



Bottom-up method to derive Cost curves for heat savings in buildings for all European countries

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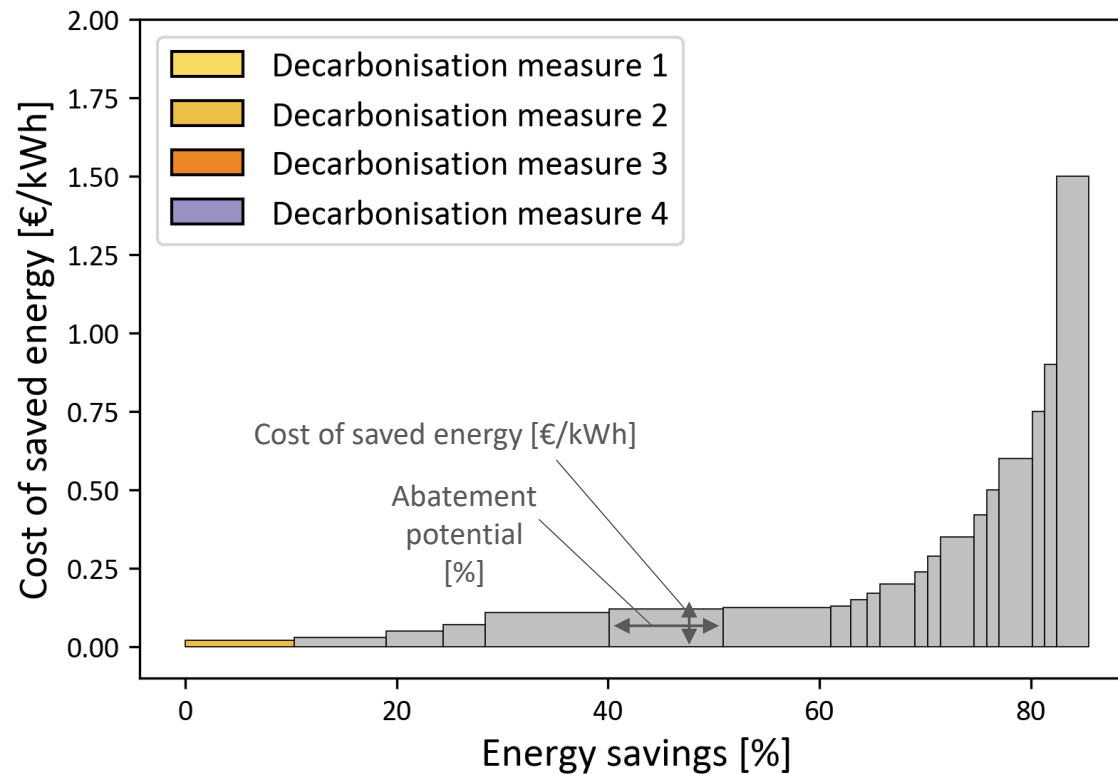
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#SESAAU2021



Objective

To develop a **methodology** to obtain **Cost curves for heat savings** in residential buildings starting from an **open database of the building stock** for all European countries



“Cost curves and especially marginal abatement cost (MAC) curves are a widely used methodology to prioritise political intervention according to costs and related potentials” [1]

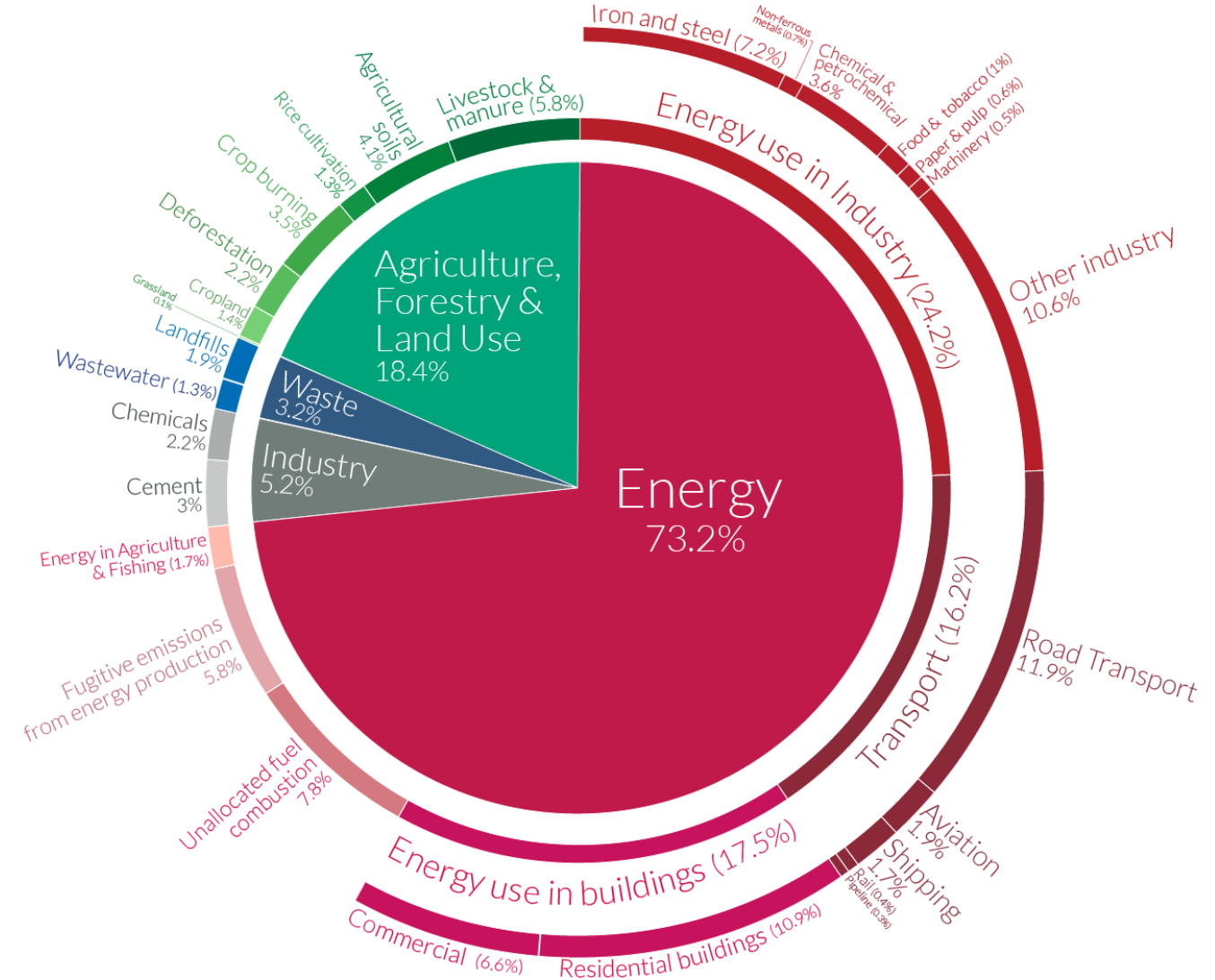
[1] Hummel M, Büchele R, Müller A, Aichinger E, Steinbach J, Kranzl L, et al. The costs and potentials for heat savings in buildings: Refurbishment costs and heat saving cost curves for 6 countries in Europe. Energy Build 2021;231:110454. <https://doi.org/10.1016/j.enbuild.2020.110454>.

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂eq.

Why is relevant?

In Europe, households represent 26% of final energy consumption (2019) [2].

In the world, 10% of the overall GHG comes from the use of energy in residential buildings (2016) [3].



OurWorldinData.org – Research and data to make progress against the world's largest problems.
Source: Climate Watch, the World Resources Institute (2020).

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[2] EUROSTAT https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_consumption_in_households, [3] Emissions by sector, OurWorldInData. <https://ourworldindata.org/emissions-by-sector>

State of the art

	Public ation year	Building simulation model (Timestep, Static vs. dynamic)	Number of categories in which the BS is divided	Number of retrofit measures	Retrofit costs database	Open database of building stock	Number of countries covered
Jakob [4]	2006	Static (annual timestep)	2	12	Costs database for Switzerland	x	1 (Switzerland)
Lund et al. [5]	2014	Static (annual timestep)	27	5	Costs database for Denmark	x	1 (Denmark)
Promjiraprawat [6]	2014	Static (annual timestep)	1	7	Costs database for Thailand	x	1 (Thailand)
Harmsen et al. [7] (HRE)	2018	Static (annual timestep)	10	12	Labour cost Index	✓ (Heat Roadmap Europe)	14 (EU countries)
Filippi Oberegger et al [8]	2020	PHPP (monthly timestep)	16	19	Costs database for South tyrol	x	1 (Italy, South Tyrol)
Hummel et al [1]	2021	Quasi-steady-state monthly energy balance approach (monthly timestep)	15	10	Costs for Germany transformed for the other countries through the construction cost Index	x (Invert/EE-Lab)	6 (AT, CZ, DK, DE, IT, RO)
Our approach	-	ISO 52016-1:2017, Dynamic (hourly timestep)	21	15	Costs for Italy transformed for the other countries through the construction cost Index	✓ (Hotmaps)	EU-27 (achieved through clustering analysis)

[4] Jakob M. Marginal costs and co-benefits of energy efficiency investments: The case of the Swiss residential sector. Energy Policy 2006;34:172–87. <https://doi.org/10.1016/J.ENPOL.2004.08.039>. [5] Lund et al. Heat saving strategies in sustainable smart energy systems. Int J Sustain Energy Plan Manag 2014;4:3–15. <https://doi.org/10.5278/ijsepm.2014.4.2>. [6] Promjiraprawat K, Winyuchakrit P, Limmeechokchai B, Masui T, Hanaoka T, Matsuoka Y. CO2 mitigation potential and marginal abatement costs in Thai residential and building sectors. Energy Build 2014;80:631–9. <https://doi.org/10.1016/J.ENBUILD.2014.02.050>. [7] Harmsen R, Harmsen R, Zuijlen B van, Manz P, al. et. Cost-curves for heating and cooling demand reduction in the built environment and industry. Utrecht: 2018. [8] Filippi Oberegger et al. Bottom-up building stock retrofit based on levelized cost of saved energy. Energy Build 2020;210. <https://doi.org/10.1016/j.enbuild.2020.109757>. [1] Hummel et al. The costs and potentials for heat savings in buildings: Refurbishment costs and heat saving cost curves for 6 countries in Europe. Energy Build 2021;231:110454. <https://doi.org/10.1016/J.ENBUILD.2020.110454>.

Open database of the building stock - HOTMAPS



Building stock data for each of EU-27 countries. It divides the building stock in the following categories:

Building age class:

- Before 1945
- 1945 - 1969
- 1970 - 1979
- 1980 - 1989
- 1990 - 1999
- 2000 - 2010
- Post 2010

Building type:

- Single family- Terraced houses
- Multifamily houses
- Apartment blocks

In particular, these **indicators** are relevant for our analysis:

- Covered area: heated [Mm²]
- Number of buildings [Mil.]
- Number of dwellings/units [Mil.]
- U-values Walls
- U-values Windows
- U-values Roof
- U-values Floor
- Space heating [kWh/m² year]

Sector	Subsector	Building type	Building age class	Covered area: constructed [Mm ²]	Covered area: heated [Mm ²]	Covered area: cooled [Mm ²]	Number of dwellings/units [Mil.]
Residential sector	Total	Total					
Residential sector	Total	Total	Before 1945	51.46	48.82	2.08	0.65
Residential sector	Total	Total	1945 - 1969	63.12	59.88	1.45	0.80
Residential sector	Total	Total	1970 - 1979	69.23	65.68	1.70	0.88
Residential sector	Total	Total	1980 - 1989	57.87	54.91	1.64	0.73

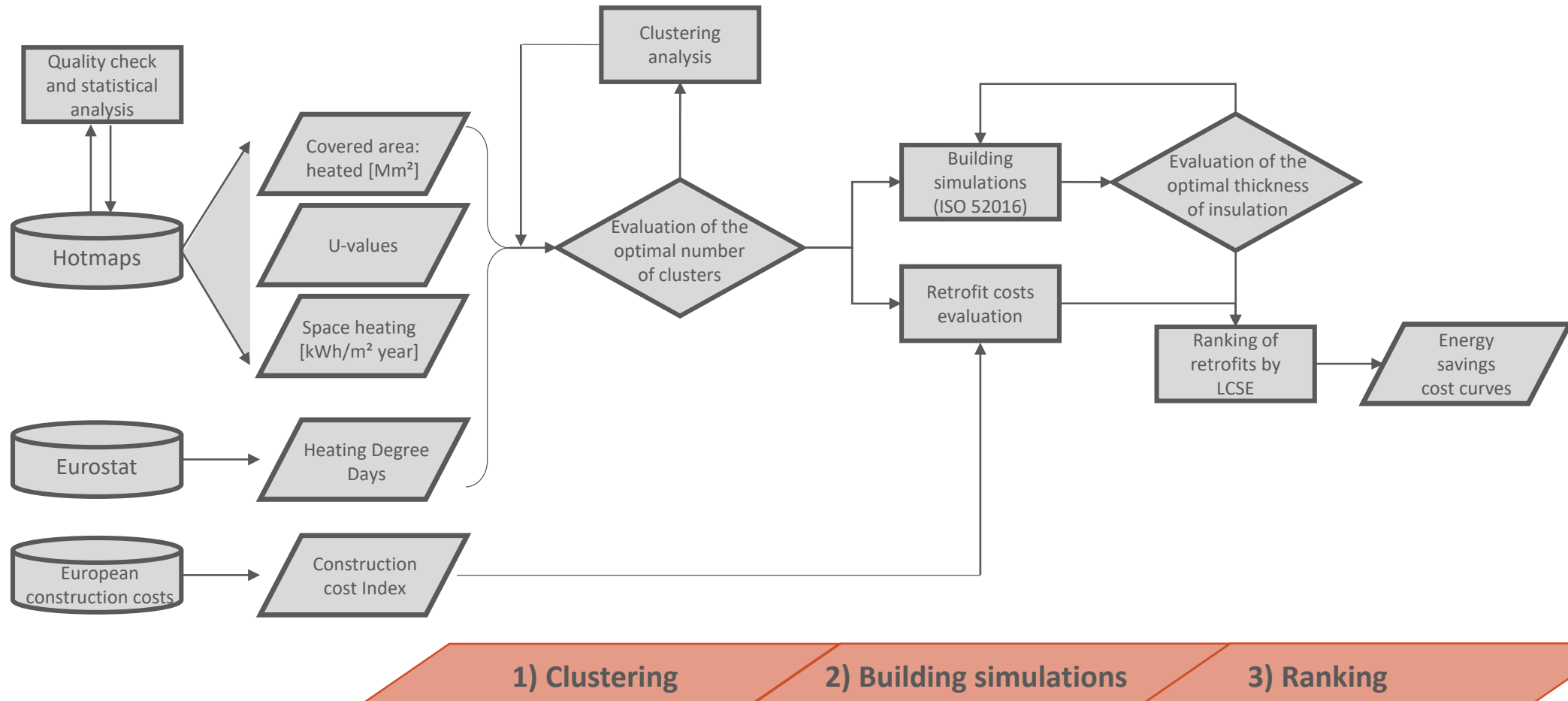
This database is going to be largely used:

