Energy Labeling, Introducing a comparison tool for energy consumption of houses in Honduras

This is the resume of the work done for finishing a bachelor thesis in Civil Engineering. This is done under supervision of *ir.* A.G. Entrop of The University of Twente in Enschede, The Netherlands and arc. A. Stassano of Techos Verdes in San Pedro Sula, Honduras. This research is done in may, june and july 2012.

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Problem (1)

Modern buildings use a lot of energy, this has an enormous environmental impact.

Problem (2)

- Cities suffer most in heat problems (Urban heat island effect)
- Problem is recognized and governments try to do something about it.

San Pedro Sula

- Uses 21 % of the total national electricity.
- Residential and commercial buildings use together 70% of the city's electricity.

In Europe

- Energy is more expensive
- People are willing to safe and generate more energy.

Energy label

- Initiated to stimulate energy efficient design.
- First used for cars and domestic appliances

How does it works? For example: Which washing machine

Machine A

Machine B

If you will buy a washing machine
But they look exactly the same, which one do you chose?

How does it works? For example: Which washing machine

Machine A

Uses 1 kWh/turn

Machine B

Uses 2 kWh/turn

Both cost the same, the only difference is the energy label.

How does it works? For example: Which washing machine

Machine A

Uses 1 kWh/turn → Yearly energy costs are 600 L

Machine B

Uses 2 kWh/turn → Yearly energy costs are 1200 L

The energy label translates the energy consumption into money. In this way it encourages the use of energy efficient equipment.

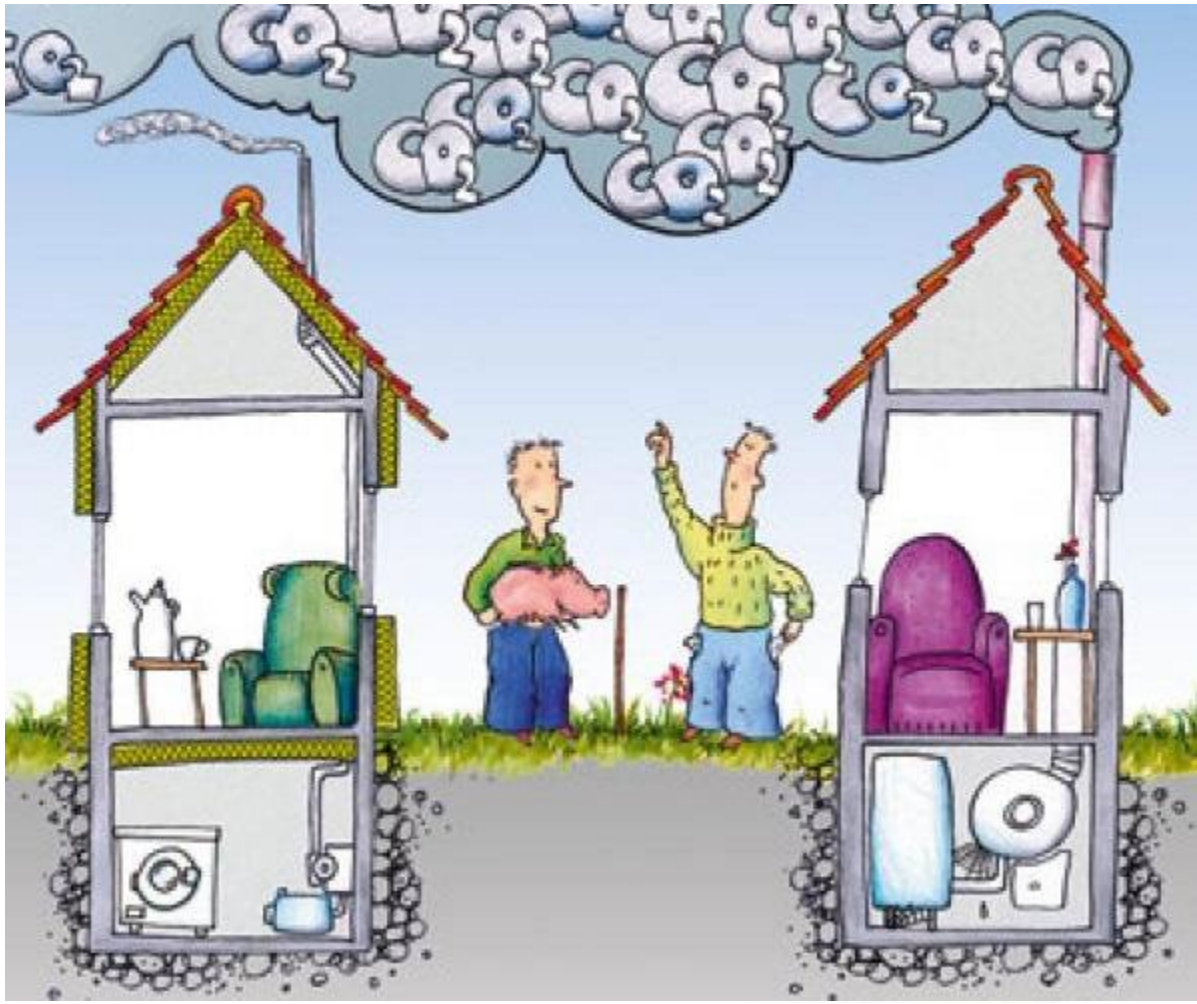
The same labels are used for houses in Europe

