Building stock progress monitoring report

D2.5 Draft

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Table of contents

Contents

1. Introduction

1.1. The BuiltHub project

The "Dynamic EU Building Stock Knowledge Hub - BuiltHub" is a 4-year European Project funded under the Horizon 2020 program of the European Union. The project aims to develop a roadmap for continuously gathering and enhancing data required to inform building-related policies and business decisions through a community and its data hub. BuiltHub intends to positively disrupt policy and market decision-making by leveraging a continuously community-enhanced evidence base. The BuiltHub community, supported by an IT platform serving as a data analytics and knowledge exchange hub, will revolutionize the way knowledge about the EU building stock is developed and shared with stakeholders across Europe.

BuiltHub aims to establish a continuous and reliable flow of building stock data at both the EU and national levels. The execution and testing of BuiltHub will be carried out through its data hub, which is an online platform equipped with powerful data analytics to deliver added value to stakeholders.

1.2. The task of monitoring the decarbonisation of the EU building stock [1] and its integration in the project and objectives

This report aims at gathering insight on the monitoring of the building stock regarding its progress towards decarbonisation. The data gathered in the BuiltHub platform shall inform this monitoring task. BuiltHub's initiatives are designed to comprehensively collect, integrate, and analyze data pertaining to the EU's building stock. The data of the building stock's evolution and their analysis is the basis for assessing progress made towards the 2050 decarbonization targets. The objective of this monitoring is to equip stakeholders with a robust, data-driven foundation to guide decision-making, highlighting key areas of deficiency where improvements are needed, and opportunities critical for achieving decarbonization. To achieve this, a coherent framework and a standardized methodology was developed to create thorough progress reports.

This first draft will be followed by the final version at the end of the project.

 The consolidated and standardised structure of this report will be used for further publication by the EC."

The buildings stock monitoring uses identified, relevant and quality assessed data sources[2] and from there identified[3] indicators that were defined within the BuiltHub project and

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[1] Task 2.5

[2] Data were identified as part of the <u>inventory structure and main feature and datasets</u> and quality control was performed using a defined <u>methodology on quality assurance</u>.

[3] Indicators were <u>defined</u> and <u>categorized</u>.

additional data collected specifically for this purpose, the latter are described in this report and attached in the ANNEX.

This draft version of the report delivers an overview of the method and results. The final version will provide more information on the single indicators.

2. Method

For the building stock monitoring the method from the EU Building Climate Tracker[4] was reviewed in a review with BuiltHub partners and found suitable. Within this task the method is being applied and extended were needed or useful.

The method consists of 3 steps:

1. Indicators that contain information about decarbonization of the building stock were researched, selected and analysed.

2. The progress of each indicator is measured relative to a goal value defined for 2050. For consistency all goal values are derived from the same scenario[5] that is to represent climate neutrality in 2050.

3. All identified indicators are normalised and then aggregated to deliver a single composite indicator that can demonstrate the decarbonisation progress of the buildings stock in one number.

These steps are briefly described in the following sections.

2.1. Selection of indicators

Five indicators were selected from more than 60 European and global data sources according to relevance, EU coverage, reliability, consistency, continuity, existing timeline, and quality, with sources in brackets:

(i) CO_2 emissions (European Environment Agency (EEA))
    a. CO_2 emissions from energy use in buildings from households
    b. CO_2 emissions from energy use in service-sector, including institutional buildings
(ii) Final energy consumption (eurostat)
    a. Final energy consumption in households
    b. Final energy consumption in the service sector
(iii) Renewable energy share (eurostat)
    a. Share of energy from renewable sources for heating and cooling
    b. Share of energy from renewable sources in gross electricity consumption
(iv) Investments in renovation (cumulative) (FIEC)

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[4] Methodology Report, Policy Report
[5] MIX scenario from the EU Green Deal

(v)   Domestic energy expenditures. (ODYSSEE)

2.2. Definition of indicator goals to represent climate neutrality 2050

To evaluate the observations against the climate neutrality objective by 2050, indicator milestones were established for 2030 and 2050 using the MIX scenario from the "Clean Planet for All" impact assessments by the European Commission, se.

To enable the aggregation and determine the influence of different indicators on the result, the observations were normalised on a scale between 0, representing the starting value in 2015, and 100, representing the 2050 milestone.