- Recently contributed to BPIE (Building Performance Institute Europe) [9] <https://www.bpie.eu/knowledge-hub/#ongoing-projects>
- Building Stock Observatory (ongoing) [10] https://ec.europa.eu/energy/eu-buildings-database_en

[9] BPIE <https://www.bpie.eu/knowledge-hub/#ongoing-projects>. [10] BSO https://ec.europa.eu/energy/eu-buildings-database_en

Methodology – flow chart

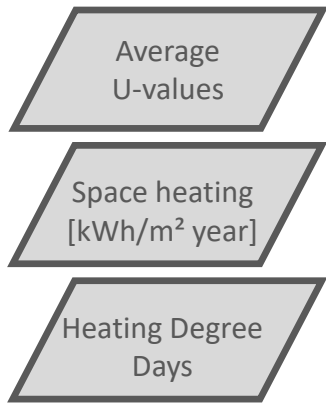
Flow chart of the different activities to obtain the energy savings cost curves.



[11] Hotmaps <https://gitlab.com/hotmaps/building-stock/-/tree/master/data>. [12] Eurostat https://ec.europa.eu/eurostat/databrowser/view/nrg_chdd_a/default/table?lang=en [13] European construction cost, <http://constructioncosts.eu/cost-index/>

1) Clustering

The Clustering analysis is performed on the following three parameters:



Additional assumption: The four U-values (Walls, Roof, Windows and Floor) are grouped using weighted average on building surface area of each of these. [14] to calculate the building surface area and geometries of the considered buildings

The Clustering analysis is performed using the following methods:

- **K-Means method:** It aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean (cluster centroid).
- **Elbow method** for optimal number of clusters
- **Silhouette Score** for optimal number of clusters

Austria	Belgium	Bulgaria	Croatia	Cyprus
[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]
SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB
Before 1945 173.3 103.6 107.9	Before 1945 410.9 195.4 195.4	Before 1945 76 55.3 55.3	Before 1945 190.8 162.7 162.7	Before 1945 56.6 45.6 45.6
1945 - 1969 175.8 120.9 111.8	1945 - 1969 410.9 195.4 195.4	1945 - 1969 78.8 54.3 54.3	1945 - 1969 204.2 136.8 136.8	1945 - 1969 57.1 42.6 42.6
1970 - 1979 163.2 111.9 103.7	1970 - 1979 333.1 182.1 182.1	1970 - 1979 74.8 49.6 49.6	1970 - 1979 163.8 90.5 90.5	1970 - 1979 57.3 39.6 39.6
1980 - 1989 131.4 93.4 85.8	1980 - 1989 255.2 168.7 168.7	1980 - 1989 41.9 45.8 45.8	1980 - 1989 161 107.9 107.9	1980 - 1989 57.6 40.5 40.5
1990 - 1999 118.6 81.6 77.1	1990 - 1999 112.9 102.4 102.4	1990 - 1999 66.2 40.7 40.7	1990 - 1999 55.5 76.3 76.3	1990 - 1999 56.4 39.2 39.2
2000 - 2010 107.9 79.1 70.9	2000 - 2010 195.6 91.5 91.5	2000 - 2010 50.9 31.1 31.1	2000 - 2010 77.1 49.3 49.3	2000 - 2010 56.4 37.3 37.3
Post 2010 92.4 66.7 61.6	Post 2010 96.2 80.7 80.7	Post 2010 45.5 29.6 29.6	Post 2010 36.4 42.2 42.2	Post 2010 56.4 34.1 34.1

Czech Republic	Denmark	Estonia	Finland	France
[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]
SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB
Before 1945 190.3 123.8 123.8	Before 1945 226.4 153.2 153.2	Before 1945 291.8 202.3 202.3	Before 1945 254.1 147.9 147.9	Before 1945 243.9 166 166
1945 - 1969 186.3 121 121	1945 - 1969 202.6 145.8 145.8	1945 - 1969 236.4 137 137	1945 - 1969 233.1 124.9 124.9	1945 - 1969 197.9 130.5 130.5
1970 - 1979 171.7 118.1 118.1	1970 - 1979 168.4 89.6 89.6	1970 - 1979 245.6 129.3 129.3	1970 - 1979 240.2 129.1 129.1	1970 - 1979 225.3 135.3 135.3
1980 - 1989 141.8 90.2 90.2	1980 - 1989 149.2 75.5 75.5	1980 - 1989 190.4 99.8 99.8	1980 - 1989 224.2 130.6 130.6	1980 - 1989 194.5 89 89
1990 - 1999 177.8 90.2 90.2	1990 - 1999 109.4 67.2 67.2	1990 - 1999 173.8 70 70	1990 - 1999 202.4 126.5 126.5	1990 - 1999 153.4 81.6 81.6
2000 - 2010 115.5 90.1 90.1	2000 - 2010 69.6 59 59	2000 - 2010 227.3 105.3 105.3	2000 - 2010 194.5 82.4 82.4	2000 - 2010 106.9 64.5 64.5
Post 2010 110.5 77.8 77.8	Post 2010 54.8 39.7 39.7	Post 2010 192.3 77.1 77.1	Post 2010 188.5 30 30	Post 2010 66.9 51.3 51.3

Germany	Greece	Hungary	Ireland	Italy
[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]
SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB
Before 1945 261.9 209.2 155.2	Before 1945 105.8 72.3 72.3	Before 1945 243.1 84.9 84.9	Before 1945 131.1 155 155	Before 1945 147.3 123.2 123.2
1945 - 1969 232.4 198.6 141.3	1945 - 1969 109.2 75.1 75.1	1945 - 1969 204.1 120.2 120.2	1945 - 1969 118.4 160.2 160.2	1945 - 1969 206 126.1 126.1
1970 - 1979 210.9 144.8 104.7	1970 - 1979 111.7 75.4 75.4	1970 - 1979 178.1 86.5 86.5	1970 - 1979 116.5 139.9 139.5	1970 - 1979 185.8 121.3 121.3
1980 - 1989 163.6 131.9 101	1980 - 1989 91.6 75.7 75.7	1980 - 1989 153.7 52.9 52.9	1980 - 1989 99.8 64.4 64.4	1980 - 1989 165.9 118.8 118.8
1990 - 1999 109.9 84.5 76.9	1990 - 1999 102 90.6 90.6	1990 - 1999 141.1 44.2 44.2	1990 - 1999 83.2 65.9 65.9	1990 - 1999 129.4 93.7 93.7
2000 - 2010 101.9 81.5 59.3	2000 - 2010 171.6 21.3 21.3	2000 - 2010 131.1 30 30	2000 - 2010 75.6 39.9 39.9	2000 - 2010 118.7 78.7 78.7
Post 2010 68.2 50.6 46	Post 2010 149.4 19.1 19.1	Post 2010 121 15.7 15.7	Post 2010 67.5 10.8 10.8	Post 2010 108 75.3 75.3

Latvia	Lithuania	Luxembourg	Malta	Netherlands
[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]
SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB
Before 1945 308.7 185.1 185.1	Before 1945 299 233.3 233.3	Before 1945 344.4 195 195	Before 1945 34.6 14.1 14.1	Before 1945 152.2 212.8 212.8
1945 - 1969 289.8 165.3 165.3	1945 - 1969 264.9 180.3 180.3	1945 - 1969 337.4 202.8 202.8	1945 - 1969 34.3 15.3 15.3	1945 - 1969 155.7 215.2 215.2
1970 - 1979 296.1 164.5 164.5	1970 - 1979 181.1 103.9 103.9	1970 - 1979 202.5 123 123	1970 - 1979 29 11.7 11.7	1970 - 1979 139.4 194.6 194.6
1980 - 1989 273 142.4 142.4	1980 - 1989 144 91 91	1980 - 1989 183.5 102.9 102.9	1980 - 1989 27.7 11.1 11.1	1980 - 1989 96.8 112.6 112.6
1990 - 1999 198.8 121 121	1990 - 1999 106.9 78 78	1990 - 1999 122.2 71.4 71.4	1990 - 1999 25.6 10.5 10.5	1990 - 1999 59.8 70.9 70.9
2000 - 2010 151.4 107.4 107.4	2000 - 2010 86.3 63.5 63.5	2000 - 2010 101.2 35.9 35.9	2000 - 2010 18.4 9.9 9.9	2000 - 2010 34.9 57.5 57.5
Post 2010 102 98 98	Post 2010 65.6 49 49	Post 2010 44.1 5.2 5.2	Post 2010 17.6 8.6 8.6	Post 2010 12 13.9 13.9

Poland	Portugal	Romania	Slovakia	Slovenia
[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]	[kWh/m²y]
SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB	SFH MFH AB
Before 1945 312.4 171.1 171.1	Before 1945 136.2 101.4 101.4	Before 1945 181.4 111.9 111.9	Before 1945 140.9 111.6 111.6	Before 1945 201 127.8 127.8
1945 - 1969 253.8 99.4 99.4	1945 - 1969 116.8 78.8 78.8	1945 - 1969 172.5 79.8 79.8	1945 - 1969 182.7 111.7 111.7	1945 - 1969 198 113.6 113.6
1970 - 1979 194 73.3 73.3	1970 - 1979 116.1 78.1 78.1	1970 - 1979 175 78.2 78.2	1970 - 1979 168.1 99.7 99.7	1970 - 1979 170.8 83.1 83.1
1980 - 1989 176 70.6 70.6	1980 - 1989 107.5 72.7 72.7	1980 - 1989 140.6 66.4 66.4	1980 - 1989 153.4 87.7 87.7	1980 - 1989 162.6 63.9 63.9
1990 - 1999 158 67.8 67.8	1990 - 1999 90.4 84.8 84.8	1990 - 1999 172.2 104.7 104.7	1990 - 1999 152.3 93.1 93.1	1990 - 1999 130.4 56.7 56.7
2000 - 2010 121.9 62.3 62.3	2000 - 2010 73.3 50.7 50.7	2000 - 2010 91.5 40 40	2000 - 2010 142.9 74.1 74.1	2000 - 2010 99 49.5 49.5
Post 2010 121.9 57.6 57.6	Post 2010 78.7 33.7 33.7	Post 2010 64.5 37.4 37.4	Post 2010 133.5 70.6 70.6	Post 2010 83 36.1 36.1

Spain	Sweden
[kWh/m²y]	[kWh/m²y]
SFH MFH AB	SFH MFH AB
Before 1945 75.9 59.3 59.3	Before 1945 263.5 182.6 182.6
1945 - 1969 80.3 55.8 55.8	1945 - 1969 216.6 134.1 134.1
1970 - 1979 76.4 51.2 51.2	1970 - 1979 160.9 87.1 87.1
1980 - 1989 46.9 38.1 38.1	1980 - 1989 140.3 70.6 70.6
1990 - 1999 47.3 36.4 36.4	1990 - 1999 166.4 77.4 77.4
2000 - 2010 43.4 29.2 29.2	2000 - 2010 156.3 67.6 67.6
Post 2010 31.7 24.1 24.1	Post 2010 146.2 57.8 57.8

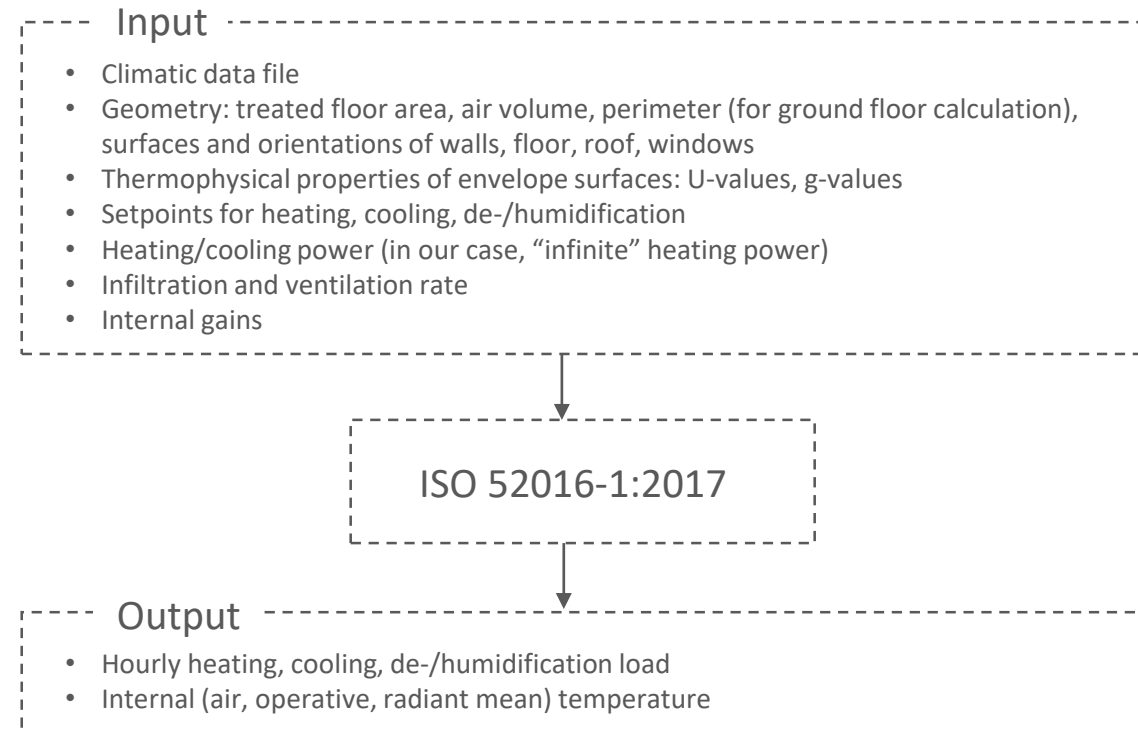
2) Building simulations - ISO 52016-1:2017

After clustering, the **closest** points **to centroids** are chosen for the building simulation and evaluation of energy savings for each retrofit package.

