HI-SMART

HI-SMART: HIGHER EDUCATION PACKAGE FOR NEARLY ZERO ENERGY AND SMART BUILDING DESIGN

MODULE #1

CHAPTER 5: RENEWABLE ENERGY AND ENERGY EFFICIENCY STATISTICS

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INTRODUCTION

Energy-efficient solutions have become increasingly important in buildings in recent times. The utilization of renewable energy sources has also been a huge development and breakthrough in the last decade, especially in solar PV technology. This chapter reviews recent changes in energy consumption, energy efficiency and renewable energy capacities at global, European and national levels.

1.5.1 GLOBAL ENERGY STATISTICS

Global energy consumption of buildings shows a rather sad picture in terms of CO_2-emissions and climate change. Almost no progress has been made in the last decade.

Global final energy use in buildings grew from 2 820 million tonnes of oil equivalent (Mtoe) in 2010 to around 3 060 Mtoe in 2018, while the share of fossil fuels decreased only slightly, from 38% in 2010 to 36% in 2018. As a result, direct emissions from buildings increased to just over 3 $GtCO_2$ in 2018.

Emissions fell after 2013, largely because of the progress in reducing power generation carbon intensity, now demand for building energy services – particularly electricity for cooling, appliances and other plug loads, and connected devices – is growing at a faster pace than decarbonised power availability, which has led to a resurgence in buildings-related emissions.

Energy intensity in buildings

The global speed of energy intensity reductions in the buildings sector has fallen in recent years, from around 2% in 2015 to an estimated low of 0.6% in 2018 – which is significantly less than the floor area increase of 2.5% from 2017 to 2018 (Figure 1.5.1).

Two-thirds of countries lacked mandatory building energy codes in 2018. To be in line with the SDS, all countries need to move towards mandatory building energy codes, and more than 50% of new buildings have to be built by the nZEB standards by 2030 on a global scale.

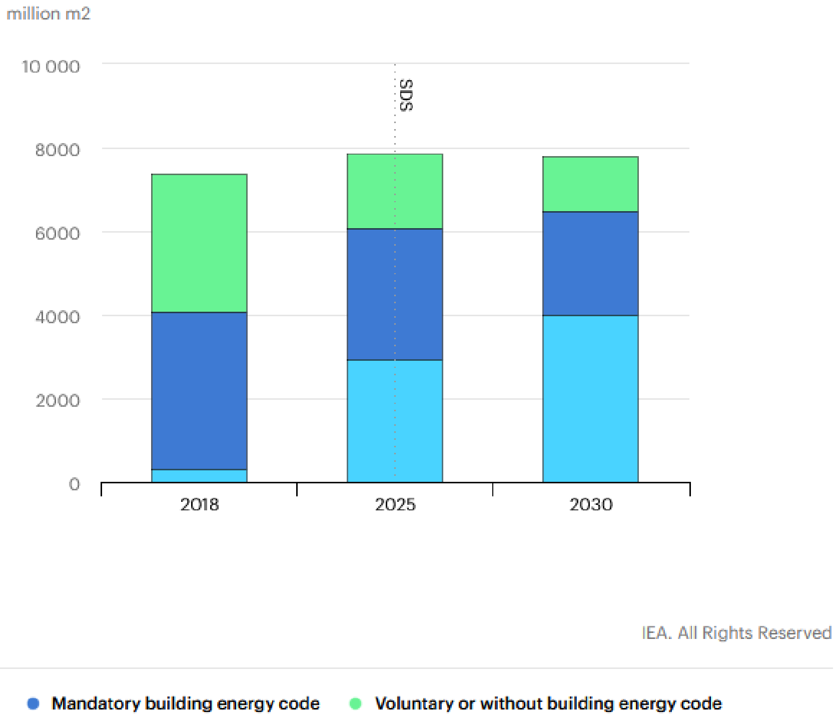

Figure 1.5.1: Estimated global buildings construction in the Sustainable Development Scenario, 2018-2030

1.5.2 EU ENERGY CONSUMPTION AND RES TARGETS

The EU energy consumption target values for 2020 and 2030 were fixed in Directive 2012/27/EU. Although Member States have sought to move closer to their targets, most of them had difficulties meeting national commitments.

While in 2014 the final energy consumption of the EU was 2.2 % below the 2020 target, in 2018 it was 3.2% above it (even if the share of RES increased in this period), which shows that climate protection measures have not been effective enough in recent years (Figure 1.5.2).

