Call on EU policymakers to revise criteria for windows in the EU Taxonomy Climate Delegated Act

EUROPEAN ALUMINIUM

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Pan-European maximum U-value for windows does not serve the environment

The present windows criteria from the EU Taxonomy Climate Delegated Act promotes triple glazed windows everywhere in the EU, even when the climatic conditions do not require it, thus causing a negative impact on the environment in terms of resource and energy used.

Using triple-glazing instead of double-glazing means:
- 50% more glass, 100% more gas, spacer, desiccant and sealing material, and heavier window frame
- about 20 kg more CO_2 per m^2 of window produced
- about 80 kWh more energy per m^2 of window produced

This problem will be particularly important in Southern Europe and in several cases in Central Europe too. This paper provides a short explanation and references to demonstrate why this is the case.

Finally, as the Delegated Act does not clearly state which criteria are applicable to curtain walls, this paper explains why they should be considered as similar to windows.

Why setting a pan European maximum U-value for windows does not make sense?

To see the impact of a window on climate change during the heating season, the heating demand or heat gain that it is causing must be calculated[1]. The thermal transmittance of the window named 'U-value' alone is not giving that information.

Thermal transmittance:	U	$\left[\frac{W}{m^2 \cdot K}\right]$

First, U must be multiplied by the heating degree hours 'A', i.e. the value that represents how much (in degrees), and for how long (in hours) the outdoor temperature across the heating season is lower compared to the indoor temperature required in buildings, expressed in kilo-Kelvin-hours [kKh].

'A' value differs for every location across Europe due to different climate conditions and is five times lower in Southern Europe than in Northern Europe. Therefore, the impact of U-value on heat losses is much lower in Southern Europe. This is why referring to U values defined by Members States makes much more sense than setting a maximum pan-European value.

Heat losses:	$A * U$	$\left[\frac{kWh}{m^2}\right]$

Second, the energy gains thanks to solar irradiation passing through the window must be considered since this is renewable and free energy.

It is calculated by multiplying two values: (1) the solar factor of the window, i.e. its 'g-value' is a percentage that depends on type of glazing and window frame characteristics, and (2) the solar irradiation 'B', a value that depends on climate conditions and the orientation of the window installation [kWh/m^2].

B-values are different in Southern Europe compared to Northern Europe, but they only differ by less than 20%. Therefore, the g-value is relevant to be considered everywhere in Europe.

It should also be noted that the window orientation has a much bigger impact on the B-value than the location of the building: it is three to four times higher for a window oriented towards the south than for ones oriented towards the north[2].

Heat gains:	$B * g$	$\left[\frac{kWh}{m^2}\right]$

[1] Impact during the cooling season should also be assessed, but not being considered by Member States today, including it in EU Taxonomy is not possible in the short term and has not been included in this document.

[2] Unfortunately, not being considered in national legislation so far, including differentiation per orientation in EU Taxonomy criteria is not possible today. Instead, LOT 32 study considered a uniform distribution of the façade windows with respect to the orientation.

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Finally, energy losses and gains must be combined together in the so-called 'Energy balance formula' [3]:

Heating energy demand: $A * U - B * g$ $\left[\frac{kWh}{m^2}\right]$

This is the principle that has been followed in the EU Ecodesign Preparatory Study on window products (LOT 32 study), where more details can be found.

In the long term, EU Taxonomy criteria should follow the 'Energy balance' approach for transparent products like windows and curtain walls, but since most Members States are unfortunately not doing so today, focusing on U-values is the only option in the short term.

As explained above, to take the different climate conditions into account **in the short term, these maximum U-values should be differentiated across the EU based on the ones from national measures implementing Directive 2010/31/EU**.

Not doing so would be counter-productive for the environment as explained in the following chapter.

Why setting a pan European maximum U-value for windows is not benefitial for the environment?

The present pan-European maximum U-value of 1,0 (W/m^{2}K) in the EU Taxonomy Climate Delegated Act means that only triple-glazed windows manufacturing is considered as sustainable.

In fact, there are no pan-European best windows, but optimal ones for each location.

For example, when a double-glazed window leads to a similar performance than a triple-glazed one, the first should be chosen because it is less material-intensive and has lower environmental impacts related to its production. It is also cheaper, which is very important since cost is a bottleneck for renovation.

As it can be seen in the LOT 32 study, in Northern Europe, the lowest U-value windows give the best results[4], but in Southern Europe, investigated double and tripled-glazed windows with U-values greater or equal to 1,0 perform quite similarly. They all show negative values, meaning that they act as heaters during winter[5].