			HDD	kWh	Average U-value
Romania	1970 - 1979	Single family-Terraced houses	2886	175.0	1.47
Portugal	1990 - 1999	Appartment blocks	1199	84.8	1.72
Ireland	1990 - 1999	Single family-Terraced houses	2804	83.2	0.69
Sweden	1945 - 1969	Multifamily houses	5175	134.1	0.59

Retrofit packages:

- | | | |
|------------------|----------------------|--|
| 1) Façade | 6) Roof + Basement | 11) Windows + Basement |
| 2) Roof | 7) Roof + Windows | 12) Roof + Façade + Basement |
| 3) Windows | 8) Façade + Windows | 13) Roof + Façade + Windows |
| 4) Basement | 9) Façade + Basement | 14) Façade + Windows + Basement |
| 5) Roof + Façade | 10) Façade + Windows | 15) Roof + Façade + Basement + Windows |



3) Ranking

Levelised Cost of Saved Energy (LCSE) indicator allows direct comparison between energy supply (e.g. natural gas price) and Retrofit packages (energy efficiency measures):

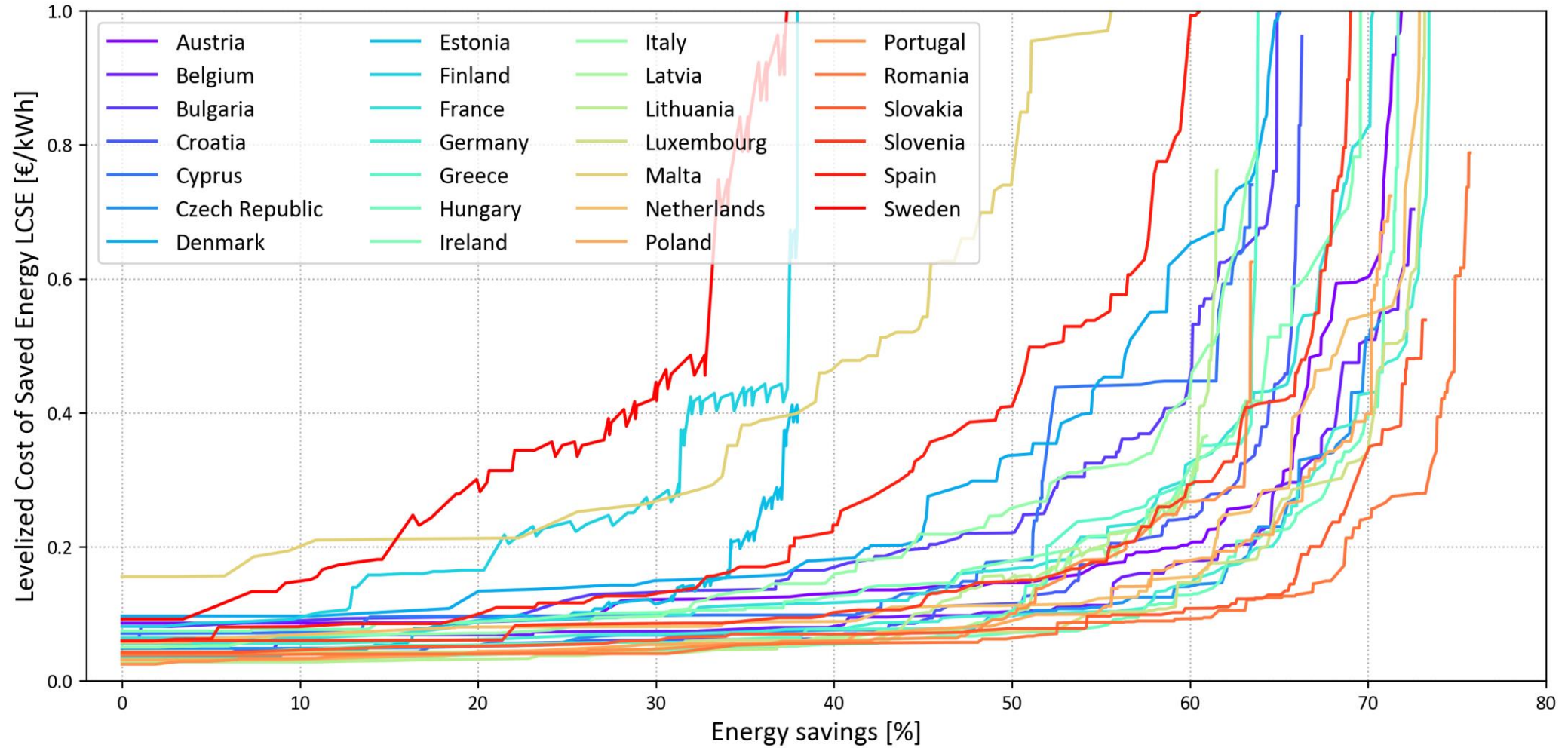
$$LCSE = \frac{C}{S} \cdot CRF$$

$$CRF = \frac{i \cdot (1 + i)^n}{(1 + i)^n - 1}$$

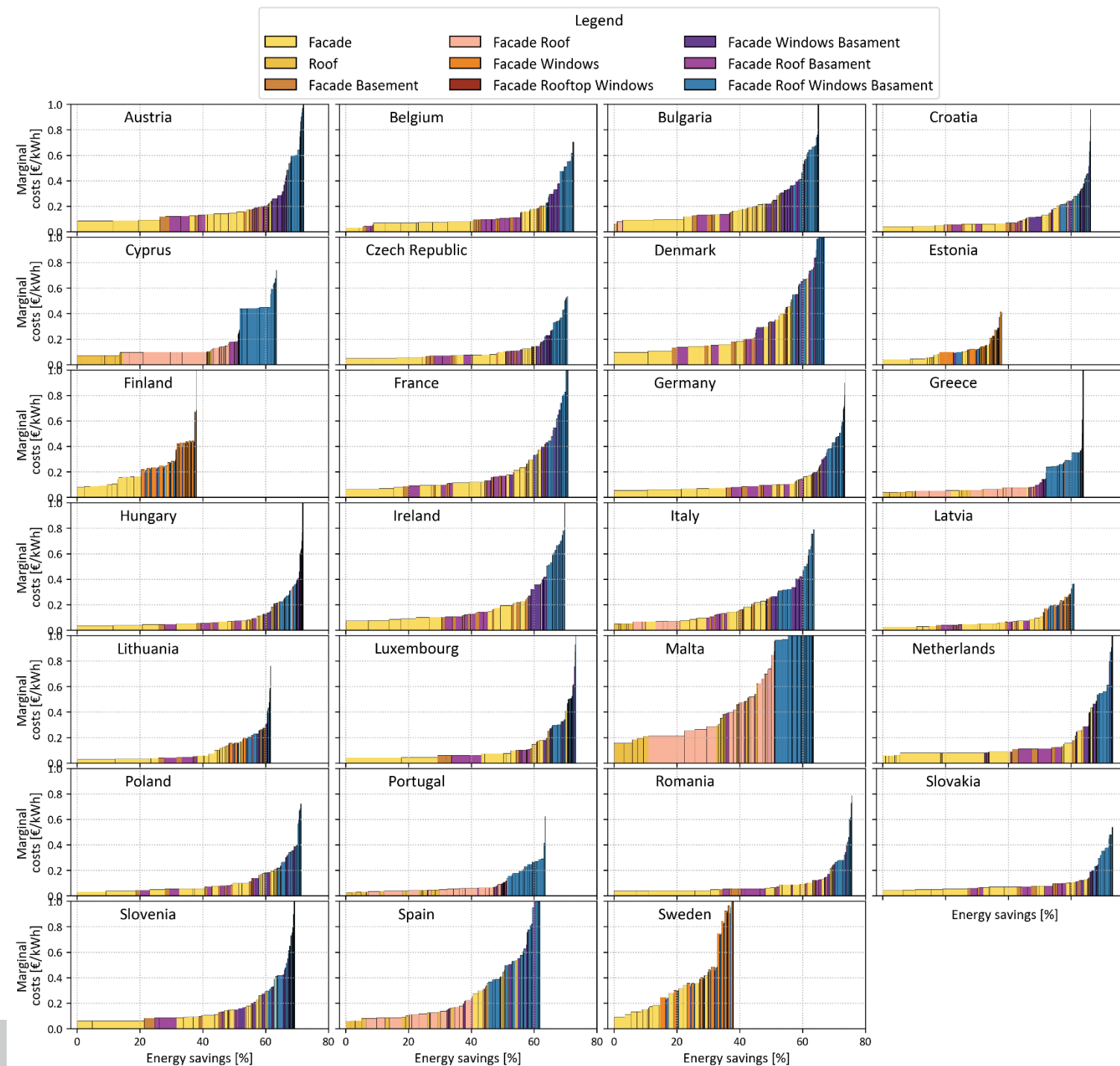
C	= Total cost spread in equal annual payments (investment cost is considered as loan with annual-repayment)
S	= Annual energy savings
CRF	= Capital Recovery Factor
i	= Discount rate (4%)
n	= Retrofit lifetime (30 years)

In this phase the algorithm (for each country) **calculates the LCSE** for each retrofit package for each building type and construction period. It ranks in **ascending order the retrofit measures** applied on the different buildings based on their LCSE.

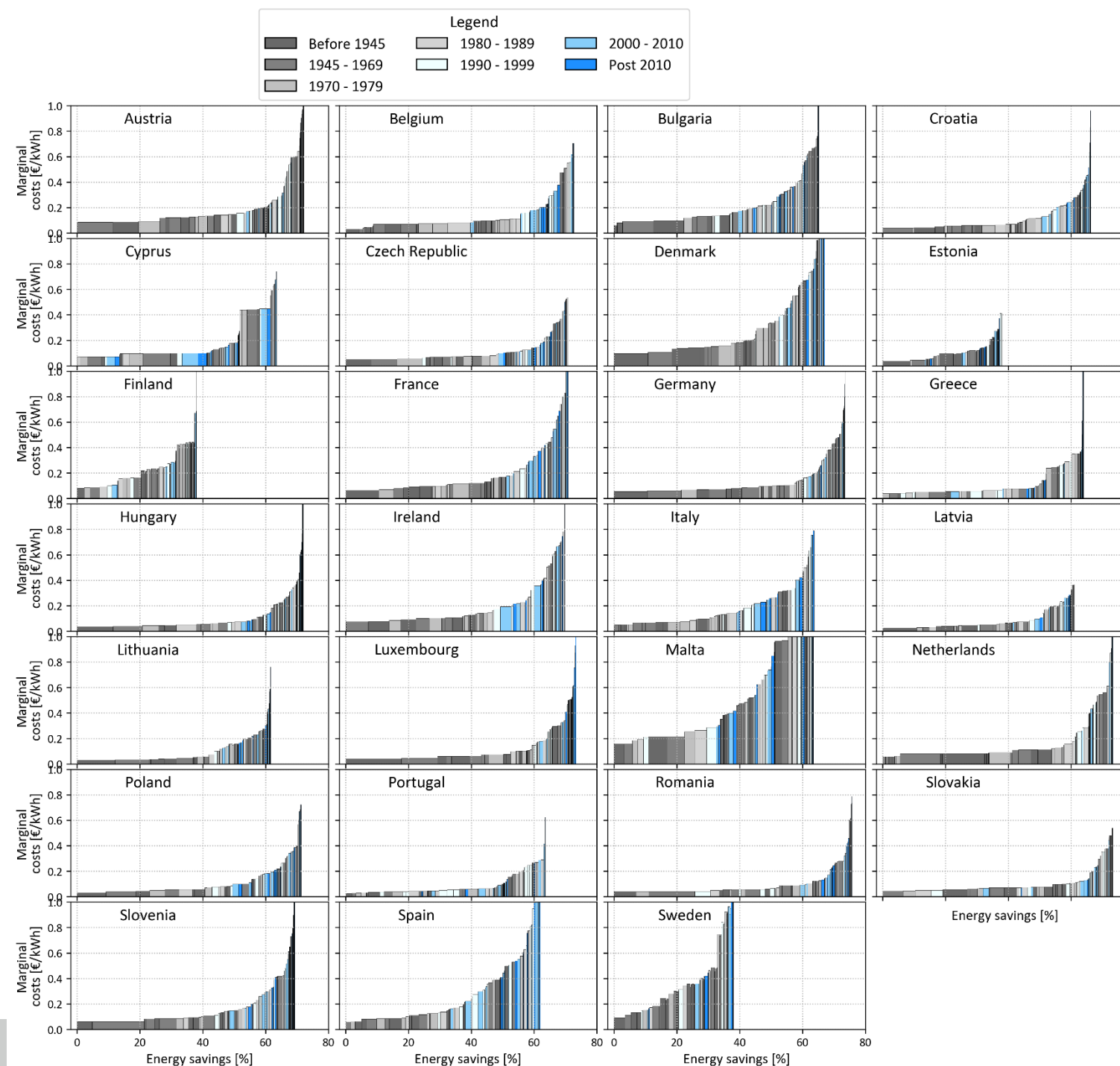
Results



Results



Results



Conclusions

- A methodology to obtain **heat savings cost curves** in residential buildings starting from an **open database** of the building stock for **all European countries** has been presented.
- Elements of **novelty**:
 - **Dynamic approach** in building simulations model applied to energy savings cost curves
 - Building stock data are taken from an **open database** and **open-source approach** (full source code can be found on GitLab repository [16])
 - Heat savings cost curves derived for **each EU country**
- Cost curves are particularly important for providing the explicit technological detail in the graphical representation
- These curves allow to evaluate the decarbonization process of the residential sector and its costs. They are **relevant** tools if used in energy system modelling to evaluate the **decarbonization process** not only through **active measures** (heat pumps, district heating, etc..) but also **passive measures** (energy efficiency options in buildings).

