Pathways towards a European Low Emission Society
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Long-Term Renovation Strategies: How the building sector can contribute to climate neutrality in the EU

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Headlines

- The European Council has endorsed an objective for the European Union (EU) to be climate neutral by 2050. To achieve this level of ambition all sectors, including the building sector, must decarbonise by that time.
- The European Commission's newly published European Green Deal aims at setting a pathway towards achieving the climate neutrality objective while ensuring a green and inclusive transition. The building sector is a key pillar in that respect and the European Commission suggests that EU and its Member States should start a "Renovation wave" to reduce energy consumption, emissions and energy poverty.
- The most ambitious pathway produced with the European Calculator (EUCalc) for the building sector achieves a reduction of CO_2 emissions of 97% by 2050 compared to 2015. This will entail policies, measures and support mechanisms leading to a refurbishment of all existing buildings by 2050 through deep renovations mainly. This pathway also assumes a demolition rate of 1%. In addition, the electricity and heat used in the building sector would need to be almost fully decarbonised.
- The EUCalc model shows that achieving a decarbonised building stock, in line with Energy Performance of Building Directive (EPBD) Long-term renovation strategies (LTRS) and the EU climate neutrality objective, is a societal challenge that will require a transformative approach both in the building sector and regarding how electricity and heat are produced. Large additional effort and major technological advances and breakthroughs in comparison to the building sector's current construction and renovation practice are necessary if the Member States are serious in taking actions that will achieve a highly energy-efficient and decarbonised building stock by 2050.

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The EUCalc model and the Transition Pathways Explorer

The EUCalc model user interface - the Transition Pathways Explorer - is a tool that allows users to build a pathway to a net-zero carbon future at European and Member State level. Its scientific mission is to provide a sophisticated, yet accessible, model to fill the gap between integrated climate-energy-economy models and the practical needs of decision-makers. The model relates emission reduction with human lifestyles, the exploitation and/or conservation of natural resources, job creation, energy production, agriculture, costs, etc. in one highly integrative approach and tool which enables decision-makers to get real-time policy support underpinned by comprehensive trade-off analyses.

Politicians, innovators and investors can use the EUCalc Transition Pathways Explorer to create their own pathways to a low-carbon future online, in real-time and together. This tool can help policy makers in the EU28 + Switzerland explore the routes they can take to delivering climate protection, whilst securing energy and other important policy priorities.

Background

Buildings account for about 36% of CO_2 emissions and 40% of energy consumption in Europe (European Commission, 2020). Currently, about 97% (BPIE, 2019) of the existing building stock is inefficient and the yearly rate of deep renovations in the EU is on average only around 0.2% (Esser, 2019). This means that a comprehensive strategy to reduce emissions from the buildings sector is urgently needed if the EU wants to meet the objectives of the Paris Agreement (UNFCCC, 2015) and achieve the carbon neutrality objective supported by the European Council (2019) on 12th December 2019. In addition, the European Commission's newly published European Green Deal (EC, 2019) recognizes the need to address energy efficiency in buildings to achieve the climate neutrality objective and suggests that the EU and Member States should engage in a "renovation wave" to support the increase of buildings' renovations and make them affordable.

With the Clean Energy for All Europeans package (EU, 2019) recently adopted and now being transposed in national legislation, Member States must plan policies that proceed in that direction. For example, the EPBD (EU, 2018) requires Member States to draft a Long-term Renovation Strategy (LTRS) to achieve a highly energy-efficient and decarbonised national building stock by 2050. This is fully compliant with the climate neutrality objective described above and with the European Green Deal focus on the rigorous enforcement of the EPBD as a priority area for action in the building sector.

Using EUCalc to model a Long-term Renovation Strategy (LTRS) in line with a climate neutrality objective

With the help of the newly developed European Calculator (EUCalc) model, it is possible to present insights into how the buildings sector (Kockat, 2019) in the EU could contribute to reduce greenhouse gas (GHG) emissions by 2050. In view of this, the EUCalc model has been used to create pathways that try to mirror the LTRS in line with the EPBD requirements, among many other possible pathways available in the model. The pathways aligned with the EPBD were generated using the EUCalc building and power modules, showing how the EUCalc model can be used to model interconnected sectors. Inputs from other modules (e.g. lifestyles, climate) have been kept to a level of ambition that corresponds to "observed trend continuation". For example, parameters such as population development and total floor area demand, which are part of the EUCalc's lifestyle module, have been kept constant.

