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Call on EU policy makers to revise criteria for windows in EU Taxonomy Climate Delegated Act

Introduction

In June 2021, the EU Taxonomy Climate Delegated Act was published in the EU Official Journal.

Unfortunately, by setting a pan-European maximum thermal transmittance value ($U \leq 1{,}0\ W/m^2K$) the present criteria for windows does not allow to factor in geographical and climatic differences to optimise resource and energy use. It rather promotes highly insulated windows everywhere in the EU irrespective of the climatic conditions.

This problem will be particularly important in hot climatic conditions and in several cases for moderate climate 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 walling, this paper explains why they should be considered as similar to windows.[1]

1. Why setting a pan European maximum U-value for windows does not serve the climate and the environment?

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. The thermal transmittance of the window named 'U-value' alone is not giving that information.

To have that information, the U-value must be multiplied by a value reflecting the difference between indoor and outdoor temperature across the heating season, the so-called 'heating degree hours'. This value depends on climatic conditions that vary a lot across the EU: it is 5 times higher in cold climate than in hot climate.

Then, the energy gains thanks to solar irradiation passing through the window must also be considered since this is renewable and free energy. To calculate it, the solar factor of the window, named 'g-value', must be considered. The g-value is the percentage of solar irradiation that a window allows entering into the building. So, multiplied by solar irradiation, it gives the solar heat gains. Solar irradiation depends on local climate condition and orientation.

Combining the heat losses and solar heat gains, i.e. making an "energy balance" gives the correct picture of the energy performance of windows and shows that windows are positive contributors to building envelopes as a source of renewable energy.

Solar gain
g-value * solar irradiation

Heat loss
U-value * heating degree hours

Energy balance

So, the <u>U-value alone is far to reflect the heating demand related to a window</u>.

To see the impact of a window on climate change during the **cooling season**, similar reasoning can be made, but solar heat gains (g value) by far dominate the energy balance, so that the <u>U value of a window has less influence on the cooling energy demand</u>.

[1] PVC not being used in Curtain Walling, EPPA is not co-signatory of section 3, of which European Aluminium and EuroWindoor are the sole authors and co-signatories.

More details can be found in Annex I.

The present pan-European maximum U-value of 1.0 (W/m^{2}K) in the EU Taxonomy Climate Delegated Act means that only the most insulated windows are considered as being sustainable while, as explained above, the U-value alone does not reflect the heating energy demand and it has less influence on the cooling energy demand.

To ensure the best building performance but also lowest environmental footprint, both the U- and g-value must be considered together with factors representing local climatic conditions. Benefits of lower energy demand during the use-phase of windows must be compared with impacts related to production, as highly insulated windows also have higher material-intensity.

When doing so, lowest U-values obtained with triple glazing and highly insulated frames generally make sense in cold climatic conditions, contrary to hot climatic conditions. An example of this is provided in Annex 2.

2. What should be done instead?

The EU Taxonomy criteria should be revised to also factor in the 'Energy balance' approach for transparent products like windows and curtain walls **by replacing the present pan-European maximum U-value** of 1.0 W/m^{2}K **by values for Heating energy demand and/or Cooling energy demand of windows according to different climatic conditions** (see Annex 1[2])**.**

3. Why should curtain walls be treated like windows?[1]

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^{2}K) 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-transmittance-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^{2}K) 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[3].

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

[2]Based on Lot 32 study Commissioned by the European Commission (2015 reports, Task 7, Chapter 4)
[3]EN 13830:2015+A1:2020 waiting for citation in EU Official Journal

Annex 1

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. 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 climatic conditions and is five times lower in hot climate than in cold climate. Therefore, the impact of U-value on heat losses is much lower in hot climatic conditions. This is the first reason why setting a pan-European maximum U-value does not make sense.

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

Second, the energy gains thanks to solar irradiation passing through the window must also be considered since this is renewable and free energy. The so-called "energy balance approach" gives a more correct picture of the energy performance of windows and shows that windows are positive contributors to building envelopes as a source of renewable 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 glass and window frame characteristics, and (2) the solar irradiation 'B', a value that depends on climatic conditions and the orientation of the window installation [kWh/m^2].

B-values are different in different climatic conditions, 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 a window oriented towards the north[4].