Thank you for your attention

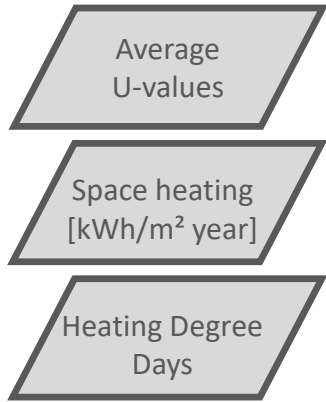
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eurac
research

1) Clustering

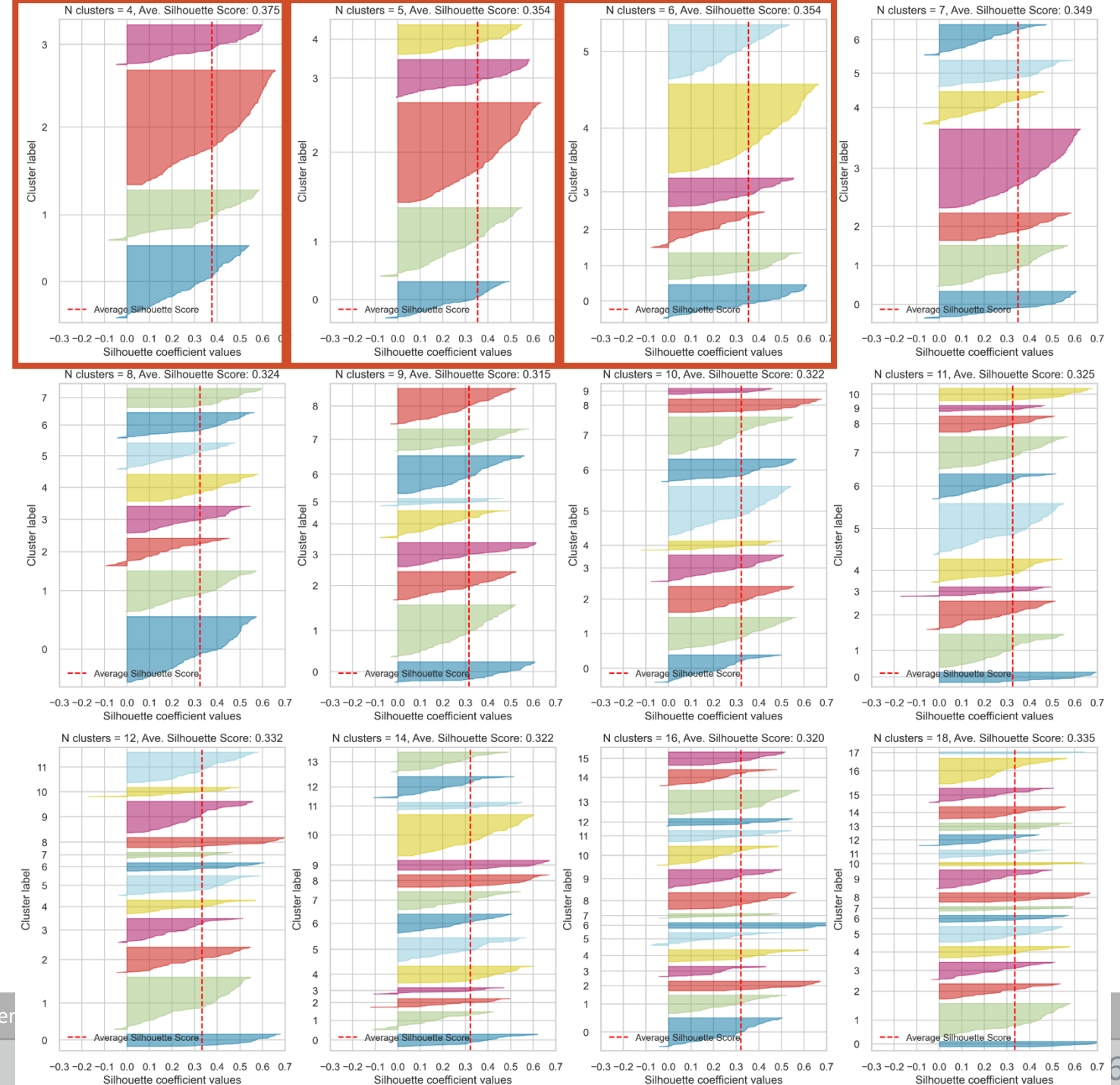
The Clustering analysis is performed on the following three variables:



Additional assumption: The four U-values (Walls, Roof, Windows and Floor) are grouped using weighted average on building surface area of each of these. [14] to calculate the building surface area and geometries of the considered buildings

The Clustering analysis is performed using the following methods:

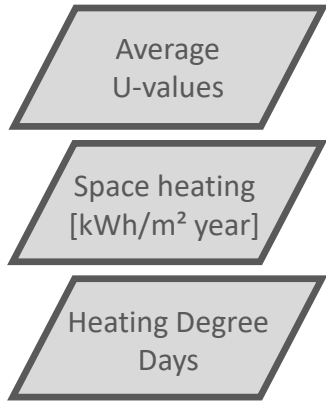
- **K-Means method:** It aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean (cluster centroid).
- **Elbow method** for optimal number of clusters
- **Silhouette Score** for optimal number of clusters



[14] Kragh J, Wittchen KB. Development of two Danish building typologies for residential buildings

1) Clustering

The Clustering analysis is performed on the following three variables:

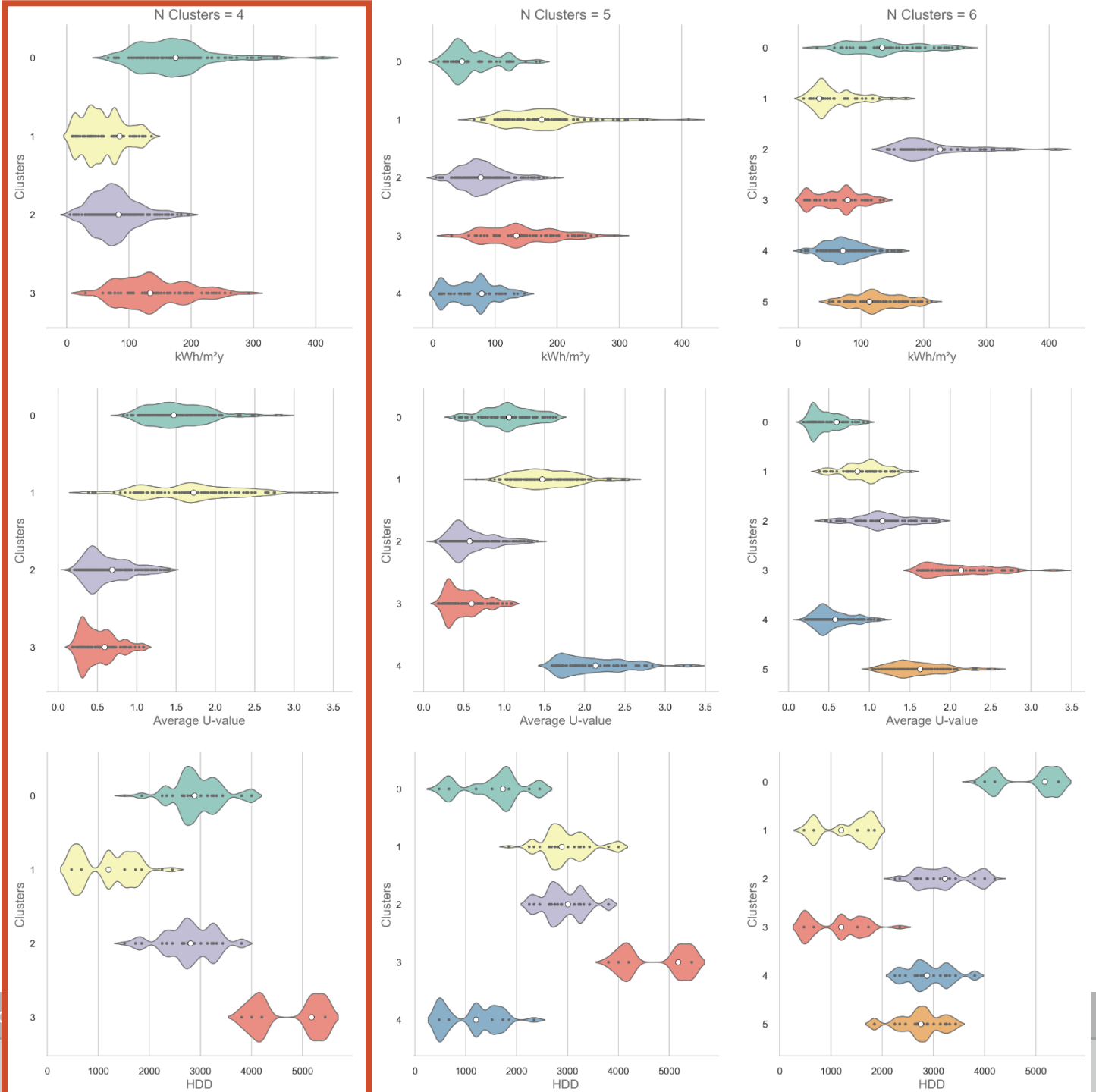


Additional assumption: The four U-values (Walls, Roof, Windows and Floor) are grouped using weighted average on building surface area of each of these. [14] to calculate the building surface area and geometries of the considered buildings

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[14] Kragh J, Wittchen KB. Development of two Danish building typologies for res



HOTMAPS data

Surface shares of area heated for building type and construction period

Austria				Belgium				Bulgaria				Croatia				Cyprus			
[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB
Before 1945	12.8	4.6	5.2	Before 1945	3.2	8.3	0.9	Before 1945	14.8	0.5	5.5	Before 1945	8.6	1.1	3.3	Before 1945	6.2	1.4	0.2
1945 - 1969	17.4	4.1	5	1945 - 1969	1	8.1	6	1945 - 1969	14.6	1.1	7	1945 - 1969	11.3	1.6	4.2	1945 - 1969	25.1	2.2	5
1970 - 1979	11.3	1.7	2.4	1970 - 1979	0.4	8.2	8.1	1970 - 1979	8.2	1.3	5.1	1970 - 1979	11.8	2.1	4.5	1970 - 1979	12.9	1.7	2.7
1980 - 1989	9.5	1.7	1.1	1980 - 1989	0.2	5.7	8	1980 - 1989	6.9	1.7	5.1	1980 - 1989	9.7	0.7	3.6	1980 - 1989	5.5	1.1	0.6
1990 - 1999	9.9	2.7	1.5	1990 - 1999	0.7	7.9	5.9	1990 - 1999	5.6	1.1	4	1990 - 1999	8.5	0.9	3.4	1990 - 1999	4.5	1.5	0.1
2000 - 2010	4.2	1.3	1.4	2000 - 2010	2.7	8	5.5	2000 - 2010	6	0.7	4.5	2000 - 2010	9.5	2.2	4	2000 - 2010	15	1	3.4
Post 2010	1.1	0.5	0.5	Post 2010	1.2	4.9	5.2	Post 2010	2.8	0.8	2.7	Post 2010	4.5	1.7	2.7	Post 2010	8.1	0.1	1.5

Czech Republic				Denmark				Estonia				Finland				France			
[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB
Before 1945	12	0.7	4.8	Before 1945	12	6.5	2.1	Before 1945	27.2	2.2	3.8	Before 1945	7.2	0.8	1.3	Before 1945	11.5	6.1	0.7
1945 - 1969	12.4	0.8	6.9	1945 - 1969	9.5	7.3	1.5	1945 - 1969	15.2	0.9	5.1	1945 - 1969	10.6	7.4	7.4	1945 - 1969	4.1	7.8	2.2
1970 - 1979	12.8	0.8	6	1970 - 1979	11.3	7.3	1.5	1970 - 1979	2.5	3.9	2.2	1970 - 1979	6.1	7.7	7.7	1970 - 1979	5.6	8	2.1
1980 - 1989	7.5	2.5	3	1980 - 1989	1.3	8.3	0.5	1980 - 1989	1.6	4.3	1.7	1980 - 1989	8.7	3.9	3.9	1980 - 1989	4.9	8.3	1.8
1990 - 1999	3.9	4.3	1.1	1990 - 1999	1.3	8.3	0.5	1990 - 1999	1.4	8.5	1.9	1990 - 1999	5.8	3.5	3.5	1990 - 1999	0.4	8.6	0.9
2000 - 2010	6.4	3.1	2.4	2000 - 2010	1.9	8.2	0.6	2000 - 2010	1.1	8.3	2.1	2000 - 2010	6.4	3.2	3.2	2000 - 2010	4.7	8.3	1.7
Post 2010	3.4	4.4	0.8	Post 2010	1.7	7.9	0.6	Post 2010	2.9	2.7	0.7	Post 2010	0.9	0.5	0.3	Post 2010	2.4	9.5	0.5