In Europe…

Energy consumption is dependents mostly of two categories:

- Insulation
- Heating equipment

Good insulation and efficient appliances ensure low energy consumption and low energy costs.



Determining a energy label for a house (1)

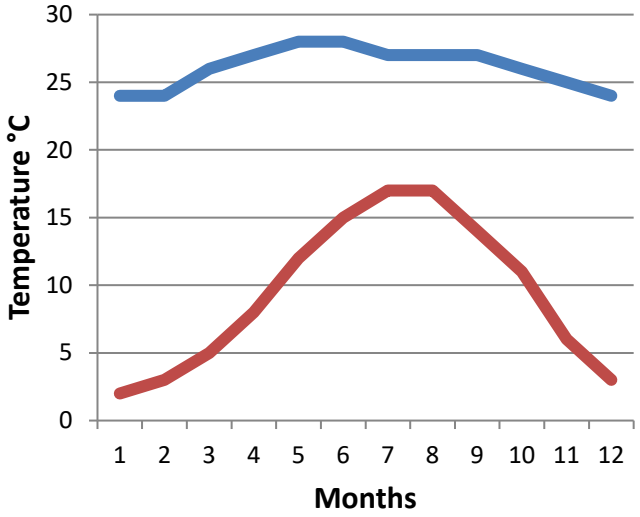
- The energy label is an index
- The evaluation of the building consists of two points:
  - Architectural specifications
  - Available installations
- Calculate the characteristic energy consumption of the building

Determining a energy label for a house (2)

- Characteristic energy consumption of the building is divided by the ground surface and the thermal transmission surface.