The situation in Central Europe is in between the two previous cases.

Extracts of LOT 32 study, task 7, Table 14				**Heating demand (kWh/m2)**		
				European region		
Without shutter				Northern	Central	Southern
Window nr	Uw (W/(m2*K))	g (%)	Glazing			
1	5,8	0,85	single	588	340	14
2	2,8	0,78	double, standard	193	88	**-64**
3	1,7	0,65	double, lowE, argon	71	16	**-74**
4	1,3	0,6	double, lowE, argon, impr	39	**-3**	**-74**
5	1,0	0,55	triple, lowE, argon	17	**-14**	**-72**
With shutter						
Window nr	Uw (W/(m2*K))	g (%)	Glazing			
1	5,8	0,85	single	391	215	-29
2	2,8	0,78	double, standard	131	49	**-78**
3	1,7	0,65	double, lowE, argon	45	**-1**	**-79**
4	1,3	0,6	double, lowE, argon, impr	22	**-13**	**-77**
5	1,0	0,55	triple, lowE, argon	7	**-21**	**-74**

[3] To be fully correct, air infiltration 'H' should also be considered, and the formula should be 'A * (U+H) – B * g', but as H depends on window's air permeability class and local wind, it is not easy to consider it in legislation.
[4] However, in Northern and Central Europe, the difference in heating energy demand between double-glazed and triple-glazed windows is smaller for South orientation than for the other orientations.
[5] Furthermore, although not shown in the above table, even single-glazed windows are performing fairly good for South-orientation in Southern Europe.

But, using triple-glazing instead of double-glazing means[6]:

- 50% more glass, 100% more gas, spacer, desiccant and sealing material, and heavier window frame[7]
- about 20 kg more CO_2 per m^2 of window produced[8]
- about 80 kWh more energy per m^2 of window produced[6]

This means that the present windows criteria from the EU Taxonomy Climate Delegated Act promote triple- glazed windows everywhere in the EU, even when the climatic conditions do not require that level, thus causing a negative impact on the environment in terms of resource and energy used. This problem will be particularly important in Southern Europe and in several cases in Central Europe, too.

Why should curtain walls be treated like windows?

Curtain walling is referred to in footnote 94 in Annex 1 and in footnote 109 in Annex 2 of the EU Taxonomy Climate Delegated Act, without specifying under which product they fall.

A maximum thermal transmittance level value of 0.5 (W/m^2K) is not achievable with transparent components like curtain walling but only with opaque external wall systems.

Curtain walls have a large proportion of glazed area and thermally behave like windows: energy gains by solar irradiation need to be considered on top of thermal transmittancez related energy losses in energy balance formulas.

For the two reasons above, **curtain walling should be treated as 'windows' and not as 'external wall systems'.**

It could also be interpreted that the 0.5 (W/m^2K) threshold for 'external wall systems' should only apply to the opaque elements of curtain walling, but this is not a workable solution.

Curtain walling is a construction product as such, which is covered by the harmonised standard hEN 13830:2003[9].

The design and construction of curtain walling systems is complex as they often contain different kinds of materials, joined in different ways, and can exhibit numerous variations of geometrical shape, with different types of glazing, frames and opaque panels.

Thermal bridge effects at the rebate or connection between the glazed area, the frame area and the panel area, are all included in the calculation of the thermal transmittance of a curtain wall according to EN ISO 12631:2017, so that setting a threshold at the level of the opaque panels separated from the whole curtain wall does not make sense.

As indicated in EN ISO 12631:2017, testing according to ISO 12567-1:2010, i.e., the hot box method for windows and doors, can be applied to curtain walls as an alternative to calculation. This testing standard is applicable to all effects of frames, sashes, shutters, blinds, screens, panels, door leaves and fittings. In other words, it considers all components of the system and their interaction. So, also in the case of determination of the thermal transmittance of a curtain wall by testing, setting a threshold at the level of the opaque panels is not useful.

More info:
- Lot 32 study Commissioned by the European Commission (tip: look for 2015 reports, Task 7, Chapter 4)
- European Aluminium movie and infographics explaining the 'energy balance'
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[6] Sources: Comparison between Environmental Products Declarations for double glazed versus triple glazed products from Environdec for Saint Gobain, AGC INIES FDES, European Aluminium for Etem, IBU for EPPA.
[7] Which also requires more human capital for handling it during production and installation phase
[8] Glazing unit replacement that is supposed to happen at half of window's life would double these values
[9] EN 13830:2015+A1:2020 waiting for citation in EU Official Journal