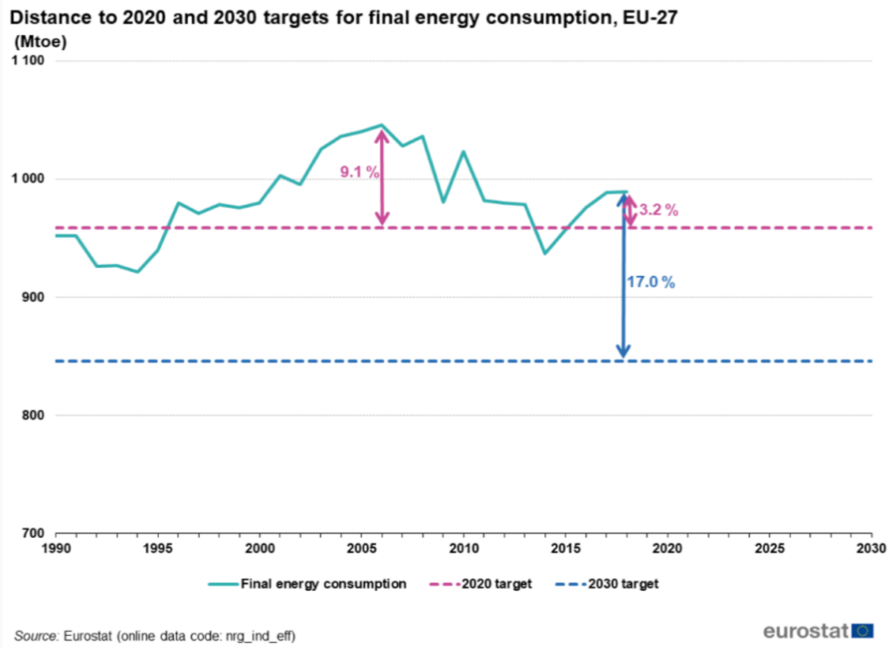

Figure 1.5.2: Evolution of final energy consumption in the EU-27 from 1990 to 2018

EU renewable energy statistics

Although there have been difficulties in reducing energy consumption in the EU, the situation is much more positive on the side of renewable energy sources. The share of renewable energy is growing dynamically in most of the Member States. Their total share in final energy consumption almost doubled between 2004 and 2018 in the EU.

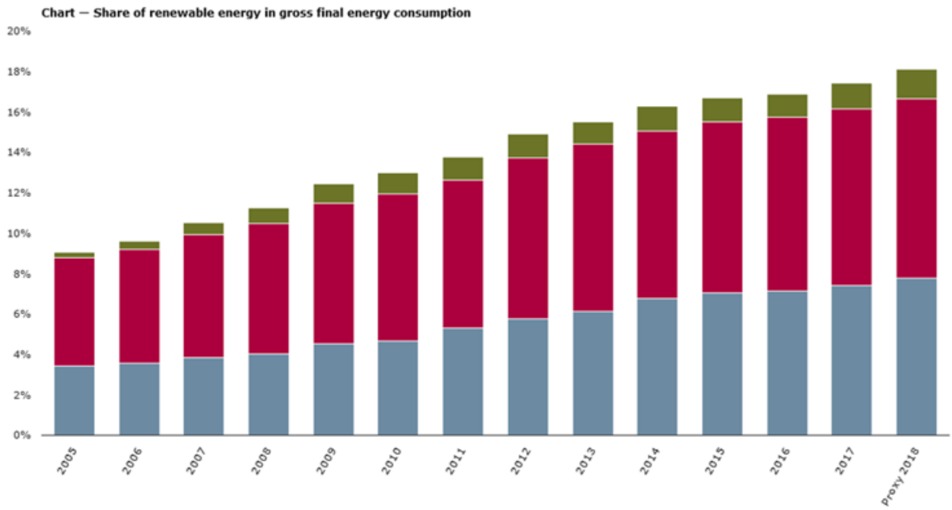

Figure 1.5.3: Share of renewable energy in gross final energy consumption (blue: electricity, red: heating and cooling, green: transport) Source: eea.europa.eu

The use of renewable energy has many potential benefits, including a reduction in greenhouse gas emissions, the diversification of energy supplies and a reduced dependency on fossil fuel markets (in particular, oil and gas). The growth of renewable energy sources may also stimulate employment through the creation of jobs in new 'green' technologies.

The EU sought to have a 20 % share of its gross final energy consumption from renewable sources by 2020; this target was distributed between the EU Member States with national action plans designed to plot a pathway for the development of renewable energies. Some of the countries managed to reach their target level, others did not.

Figure 1.5.4 shows the share of renewable energies in gross final energy consumption in 2018, and the targets that have been set for 2020. The share of renewables in gross final energy consumption stood at 18.9 % in the EU in 2018, compared with 9.6 % in 2004.