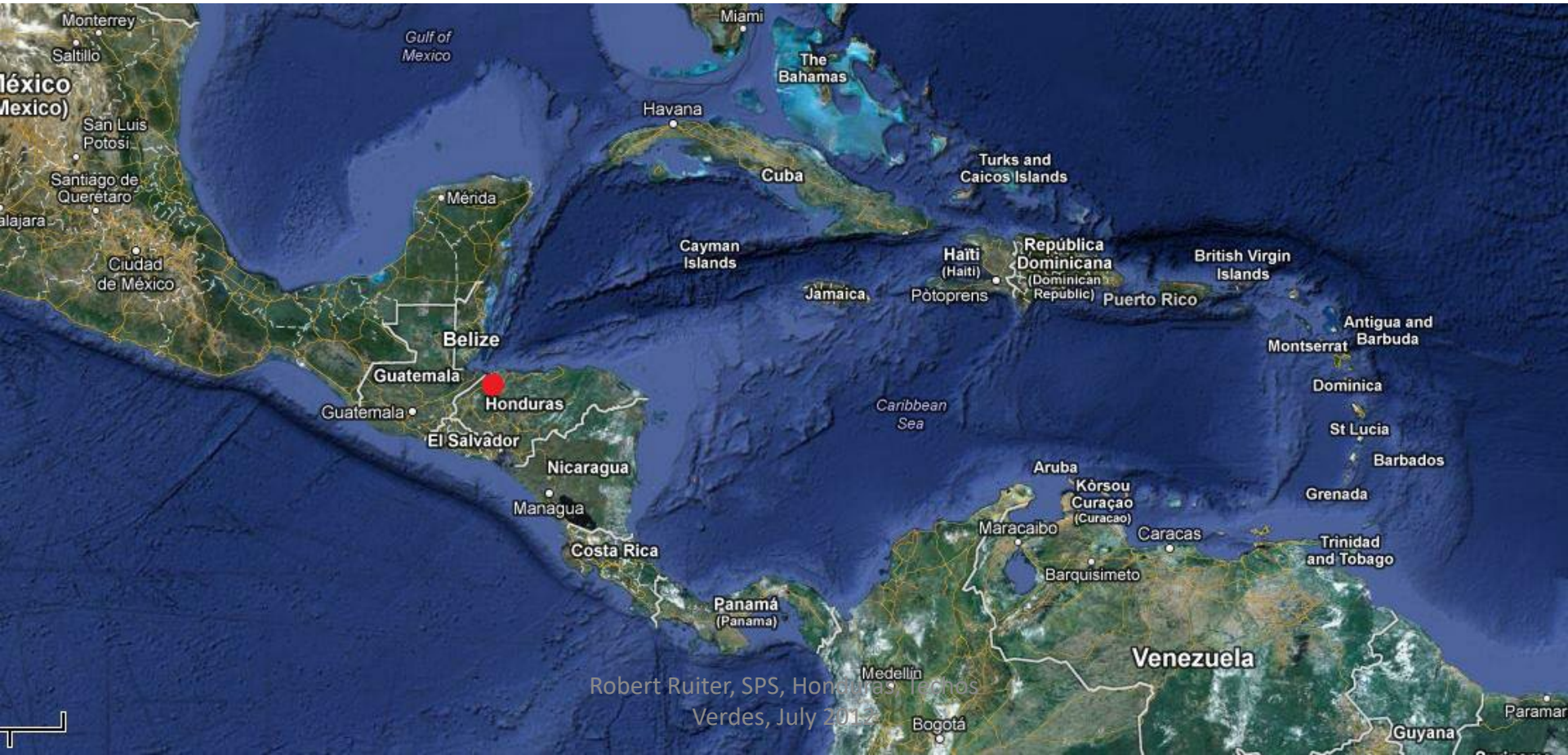
Temperature

- Temperature in SPS is whole year high and almost equal. (Blue line)
- Temperature in The Netherlands is different during the year. And far lower as in Honduras. (Red line)



Scope

Hot humid climate of San Pedro Sula, Honduras
Average temperature: 26 °C
Annual precipitation: 1150 mm



Challenges

- The European energy labeling system is designed for a total different climate than Honduras.
- Buildings designs, installations and building usage is different.
- The economical and sociological situation is totally different in both countries.

Goal

- Making a guide what can help to evaluate the design of buildings in terms of energy consumption in the hot humid climate of SPS.
- Two main cooling options:
  - Ventilation
  - Air conditioning
- Both have many possibilities for improvement.