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

Finally, energy losses and gains must be combined together in the so-called 'Energy balance formula' [5]:

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

So, the <u>U-value alone is far to reflect the heating demand related to a window</u>.

To see the impact of a window on climate change during the **cooling season**, similar reasoning can be made,

Cooling energy demand:	$-X * U + Y * g$	$\left[\frac{kWh}{m^2}\right]$

where X are cooling degree hours and Y the solar radiation leading to overheating. However, the X value being in all cases very low, the expression can be simplified as follows

Cooling energy demand:	$\boldsymbol{Y * g}$	$\left[\boldsymbol{\frac{kWh}{m^2}}\right]$

In other words, the <u>U value of a window has a low influence on the cooling energy demand and might be neglected</u>.

[4] 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.
[5] 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.

The value of the parameter Y depends significantly on the boundary conditions of the building e.g. climatic condition, orientation, insulation level of the building envelope, possibility to consider ventilative cooling etc., while the g-value of the window mainly depends on glass type and the presence of solar control/protection.

These principles have been followed in the EU Ecodesign Preparatory Study on window products (LOT 32 study), where more details can be found.

Annex 2

As it can be seen in the LOT 32 study, for the cooling season in Cold climatic condition[6], the lowest U-value windows give the best results[7], but in Hot climatic condition, investigated double and tripled-glazed windows with U-values greater or equal to 1.0 W/(m²K) perform quite similarly. They all show negative values, meaning that they act as heaters during winter[8]. The situation in Medium climatic condition is in between the two previous cases.

Extracts of LOT 32 study, task 7, Table 14				**Heating demand (kWh/m2)**		
				Climatic condition		
Without shutter				Cold	Moderate	Hot
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**

But, using triple-glazing instead of double-glazing means[9]:

- 50% more glass, 100% more gas, spacer, desiccant and sealing material, and heavier window frame[10]
- about 20 kg more CO_2 per m^2 of window produced[11]
- 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 promotes triple-glazed windows everywhere in the EU without taking into account whether the higher environmental impact of manufacturing the product can pay off during the lifetime of at least 30 years. If the climatic conditions do not require that level, it will cause a negative impact on the environment in terms of resource and energy used. This problem will be particularly important for hot climatic conditions.

[6] LOT 32 study talks about North, Central and South Europe, that we renamed Cold, Medium and Hot climate conditions in the present paper.
[7] However, in Cold and Moderate climatic conditions, the difference in heating energy demand between double-glazed and triple-glazed windows is smaller for South orientation than for the other orientations.
[8] Furthermore, although not shown in the above table, even single-glazed windows are performing fairly good for Hot climatic conditionpe.
[9] 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.
[10] Which also requires more human capital for handling it during production and installation phase
[11] Glazing unit replacement that is supposed to happen at half of window's life would double these values

About

EPPA, the European PVC Profiles and related Building Products Association represents the manufacturers of PVC window systems and related building products in Europe. About 25,000 employees process about 1,4 million tonnes of PVC creating a turnover of €4 billion with profile systems and building products. Based in Brussels, EPPA provides a common platform for bundling national activities in the fields of PVC window technology, recycling, environment, and public affairs.
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European Aluminium, founded in 1981 and based in Brussels, is the voice of the aluminium value chain in Europe. We actively engage with decision makers and the wider stakeholder community to promote aluminium's strategic role, secure growth, and stress our metal's contribution to meeting Europe's sustainability challenges. We do this through environmental and technical expertise, economic and statistical analysis, scientific research, sharing of best practices, and public affairs and communication activities. Our 95+ members include alumina refiners and primary aluminium producers; downstream manufacturers of extruded, rolled and cast aluminium; aluminium recyclers and national aluminium associations, representing together more than 600 plants and 1 million (direct and indirect) jobs in 30 European countries.
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EuroWindoor AISBL was founded as an international non-profit Association, in order to represent the interests of the European window, door and facade (curtain walling) sector. Our 19 national associations speak for European window, door and facade manufacturers that are in direct contact with consumers, and thereby having large insights on consumers' demands and expectations. We are at the forefront interacting with dealers, installers and consumers buying windows and doors, and the companies behind the associations cover selling all over Europe.
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