The EUCalc building module also includes energy for appliances, but the energy used by appliances has been excluded for the purpose of this briefing. This is because the EPBD does not cover the energy used by household appliances, which is regulated separately under the Ecodesign Directive (EU, 2009).

The EUCalc model has been used in line with the framework of the modelling assumptions explained above to model a carbon neutrality pathway for the buildings sector up to 2050 for the EU as a whole (Figure 1); these pathways are an illustration of possible scenarios for the building sector rather than a forecast. The results here shown were simulated using the December 2019 version of the EUCalc model and, therefore, future updates may affect these results.

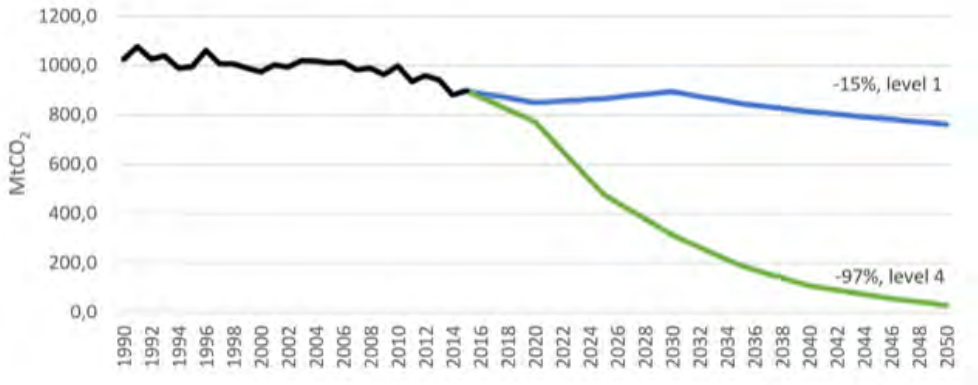

Figure 1: CO2 emissions from space heating, electricity for space cooling and hot water, and district heating in the European Union, according to two different levels of carbon mitigation efforts, using the EUCalc.

The pathway level 1 ("observed trends continuation") shows a decrease of buildings' CO_2 emissions of 15% by 2050, compared to 2015, whilst the most ambitious scenario (Level 4) results in a reduction of CO_2 emissions of 97% in 2050 in the EU.

This most ambitious pathway can be considered consistent with the obligation of the EPBD that requires the EU Member States to develop LTRSs that achieve a decarbonised building stock by 2050. Level 4 demands transformational change in current demolition, construction and renovation practices. It also requires a full decarbonisation of the heat and electricity used in the building sector showing how demand-side and supply-side measures are both necessary to achieve this level of ambition. Therefore, level 4 represents an extremely ambitious and unprecedent effort for climate change mitigation in the building sector.

The EUCalc model gives an indication of the scale of the efforts that Member States need to achieve to comply with this obligation and the transformative effects that LTRS policies and measures would require. The level 4 pathway assumes a renovation rate of 3%, leading to a refurbishment of all existing buildings by 2050; out of these renovations, the great majority are assumed to be deep renovations with no shallow refurbishment. Also, level 4 assumes a demolition rate of 1%, which would mean about 37% of existing buildings will be demolished and replaced by new nearly zero-energy buildings by 2050. In addition, the electricity and heat used in the buildings sector would need to be almost fully decarbonised (Figure 2).