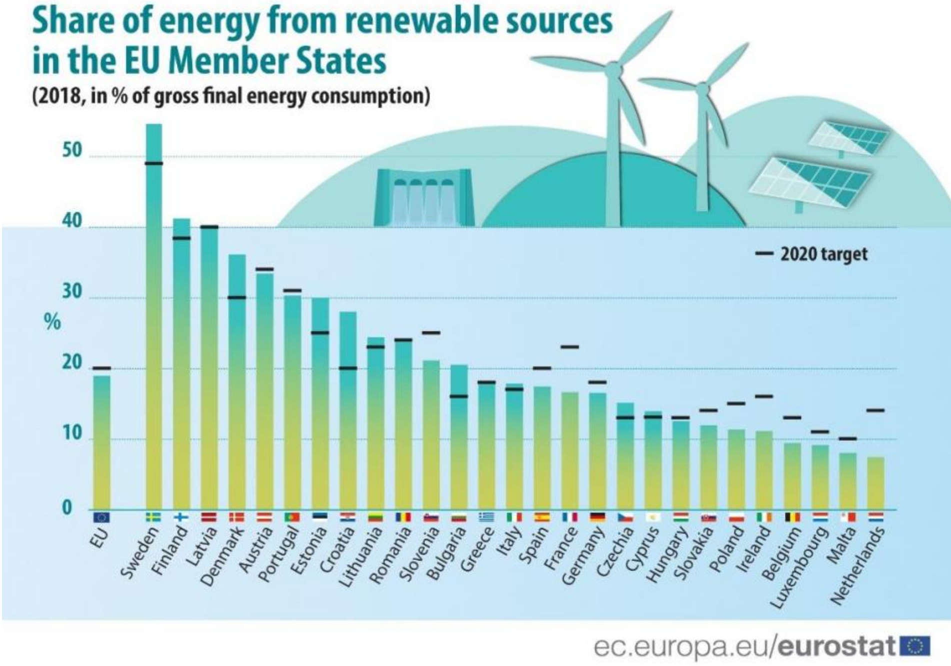

Figure 1.5.4: Share of energy from renewable sources in the EU Member States in 2018

Focusing on heating and cooling of buildings, in 2004, renewable energy accounted for 11.7 % of total energy use in the EU. By 2018, it increased to 21.1 %, which is a significant progress. Increases in industrial sectors, services and households all contributed to this growth.

There has been a huge increase in solar PV capacity in recent years, a significant part of which is covered by the household systems installed on the roof surfaces of buildings. The capacity increase is both triggered by the technology improvements and the decline in market prices, since solar PV has seen the largest cost reductions of any renewable technology in the last decade. Solar PV became cheaper than most fossil fuel based power generation. At household level, the price of a PV system in 2020 is about 1/3 of its price 8 years ago.

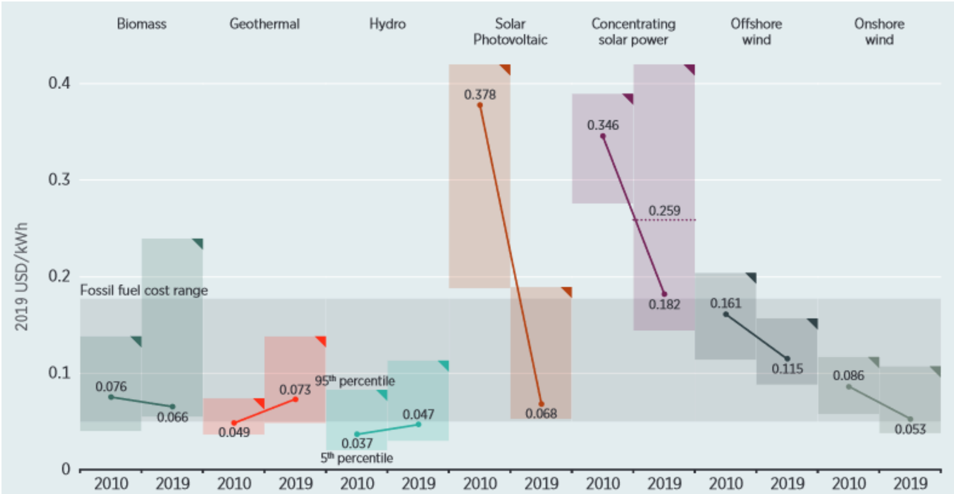

Figure 1.5.5: Global weighted average levelized cost[1] of electricity (LCOE) from utility-scale renewable power generation technologies, 2010 and 2019. Source: https://www.irena.org/publications/2020/Jun/Renewable-Power-Costs-in-2019

The future is also bright for solar PV technology in the EU. According to the predictions for 2030:

- there will be 300 000 solar energy related jobs, compared to 81 000 full-time equivalent jobs (FTE) in 2016,
- at least 20% of Europe's electricity demand will be supplied by solar energy and
- a minimum of 30 million solar roofs installed in Europe.

