

IS THE EUROPEAN BUILDING SECTOR ON THE WAY TO DECARBONISATION?

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Overview

European Union has set a roadmap for moving to a competitive low carbon economy in 2050, which provides a long term pathway to achieve an 80% cut in domestic emissions compared to 1990 by 2050 [1]. The European building sector (residential and services) can contribute to this goal by using two main instruments, energy efficiency measures and substitution of the fossil fuels with renewable energy sources.

The achievements of the CO₂-emission reduction differ from one European country to another in terms of the differences in the existing building stock characteristics, ambitiousness of the energy efficiency requirements for new construction and building renovation required in the national legislations as well as different energy fuel market shares for space heating and domestic hot water.

This paper aims at modelling what CO₂-emission reduction and energy demand reduction can be achieved until 2050 in France, Italy, Norway and Poland's building stock, which makes up 34% of the total European building floor area (EU 28 and Norway) while considering the following parameters:

- Existing building stock characteristics (building thermal conductivities, user profiles and installed energy supply systems of the different building categories);
- Policies to reduce energy demand (Implementation of the European legislation: Energy Performance of Buildings Directive (EPBD) and Energy Efficiency Directive EED)¹;
- Energy fuel prices;
- Technological learning effects of the heating systems.

Methods

The calculation of the final energy demand for space heating and hot water is based on a bottom-up approach taking into account disaggregated building stock data. The building stock simulation tool Invert-EE/Lab is applied [2], [3]. Invert/EE-Lab is a dynamic bottom-up techno-socio-economic simulation tool that evaluates the effects of different policies on the total energy demand, energy carrier mix and CO₂-emission reduction. Scenario modelling is based on two main approaches: the Weibull-distribution and investment-decision module with the nested logit approach. By using these approaches, building demolition and renovation rates as well as heating system change rates are calculated. Data on the building stock, national policy measures and energy fuel prices were collected in European research projects ENTRANZE and ZERBA2020 [4], [5].

Results

Fig. 1 shows the CO₂-emissions caused by the building sector in France, Italy, Norway and Poland from 2012 until 2050. CO₂-emissions polluted by the countries' building stock and its final energy demand for space heating and hot water is in 2012 89 Mt, 78 Mt, 7 Mt and 56 Mt in France, Italy, Norway and Poland respectively. The reduction of the CO₂-emissions from 2012 and 2050 is as follows: 67%, 55%, 63% and 48% in France, Italy, Norway and Poland respectively. The main drivers of the reduction is the energy demand reduction, the heating system exchange rate, the substitution of the fossil energy used heating systems with the renewable systems and the electricity generation mix. The CO₂-emission factor for electricity was derived by [6], who calculated the factor by using the electricity generation mix based on the reference scenario provided by the European Commission [7]. Final energy demand is expected to be reduced by 2050 in all investigated countries due to the building stock transition namely the new building stock with very high energy efficiency (nearly Zero Energy buildings), building renovation and demolishment of the old building stock. The final energy reduction from 2012 and 2050 is 14%, 30%, 44%, 48% in France, Italy, Norway and Poland respectively. The main drivers of the energy reduction are the renovation rate which is a result of the vintage of the building stock and the depth of renovation.

¹ Although no EU member state, Norway is following a similar approach to European legislation (EPBD, EED).

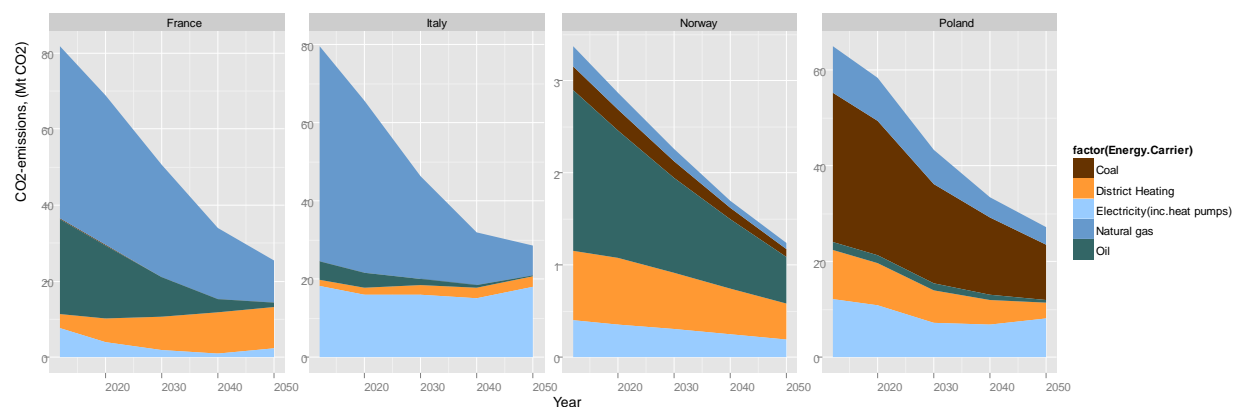


Fig. 1 CO₂-emissions by energy fuels caused by the building stock's final energy demand for space heating and hot water in France, Italy Norway and Poland in 2012, 2020, 2030 2040 and 2050 in the BAU scenario

Conclusions

In the European roadmap for moving to a competitive low carbon economy in 2050 it is stated that electricity will play a central role in the low carbon economy. This might be a crucial condition for the decarbonisation of the European building sector. The scenario results have shown that in many countries the fossil fuels like oil and gas in Italy and particularly coal in Poland are substituted with the electricity, which energy mix is dominated by the fossil fuel and corresponding high CO₂-emission pollution according to the BAU scenario. This leads to an untapped potential of CO₂-emission saving. Thus, these results call for a) an ambitious shift towards low-carbon electricity generation and b) in the light of climate change mitigation a binding United Nations CO₂-emission reduction agreement.

References

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