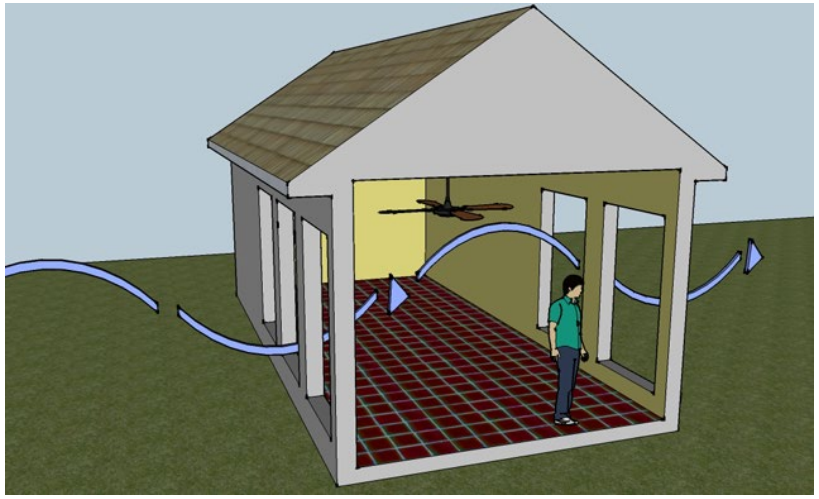
Parts of a house what have influence on energy consumption

- Roof: ±23%
- Windows: ±17%
- Walls: ±7%
- Surroundings: ±10%
- Green solutions: ±10%
- Appliances: ±33% (with a fully air conditioned house this amount is even higher: ±50%)

Roof

- A good roof provides protection from sun and rain to the entire building.

Windows



- Windows give light and are capable of keeping cool air inside. When windows can be opened they provide fresh air and ventilation. Their design and location affects this.
- Direct sunlight in a building is not desired.

Walls

- The walls of a house are capable of keeping cool air inside.
- It is really important the walls do not catch sunlight.

Surroundings

- Good ventilation opportunities around the building are necessary.
- Also shading from other items (buildings, walls) can help to keep the building cool.

Green solutions

- Using plants and trees is a good opportunity to decrease the energy consumption of a house.

- Green roofs and walls provide cooling
- Trees give shade and green surface

surrounding the house cools the surrounding air.

Appliances

- Most appliances use a lot of energy, but it is also easy to improve their energy consumption.
- The most energy goes to air conditioning devices, followed by water heating.

Practice

- The roof, windows, walls, surrounding, green solutions and the appliances together determine whether a building is energy efficient or not.
- With this knowledge is a checklist formulated.
- The checklist calculates the energy consumption label of a building with normal uses, this can be really different compared to the actual energy consumption per family.

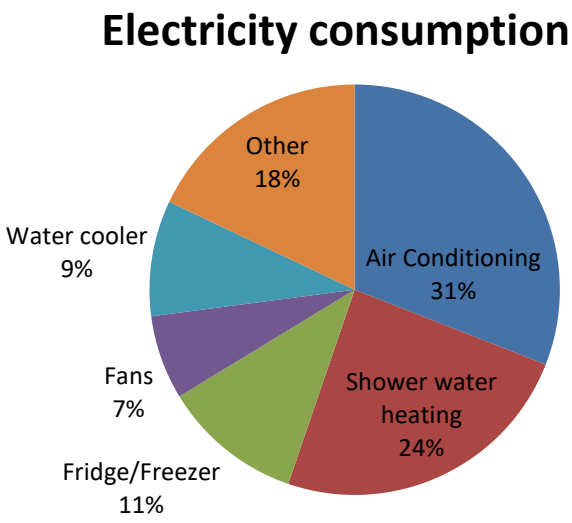
This checklist is applied to 2 houses (red dots) and 2 offices (blue dots) in San Pedro Sula, Honduras

Case building (1)

- House with two air conditioning devices.
- 5 residents (5 adults). 94 m^2 Floor surface
- 38% of the used energy goes to fans and AC.

Case building (1)

- Total energy consumption = 362 kWh
- Closed house with few ventilation options
- Label D
- Explanation: This family consumes a little bit of energy for this type of house.