Germany				Greece				Hungary				Ireland				Italy			
[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB
Before 1945	14.3	6.6	0.5	Before 1945	4.6	2.5	1.1	Before 1945	12.1	2	3.9	Before 1945	7.5	0.1	8.7	Before 1945	4.3	7.3	4.3
1945 - 1969	16.8	9.8	3.6	1945 - 1969	13.4	3.2	6.1	1945 - 1969	11.6	2	4.1	1945 - 1969	7.2	0.2	9.1	1945 - 1969	3.6	8.3	3.3
1970 - 1979	8.4	3.7	3.1	1970 - 1979	10.9	3.4	4.8	1970 - 1979	7.7	3	2.4	1970 - 1979	7	0.6	4.8	1970 - 1979	3.9	8.4	3.2
1980 - 1989	6.7	2.9	1.1	1980 - 1989	12.5	3.2	6.6	1980 - 1989	10.8	3.1	4.5	1980 - 1989	6.1	0.4	9.6	1980 - 1989	2.9	9.3	2.3
1990 - 1999	7	2.4	1.1	1990 - 1999	9.8	1.8	4.6	1990 - 1999	4.5	3.3	3.2	1990 - 1999	9.4	0.5	0.3	1990 - 1999	1.9	10.3	1.3
2000 - 2010	5.7	1.4	0.5	2000 - 2010	2.7	3.4	0.2	2000 - 2010	5.6	3.2	3.9	2000 - 2010	18	1	2.5	2000 - 2010	1.7	10.3	1.3
Post 2010	2.7	1.3	0.3	Post 2010	1.7	3.4	0.1	Post 2010	3.4	2.5	3.3	Post 2010	5.6	0.1	1.5	Post 2010	1.5	9.5	1.1

Latvia				Lithuania				Luxembourg				Malta				Netherlands			
[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB
Before 1945	12.3	8	1.6	Before 1945	13.3	0.8	3.4	Before 1945	20.6	1.9	2.8	Before 1945	11.4	2.5	4.4	Before 1945	20.6	1	1.1
1945 - 1969	2.4	8.6	2.6	1945 - 1969	13.3	1.3	6.3	1945 - 1969	13.5	2.1	2.7	1945 - 1969	10.2	2.6	4.3	1945 - 1969	19.3	1	1.1
1970 - 1979	2.3	9.2	1.9	1970 - 1979	8.2	1.4	5	1970 - 1979	9.2	3.9	0.8	1970 - 1979	7.4	2.5	3.7	1970 - 1979	11.3	1.7	0.4
1980 - 1989	2.9	8.9	2.3	1980 - 1989	9.3	0.3	5	1980 - 1989	6.9	4.4	0.3	1980 - 1989	9	2.5	3.9	1980 - 1989	11.9	1.6	0.5
1990 - 1999	2.8	8.9	2.2	1990 - 1999	6.5	2.4	2.4	1990 - 1999	3.6	5	0.3	1990 - 1999	7.8	2.5	3.9	1990 - 1999	10.7	1.7	0.4
2000 - 2010	2.7	10	2.3	2000 - 2010	7	2.5	2.4	2000 - 2010	8.9	2	1.3	2000 - 2010	4.9	3.2	3.2	2000 - 2010	7.7	1.9	0.2
Post 2010	1.4	5.1	1.5	Post 2010	5.5	2.3	1.4	Post 2010	7.7	1.5	0.7	Post 2010	4	3.1	2.9	Post 2010	3.8	2	0.1

Poland				Portugal				Romania				Slovakia				Slovenia			
[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB
Before 1945	8.8	1.2	5.7	Before 1945	7.7	0.5	3.1	Before 1945	9.2	0.5	2.8	Before 1945	14.1	0.2	8.9	Before 1945	5.9	3	3.5
1945 - 1969	11.4	0.4	6.6	1945 - 1969	6.5	3.1	3.1	1945 - 1969	20.4	2	8.6	1945 - 1969	9.1	0.7	10.3	1945 - 1969	20.8	3.2	5.1
1970 - 1979	7.4	0.7	4.5	1970 - 1979	7.8	5.3	5.3	1970 - 1979	5.6	0.8	6.3	1970 - 1979	5.9	1.9	4.5	1970 - 1979	6.2	3.3	3.2
1980 - 1989	7.2	0.6	4.3	1980 - 1989	8	4.6	4.6	1980 - 1989	4.8	0.6	5.3	1980 - 1989	8.5	1.4	6	1980 - 1989	4.4	3.6	2.8
1990 - 1999	7.3	0.5	4.2	1990 - 1999	8.3	6.4	6.4	1990 - 1999	6.8	0.6	2.8	1990 - 1999	6.1	3.1	3.4	1990 - 1999	4.1	3.7	2.8
2000 - 2010	8.8	1.7	7.1	2000 - 2010	8.3	2.6	2.6	2000 - 2010	6.7	1.2	3.8	2000 - 2010	6.6	2.1	4.4	2000 - 2010	7.4	3.1	3.3
Post 2010	4.8	3.9	3	Post 2010	3.2	0.4	2.1	Post 2010	6.4	1.2	3.6	Post 2010	1.2	0.8	1.1	Post 2010	4.8	2.9	3

Spain				Sweden				United Kingdom			
[%]	SFH	MFH	AB	[%]	SFH	MFH	AB	[%]	SFH	MFH	AB
Before 1945	8	2	5.5	Before 1945	7.7	6.2	4.5	Before 1945	24.5	5.5	0.8
1945 - 1969	6.4	0.6	6.9	1945 - 1969	5.3	9.5	1.2	1945 - 1969	17.3	1.9	0.5
1970 - 1979	5.3	0.8	6.8	1970 - 1979	5.1	9.4	1.2	1970 - 1979	6.6	1.8	0.2
1980 - 1989	6.9	2	5.6	1980 - 1989	3.9	9.4	1.3	1980 - 1989	4.7	1.2	0.2
1990 - 1999	6.8	1.9	5.6	1990 - 1999	1.8	9.8	0.9	1990 - 1999	4.7	1.1	0.1
2000 - 2010	6.6	3.1	9.8	2000 - 2010	1.4	10.3	0.3	2000 - 2010	13.7	2.4	0.5
Post 2010	3.6	2.2	3.7	Post 2010	1.2	9.2	0.3	Post 2010	10.7	1.4	0.3

HOTMAPS data

Surface shares of area heated for building type and construction period

Austria				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	173.3	103.6	107.9	
1945 - 1969	175.8	120.9	111.8	
1970 - 1979	163.2	111.9	103.7	
1980 - 1989	131.4	93.4	85.8	
1990 - 1999	118.6	81.6	77.1	
2000 - 2010	107.9	79.1	70.9	
Post 2010	92.4	66.7	61.6	

Belgium				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	410.9	195.4	195.4	
1945 - 1969	410.9	195.4	195.4	
1970 - 1979	333.1	182.1	182.1	
1980 - 1989	255.2	168.7	168.7	
1990 - 1999	112.9	102.4	102.4	
2000 - 2010	195.6	91.5	91.5	
Post 2010	96.2	80.7	80.7	

Bulgaria				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	76	55.3	55.3	
1945 - 1969	78.8	54.3	54.3	
1970 - 1979	74.8	49.6	49.6	
1980 - 1989	41.9	45.8	45.8	
1990 - 1999	66.2	40.7	40.7	
2000 - 2010	50.9	31.1	31.1	
Post 2010	45.5	29.6	29.6	

Croatia				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	190.8	162.7	162.7	
1945 - 1969	204.2	136.8	136.8	
1970 - 1979	163.8	90.5	90.5	
1980 - 1989	161	107.9	107.9	
1990 - 1999	55.5	76.3	76.3	
2000 - 2010	77.1	49.3	49.3	
Post 2010	36.4	42.2	42.2	

Cyprus				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	56.6	45.6	45.6	
1945 - 1969	57.1	42.6	42.6	
1970 - 1979	57.3	39.6	39.6	
1980 - 1989	57.6	40.5	40.5	
1990 - 1999	56.4	39.2	39.2	
2000 - 2010	56.4	37.3	37.3	
Post 2010	56.4	34.1	34.1	

Czech Republic				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	190.3	123.8	123.8	
1945 - 1969	186.3	121	121	
1970 - 1979	171.7	118.1	118.1	
1980 - 1989	141.8	90.2	90.2	
1990 - 1999	177.8	90.2	90.2	
2000 - 2010	115.5	90.1	90.1	
Post 2010	110.5	77.8	77.8	

Denmark				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	226.4	153.2	153.2	
1945 - 1969	202.6	145.8	145.8	
1970 - 1979	168.4	89.6	89.6	
1980 - 1989	149.2	75.5	75.5	
1990 - 1999	109.4	67.2	67.2	
2000 - 2010	69.6	59	59	
Post 2010	54.8	39.7	39.7	

Estonia				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	291.8	202.3	202.3	
1945 - 1969	236.4	137	137	
1970 - 1979	245.6	129.3	129.3	
1980 - 1989	190.4	99.8	99.8	
1990 - 1999	173.8	70	70	
2000 - 2010	227.3	105.3	105.3	
Post 2010	192.3	77.1	77.1	

Finland				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	254.1	147.9	147.9	
1945 - 1969	233.1	124.9	124.9	
1970 - 1979	240.2	129.1	129.1	
1980 - 1989	224.2	130.6	130.6	
1990 - 1999	202.4	126.5	126.5	
2000 - 2010	194.5	82.4	82.4	
Post 2010	188.5	30	30	

France				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	243.9	166	166	
1945 - 1969	197.9	130.5	130.5	
1970 - 1979	225.3	135.3	135.3	
1980 - 1989	194.5	89	89	
1990 - 1999	153.4	81.6	81.6	
2000 - 2010	106.9	64.5	64.5	
Post 2010	66.9	51.3	51.3	

Germany				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	261.9	209.2	155.2	
1945 - 1969	232.4	198.6	141.3	
1970 - 1979	210.9	144.8	104.7	
1980 - 1989	163.6	131.9	101	
1990 - 1999	109.9	84.5	76.9	
2000 - 2010	101.9	81.5	59.3	
Post 2010	68.2	50.6	46	

Greece				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	105.8	72.3	72.3	
1945 - 1969	109.2	75.1	75.1	
1970 - 1979	111.7	75.4	75.4	
1980 - 1989	91.6	75.7	75.7	
1990 - 1999	102	90.6	90.6	
2000 - 2010	171.6	21.3	21.3	
Post 2010	149.4	19.1	19.1	

Hungary				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	243.1	84.9	84.9	
1945 - 1969	204.1	120.2	120.2	
1970 - 1979	178.1	86.5	86.5	
1980 - 1989	153.7	52.9	52.9	
1990 - 1999	141.1	44.2	44.2	
2000 - 2010	131.1	30	30	
Post 2010	121	15.7	15.7	

Ireland				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	131.1	155	155	
1945 - 1969	118.4	160.2	160.2	
1970 - 1979	116.5	139.9	139.5	
1980 - 1989	99.8	64.4	64.4	
1990 - 1999	83.2	65.9	65.9	
2000 - 2010	75.6	39.9	39.9	
Post 2010	67.5	10.8	10.8	

Italy				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	147.3	123.2	123.2	
1945 - 1969	206	126.1	126.1	
1970 - 1979	185.8	121.3	121.3	
1980 - 1989	165.9	118.8	118.8	
1990 - 1999	129.4	93.7	93.7	
2000 - 2010	118.7	78.7	78.7	
Post 2010	108	75.3	75.3	

Latvia				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	308.7	185.1	185.1	
1945 - 1969	289.8	165.3	165.3	
1970 - 1979	296.1	164.5	164.5	
1980 - 1989	273	142.4	142.4	
1990 - 1999	198.8	121	121	
2000 - 2010	151.4	107.4	107.4	
Post 2010	102	98	98	

Lithuania				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	299	233.3	233.3	
1945 - 1969	264.9	180.3	180.3	
1970 - 1979	181.1	103.9	103.9	
1980 - 1989	144	91	91	
1990 - 1999	106.9	78	78	
2000 - 2010	86.3	63.5	63.5	
Post 2010	65.6	49	49	

Luxembourg				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	344.4	195	195	
1945 - 1969	337.4	202.8	202.8	
1970 - 1979	202.5	123	123	
1980 - 1989	183.5	102.9	102.9	
1990 - 1999	122.2	71.4	71.4	
2000 - 2010	101.2	35.9	35.9	
Post 2010	44.1	5.2	5.2	

Malta				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	34.6	14.1	14.1	
1945 - 1969	34.3	15.3	15.3	
1970 - 1979	29	11.7	11.7	
1980 - 1989	27.7	11.1	11.1	
1990 - 1999	25.6	10.5	10.5	
2000 - 2010	18.4	9.9	9.9	
Post 2010	17.6	8.6	8.6	

Netherlands				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	152.2	212.8	212.8	
1945 - 1969	155.7	215.2	215.2	
1970 - 1979	139.4	194.6	194.6	
1980 - 1989	96.8	112.6	112.6	
1990 - 1999	59.8	70.9	70.9	
2000 - 2010	34.9	57.5	57.5	
Post 2010	12	13.9	13.9	

Poland				
[kWh/m ² y]	SFH	MFH	AB	
Before 1945	312.4	171.1	171.1	
1945 - 1969	253.8	99.4	99.4	
1970 - 1979	194	73.3	73.3	
1980 - 1989	176	70.6	70.6	
1990 - 1999	158	67.8	67.8	
2000 - 2010	121.9	62.3	62.3	
Post 2010	121.9	57.6	57.6	

U-values

Walls

Austria				
[U-values]	SFH	MFH	AB	
Before 1945	1.34	1.5	1.5	
1945 - 1969	1.4	1.4	1.4	
1970 - 1979	1.3	1.8	1.1	
1980 - 1989	0.95	0.6	0.7	
1990 - 1999	0.35	0.35	0.35	
2000 - 2010	0.22	0.16	0.27	
Post 2010	0.34	0.35	0.35	