In terms of solar PV capacity per capita, Germany is the leader in the EU with 590 W/inhab. Capacities are growing rapidly in Hungary in the last couple of years, reaching 131 W/inhab. in 2019 (Eurobserv'er, 2020).

The explosive development of solar and wind energy in the last decade has also contributed to the European Commission's decision to increase its 2030 renewable energy target from the current 32% up to 38–40%, for which a proposal will be submitted by June 2021. This will see Europe lead the world in renewable energy technologies and will help to achieve the increased emissions targets by 2030.

[1] The levelized cost of energy (LCOE), or levelized cost of electricity, is a measure of the average net present cost of electricity generation for a generating plant over its lifetime.

Nevertheless, a major milestone has already been passed in 2020: renewable energies overtake fossil fuels in electricity generation in the EU.

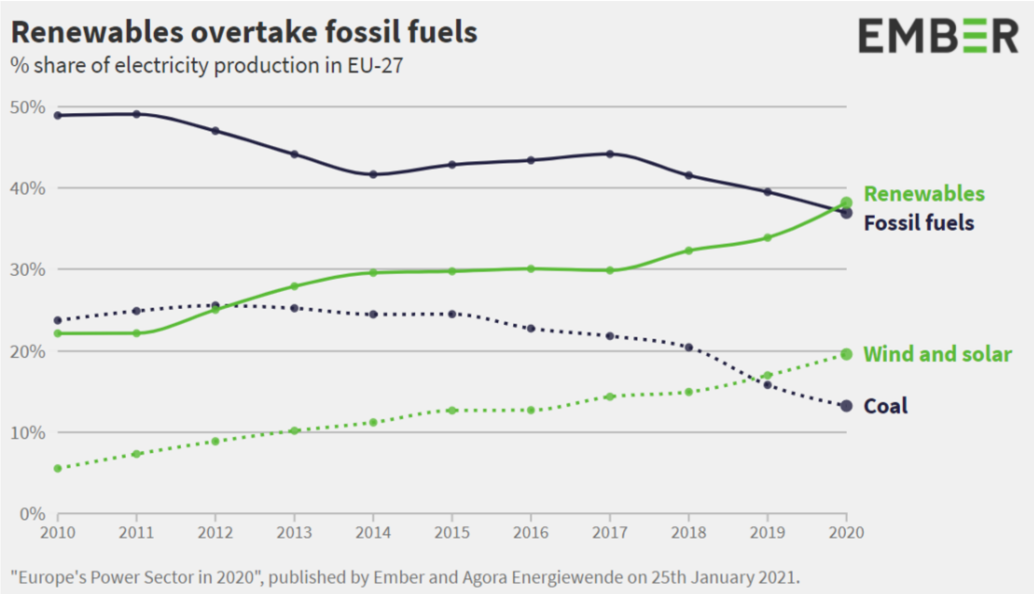

Figure 1.5.6: Share of different energy sources in power generation in the EU (Ember)

Increase in renewable power generation is led by solar and wind energy. Capacities have been multiplied over the past decade.