To accurately reflect each indicator's significance in relation to the envisioned climate-neutral building stock of 2050 within the composite index, weights had to be assigned. CO_2 emissions and Final energy consumption are the main indicators to monitor the decarbonisation and energy performance in buildings. Each of them was assigned with 25% weight to represent together half of the EU BCT index. The remaining indicators were allocated an equal weight of 16.7% each.

Table 1. Summary of key elements of the indicators of the EU BCT

Indicator	Data source	Weight	Starting point in 2015	2050 Milestone	BuiltHub platform
(i) CO₂ emissions	EEA	25%	445.2 [MtCO₂]	0 [MtCO₂]	Not currently
(ii) Final energy consumption	Eurostat	25%	4,344 [TWh]	3,315 [TWh]	Yes
(iii) Renewable energy share	Eurostat (SHARES)	16.7%	20.3% (a. heating and cooling)	100% (a. heating and cooling)	Yes
			29.7% (b. in gross electricity consumption)	85% (b. in gross electricity consumption)	Yes
Investments in renovation	FIEC	16.7%	277 [billion EUR2015]	20,778 [billion EUR2015]	Not currently
Energy expenditures per household	ODYSSEE	16.7%	1,475 [EUR2010]	1,120 [EUR2010]	Not currently

2.3. Normalisation and aggregation

Once the data for the indicators is collected, it is necessary to process it. To enable a more homogeneous analysis of the indicators and allow their aggregation into a final composite index, all the indicators are transformed to a common scale, normalizing their values as follows: 1) the absolute values for each indicator (x_i) are collected from the data sources; 2) the base range for each indicator is defined, i.e. the final goal value in 2050 (x^*_{2050}) minus the reference value in 2015 (x_{2015}), both in absolute values; 3) each indicator is normalized using this base range as described by Equation (1).

$$v_i = \frac{x_i - x_{2015}}{x^*_{2050} - x_{2015}}$$

Once all the indicators are transformed to a common scale using the normalisation described previously, they are aggregated using the weights shown in Table 1 to obtain the index monitoring the progress of the EU building stock towards climate neutrality.

3. Results

The composite tracker's results indicate that after establishing the reference point in 2015, the EU building stock's progress towards climate neutrality deviated from the intended path in 2016 and 2017. However, post-2017, there was an upturn in overall performance that surpassed the initial levels, though it continued to diverge from the reference trajectory. Consequently, the gap between the tracker's progress (represented by the orange line) and the intended reference path (denoted by the dashed line) has widened twofold since 2016. A modest improvement was observed between 2019 and 2020.
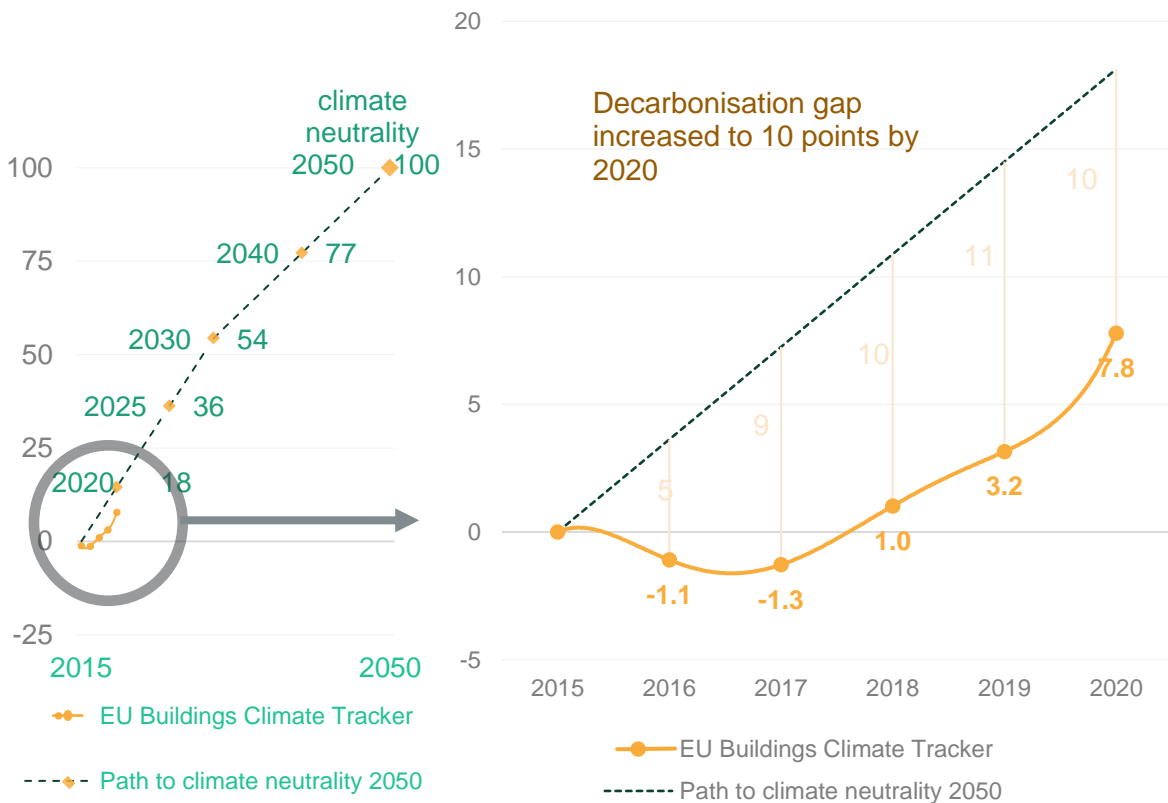
Figure 1. left: Path to climate neutrality 2050 with milestones, EU; right: Composite index of the EU BCT tracker, EU