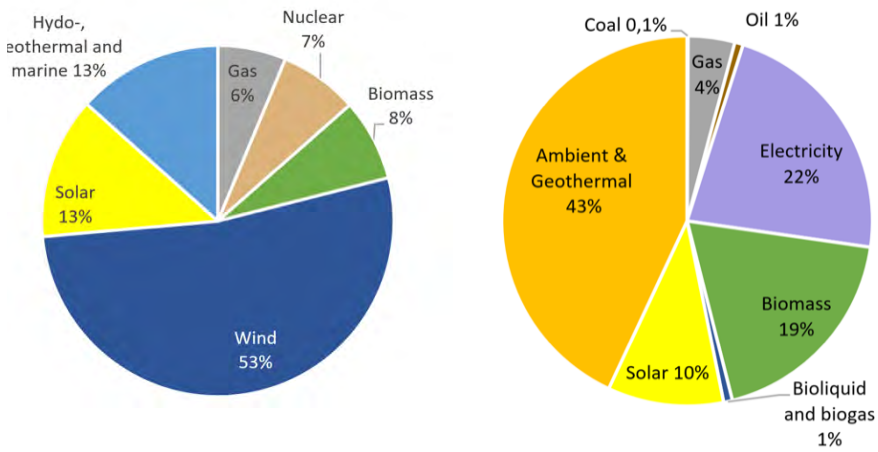

Figure 2: EU Fuel mix of the electricity and CHP-heat production in 2050 (left graph); EU Fuel mix of the decentral heat and additional district heat generation in 2050 (right graph) - EUCalc level 4 pathway.

[1] *2015 was used as a base year for the analysis, because it provides the latest complete dataset. No changes were assumed before 2020 in any scenario, i.e. the observed trend was assumed.*

Implications and conclusions

When Member States draft and implement LTRSs that are in line with the objective of decarbonising their national building stock, therefore contributing to the climate neutrality objective of the European Green Deal, they must put in place policies and measures that lead to a transformation of the building sector compared to today.

The most ambitious (level 4) pathway modelled with the EUCalc model and described above gives an indication of the efforts, for example, in terms of renovation rates and depth of renovations, that Member States must achieve with the policies and measures planned in their LTRSs. To achieve similar impacts, Member States must use the drafting of their LTRS as an occasion to rethink their policy interventions in the buildings sector and put in place a coherent strategy that mobilises resources and actors towards the EU long-term decarbonisation goal.

Member States have at their disposal a broad range of policy instruments, which must be tailored to the national situation and at a different starting point of every country. An increase in the renovation rate of existing buildings from the current 1% to 3% would require the adoption and mainstreaming of a combination of policy measures such as minimum energy performance requirements for existing buildings (e.g. when a building is sold or rented) and advisory tools like one-stop-shops to help citizens in their renovation journey. It would also require exploring industrialised and prefabricated renovation solutions, on the model of the Dutch Energiesprong (2019), which would reduce costs of deep renovations and increase their renovation rate. Achieving an increased renovation rate would also require large mobilisation of investments through both private and public funds, at local, national and regional level, especially to support the renovation of residential buildings.

Increased demolition also plays a role in the most ambitious pathway modelled, with a demolition rate assumed to increase from 0.1% to 1%. This means that some of the worst-performing buildings, which are more costly to renovate than to rebuild, would be demolished. Any demolition strategy should be carefully designed by prioritising commercial buildings that already have a shorter lifespan and a higher demolition rate than residential buildings. It must also take into account circular economy principles, including the need to reduce construction waste.

Additionally, a much more integrated planning approach that captures the inter-dependencies between supply and demand in the building sector is crucial for decarbonisation. The deployment of renewable heat technologies, like the latest generation district heating and cooling systems or heat pumps, work best with highly efficient buildings. Combining the planning of renovations in both buildings and heating systems can effectively avoid unnecessary investments and lock-in effects. LTRSs should capture and plan how to maximise these synergies.

To this end, this briefing shows that decarbonising the building stock is a societal challenge that will require wide socio-economic transformation. Achieving the level of impacts in line with the most ambitious pathway will require acceptance and support from a wide spectrum of stakeholders, from local authorities to the construction industry, to civil society organisations, to installers and builders. In this context, the European Green Deal suggests the Commission will work with stakeholders on a new initiative on renovations in 2020. Ultimately, only a shared ownership of the long-term decarbonisation objective and collective support for the building renovation measures that must happen on the ground can make the “renovation wave” materialise.

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References:

BPIE (2019). 97% of buildings in the EU need to be upgraded.
Available at: bpie.eu/wp-content/uploads/2017/12/State-of-the-building-stock-briefing_Dic6.pdf (Accessed: 14 Jan. 2019).

EC – European Commission (2019). Communication from the Commission to the European Parliament, The European Council, The Council, The European Economic and Social Committee and the Committee of the Regions: The European Green Deal. Document ref. COM(2019) 640 final, 11.12.2019, Brussels.
Available at: https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf (Accessed: 9 Jan. 2020).

Energiesprong (2019). The Netherlands. Available at: www.energiesprong.org (Accessed: 9 Jan. 2020).

