

# Intelligent buildings for energy consumption management

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## 1. INTRODUCTION

The building sector consumes almost one third of primary energy (Fig. 1) and an intelligent use of the energy should have an impact over the energy consumption. In order to make a difference in the building sector (and also in the climate change), intelligent buildings depend on the non-fossil sources. Energy consumption costs will decrease with the use of renewable energy sources, such as solar and wind energy.

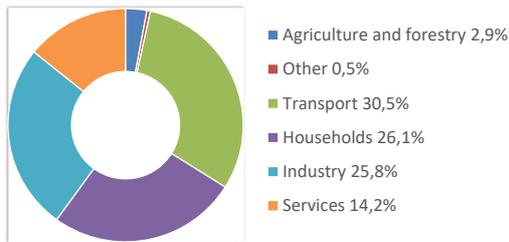


Fig.1. Final energy consumption, EU, 2018 [1]

The usual renewable energy sources are solar, wind, water (hydro), biomass and geothermal. The most used renewable energy sources in the intelligent building sector are solar, wind, and geothermal.

Beside the energy sources, the building's insulation is another important step to take into consideration, since the energy loss dictates the energy consumption. Insulating the building efficiently increases the energy efficiency. Furthermore, a thermal and auditory comfort is given by double-skin facades.

## 2. METHODS AND PROCEDURES

This paper analyzes the new concept of intelligent buildings and traces the link between comfort, smart systems and energy efficiency. An intelligent building allows its occupants to control the appliances and the energy consumption. Smart homes are set up with wireless or hardwiring sensor systems and they are built in such a way that they have a low energy consumption and rely mostly on renewable energy sources.

## 3. ADVANTAGES AND DISADVANTAGES OF INTELLIGENT BUILDINGS

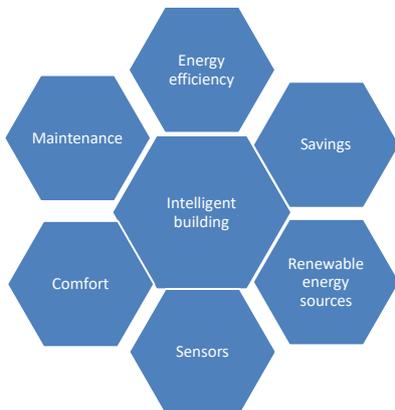


Fig.2. Advantages of the intelligent buildings

Intelligent buildings have many advantages (Fig.2.). The most important one is the comfort (which translates to a satisfaction about the surrounding environment) that they bring to the occupants. Smart buildings have an intelligent set up that allows its owners to control the appliances remotely, using an internet connection. In addition to this, the comfort in a smart building can be achieved through a good design. The thermal comfort can be achieved by maintaining a good thermal environment, regarding the temperature, air quality, heat loss, humidity etc. Besides the thermal comfort, the acoustic comfort is also important, and it is achieved with a good acoustic insulation. The lighting affects the comfort directly and it is taken into consideration when designing an intelligent building. Lighting is also important in the comfort of an intelligent building, since different spaces (designed for different activities) require different lighting levels.

In the European Union, the energy consumption in 2018 in households are as shown in table one. The energy consumption in an intelligent building is an important step that is taken into consideration in the designing and construction stages. First of all, there is the thermal insulation that reduces the heat transfer, both during winter and summer, by keeping the temperatures between a suitable range. The building envelope should be designed in such a way that the heat transfer is minimal. The building envelope is the direct link between energy loss and energy consumption. The maximum energy efficiency is achieved as long as the heat transfer is minimal. Second of all, energy efficiency is achieved also when providing a significant reduction of electrical energy consumption. This means controlling the appliances energy consumption and using low energy light bulbs.

Space heating	63.6%
Water heating	14.8%
Lighting and appliances	14.1%
Cooking	6.1%
Space cooling	0.4%
Other	1%

Tab 1. Energy consumption in households [2]

In the European Union, in 2015, only 15.7% was covered by renewable energy sources (Fig.3). An important advantage of an intelligent building is the use of the renewable energy sources. An intelligent approach to an intelligent building is integrating the energy production by using renewable sources, such as solar, wind and geothermal. The most used technologies that can be integrated in the building's energy system are photovoltaic systems, solar thermal, geothermal heat pump and wind turbines. Usually for the electrical energy production, the photovoltaic systems are the most used. The small wind turbines that can be installed near the building are less used, since they take up valuable space and they can make too much noise. For heating the space, the geothermal heat pump is the go-to choice.

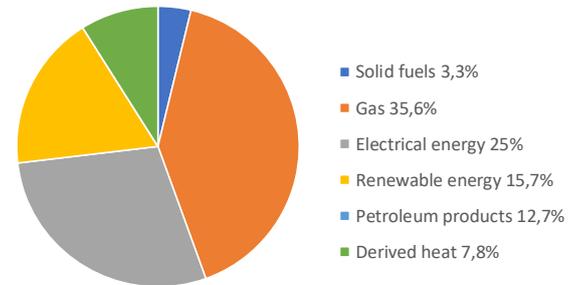


Fig.3. Final energy consumption of households by energy product, EU, 2015 [3]

A great advantage of an intelligent building is the fact that they have a hands-free convenience and that they save time with the automated tasks. For example, the sensor system that the building has can detect many of the malfunctions of the systems, alert the owner and therefore the failure can be fixed in time, with a minimal investment.

On the other hand, one of the prime disadvantage is the higher investment that an intelligent building requires. Some of the technology mentioned is relatively new, therefore it is more expensive. Also, a smart building integrates the energy production systems that have a higher price-tag, but over time, the investment pays off. As long as the building system are capable of producing the necessary energy, the energy consumption costs will be smaller or even absent.

Another disadvantage is the dependency on the professionals. Usually if there is a malfunction in the smart-system, there are only a handful of people that can take care of it. Usually the companies that installed the system provide help and handle the problems.

## 4. CONCLUSIONS

The intelligent building systems are the future of the building sector. Investing in an intelligent building can affect the energy consumption of the household, therefore on the long run there will be significant savings. The most of the energy in households is consumed by heating the spaces, so significant savings can be seen by insulating the envelope and by designing the space heating properly. The use of renewable energy sources provide lower running costs, reduce carbon dioxide emissions, which meets with the green and sustainable directives. An intelligent building has an automation system which is able to provide information about the linked systems by using sensors. Therefore, the automation system helps to provide enough information in order to prevent energy losses, it can detect an early malfunction and also is allows the owner or the users to access the system remotely. So far, more and more people choose to invest in intelligent buildings. Even if the investment is pretty high, over time it pays off. Furthermore, an intelligent building offers a higher level of comfort, both for a home or a work space.

## REFERENCES:

- [1][https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Final\\_energy\\_consumption\\_in\\_the\\_residential\\_sector\\_by\\_use\\_EU-27\\_2018.png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Final_energy_consumption_in_the_residential_sector_by_use_EU-27_2018.png) (accessed on the 1<sup>st</sup> of October)
- [2][https://ec.europa.eu/eurostat/statistics-explained/index.php/Energy\\_consumption\\_in\\_households#Energy\\_consumption\\_in\\_households\\_by\\_type\\_of\\_end-use](https://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_consumption_in_households#Energy_consumption_in_households_by_type_of_end-use) (accessed on the 1<sup>st</sup> of October)
- [3]<https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20170328-1> (accessed on the 1<sup>st</sup> of October)