Belgium				
[U-values]	SFH	MFH	AB	
Before 1945	1.76	2.2	1.7	
1945 - 1969	1.7	1.7	1.7	
1970 - 1979	1	1	1.7	
1980 - 1989	1	1	1.7	
1990 - 1999	0.6	0.6	0.85	
2000 - 2010	0.4	0.4	0.4	
Post 2010	0.23	0.23	0.23	

Bulgaria				
[U-values]	SFH	MFH	AB	
Before 1945	1.36	1.41	1.39	
1945 - 1969	1.57	1.39	1.16	
1970 - 1979	1.2	1.16	0.93	
1980 - 1989	0.83	0.93	0.8	
1990 - 1999	0.62	0.68	0.68	
2000 - 2010	0.41	0.43	0.44	
Post 2010	0.5	0.34	0.34	

Croatia				
[U-values]	SFH	MFH	AB	
Before 1945	1.5	1.5	2.8	
1945 - 1969	1.02	1.8	2.25	
1970 - 1979	0.54	1.21	1.71	
1980 - 1989	0.41	0.62	0.62	
1990 - 1999	0.22	0.44	0.44	
2000 - 2010	0.24	0.27	0.27	
Post 2010	0.27	0.1	0.1	

Cyprus				
[U-values]	SFH	MFH	AB	
Before 1945	1.39	1.39	1.39	
1945 - 1969	1.06	1.06	1.06	
1970 - 1979	0.89	0.9	0.9	
1980 - 1989	0.81	0.82	0.82	
1990 - 1999	0.77	0.78	0.78	
2000 - 2010	0.75	0.76	0.76	
Post 2010	0.73	0.74	0.74	

Czech Republic				
[U-values]	SFH	MFH	AB	
Before 1945	1.28	1.34	1.4	
1945 - 1969	1.4	1.43	1.43	
1970 - 1979	1.42	1.08	1.08	
1980 - 1989	0.96	0.87	0.87	
1990 - 1999	0.33	0.38	0.6	
2000 - 2010	0.33	0.38	0.33	
Post 2010	0.25	0.36	0.36	

Denmark				
[U-values]	SFH	MFH	AB	
Before 1945	1.19	0.9	1.68	
1945 - 1969	1.02	0.7	1.08	
1970 - 1979	0.3	0.5	0.6	
1980 - 1989	0.39	0.4	0.34	
1990 - 1999	0.3	0.35	0.26	
2000 - 2010	0.2	0.3	0.19	
Post 2010	0.17	0.2	0.1	

Estonia				
[U-values]	SFH	MFH	AB	
Before 1945	0.5	0.5	0.5	
1945 - 1969	0.35	0.35	0.35	
1970 - 1979	0.27	0.27	0.27	
1980 - 1989	0.23	0.23	0.23	
1990 - 1999	0.21	0.21	0.21	
2000 - 2010	0.2	0.2	0.2	
Post 2010	0.2	0.2	0.2	

Finland				
[U-values]	SFH	MFH	AB	
Before 1945	0.6	0.6	0.6	
1945 - 1969	0.5	0.5	0.5	
1970 - 1979	0.4	0.4	0.4	
1980 - 1989	0.3	0.3	0.3	
1990 - 1999	0.25	0.25	0.25	
2000 - 2010	0.2	0.2	0.2	
Post 2010	0.13	0.13	0.13	

France				
[U-values]	SFH	MFH	AB	
Before 1945	1.62	1.55	2.1	
1945 - 1969	2.2	3	3	
1970 - 1979	1.93	0.7	0.78	
1980 - 1989	0.44	0.36	0.78	
1990 - 1999	0.36	0.33	0.36	
2000 - 2010	0.32	0.32	0.31	
Post 2010	0.23	0.18	0.24	

Germany				
[U-values]	SFH	MFH	AB	
Before 1945	1.76	1.97	1.55	
1945 - 1969	1.25	1.2	1.2	
1970 - 1979	1	1	1.1	
1980 - 1989	0.55	0.6	0.6	
1990 - 1999	0.45	0.4	0.4	
2000 - 2010	0.3	0.25	0.25	
Post 2010	0.22	0.29	0.29	

Greece				
[U-values]	SFH	MFH	AB	
Before 1945	2.17	3.08	1.6	
1945 - 1969	1.89	2.2	1.25	
1970 - 1979	1.34	2.12	1.07	
1980 - 1989	0.79	2.04	0.9	
1990 - 1999	0.74	1.37	0.8	
2000 - 2010	0.7	0.7	0.7	
Post 2010	0.49	0.48	0.48	

Hungary				
[U-values]	SFH	MFH	AB	
Before 1945	0.94	1.1	1.1	
1945 - 1969	1.35	1.37	1.37	
1970 - 1979	1.36	1.36	1.36	
1980 - 1989	1.37	1.35	1.35	
1990 - 1999	0.49	0.49	0.49	
2000 - 2010	0.35	0.35	0.35	
Post 2010	0.22	0.22	0.22	

Ireland				
[U-values]	SFH	MFH	AB	
Before 1945	2.15	1.9	1.9	
1945 - 1969	2.4	1.8	1.78	
1970 - 1979	1.78	1.7	1.7	
1980 - 1989	0.6	0.7	0.6	
1990 - 1999	0.55	0.5	0.55	
2000 - 2010	0.27	0.3	0.27	
Post 2010	0.21	0.28	0.21	

Italy				
[U-values]	SFH	MFH	AB	
Before 1945	1.66	1.18	1.1	
1945 - 1969	1.32	1.48	1.15	
1970 - 1979	1.26	1.15	1.1	
1980 - 1989	0.76	0.8	0.76	
1990 - 1999	0.59	0.59	0.59	
2000 - 2010	0.46	0.46	0.46	
Post 2010	0.34	0.34	0.34	

Latvia				
[U-values]	SFH	MFH	AB	
Before 1945	1	1.1	1.1	
1945 - 1969	0.95	1	1	
1970 - 1979	0.92	0.95	0.95	
1980 - 1989	0.92	0.92	0.92	
1990 - 1999	0.91	0.92	0.92	
2000 - 2010	0.9	0.9	0.9	
Post 2010	0.86	0.82	0.82	

Lithuania				
[U-values]	SFH	MFH	AB	
Before 1945	1	1	1	
1945 - 1969	0.75	0.75	0.75	
1970 - 1979	0.5	0.5	0.5	
1980 - 1989	0.35	0.35	0.35	
1990 - 1999	0.28	0.28	0.28	
2000 - 2010	0.2	0.2	0.2	
Post 2010	0.78	0.78	0.78	

Luxembourg				
[U-values]	SFH	MFH	AB	
Before 1945	1.6	1.6	1.6	
1945 - 1969	1.1	1.1	1.1	
1970 - 1979	0.85	0.85	0.85	
1980 - 1989	0.6	0.6	0.6	
1990 - 1999	0.5	0.5	0.5	
2000 - 2010	0.4	0.4	0.4	
Post 2010	0.34	0.34	0.34	

Malta				
[U-values]	SFH	MFH	AB	
Before 1945	2	2	2	
1945 - 1969	1.75	1.75	1.75	
1970 - 1979	1.62	1.62	1.62	
1980 - 1989	1.56	1.56	1.56	
1990 - 1999	1.53	1.53	1.53	
2000 - 2010	1.5	1.5	1.5	
Post 2010	0.34	0.34	0.34	

Netherlands				
[U-values]	SFH	MFH	AB	
Before 1945	1.92	1.61	1.61	
1945 - 1969	1.68	1.53	1.53	
1970 - 1979	1.45	1.45	1.45	
1980 - 1989	0.64	0.64	0.64	
1990 - 1999	0.36	0.36	0.36	
2000 - 2010	0.27	0.27	0.27	
Post 2010	0.21	0.21	0.21	

Poland				
[U-values]	SFH	MFH	AB	
Before 1945	1.75	1.55	1.7	
1945 - 1969	1.55	1.42	1.4	
1970 - 1979	1.03	1.3	1.3	
1980 - 1989	0.9	1.1	0.74	
1990 - 1999	0.3	0.19	0.18	
2000 - 2010	0.24	0.18	0.18	
Post 2010	0.19	0.18	0.19	

Portugal			
[U-values]	SFH	MFH	AB
Before 1945	2	2	2
1945 - 1969	1.5	1.5	1.5
1970 - 1979	1.45	1.45	1.45
1980 - 1989	1.4	1.4	1.4
1990 - 1999	1.2	1.2	1.2
2000 - 2010	0.8	0.8	0.8
Post 2010	0.54	0.54	0.54

U-values

Windows

Austria			
[U-values]	SFH	MFH	AB
Before 1945	2	1.8	2.2
1945 - 1969	2.65	3	2.3
1970 - 1979	2.6	1.5	2.6
1980 - 1989	1.8	2.5	2.5
1990 - 1999	1.25	1.4	1.4
2000 - 2010	1.4	1.24	1.32
Post 2010	0.92	1.08	1.24

Belgium			
[U-values]	SFH	MFH	AB
Before 1945	5	5	5
1945 - 1969	4.25	4.65	5
1970 - 1979	3.5	4.3	4.3
1980 - 1989	3.12	3.9	3.9
1990 - 1999	2.75	3.5	3.5
2000 - 2010	2	2	2
Post 2010	1.7	1.7	1.7

Bulgaria			
[U-values]	SFH	MFH	AB
Before 1945	5.88	4.69	2.32
1945 - 1969	4.99	2.32	2.46
1970 - 1979	4.1	2.47	2.6
1980 - 1989	2.32	2.63	2.4
1990 - 1999	1.96	1.86	2.2
2000 - 2010	1.61	1.1	1.8
Post 2010	0.9	1	1

Croatia			
[U-values]	SFH	MFH	AB
Before 1945	2.2	2.2	2.8
1945 - 1969	2.8	2.5	2.69
1970 - 1979	2.5	2.8	2.58
1980 - 1989	1.9	1.4	2.37
1990 - 1999	1.1	1.25	1.95
2000 - 2010	0.85	1.1	1.1
Post 2010	0.6	0.75	1.12

Cyprus			
[U-values]	SFH	MFH	AB
Before 1945	6.1	6.1	6.1
1945 - 1969	4.65	4.65	4.4
1970 - 1979	3.92	3.92	3.55
1980 - 1989	3.56	3.56	3.12
1990 - 1999	3.38	3.38	2.91
2000 - 2010	3.29	3.29	2.8
Post 2010	3.2	3.2	2.7

Czech Republic			
[U-values]	SFH	MFH	AB
Before 1945	2.7	2.7	2.7
1945 - 1969	2.75	2.8	2.8
1970 - 1979	2.8	2.3	2.45
1980 - 1989	2.1	2.05	2.27
1990 - 1999	1.75	1.92	2.1
2000 - 2010	1.4	1.8	1.4
Post 2010	1.2	1.2	1.2

Denmark			
[U-values]	SFH	MFH	AB
Before 1945	2.73	2.6	2.73
1945 - 1969	2.75	2.55	2.76
1970 - 1979	2.45	2.5	2.8
1980 - 1989	2.15	2.4	2.7
1990 - 1999	1.87	2.05	2.15
2000 - 2010	1.6	1.7	1.6
Post 2010	1.05	1.67	1.05

Estonia			
[U-values]	SFH	MFH	AB
Before 1945	1.7	1.7	1.7
1945 - 1969	1.4	1.4	1.4
1970 - 1979	1.25	1.25	1.25
1980 - 1989	1.17	1.17	1.17
1990 - 1999	1.13	1.13	1.13
2000 - 2010	1.11	1.11	1.11
Post 2010	1.1	1.1	1.1

Finland			
[U-values]	SFH	MFH	AB
Before 1945	2.2	2.2	2.2
1945 - 1969	2.05	2.05	2.05
1970 - 1979	1.9	1.9	1.9
1980 - 1989	1.7	1.7	1.7
1990 - 1999	1.6	1.6	1.6
2000 - 2010	1.5	1.5	1.5
Post 2010	1.38	1.38	1.38

France			
[U-values]	SFH	MFH	AB
Before 1945	4.8	2.67	3.8
1945 - 1969	2.6	4.8	2.6
1970 - 1979	2.77	4.2	2.7
1980 - 1989	2.95	2.8	2.6
1990 - 1999	2.2	2.6	3.3
2000 - 2010	1.6	1.6	1.6
Post 2010	1.4	1.4	1.4

Germany			
[U-values]	SFH	MFH	AB
Before 1945	2.78	2.83	2.9
1945 - 1969	2.8	3	3
1970 - 1979	2.8	2.45	2.45
1980 - 1989	3	1.28	1.28
1990 - 1999	1.75	1.9	1.9
2000 - 2010	1.35	1.4	1.4
Post 2010	1.2	1.2	1.2

Greece			
[U-values]	SFH	MFH	AB
Before 1945	3.9	4.7	4.1
1945 - 1969	4.6	4.3	3.65
1970 - 1979	5.15	5	3.42
1980 - 1989	5.7	5.7	3.2
1990 - 1999	4.9	4.9	3.15
2000 - 2010	4.1	4.1	3.1
Post 2010	2.9	2.9	2.9

Hungary			
[U-values]	SFH	MFH	AB
Before 1945	3.5	3.5	3.5
1945 - 1969	2.75	2.5	2.5
1970 - 1979	2.37	2.25	2.25
1980 - 1989	2.18	2.12	2.12
1990 - 1999	2	2	2
2000 - 2010	1.75	1.75	1.75
Post 2010	1.5	1.5	1.5

Ireland			
[U-values]	SFH	MFH	AB
Before 1945	4.8	4.7	4.7
1945 - 1969	5.7	4.6	5.7
1970 - 1979	5.25	4.5	4.5
1980 - 1989	3.1	3.3	4.8
1990 - 1999	2.8	2.9	2.8
2000 - 2010	2.4	2.5	2
Post 2010	1.3	1.51	1.3

