Outside the Box Portfolio

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The great challenges of the 21^{st} century

Through the portfolio, I will unfold the great challenges of the 21^{st} century, all related to climate change considerations and the modern society. I will develop various related subjects, such as energy and transport.

The importance of energy

There are two types of energy:

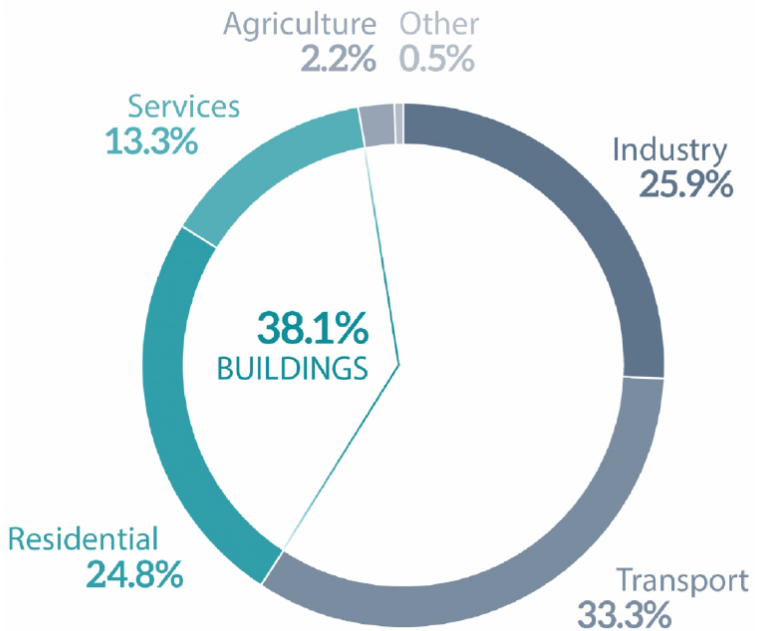
- Primary energy: The energy in its primal form, as is, when extracted from the earth. Oil barrels, uranium, wind, ...
- Final energy: Energy under the form used by a consumer: electricity, gas, diesel, ...

Today, the energy is inseparable from the modern society and lifestyle. It is the easily extractable oil that lead to the economic growth that build the modern living standards. Nowadays, almost everybody has access to powerful appliances that were almost unimaginable a century ago: microwaves, computers, radiators... Power has been made accessible to almost everyone, at every moment.

Current enerrgy expenses

The access to energy has perhaps been too easy during the last century and today humankind is at risk of losing it. One must save energy, consume it wisely.
Buildings currently represent almost 40% of humankind's energy expenses.

Figure 1 – 2014 energy consumption by sector in the EU-28



Data source: Eurostat, 2014.

Energy in buildings

Moreover, most of the energy used in buildings is for space heating, as show the following figure:

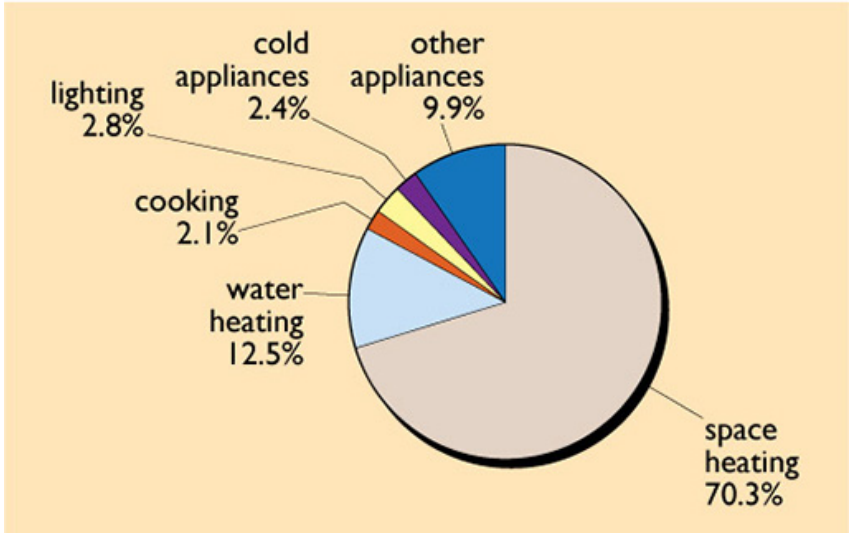


Figure: Energy consumption in the UK for domestic use

Reduce space heating demand

To reduce energy demand, one must first reduce the energy needed for a same result, which means optimising systems: reducing the amount of energy that goes to waste. One must tackle the problem of heat loss regarding buildings, there are three different ways for a building to lose its heat:

- Fabric heat loss: due to heat conduction by the materials that compose a building
- Ventilation loss: due to the air circulation between a building and outside.
- Flue heat loss: due to the heating system inefficiency.

Tackling the fabric heat loss issue

One can assign to every component of a building (say wall, ceiling, floor, windows) a U-value, which is the proportion of heat transmitted by the component regarding a certain temperature between inside and outside.
Which can be summed up by the formulation:

$$\phi = U(T_{\text{int}} - T_{\text{out}})$$

Where ϕ represents the heat power lost every second through the component which has a the U-value of U. The U-value is the inverse of the thermal resistance of the component: the higher the value, the higher the heat loss will be.

Reducing the U-value

There exists a way to reduce the U-value of a building component, which is insulation. There exists three ways for a material to transmit heat:

- Conduction: heat transmitted by contact.
- Convection: heat transmitted by being transported by a fluid (air, water)
- Radiation: heat which is transmitted by light (infrareds in this case)

There exists insulation technologies to hinder those factors. Honeycombed bricks, because air is a great **conduction** insulator, or polystyrene that can be placed between the outside wall and the inside plasterboard for instance.

Tackling ventilation loss

Ventilation is essential regarding the salubrity matter. Indeed, it allows to recycle the air, control its humidity and also reduce the chances of gaseous elements intoxication, for instance: carbon monoxide and dioxide that are produced by heating systems.
But in the case of uncontrolled ventilation, the heat loss can be tremendous as the warm air might be constantly replaced by the cold outside air, therefore making every aforementioned insulation effort useless.
Making buildings more airtight allows to reduce the ventilation heat loss.

Heating systems efficiency

Finally, the heat loss factor that can be tackled is related to heating systems efficiency. For instance, one might want to replace older heating technologies for now ones. For instance, gas boilers can be replaced by condensing gas boilers: water vapour, produced by the combustion reaction is condensed to retrieve the consequent amount of thermal energy that is released during this process, instead of just losing the potential heat by releasing the steam in the outside environment.
One can also use different technologies such as heat pumps, which only use electricity to produce heat in a very efficient way, this is particularly interesting in the case of a low-carbon electricity production.

Electric appliances, lighting

A last place of energy consumption, are the electric appliances and the lighting.
Regarding lighting the old tungsten filament lightbulbs are terribly inefficient as only 5% of the consumed electricity is transformed into light, the rest is pure heat loss. Today there exists compact fluorescent lights and LEDs which are very efficient regarding lighting.
Regarding electric appliances such as fridges, televisions, . . . , one can check before buying the mandatory energy rating of the appliance, to ensure good efficiency and low consumption of electricity.

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Nuclear fusion

title

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