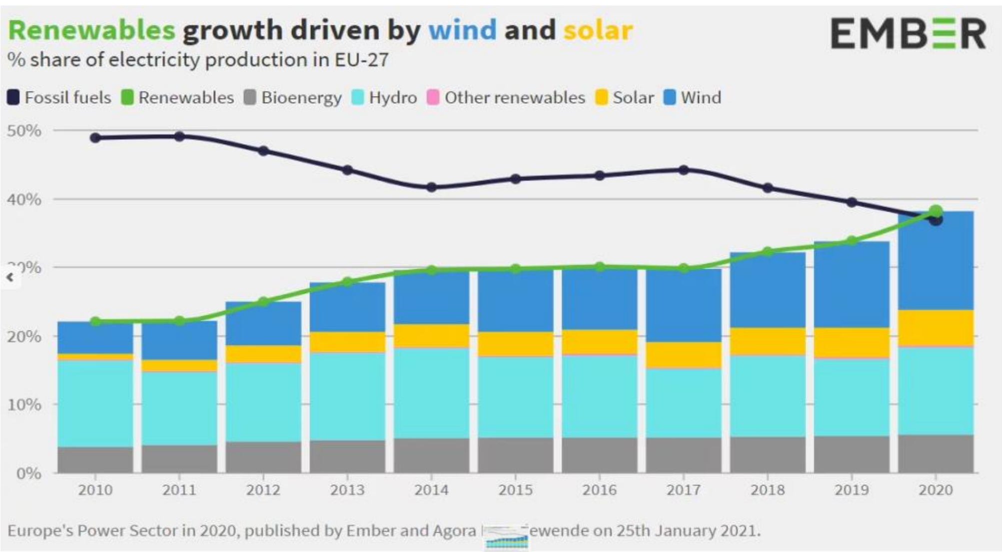

Figure 1.5.7: Share of different energy sources in power generation in the EU (Ember)

Energy consumption in buildings

Over the period 1990-2016, the energy efficiency of end-use sectors improved by 30 % in the EU-28 countries at an annual average rate of 1.4 %/year. It was mainly driven by improvements in the industry sector (1.8 %/year) and the households sector (1.6 %/year).

The energy intensity of the building sector decreased by 20% in Europe between 2000 and 2018, and is expected to decrease by another 20% until 2030 according to IEA's Sustainable Development Scenario.

The energy efficiency based distribution of new dwellings still varies greatly from one Member State to another.

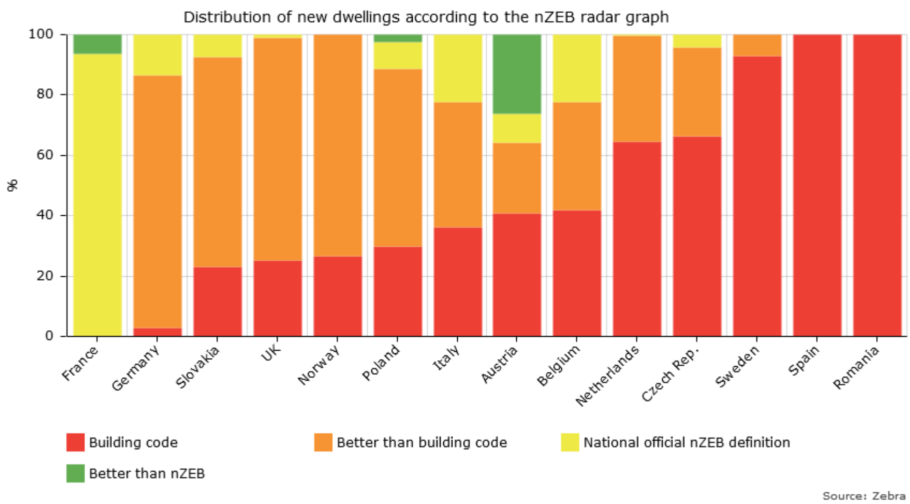

Figure 1.5.8: Distribution of new dwellings according to energy efficiency in different EU Member States (ZEBRA)

The effect of building codes is clear in terms of average energy consumption of the building stock in the EU. Between 1990 and 2016 the average heating consumption decreased by more than 1% per year. Heating consumption of new dwellings decreased in this period by an average of 0,7% per year, which shows that the building codes became stricter in terms of energy consumption.

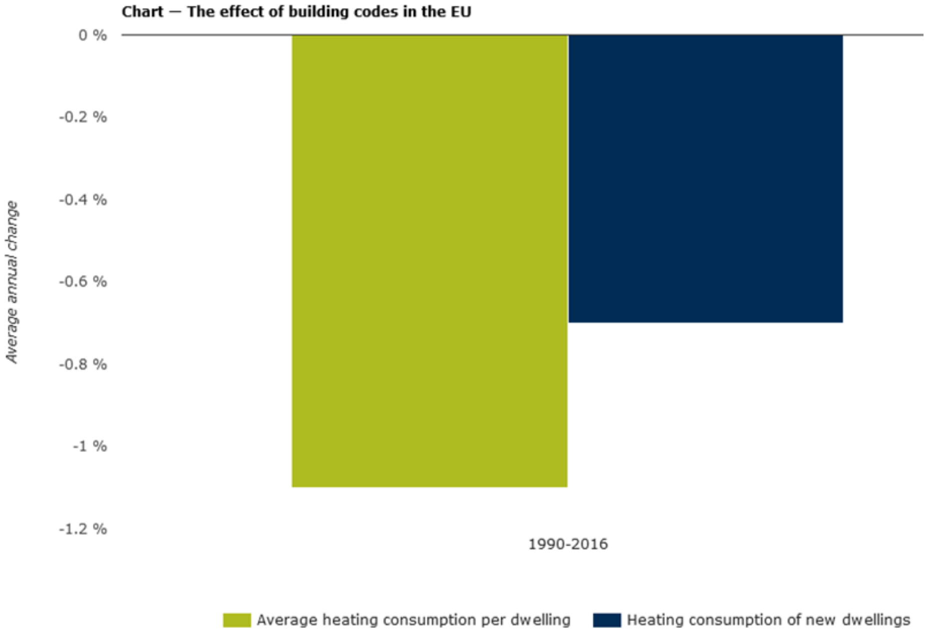

Figure 1.5.9: Effect of building codes on heating consumption in the EU between 1990 and 2016 (EEA)