Italy			
[U-values]	SFH	MFH	AB
Before 1945	4.9	4.9	5.17
1945 - 1969	3.85	4.6	4.9
1970 - 1979	3.32	4.3	4.3
1980 - 1989	2.8	3.7	3.7
1990 - 1999	2.5	2.95	3.4
2000 - 2010	2.35	2.57	2.8
Post 2010	2.2	2.2	2.2

Latvia			
[U-values]	SFH	MFH	AB
Before 1945	2.7	2.7	2.7
1945 - 1969	2.6	2.6	2.6
1970 - 1979	2.55	2.55	2.55
1980 - 1989	2.5	2.5	2.5
1990 - 1999	2.15	2.15	2.15
2000 - 2010	1.8	1.8	1.8
Post 2010	1.3	1.3	1.3

Lithuania			
[U-values]	SFH	MFH	AB
Before 1945	2.2	2.2	2.2
1945 - 1969	2	2	2
1970 - 1979	1.8	1.8	1.8
1980 - 1989	1.7	1.7	1.7
1990 - 1999	1.65	1.65	1.65
2000 - 2010	1.6	1.6	1.6
Post 2010	2.37	2.37	2.37

Luxembourg			
[U-values]	SFH	MFH	AB
Before 1945	4.5	4.5	4.5
1945 - 1969	3.8	3.8	3.8
1970 - 1979	3	3	3
1980 - 1989	2	2	2
1990 - 1999	1.6	1.6	1.6
2000 - 2010	1.3	1.3	1.3
Post 2010	1.4	1.4	1.4

Malta			
[U-values]	SFH	MFH	AB
Before 1945	5.8	5.8	5.8
1945 - 1969	3.6	3.6	3.6
1970 - 1979	2.5	2.5	2.5
1980 - 1989	1.95	1.95	1.95
1990 - 1999	1.67	1.67	1.67
2000 - 2010	1.53	1.53	1.53
Post 2010	1.4	1.4	1.4

Netherlands			
[U-values]	SFH	MFH	AB
Before 1945	4.05	4.05	2.9
1945 - 1969	2.9	3.48	2.35
1970 - 1979	2.35	3.19	2.07
1980 - 1989	2.07	2.9	1.93
1990 - 1999	1.93	2.35	1.86
2000 - 2010	1.86	2.07	1.83
Post 2010	1.8	1.8	1.8

Poland			
[U-values]	SFH	MFH	AB
Before 1945	5	5	4.6
1945 - 1969	3.8	3.8	3.6
1970 - 1979	3.2	3.2	3.1
1980 - 1989	2.6	2.6	2.6
1990 - 1999	1.6	1.6	1.6
2000 - 2010	1.2	1.5	1.5
Post 2010	1.1	1.4	1.4

Portugal			
[U-values]	SFH	MFH	AB
Before 1945	4.3	4.3	4.3
1945 - 1969	4.2	4.2	4.2
1970 - 1979	3.5	3.5	3.5
1980 - 1989	3.15	3.15	3.15
1990 - 1999	2.97	2.97	2.97
2000 - 2010	2.88	2.88	2.88
Post 2010	2.8	2.8	2.8

Romania			
[U-values]	SFH	MFH	AB
Before 1945	2.6	2.6	2.6
1945 - 1969	2.5	2.5	2.5
1970 - 1979	2.45	2.45	2.45
1980 - 1989	2.43	2.43	2.43
1990 - 1999	2.4	2.4	2.4
2000 - 2010	1.4	1.4	1.4
Post 2010	1.3	1.3	1.3

Slovakia			
[U-values]	SFH	MFH	AB
Before 1945	3.7	3.7	3.7
1945 - 1969	3.7	3.7	3.7
1970 - 1979	3.3	3.3	3.3
1980 - 1989	2.9	2.9	2.9
1990 - 1999	2.3	2.3	2.3
2000 - 2010	2	2	2
Post 2010	1.7	1.7	1.7

Slovenia			
[U-values]	SFH	MFH	AB
Before 1945	2.2	2.2	2.8
1945 - 1969	2.8	2.5	2.69
1970 - 1979	2.5	2.8	2.58
1980 - 1989	1.9	1.4	2.37
1990 - 1999	1.1	1.25	1.95
2000 - 2010	0.85	1.1	1.1
Post 2010	0.6	0.75	1.12

Spain			
[U-values]	SFH	MFH	AB
Before 1945	4.73	5.47	5.1
1945 - 1969	4.59	5.7	4.59
1970 - 1979	5.15	5.7	5.7
1980 - 1989	3.09	4.54	4.53
1990 - 1999	3.05	3.96	3.95
2000 - 2010	3.03	3.66	3.66
Post 2010	3.01	3.37	3.37

Sweden			
[U-values]	SFH	MFH	AB
Before 1945	2.34	2.22	3.2
1945 - 1969	2.32	2.13	2.22
1970 - 1979	2.3	2.08	2.13
1980 - 1989	2.01	2.04	2.04
1990 - 1999	1.94	1.8	1.8
2000 - 2010	1.87	1.97	1.97
Post 2010	1.3	1.3	1.3

United Kingdom			
[U-values]	SFH	MFH	AB
Before 1945	4.8	4.8	4.8
1945 - 1969	4.38	4.38	4.38
1970 - 1979	3.95	3.95	3.95
1980 - 1989	3.1	3.1	3.52
1990 - 1999	2.48	2.48	3.1
2000 - 2010	2.16	2.16	1.85
Post 2010	1.85	1.85	1.85

U-values

Roof

Austria			
[U-values]	SFH	MFH	AB
Before 1945	1.11	1.01	0.8
1945 - 1969	0.62	1.13	1.13
1970 - 1979	0.8	0.58	0.9
1980 - 1989	0.52	0.44	0.6
1990 - 1999	0.28	0.36	0.19
2000 - 2010	0.2	0.17	0.18
Post 2010	0.12	0.2	0.2

Belgium			
[U-values]	SFH	MFH	AB
Before 1945	1.42	3.5	3.5
1945 - 1969	1.9	3.5	3.5
1970 - 1979	0.85	0.85	0.85
1980 - 1989	0.72	1.3	0.65
1990 - 1999	0.6	0.45	0.45
2000 - 2010	0.3	0.3	0.3
Post 2010	0.21	0.21	0.21

Bulgaria			
[U-values]	SFH	MFH	AB
Before 1945	1.38	1.26	1.29
1945 - 1969	1.24	1.29	0.94
1970 - 1979	1.25	0.94	0.59
1980 - 1989	1.26	0.59	0.51
1990 - 1999	0.77	0.43	0.43
2000 - 2010	0.27	0.27	0.27
Post 2010	0.27	0.18	0.18

Croatia			
[U-values]	SFH	MFH	AB
Before 1945	1.74	0.77	1.8
1945 - 1969	0.69	1.17	1.17
1970 - 1979	0.54	0.97	0.86
1980 - 1989	0.21	0.77	0.56
1990 - 1999	0.14	0.47	0.37
2000 - 2010	0.17	0.18	0.18
Post 2010	0.2	0.2	0.2

Cyprus			
[U-values]	SFH	MFH	AB
Before 1945	3.42	3.42	3.42
1945 - 1969	2.05	2.05	2.01
1970 - 1979	1.37	1.37	1.3
1980 - 1989	1.03	1.03	0.95
1990 - 1999	0.86	0.86	0.77
2000 - 2010	0.77	0.77	0.68
Post 2010	0.68	0.68	0.6

Czech Republic			
[U-values]	SFH	MFH	AB
Before 1945	0.97	0.91	1.2
1945 - 1969	0.94	0.94	0.94
1970 - 1979	0.85	0.35	0.58
1980 - 1989	0.35	0.29	0.35
1990 - 1999	0.33	0.26	0.33
2000 - 2010	0.33	0.24	0.32
Post 2010	0.2	0.2	0.2

Denmark			
[U-values]	SFH	MFH	AB
Before 1945	0.83	0.6	0.83
1945 - 1969	0.51	0.4	0.94
1970 - 1979	0.45	0.3	0.56
1980 - 1989	0.16	0.2	0.37
1990 - 1999	0.15	0.15	0.28
2000 - 2010	0.14	0.1	0.19
Post 2010	0.12	0.03	0.1

Estonia			
[U-values]	SFH	MFH	AB
Before 1945	0.5	0.5	0.5
1945 - 1969	0.35	0.35	0.35
1970 - 1979	0.27	0.27	0.27
1980 - 1989	0.23	0.23	0.23
1990 - 1999	0.21	0.21	0.21
2000 - 2010	0.2	0.2	0.2
Post 2010	0.2	0.2	0.2

Finland			
[U-values]	SFH	MFH	AB
Before 1945	0.4	0.4	0.4
1945 - 1969	0.35	0.35	0.35
1970 - 1979	0.3	0.3	0.3
1980 - 1989	0.2	0.2	0.2
1990 - 1999	0.15	0.15	0.15
2000 - 2010	0.13	0.13	0.13
Post 2010	0.1	0.1	0.1

France			
[U-values]	SFH	MFH	AB
Before 1945	1.36	1.35	2.3
1945 - 1969	1.2	2.42	3.2
1970 - 1979	1.31	0.59	1.98
1980 - 1989	0.29	0.62	0.52
1990 - 1999	0.22	0.38	0.43
2000 - 2010	0.18	0.23	0.25
Post 2010	0.14	0.14	0.12

Germany			
[U-values]	SFH	MFH	AB
Before 1945	1.55	1.49	0.98
1945 - 1969	0.84	0.8	0.81
1970 - 1979	0.51	0.51	0.51
1980 - 1989	0.4	0.36	0.36
1990 - 1999	0.35	0.32	0.32
2000 - 2010	0.23	0.2	0.2
Post 2010	0.17	0.23	0.23

Greece			
[U-values]	SFH	MFH	AB
Before 1945	3.05	3.05	2.5
1945 - 1969	2.61	3.05	1.8
1970 - 1979	2.01	1.8	1.45
1980 - 1989	1.42	1.17	1.1
1990 - 1999	0.96	0.86	0.8
2000 - 2010	0.5	0.55	0.5
Post 2010	0.43	0.44	0.44

Hungary			
[U-values]	SFH	MFH	AB
Before 1945	1.25	0.54	0.54
1945 - 1969	0.94	0.84	0.84
1970 - 1979	0.65	0.58	0.58
1980 - 1989	0.36	0.45	0.45
1990 - 1999	0.25	0.32	0.32
2000 - 2010	0.23	0.26	0.26
Post 2010	0.21	0.21	0.21

Ireland			
[U-values]	SFH	MFH	AB
Before 1945	1.33	1	1
1945 - 1969	0.68	0.9	0.68
1970 - 1979	0.68	0.8	0.8
1980 - 1989	0.4	0.4	0.4
1990 - 1999	0.26	0.35	0.35
2000 - 2010	0.16	0.3	0.22
Post 2010	0.16	0.14	0.16

Italy			
[U-values]	SFH	MFH	AB
Before 1945	1.74	1.43	1.47
1945 - 1969	2.2	1.1	1.1
1970 - 1979	2.03	0.92	0.92
1980 - 1989	1.55	0.75	0.75
1990 - 1999	0.57	0.57	0.57
2000 - 2010	0.42	0.42	0.42
Post 2010	0.28	0.28	0.28

Latvia			
[U-values]	SFH	MFH	AB
Before 1945	1.2	1.2	1.2
1945 - 1969	1.2	1.15	1.15
1970 - 1979	1.1	1.1	1.1
1980 - 1989	0.9	0.9	0.9
1990 - 1999	0.7	0.7	0.7
2000 - 2010	0.5	0.5	0.5
Post 2010	0.33	0.33	0.33

Lithuania			
[U-values]	SFH	MFH	AB
Before 1945	1	1	1
1945 - 1969	0.8	0.8	0.8
1970 - 1979	0.6	0.6	0.6
1980 - 1989	0.5	0.5	0.5
1990 - 1999	0.45	0.45	0.45
2000 - 2010	0.4	0.4	0.4
Post 2010	0.35	0.35	0.35

Luxembourg			
[U-values]	SFH	MFH	AB
Before 1945	1.43	1.43	1.43
1945 - 1969	0.93	0.93	0.93
1970 - 1979	0.57	0.57	0.57
1980 - 1989	0.35	0.35	0.35
1990 - 1999	0.28	0.28	0.28
2000 - 2010	0.25	0.25	0.25
Post 2010	0.2	0.2	0.2

Malta			
[U-values]	SFH	MFH	AB
Before 1945	1.9	1.9	1.9
1945 - 1969	1.85	1.85	1.85
1970 - 1979	1.82	1.82	1.82
1980 - 1989	1.81	1.81	1.81
1990 - 1999	1.81	1.81	1.81
2000 - 2010	1.8	1.8	1.8
Post 2010	0.2	0.2	0.2

Netherlands			
[U-values]	SFH	MFH	AB
Before 1945	1.81	1.54	1.54
1945 - 1969	1.35	1.22	1.22
1970 - 1979	0.89	0.89	0.89
1980 - 1989	0.64	0.64	0.64
1990 - 1999	0.36	0.36	0.36
2000 - 2010	0.23	0.23	0.23
Post 2010	0.16	0.16	0.16

Poland			
[U-values]	SFH	MFH	AB
Before 1945	0.8	0.9	0.8
1945 - 1969	0.7	0.5	0.7
1970 - 1979	0.6	0.6	0.33
1980 - 1989	0.5	0.5	0.9
1990 - 1999	0.4	0.45	0.5
2000 - 2010	0.3	0.4	0.6
Post 2010	0.25	0.3	0.5

Portugal			
[U-values]	SFH	MFH	AB
Before 1945	3.1	3.1	3.1
1945 - 1969	3	3	3
1970 - 1979	2.7	2.7	2.7
1980 - 1989	2.6	2.6	2.6
1990 - 1999	2.4	2.4	2.4
2000 - 2010	1.3	1.3	1.3
Post 2010	0.55	0.55	0.55