Esser, A., Dunne, A., Meeusen,T., Quaschning, S., Wegge,D., Hermelink, A., Schimschar,

S., Offermann, M., John, A., Reiser, M., Pohl, A., Grözinger, J. (2019) Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU.
Available at: ec.europa.eu/energy/sites/ener/files/documents/1.final_report.pdf (Accessed: 14 Jan. 2019).

EU – European Union (2009). Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products.
Available at: http://data.europa.eu/eli/dir/2009/125/2012-12-04 (Accessed: 25 Jan. 2020).

EU – European Union (2018). Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency. Available at: data.europa.eu/eli/dir/2018/844/oj (Accessed: 14 Jan. 2020).

EU – European Union (2019). Clean energy for all Europeans. Directorate-General for Energy, Brussels. DOI: 10.2833/9937. Available at: op.europa.eu/en/publication-detail/-/publication/b4e46873-7528-11e9-9f05-01aa75ed71a1 (Accessed: 9 Jan. 2020).

European Commission (2020). Energy performance of buildings directive. Available at: ec.europa.eu/energy/en/topics/energy-efficiency/energy-performance-of-buildings/energy-performance-buildings-directive#facts-and-figures (Accessed: 14 Jan.2020)

European Council (2019). European Council meeting (12 December 2019) – Conclusions.
Available at: www.consilium.europa.eu/media/41768/12-euco-final-conclusions-en.pdf (Accessed: 14 Jan. 2019).

Kockat, J., Wallerand, S. (2019). WP2 –Buildings module documentation (including households and services). EU Calculator: Trade-offs and pathways towards sustainable and low-carbon European Societies.
Available at: www.european-calculator.eu/wp-content/uploads/2019/09/EUCalc_Building_documentation.pdf (Accessed: 14 Jan. 2019).

UNFCCC – United Nations Framework Convention on Climate Change (2015). The Paris Agreement (13 Dec 2015), UNFCCC COP Report no. 21, incl. Addendum U.N. Doc. FCCC/CP/2015/10/Add, 1 (Accessed: 29 Jan. 2016).

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Further information on the EUCalc project:

The EUCalc project aims at providing a highly accessible, user-friendly, dynamic modelling solution to quantify the sectoral energy demand, greenhouse gas (GHG) trajectories and social implications of lifestyle and energy technology choices in Europe.

The novel and pragmatic modelling approach is rooted between pure complex society-energy systems and integrated impact assessment tools. The EUCalc model with its user interface - the Transition Pathways Explorer - has been designed to be both accurate but also accessible to decision-makers and practitioners. It covers all sectors and can be used by one or many people. The model is also open source so that experts can refine the model itself. The tool will have an e-learning version, the "My Europe 2050" tool as well as a Massive open online course (MOOC). See more on the EUCalc project, its scientific reports and all other outputs and access the Transition Pathways Explorer at:

www.european-calculator.eu

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Policy Briefs - Pathways towards a European Low Emission Society

The Policy Briefs on Pathways towards a European Low Emission Society, summarises key finding of the EUCalc project with a clear policy orientation, which provides practical climate change mitigation insights to both EU and individual Member States decision-makers. These policy briefs cover the following topics:

No. 1	The role of lifestyles changes in EU climate mitigation
No. 2	Innovation and technology development: Decarbonisation pathways for manufacturing & production sector
No. 3	Long-Term Renovation Strategies: How the building sector can contribute to climate neutrality in the EU
No. 4	Avoid, shift, improve: Decarbonisation pathways for the transport sector in Europe
No. 5	Mitigating GHG Emissions through Agriculture and Sustainable Land Use: An Overview on the EUCalc Food & Land Module (will be published in February 2020)
No. 6	Decarbonizing the EU electricity sector from ageing powerplants to renewable energy futures
No. 7	Implications of decarbonizing the EU economy on trade flows and carbon leakages: insights from the EU Calculator (will be published in March 2020)
No. 8	EUCalc scenarios on impact of European air pollution on human health (will be published in February 2020)
No. 9	How will decarbonisation pathways affect employment in Europe in 2050? Insights from the EU Calc (will be published in March 2020)
No. 10	Prosperous living for the Europe in 2050: An insight from the EU Calculator (will be published in February 2020)

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