The total floor area of buildings in the EU showed a steady upward trend, representing about 26 billion square meters in 2016. The household sector represented about 76 % of total floor area. The average annual specific energy consumption per square metre for all types of buildings was around 215 kWh/m^2 in 2016. Non-residential buildings are, on average, 70 % more energy intensive than residential buildings (300 kWh/m^2 compared with 178 kWh/m2).

In terms of final energy consumption, space heating requires more energy in most EU countries than other types of energy consumption combined (except in a few Mediterranean countries). Water heating and lighting/electrical appliances are roughly on the same level. Total energy consumption per dwelling is higher in more developed and northern countries.

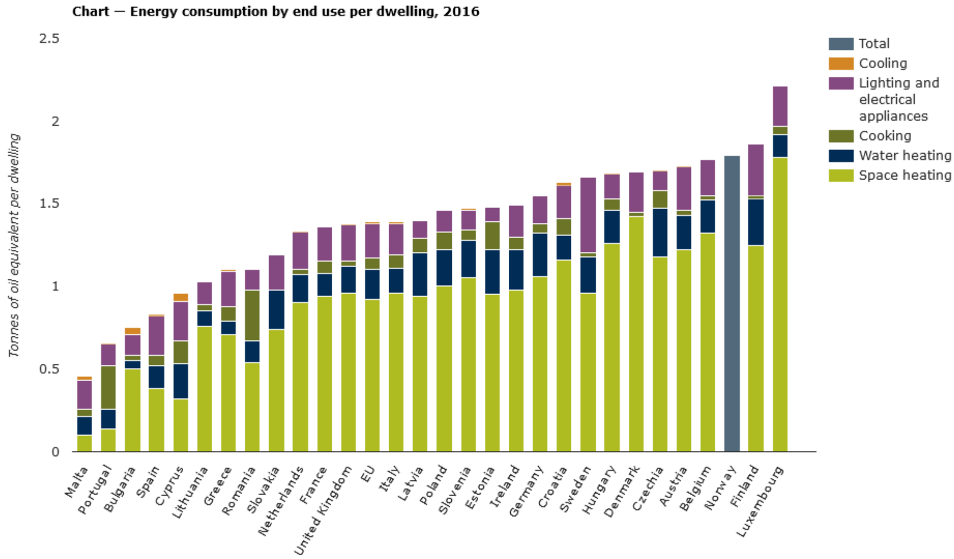

Figure 1.5.10: Energy consumption by end use per dwelling in EU countries in 2016 (EEA)

Unfortunately, half of the efficiency gains achieved through technological innovation in the household sector were offset by the increasing number of electrical appliances and by larger homes. Floor area per capita increased by more than 30% in 25 years. Europeans live in more and more energy efficient homes, but require more and more living space, which results in a roughly constant energy consumption.

Regarding electrical appliances, the rate of growth in the number of TVs is the fastest, but the most noticeable is the dramatic increase in cooling energy demand of households. The total energy consumption by households for space cooling was seven times higher in 2016 than in 1990.

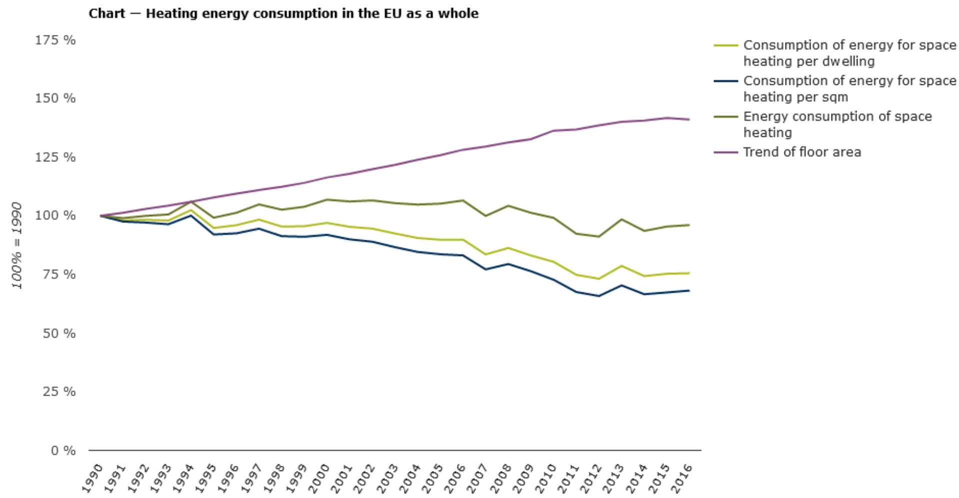

Figure 1.5.11: Heating energy consumption in the EU (EEA)