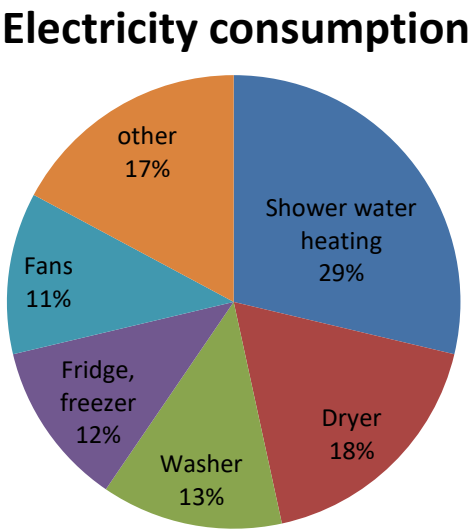


Case building (2)

- House without air conditioning.
- 6 residents (4 adults, 2 children). 100 m² Floor surface
- 8% of the used energy goes to fans.

Case building (2)

- Total energy consumption = 715 kWh
- Fully ventilated house, build on poles and surrounded by green.
- Label A
- Explanation: this family consumes a lot of energy for this type of house

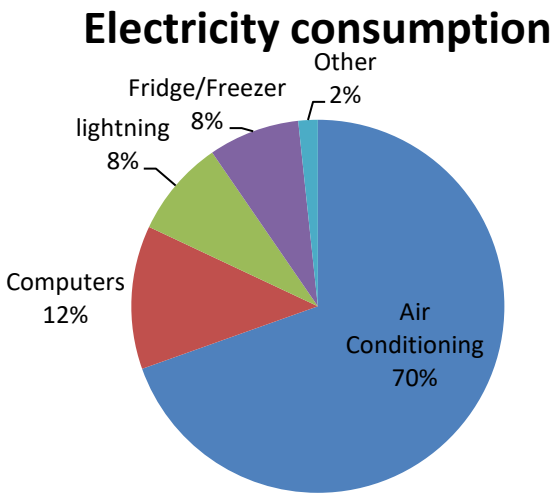


Case building (3)

- Office with an air conditioning device.
- 4 employees. 30 m² Floor surface
- 70% of the used energy goes to AC.

Case building (3)

- Total energy consumption = 772 kWh
- Building with no possibilities for ventilation, cooling only by air conditioning
- Label D
- Explanation: the users have no other choice than to turn on the air conditioning every day.



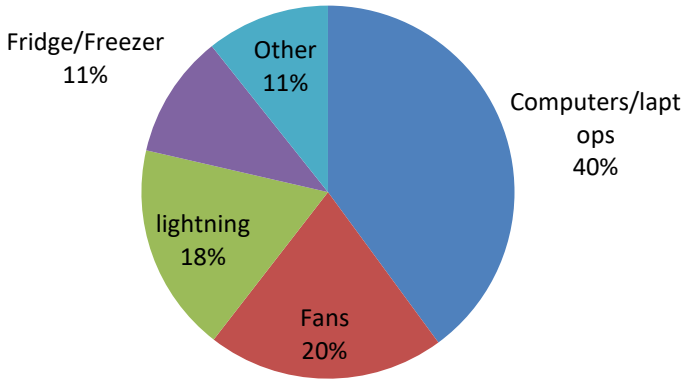
Case building (4)

- Office without air conditioning.
- 4 employees. 40 m² Floor surface
- 20% of the used energy goes to fans.

Case building (4)

- Total energy consumption = 243 kWh
- Ventilated building but shielded from direct wind by other buildings.
- Label B
- Explanation: natural ventilation in combination with fans gives enough fresh air, AC is not necessary.

Electricity consumption



Conclusion

- When applying smart design on buildings and their surroundings, it is possible to decrease the energy consumption with a large part. Introducing an energy labeling system will accelerate this process.
- As you can see, the actual energy consumption is really different from the calculated energy label, this is because the actual energy consumption is dependent of the residents. The energy label is not affected by the users of the premises.

Consequences for the urban environment

- In cities in a tropical climate have many heat problems, the following can be prevented:
- Overloading of the electrical grid.
- Heat exhaust from AC devices.
- An overheated city struggling with the urban heat island effect.

Further steps

- This research was particularly exploring, the system has to be extended to be more accurate.
- Because a system like this will not change much without governmental support it is useful to introduce the system in governmental agencies.

It was an honor to live and work in Honduras

This picture is made while building a green roof in SPS