4. Conclusion

The building stock monitoring is interesting for those stakeholders that want to understand what the result of the European effort since the Paris Agreement is.

The results show that the decarbonization of the EU building stock is far from being on track. If the gap between the observed values and the reference path to climate neutrality continues to be the same or to increase, it may be difficult to reverse the trend to move in the direction of the reference path to be on track towards carbon neutrality. More ambitious policies covering the different aspects included in the EU BCT tracker need to be applied to accelerate the progress to close the gap.

1. ANNEX I supplemental data

1.1. EEA CO2 emissions residential

Name	EEA greenhouse gases - 1.A.4.b Residential - CO2
Unit	t CO2 emissions
Source	EEA - European Environment Agency
Link	https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer
Source notes	EEA greenhouse gases — data viewer - 1.A.4.b Residential - CO2; Data viewer on greenhouse gas emissions and removals, sent by countries to UNFCCC and the EU Greenhouse Gas Monitoring Mechanism (EU Member States). Prod-ID: DAS-270-en, Published 18 Apr 2023

Territory	2015	2016	2017	2018	2019	2020	2021
EU27	315,947,019	322,256,156	319,432,570	309,024,758	302,680,810	301,475,507	305,879,081
Belgium	16,500,740	16,270,940	16,020,097	15,975,965	15,280,320	14,973,996	16,201,724
Bulgaria	743,136	807,720	833,227	674,110	622,684	642,969	837,520
Czechia	8,047,653	8,467,537	8,761,650	8,115,062	7,347,782	7,361,823	7,847,614
Denmark	2,003,467	2,037,738	1,929,881	1,864,307	1,779,685	1,553,748	1,418,705
Germany	86,733,469	88,248,344	86,618,507	84,578,431	89,449,108	88,624,848	82,296,466
Estonia	171,622	182,907	171,118	166,464	175,500	158,209	163,736
Ireland	6,486,868	6,764,607	6,414,724	6,893,037	6,648,718	7,179,320	6,744,695
Greece	5,050,402	4,687,466	4,695,815	3,973,087	4,461,079	4,998,724	4,548,728
Spain	16,887,892	16,134,051	15,767,655	16,842,840	15,226,964	15,379,051	15,313,992
France	44,869,029	45,987,536	45,000,425	41,631,392	40,268,805	38,229,162	40,458,717
Croatia	1,502,518	1,544,393	1,565,729	1,478,113	1,400,819	1,477,274	1,517,924
Italy	47,978,956	48,332,045	47,991,405	46,395,117	44,728,936	44,063,246	46,677,919
Cyprus	352,676	355,661	349,015	284,480	328,053	323,963	293,633
Latvia	416,773	448,812	462,008	465,533	434,586	418,808	431,100
Lithuania	591,038	684,073	751,291	771,317	735,059	703,511	836,020
Luxembourg	1,072,174	1,104,167	1,125,267	1,028,455	940,882	1,029,439	986,302
Hungary	6,940,812	7,420,022	7,933,838	7,405,952	7,153,904	7,637,923	8,314,936
Malta	46,725	37,734	43,431	40,447	41,678	40,729	39,243
Netherlands	16,280,802	16,956,877	16,472,758	16,357,329	15,788,066	15,038,178	17,097,134
Austria	6,581,746	6,879,700	6,847,873	6,185,685	6,393,241	6,469,480	7,184,553
Poland	33,478,456	35,649,510	35,916,203	34,305,932	29,887,246	31,113,117	31,457,184
Portugal	1,791,908	1,761,587	1,747,530	1,784,278	1,816,363	1,904,978	1,730,001
Romania	6,156,210	6,223,336	6,529,153	6,766,349	6,823,506	7,218,942	8,327,903
Slovenia	706,451	701,692	681,266	634,412	625,350	648,572	614,178
Slovakia	2,722,916	2,782,419	3,092,092	2,808,897	2,841,015	2,894,030	3,173,036
Finland	1,259,128	1,286,852	1,204,586	1,110,900	1,024,128	913,876	841,028
Sweden	573,450	498,429	506,026	486,867	457,333	477,591	525,091