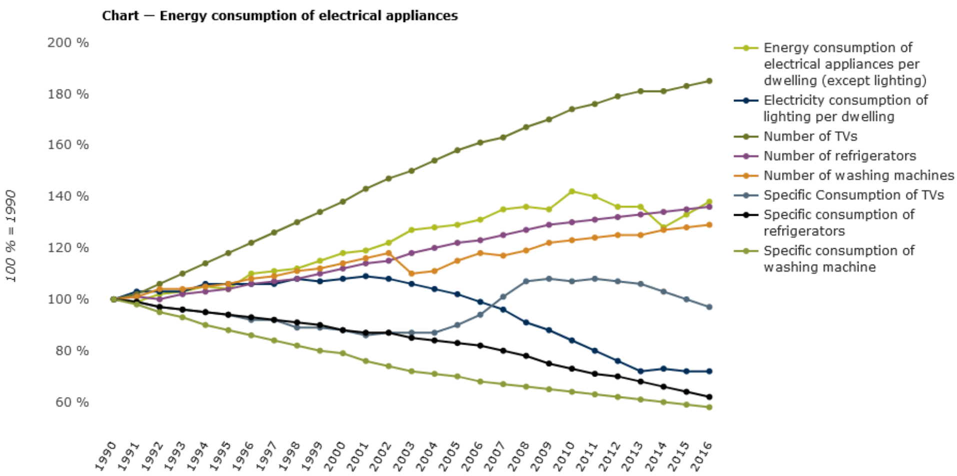

Figure 1.5.12: Energy consumption of electrical appliances in the EU (EEA)

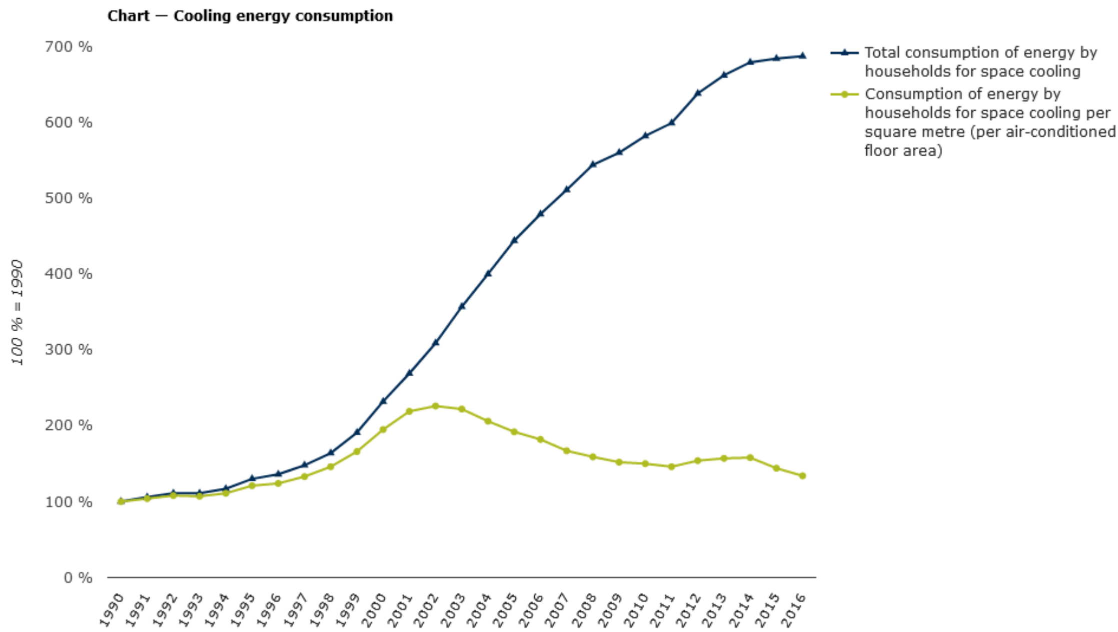

Figure 1.5.13: Cooling energy consumption in the EU (EEA)

