TECHNISCHE UNIVERSITÄT WIEN

Tagungsband

SYMPOSIUM

30 Jahre „Angepasste Technologie – Eine Erfolgsgeschichte“

Wien, 28. April 2016

Fotos: links TU Wien, Gisela Erlacher, Mitte und rechts GrAT

bmvit GrAT Center for Appropriate Technology TU WIEN Forschungszentrum Energie und Umwelt NEU STIFTER KREIS

STADT der Zukunft THTU Energy Economics Group eco plus bau.energie.umwelt cluster niederösterreich Europäische Union Investitionen in Wachstum & Beschäftigung. Österreich EFRE N

EUROPE'S PATHWAY TOWARDS NEARLY ZERO-ENERGY BUILDINGS: ZEBRA BUILDING SCENARIOS BY 2050

EUROPA AM WEG ZUM NIEDRIGSTENERGIEGEBÄUDE: ZEBRA-GEBÄUDESZENARIEN BIS 2050

Agnė TOLEIKYTĖ, Raphael BOINTNER
Energy Economics Group, TU Wien, Gusshausstraße 25-29/370-3, 1040 Wien
E-mail: toleikyte@eeg.tuwien.ac.at

Overview

Sustainability of the European society will be based on renewable energy and resource efficiency. The large scale deployment of nearly zero-energy buildings (nZEB) is essential to reach this goal. Thus, the Energy Performance of Buildings Directive 2010/31/EU (EPBD) define nZEBs as a future standard in Europe. The EU-Member States must set minimum energy performance requirements for the major renovation of buildings [1]. The directive has to be implemented on the national level. Due to various country specific conditions, the transposition of the directive differs from country to country, e. g. different energy efficiency requirements for new construction and renovation. In this paper we investigate the energy demand reduction potential in the building sector by 2050 in France´s, Italy´s and Poland´s building stock, which makes up 38% of the total European building floor area (EU 28). In order to do so, we firstly analyse the national legislation on the building energy performance requirements and assess building construction statistics. In a second step, by using a bottom-up approach, we calculate energy demand scenarios by 2050.

Method

A comprehensive compilation of building construction data is provided by ZEBRA2020 [2]. Based on that building standards for new construction are defined a) buildings built worse than building code, b) buildings built according to the national building code in 2012 and c) buildings built according to the national nZEB definition or even better. The first category assume that in reality not all buildings fulfil the criteria set in the building legislation, the second category reflect the building standards of 2012 and the last one is following the requirements set in the European Directive 2010/31/EU on the energy performance of buildings [1]. Renovation activities are being defined similar to new construction with a) renovation worse than building code, b) renovation according to the national building code in 2012, c) renovation better than building code and d) maintenance without any influence on the energy demand. If there is a certain nZEB building standard in place, the selection of building components is restricted. If there is no nZEB obligation the selection depends on their cost-effectiveness. Selecting renovation standards follows the same procedure according to the abovementioned retrofitting options. All these categories for new building construction and renovation lead to specific energy savings, investment costs and cash flows. The nZEB-share in new buildings and renovations and related energy savings are calculated in the building stock simulation tool Invert-EE/Lab from 2012 to 2050. Invert/EE-Lab is a dynamic bottom-up techno-socio-economic simulation tool that evaluates the effects of building policies on the energy demand, the energy carrier mix and the CO_2-emission reduction [3], [4], [5]. The model also includes exogenous economic parameters (e.g. fuel prices), which influence the decision process. Data sources: [2], [6], [7], [8], [9].

Results

Two main drivers for energy savings were considered, renovation rate and renovation depth. Figure 1 shows the cumulated building floor area, namely the non-renovated building stock and renovated building stock by different renovation levels (y-axis, left hand). Moreover, the figure indicates the yearly total renovation rate and the renovation rate excluding maintenance (y-axis, right hand). Total yearly renovation rate includes all undertaken renovation activities in the country, while renovation rate without maintenance includes only thermal renovation activities meaning renovation actions which lead to energy savings. The total yearly renovation rate varies from 1.2% to 2.5% over time in France. However, the yearly renovation rate without maintenance ranges between 0.6% and 1.3%. By 2050 74% of the total building floor area could be renovated but the share of the thermal renovated building floor area by 2050 is 37% only. In Italy, the share of the renovated building floor area is 91% by 2050, the share of the thermal renovated floor area is 45%. 50% of these buildings undertake minor renovation levels, which is less ambitious than the current building energy performance requirements. In Poland, the total renovated building floor area is 77% by 2050. The share of buildings with thermal renovation is with only 10% remarkably lower compared to the other countries. This result was influenced by the given parameters of the business-as-usual (BAU) scenario such as low energy fuel prices and lack of financial public support. Figure 2 shows the total final energy demand for space heating and hot water caused by the building sector in France, Italy 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 rates and depth as well as demolishment of the old (inefficient) building stock. The final energy reduction from 2012 to 2050 is 18%, 44%, 28% in France, Italy and Poland respectively. The main drivers of the energy reduction are the renovation rates, which results from the vintage building stock and the depth of renovation. Figure 2 indicates the energy fuel mix which is the main driver of the CO_2-emission reduction in the building sector. The energy fuel mix in the scenario is the result of the current fuel mix in the countries´ building sector and the future installation rate of the new technologies. The type of the installed heating system depends on the energy fuel prices, technological learning effects and policy interaction. The fossil-fuel-based heating systems are slowly replaced with the renewable systems in all countries.

