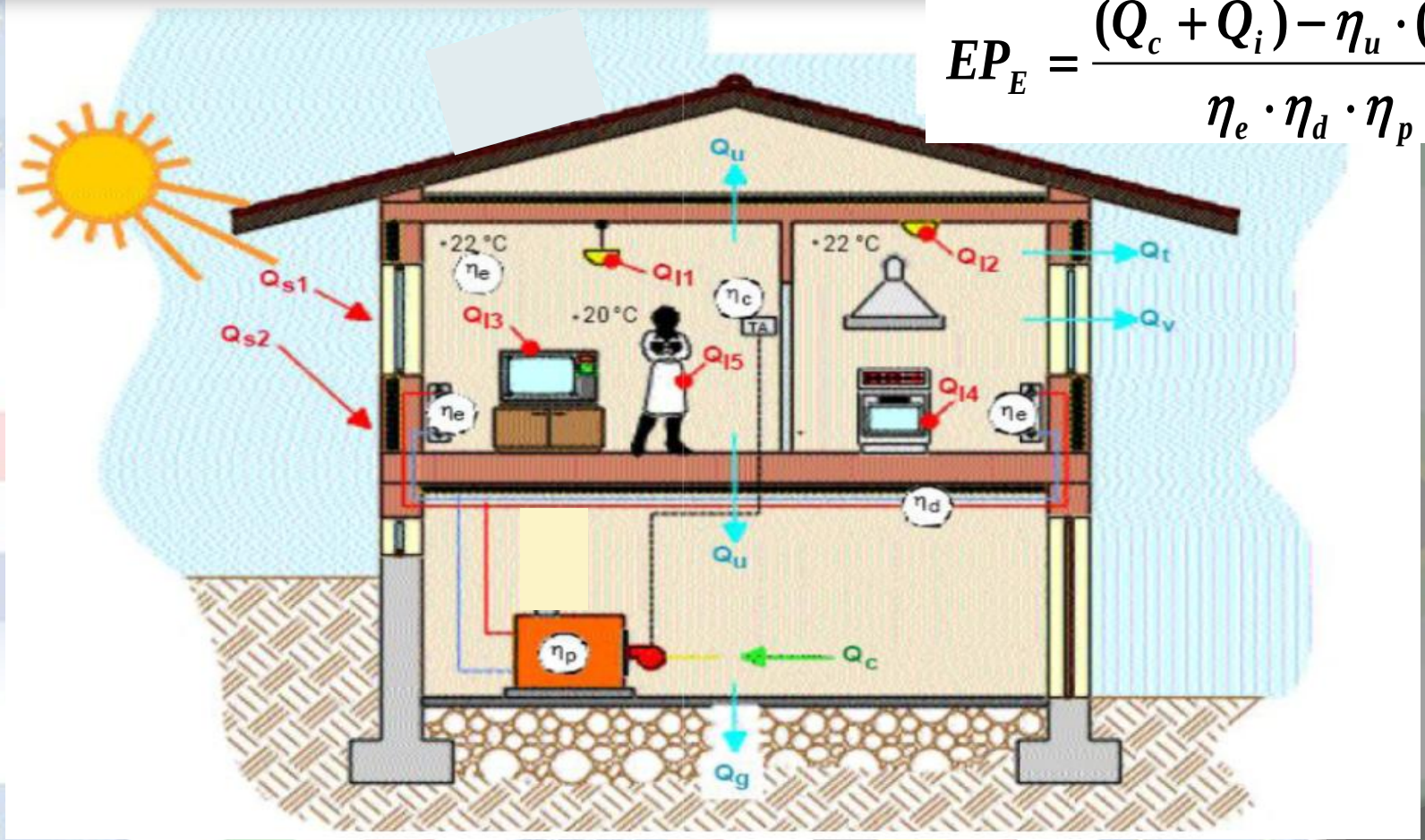
-assess any criticality of the model applied on non-European building;

-identify any analytical design aspects **necessary for the calculation model to be applied in the UAE.**

We are already working on a Villa representative of other 12,000 villas of similar size and footprint, and quite representative as well of UAE building stock

THE ESSENTIAL OF UNI TS CALCULATIONAL MODEL

$$EP_E = \frac{(Q_c + Q_i) - \eta_u \cdot (Q_t + Q_v)}{\eta_e \cdot \eta_d \cdot \eta_p \cdot \eta_c}$$



The analytical model expected to make a balance, as shown in the formula, between the solar and internal loads, and the gain due to heat loss through the outside.