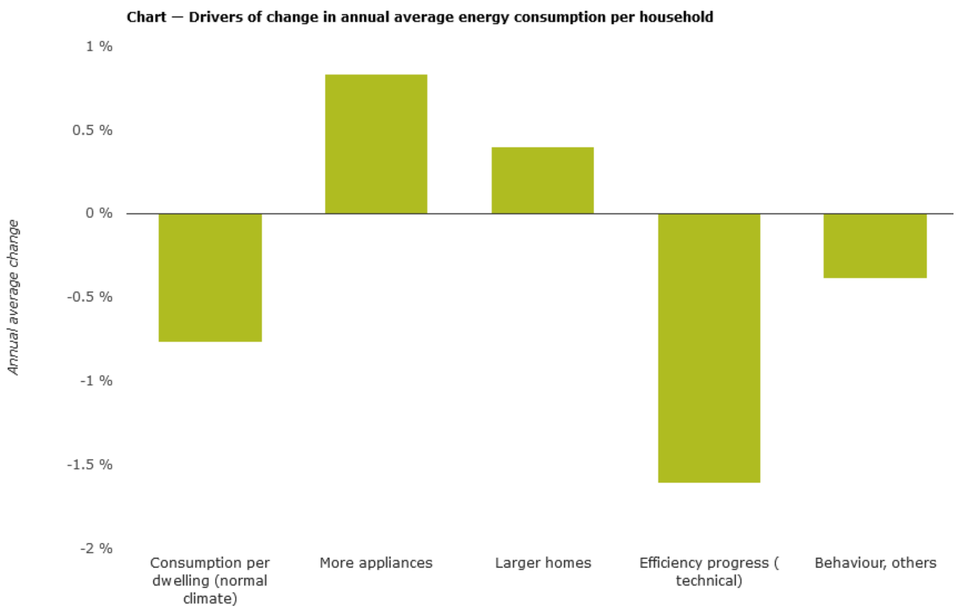

Figure 1.5.14: Drivers of change in annual average energy consumption per household (EEA)

The state of the art

Very low energy buildings are designed to provide a significantly higher standard of energy efficiency than the minimum required by national Building Regulations. These buildings are very often designed without traditional heating systems and without active cooling. This results in a 70 to 90% saving in energy consumption compared to the existing building stock.

The definition of very low energy buildings varies significantly across Europe. The variation exists in terms of the absolute possible level of energy consumption; the calculation methods and the energy flows included in the requirements vary from country to country.

Examples of such buildings are:

- Passivhaus (Germany),
- BBC - Bâtiment Basse Consommation - Effinergie (France),
- "zero" carbon house (UK),
- Minergie (CH)

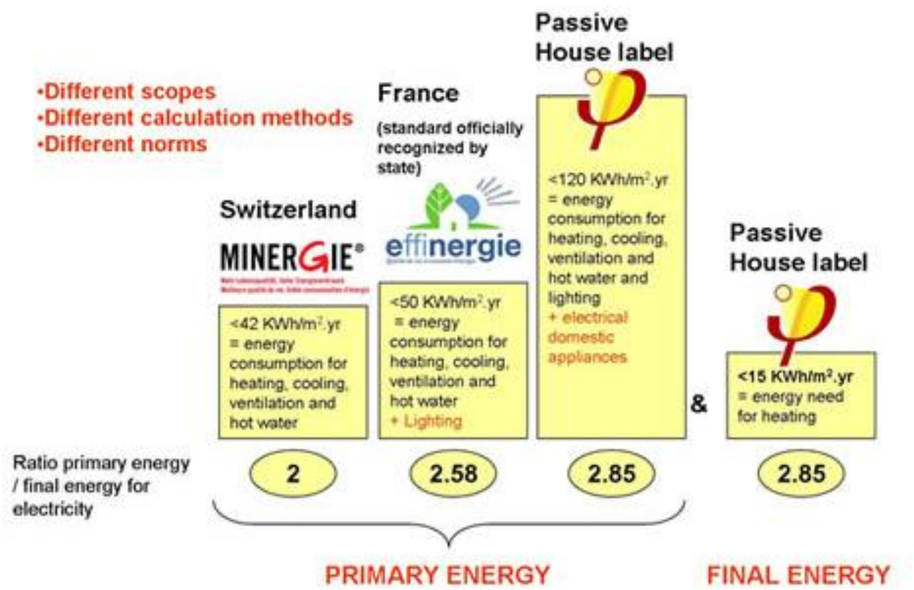

Figure 1.5.15: Examples of very low energy buildings in different European countries (isover.com)

1.5.3 REFERENCES

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