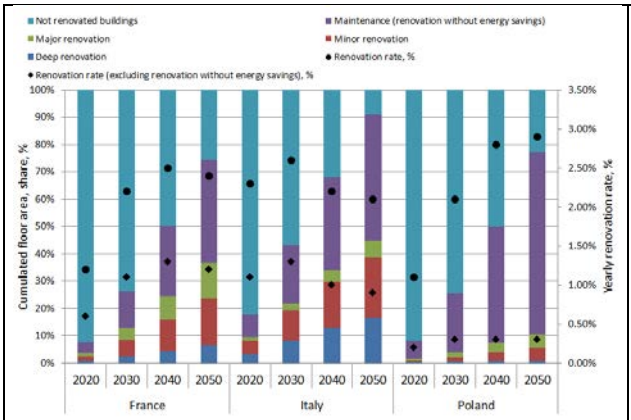

Figure 1. Cumulated floor area by renovation levels (y-axis, left hand) and yearly renovation rate (y-axis, right hand) in France, Italy and Poland; BAU scenario

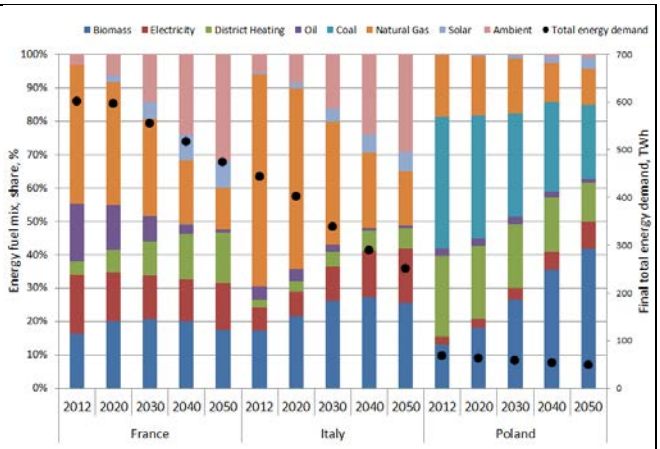

Figure 2. Energy fuel mix on the total final energy demand for space heating and hot water (y-axis, left hand) and total final energy demand for space heating and hot water (y-axis, right hand) in France, Italy and Poland; BAU scenario

Conclusions

The national definition of the current building codes and nZEB building standards as well as different renovation levels were implemented in Invert-EE/Lab to calculate the cumulated floor area and its related energy demand up to 2050. The scenario results show a quite different outlook for the investigated countries with today's building codes. However, what they all have in common is a large, untapped potential for increased energy savings by implementing further measures and incentives in order to boost high-quality renovation. This is especially true for maintenance without improvement of the thermal quality and comfort, which takes a notable share of the 2050 building stock. Beside the countries' purchase power, the level of investments depends on the quality of the renovation measures and the renovated floor area. More information will be shown in the ZEBRA2020 reports during the course of 2016.

Acknowledgment

This work and the presented findings are based on the IEE-Project ZEBRA2020 (http://zebra2020.eu), funded by the European Commission under the Grant Agreement No. IEE/13/675.S12.675834. The sole responsibility for the content of this paper lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EASME nor the European Commission are responsible for any use that may be made of the information contained therein.

References (selection)

[1] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings
[2] Zebra2020 - Nearly Zero-Energy Building Strategy 2020. [Online] http://zebra2020.eu/. [last accessed 14-Dec-2015].
[3] M. Stadler, L. Kranzl, C. Huber, R. Haas, und E. Tsioliaridou, „Policy strategies and paths to promote sustainable energy systems—The dynamic Invert simulation tool", Energy Policy, Bd. 35, Nr. 1, S. 597–608, Jan. 2007.
[4] L. Kranzl, M. Hummel, A. Müller, und J. Steinbach, „Renewable heating: Perspectives and the impact of policy instruments", Energy Policy, Bd. 59, S. 44–58, Aug. 2013.
[5] L. Kranzl, et al, „Deriving efficient policy portfolios promoting sustainable energy systems—Case studies applying Invert simulation tool", Renew. Energy, Bd. 31, Nr. 15, S. 2393–2410, Dez. 2006.
[6] Entranze Interactive Online Data Tool. 2014. [Online] http://www.entranze.enerdata.eu/. [last accessed 14-Dec-2015].
[7] M. Fernandez Boneta, „Cost of energy efficiency measures in buildings refurbishment: a summary report on target countries. D3.1 of WP3 from Entranze Project", CENER.
[8] B. Atanasiu, et al, „Overview of the EU-27 building policies and programs. Factsheets on the nine Entranze target countries. Cross-analysis on member-states´ plans to develop their building regulations towards the nZEB standard", Report.
[9] ZEBRA2020 data tool, 2015. [Online] http://www.zebra-monitoring.enerdata.eu/. [last accessed 14-Dec-2015].