Romania			
[U-values]	SFH	MFH	AB
Before 1945	1.4	1.4	1.4
1945 - 1969	1.3	1.3	1.3
1970 - 1979	1.25	1.25	1.25
1980 - 1989	1.23	1.23	1.23
1990 - 1999	1.2	1.2	1.2
2000 - 2010	1	1	1
Post 2010	0.29	0.29	0.29

Slovakia			
[U-values]	SFH	MFH	AB
Before 1945	2	2	2
1945 - 1969	1.5	1.5	1.5
1970 - 1979	1.1	1.1	1.1
1980 - 1989	0.7	0.7	0.7
1990 - 1999	0.6	0.6	0.6
2000 - 2010	0.42	0.42	0.42
Post 2010	0.23	0.23	0.23

Slovenia			
[U-values]	SFH	MFH	AB
Before 1945	1.74	0.77	1.8
1945 - 1969	0.69	1.17	1.17
1970 - 1979	0.54	0.97	0.86
1980 - 1989	0.21	0.77	0.56
1990 - 1999	0.14	0.47	0.37
2000 - 2010	0.17	0.18	0.18
Post 2010	0.2	0.2	0.2

Spain			
[U-values]	SFH	MFH	AB
Before 1945	3.4	2.63	2.87
1945 - 1969	2.92	1.67	1.37
1970 - 1979	2.92	1.61	1.92
1980 - 1989	1.27	0.56	0.61
1990 - 1999	0.86	0.51	0.54
2000 - 2010	0.66	0.48	0.51
Post 2010	0.45	0.45	0.48

Sweden			
[U-values]	SFH	MFH	AB
Before 1945	0.29	0.36	0.4
1945 - 1969	0.25	0.28	0.36
1970 - 1979	0.21	0.2	0.2
1980 - 1989	0.15	0.17	0.17
1990 - 1999	0.12	0.15	0.15
2000 - 2010	0.12	0.14	0.14
Post 2010	0.13	0.13	0.13

United Kingdom			
[U-values]	SFH	MFH	AB
Before 1945	2.3	2.3	2.4
1945 - 1969	1.9	1.9	2.3
1970 - 1979	1.5	1.5	1.5
1980 - 1989	0.4	0.4	0.4
1990 - 1999	0.35	0.35	0.32
2000 - 2010	0.2	0.2	0.25
Post 2010	0.16	0.16	0.16

U-values

Floor

Austria			
[U-values]	SFH	MFH	AB
Before 1945	1.3	1.13	0.71
1945 - 1969	1.08	3.5	0.77
1970 - 1979	0.65	1.1	0.65
1980 - 1989	0.51	0.51	0.6
1990 - 1999	0.38	0.36	0.36
2000 - 2010	0.22	0.23	0.25
Post 2010	0.38	0.36	0.36

Belgium			
[U-values]	SFH	MFH	AB
Before 1945	0.76	0.68	0.68
1945 - 1969	0.68	3.5	0.68
1970 - 1979	0.85	0.85	0.68
1980 - 1989	0.72	1.3	0.63
1990 - 1999	0.6	0.45	0.58
2000 - 2010	0.3	0.3	0.51
Post 2010	0.21	0.21	0.21

Bulgaria			
[U-values]	SFH	MFH	AB
Before 1945	0.56	0.64	1.29
1945 - 1969	1.24	0.96	1.64
1970 - 1979	1.25	1.11	2
1980 - 1989	1.26	1.29	1.07
1990 - 1999	1.26	1.09	0.86
2000 - 2010	1.25	0.9	0.43
Post 2010	0.52	0.52	0.52

Croatia			
[U-values]	SFH	MFH	AB
Before 1945	1.17	1.46	0.77
1945 - 1969	1.22	1.03	0.73
1970 - 1979	0.7	0.75	0.7
1980 - 1989	0.44	0.65	0.63
1990 - 1999	0.18	0.22	0.49
2000 - 2010	0.23	0.26	0.22
Post 2010	0.29	0.3	0.28

Cyprus			
[U-values]	SFH	MFH	AB
Before 1945	1.97	1.56	1.56
1945 - 1969	1.44	1.13	1.13
1970 - 1979	1.17	0.92	0.92
1980 - 1989	1.04	0.81	0.81
1990 - 1999	0.97	0.76	0.76
2000 - 2010	0.94	0.73	0.73
Post 2010	0.91	0.71	0.71

Czech Republic			
[U-values]	SFH	MFH	AB
Before 1945	2.15	0.84	0.84
1945 - 1969	1.08	1.03	1.03
1970 - 1979	1.01	1.03	0.97
1980 - 1989	0.8	1.1	0.92
1990 - 1999	0.48	0.51	0.68
2000 - 2010	0.39	0.43	0.45
Post 2010	0.3	0.36	0.36

Denmark			
[U-values]	SFH	MFH	AB
Before 1945	0.97	0.9	0.74
1945 - 1969	0.67	0.7	0.99
1970 - 1979	0.34	0.3	0.46
1980 - 1989	0.26	0.25	0.19
1990 - 1999	0.2	0.22	0.18
2000 - 2010	0.14	0.2	0.18
Post 2010	0.11	0.06	0.14

Estonia			
[U-values]	SFH	MFH	AB
Before 1945	0.5	0.5	0.5
1945 - 1969	0.35	0.35	0.35
1970 - 1979	0.27	0.27	0.27
1980 - 1989	0.23	0.23	0.23
1990 - 1999	0.21	0.21	0.21
2000 - 2010	0.2	0.2	0.2
Post 2010	0.2	0.2	0.2

Finland			
[U-values]	SFH	MFH	AB
Before 1945	0.6	0.6	0.6
1945 - 1969	0.5	0.5	0.5
1970 - 1979	0.4	0.4	0.4
1980 - 1989	0.3	0.3	0.3
1990 - 1999	0.2	0.2	0.2
2000 - 2010	0.15	0.15	0.15
Post 2010	0.1	0.1	0.1

France			
[U-values]	SFH	MFH	AB
Before 1945	1.81	2.1	1.97
1945 - 1969	1.96	1.55	1.43
1970 - 1979	0.72	1.34	1.45
1980 - 1989	0.78	0.62	0.37
1990 - 1999	0.42	0.38	0.37
2000 - 2010	0.28	0.32	0.25
Post 2010	0.2	0.2	0.27

Germany			
[U-values]	SFH	MFH	AB
Before 1945	1.23	0.95	0.82
1945 - 1969	1.06	1.21	1.19
1970 - 1979	0.77	0.77	0.77
1980 - 1989	0.51	0.51	0.51
1990 - 1999	0.43	0.4	0.4
2000 - 2010	0.28	0.32	0.32
Post 2010	0.26	0.32	0.32

Greece			
[U-values]	SFH	MFH	AB
Before 1945	2.17	3.1	2.4
1945 - 1969	2.56	2.87	1.97
1970 - 1979	2.56	2.76	1.76
1980 - 1989	2.55	2.65	1.65
1990 - 1999	1.89	1.72	1.55
2000 - 2010	1.23	0.79	0.7
Post 2010	0.8	0.63	0.63

Hungary			
[U-values]	SFH	MFH	AB
Before 1945	1.04	0.75	0.75
1945 - 1969	0.98	0.7	0.7
1970 - 1979	0.84	0.53	0.53
1980 - 1989	0.7	0.45	0.45
1990 - 1999	0.37	0.37	0.37
2000 - 2010	0.4	0.29	0.29
Post 2010	0.44	0.22	0.22

Ireland			
[U-values]	SFH	MFH	AB
Before 1945	1.71	1.4	1.4
1945 - 1969	1.29	1.1	1.08
1970 - 1979	1.48	0.95	1.4
1980 - 1989	1.22	0.8	1.22
1990 - 1999	0.76	0.55	0.86
2000 - 2010	0.5	0.3	0.43
Post 2010	0.3	0.17	0.36

Italy			
[U-values]	SFH	MFH	AB
Before 1945	1.84	1.17	1.15
1945 - 1969	1.47	0.94	0.94
1970 - 1979	2	0.96	1.3
1980 - 1989	0.76	0.98	0.76
1990 - 1999	0.63	0.63	0.63
2000 - 2010	0.48	0.46	0.46
Post 2010	0.33	0.3	0.3

Latvia			
[U-values]	SFH	MFH	AB
Before 1945	0.9	0.9	0.9
1945 - 1969	0.75	0.75	0.75
1970 - 1979	0.67	0.67	0.67
1980 - 1989	0.6	0.6	0.6
1990 - 1999	0.45	0.45	0.45
2000 - 2010	0.3	0.3	0.3
Post 2010	0.15	0.15	0.15

Lithuania			
[U-values]	SFH	MFH	AB
Before 1945	0.8	0.8	0.8
1945 - 1969	0.65	0.65	0.65
1970 - 1979	0.5	0.5	0.5
1980 - 1989	0.35	0.35	0.35
1990 - 1999	0.28	0.28	0.28
2000 - 2010	0.2	0.2	0.2
Post 2010	0.6	0.6	0.6

Luxembourg			
[U-values]	SFH	MFH	AB
Before 1945	1.8	1.8	1.8
1945 - 1969	1.4	1.4	1.4
1970 - 1979	0.6	0.6	0.6
1980 - 1989	0.55	0.55	0.55
1990 - 1999	0.5	0.5	0.5
2000 - 2010	0.4	0.4	0.4
Post 2010	0.37	0.37	0.37

Malta			
[U-values]	SFH	MFH	AB
Before 1945	3	3	3
1945 - 1969	2.5	2.5	2.5
1970 - 1979	2.25	2.25	2.25
1980 - 1989	2.12	2.12	2.12
1990 - 1999	2.06	2.06	2.06
2000 - 2010	2	2	2
Post 2010	0.37	0.37	0.37

Netherlands			
[U-values]	SFH	MFH	AB
Before 1945	2.08	1.72	1.14
1945 - 1969	2.2	2.02	1.25
1970 - 1979	2.33	2.33	1.37
1980 - 1989	0.96	1.28	0.54
1990 - 1999	0.36	0.36	0.32
2000 - 2010	0.31	0.32	0.28
Post 2010	0.27	0.27	0.25

Poland			
[U-values]	SFH	MFH	AB
Before 1945	2.2	1.17	1.9
1945 - 1969	1.8	1.03	1.4
1970 - 1979	1.6	0.94	0.94
1980 - 1989	1.4	0.83	0.83
1990 - 1999	0.89	0.65	0.65
2000 - 2010	0.6	0.51	0.51
Post 2010	0.47	0.43	0.43

Portugal			
[U-values]	SFH	MFH	AB
Before 1945	2.1	2.1	2.1
1945 - 1969	2.05	2.05	2.05
1970 - 1979	2.02	2.02	2.02
1980 - 1989	2.01	2.01	2.01
1990 - 1999	2	2	2
2000 - 2010	1.3	1.3	1.3
Post 2010	0.62	0.62	0.62

Romania			
[U-values]	SFH	MFH	AB
Before 1945	1.6	1.6	1.6
1945 - 1969	1.4	1.4	1.4
1970 - 1979	1.3	1.3	1.3
1980 - 1989	1.1	1.1	1.1
1990 - 1999	1	1	1
2000 - 2010	0.61	0.61	0.61
Post 2010	0.22	0.22	0.22

Slovakia			
[U-values]	SFH	MFH	AB
Before 1945	2	2	2
1945 - 1969	1.7	1.7	1.7
1970 - 1979	1.6	1.6	1.6
1980 - 1989	1.55	1.55	1.55
1990 - 1999	1.5	1.5	1.5
2000 - 2010	1	1	1
Post 2010	0.4	0.4	0.4

Slovenia			
[U-values]	SFH	MFH	AB
Before 1945	1.17	1.46	0.77
1945 - 1969	1.22	1.03	0.73
1970 - 1979	0.7	0.75	0.7
1980 - 1989	0.44	0.65	0.63
1990 - 1999	0.18	0.22	0.49
2000 - 2010	0.23	0.26	0.22
Post 2010	0.29	0.3	0.28

Spain			
[U-values]	SFH	MFH	AB
Before 1945	1.43	1.19	1.07
1945 - 1969	1.34	1.26	0.91
1970 - 1979	0.85	0.71	1.13
1980 - 1989	1.08	1.39	1.31
1990 - 1999	0.98	0.98	1.01
2000 - 2010	0.93	0.77	0.86
Post 2010	0.88	0.56	0.71

Sweden			
[U-values]	SFH	MFH	AB
Before 1945	0.28	0.32	0.3
1945 - 1969	0.3	0.29	0.32
1970 - 1979	0.32	0.26	0.26
1980 - 1989	0.27	0.27	0.27
1990 - 1999	0.24	0.24	0.24
2000 - 2010	0.18	0.21	0.21
Post 2010	0.15	0.15	0.15

United Kingdom			
[U-values]	SFH	MFH	AB
Before 1945	0.54	0.4	2
1945 - 1969	0.48	0.32	0.4
1970 - 1979	0.44	0.27	0.32
1980 - 1989	0.42	0.25	0.28
1990 - 1999	0.4	0.24	0.25
2000 - 2010	0.23	0.23	0.23
Post 2010	0.21	0.21	0.21

Clustering - Silhouette Score

The silhouette value is a measure of how similar an object is to its own cluster (cohesion) compared to other clusters (separation).

- If the score is 1, the cluster is dense and well-separated than other clusters.
- A value near 0 represents overlapping clusters with samples very close to the decision boundary of the neighboring clusters.
- A negative score $[-1, 0]$ indicates that the samples might have got assigned to the wrong clusters

If most objects have a high value, then the clustering configuration is appropriate. If many points have a low or negative value, then the clustering configuration may have too many or too few clusters.

[https://en.wikipedia.org/wiki/Silhouette_\(clustering\)](https://en.wikipedia.org/wiki/Silhouette_(clustering))

Starting point = 0

