IS THE EUROPEAN BUILDING SECTOR ON THE WAY TO DECARBONISATION?

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Motivation

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 CO_2-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.

Research questions

What CO_2-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), (although no EU member state, Norway is following a similar approach to European legislation (EPBD, EED))
- Energy fuel prices
- Technological learning effects of the heating systems?

Method

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 CO_2-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 total final energy demand for space heating and hot water and CO_2-emissions caused by the building sector in France, Italy, Norway and Poland from 2012 until 2050. 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 18%, 44%, 27%, 28% in France, Italy, Norway and Poland respectively.

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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. CO_2-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 CO_2-emissions from 2012 and 2050 is as follows: 66%, 63%, 40% and 37% in France, Italy, Norway and Poland respectively. The main drivers of the CO_2-emission reduction in the building sector are the heating system exchange rate and the substitution of the fossil energy used heating systems with the renewable systems. The type of the heating system being installed depends on the energy fuel prices, technological learning effects and policy interaction. However, the results are strongly affected by assumed the CO_2-emission conversion factor of electricity, which varies strongly from one country due to the generation mix. The BAU scenario assumes a constant electricity energy mix until 2050 2.

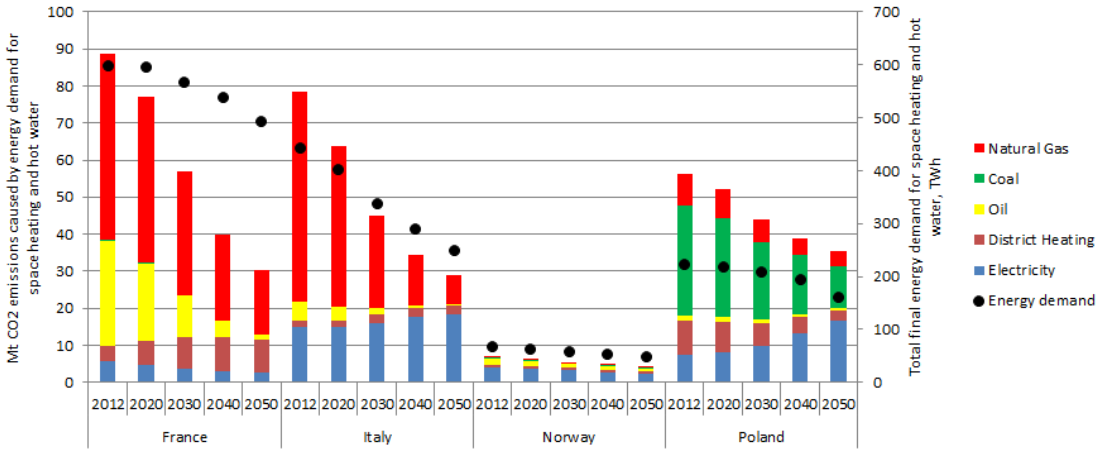

Figure 1: **CO_2-emissions by energy fuels caused by the building stock´s final energy demand for space heating and hot water (y-axis, left hand) and total final energy demand for space heating and hot water (y-axis, right hand) in France, Italy Norway and Poland in 2012, 2020, 2030 2040 and 2050 in the BAU scenario. The CO_2-emission conversion factors for the energy fuels are assumed to be constant from 2012 until 2050.**
In the full paper, the dynamic development of the CO_2-imission factors until 2050 which were derived in the POLES scenarios will be taken into calculation.

Discussion

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 CO_2-emission pollution according to the BAU scenario. This leads to an untapped potential of CO_2-emisson 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 CO_2-emission reduction agreement.

References

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