1.2. Energy saving rate in households since 2000

Unit   %
Source   ODYSSEE
Link   https://www.indicators.odyssee-mure.eu/online-indicators.html

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	0	2.2	5.9	9.7	13.7	16.7	17.3	17.5	17.8	18.2	18.6	19.2	19.6	20.1	20.3	20.5	20.6	21	21.4	22.2	22.7	23.1
Belgium	0	1.8	5.5	8.5	10.7	13.7	16.2	18.6	21	22.8	24.8	27	28.2	29.8	30.5	31.6	32.3	33	33.3	33.6	34	34.2
Bulgaria	0	3.9	8.8	9.7	10.2	10.7	10.9	11.2	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Croatia	0	1.7	3.8	4.4	5.6	6.8	8.1	8.7	9.4	10.2	11.1	12.9	14.6	16.4	17.7	19.2	21.4	23.1	24.6	25.1	25.8	26.2
Cyprus	0	0.2	0.3	1.3	2.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	5.1	7.1	9.3	9.7	9.7	9.7	10	10.2	10.5	10.5
Czechia	0	1.4	3.1	3.5	6.3	9.2	12.2	13	14	14.5	15.2	15.9	16.4	17.5	18.5	19.5	19.7	19.9	20.1	20.4	20.7	20.8
Denmark	0	1.2	2.8	3.4	4.2	5.4	6.9	8.1	8.9	9.2	9.4	10.7	12	14.2	15.2	16.3	16.8	17.4	18	18.6	19.8	20.5
Estonia	0	3.3	8.2	9.3	10.7	11.7	12.6	12.8	12.9	13.1	13.3	13.8	14.1	15.2	16.4	17.7	18.5	19.2	19.7	19.7	20.8	21.3
Finland	0	0.7	1.5	1.7	1.9	2.2	2.4	2.8	3.5	4.6	6	7.8	9.6	11.4	12.6	13.8	15	16	18.3	20.2	22.1	22.5
France	0	1.1	3.1	4.6	7	8.8	10.7	11.7	12.6	15.1	17.7	20.4	21.1	22.6	24.2	25.8	26.6	27.4	28.9	30.2	31.9	32.4
Germany	0	1.9	6	8.9	12	13.6	16.4	18.7	21.1	23.8	26.5	29.2	29.3	29.5	30.1	30.7	31.3	31.6	31.9	32.3	33.5	34.2
Greece	0	0.7	2.4	3.3	4.4	5.5	6.6	7.4	8.2	9	9.8	10.1	14.8	19.5	24.2	24.3	24.5	25	25.6	26.1	26.9	27.3
Hungary	0	1.3	3.5	5.8	8.1	9.4	9.7	10	10.4	10.4	10.5	11	11.7	12.7	13.2	13.6	13.5	13.4	13.3	13.2	13.5	13.6
Ireland	0	0.6	2	2.9	3.9	4.9	5.7	6.8	9.1	13.6	19.8	26.3	31	35	37.7	39.7	40.3	40.4	40.6	40.8	41	41.1
Italy	0	0.1	0.3	0.4	0.5	0.6	1.1	1.7	2.3	2.6	2.9	3.3	4	6.2	8.3	10.4	11.2	12	12.8	13.6	14.1	14.4
Latvia	0	0.8	2.6	4.7	6.8	9.1	10.2	11.1	11.3	14.7	18	21.3	21.8	22.8	25.5	28.8	31.5	32.4	32.4	32.5	33	33.3
Lithuania	0	2.6	5.8	6.4	6.9	7.1	7.4	7.7	8	10	12	13.9	14	15.6	17.4	20	21.6	23	23.6	23.7	25.8	26.7
Luxembourg	0	3.2	7.6	8.7	9.7	10.8	12	13.6	15.5	20	24.1	27.9	30.2	32.5	34.9	35.9	36.9	38	39.6	41.1	43.5	44.3
Malta	0	0.8	2.1	2.5	11.9	21.9	32.8	34.6	36.6	38.1	40.2	41.4	42.6	43.4	43.9	44	44	44	44.2	44.3	44.6	44.7
Netherlands	0	0.9	3.4	6.4	10	12.9	15.5	17.5	19.6	20.8	22.8	25.1	26.8	28.9	31.6	34.4	36	36.7	37.6	38.5	39.4	39.8
Poland	0	1.6	5.3	7.5	9.6	9.7	9.9	10.3	10.8	11.2	11.8	12.3	13.1	14.3	15.6	16.7	17.4	18	18.6	19	19.5	19.8
Portugal	0	2.4	5.1	6.7	8.8	10.8	11.4	11.8	12.2	17	22.9	30.1	33.4	35.9	37.2	38.1	38.5	38.7	38.7	39	39.3	39.6
Romania	0	9.8	21.7	23.6	25.2	25.4	25.4	25.4	25.4	25.6	27.3	29	31	32.5	34.9	37.6	39.2	39.8	39.8	39.9	40	40
Slovakia	0	0.2	2	5.1	9.7	15.1	20.4	24	25.7	26.1	26.7	28.3	29.8	31.3	31.9	32.4	32.7	33	33.2	33.4	33.6	33.6
Slovenia	0	1.1	3.6	5.9	8.2	10	11.2	12.5	13.3	15.7	18.1	20.9	22.7	25.1	27.1	28.6	30.8	33.2	36.2	38.3	40.4	41.2
Spain	0	2	7	8.8	9.6	10.3	11.2	12.4	13.5	15.9	18.8	23	26.9	29.8	31.1	31.4	31.4	32.5	33.7	34.8	34.8	34.8
Sweden	0	1.3	5	7.2	8.3	9.3	10.3	12.7	15.4	17.7	18.6	18.9	18.9	19.2	19.6	20.9	22.6	24.9	26.9	28.5	29.5	29.8
EU27	0	1.3	4	5.7	7.2	8	9.7	11.5	13.4	15.2	17.3	19.7	21	22.9	24.4	25.8	26.5	27.2	27.9	28.6	29.3	29.7