THE ESSENTIAL OF UNI TS CALCULATIONAL MODEL

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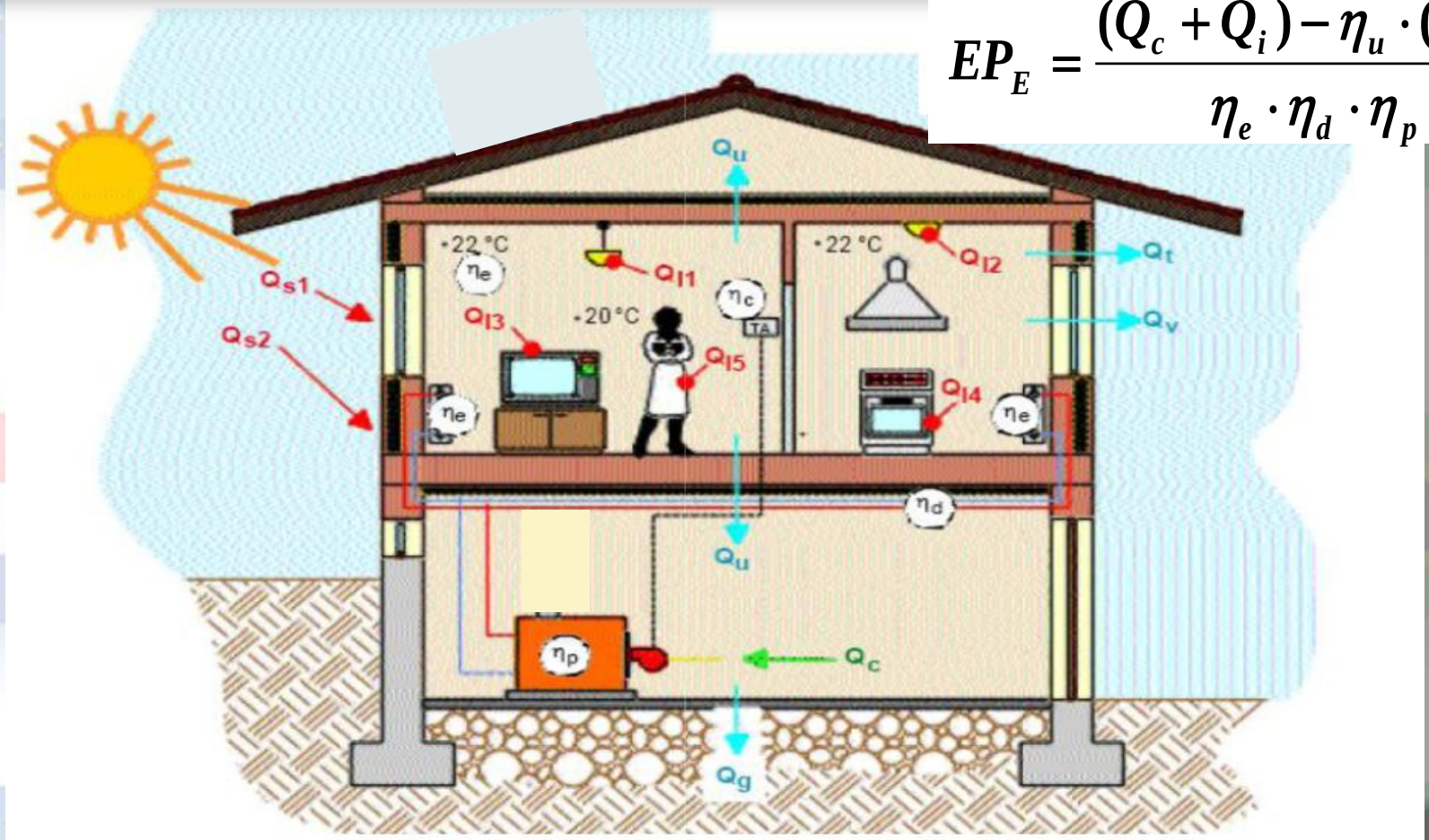

Q_c = *Solar Load*
Q_i = *Internal Load*
Q_t = *Transmission heat lost*
Q_v = *Ventilation heat lost*

η_p = *Cooling efficiency of the generator*
η_e = *Emission system efficiency*
η_d = *Distribution system efficiency*
η_e = *Contol system efficiency*

THANKS

A special and personal thanks from me, and on behalf of Pisa University , goes to Dubai Carbon and in particular to Ivano Iannelli for its special willingness.

Thanks to you all for your attention