4.1. Investment in renovation

Unit   %
Source   FIEC
Link   https://fiec-statistical-report.eu/

Source notes % increase of investment compared to 2015; Data gathered from online report using guidance from the FIEC team

Territory	2015	2016	2017	2018	2019	2020	2021	2022
EU27	0.0	2.7	4.1	7.5	11.5	13.6	22.5	28.8
Austria	0.0	1.9	6.5	6.3	11.9	12.7	23.6	30.0
Belgium	0.0	2.9	4.9	6.3	10.4	14.0	16.1	11.9
Bulgaria	0.0	17.9	48.2	39.8	37.6	16.1	16.6	23.1
Czechia	0.0	61.4	-3.0	95.1	157.5	151.6	148.0	160.6
Germany	0.0	5.1	5.9	12.1	17.2	25.4	32.9	39.6
Denmark	0.0	-37.9	-35.5	-32.9	-28.5	-36.1	-27.4	-26.2
Estonia	0.0	12.4	55.4	57.3	-26.7	25.8	19.4	19.9
Spain	0.0	-4.0	-5.7	-9.3	3.8	4.1	-11.5	-17.9
Finland	0.0	8.4	11.6	13.8	12.1	13.2	13.4	6.9
France	0.0	1.1	3.1	1.2	0.9	-6.2	2.9	8.7
Ireland	0.0	18.6	39.4	72.3	48.9	40.7	52.9	67.6
Italy	0.0	1.9	0.1	1.5	0.9	-5.1	19.2	37.7
Netherlands	0.0	10.0	23.7	27.9	39.8	49.7	57.3	52.5
Poland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Portugal	0.0	13.2	39.7	61.6	86.2	109.5	136.6	146.4
Sweden	0.0	0.5	5.5	6.7	12.0	19.2	23.8	27.0
Slovenia	0.0	15.7	17.1	43.8	340.5	311.2	415.7	447.2