Ecomerchant: How to choose and buy windows.

An Ecomerchant guide

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ETHICAL · HEALTHY · SUSTAINABLE

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Where to start:

Who would have thought that buying windows could be so potentially confusing? Well it can be. Ecomerchant have written this straightforward guide to help you through the process. Windows and doors form part of the fabric of your house and so are integral in maintaining the energy efficiency (we commonly measure this in running costs i.e. my fuel bill is £x's per year) this is why it is important in the first instance to match the windows and doors to the building in which they are being installed. There are a number of simple questions you should ask yourself to narrow your options down, these include building type, budget, and performance and where the building is, all of which can affect your options. Next, cost: one of the best ways to compare prices is by £'s per m^2 installed (there is a ready reckoner later in the document) however it may also be worth comparing £'s per m2 for a specific level of performance usually listed as a U Value, this will give you an idea of how much performance (equals savings) is costing to install.

To get us started suppose we begin by assuming you are in the market for some new windows but you have no idea where to start, you could Google 'double glazed windows' and see if that helps, typically this will offer up around 15 to 18 million web pages! This is not really very helpful, so refine your search maybe use 'inexpensive double glazing ' this brings up 600,000 pages maybe try 'performance double glazing' over 3.5 million this time. There must be a better way to begin this journey and there is. Begin by following the basic steps below to at least hone down the window types that may suit your property.

Question 1. Is where the building is a determining factor in the choice of window? This would include, listed properties, being in a conservation area etc. This may limit the materials and style of the windows you can have.

Question 2. What building regulations do you have to conform to? For new build you need to achieve a minimum U Value of 1.4 for the whole window for retrofit the requirement is a U value of 1.6 or an energy rating of 'C' or better.

Question 3. Is the type of construction a determining factor, for example are you building to a target level of energy performance and so need a minimum level of performance form the windows? Match you window type to the desired performance level. If retro fitting ask, do we know how efficient the building fabric is or how much of my exposed facades are glazed. Replacing leaky windows can have a dramatic effect on building performance with consequential benefits such as reduced heating bills.

Question 4. Has my architect specified a window type? This may be a result of answering the questions above and the scope of choice narrowed to within a small range of options. Comparing prices for a specification with a named supplier and model is the ultimate in refining your search. If you or your architect have not done this then the next question is relevant

Question 5. Find out what level of performance you need, to under specify a windows performance will cost you in lost heat, increased noise, maintenance etc. over specifying a window equally is money spent on redundant benefits. Match the performance to the rating and layout of the rest of the build Passive Haus windows are designed for Passiv Houses and budget UPVC for a budget market. The key performance drivers are frame material, frame design, glazing type and glazing configuration i.e. double / triple. A good rule of thumb, as these all improve the price goes up.

Question6. Establish a budget; seems common sense doesn't it, windows come in a vast array of options and therefore prices, the key here is a few basic rules of thumb price goes up with quality. Increasing the quality of a window can be by using heart wood only, fitting better running gear and furniture, changing the gas used to fill glazing units, increasing the number of components to manage thermal bridging or facing with aluminium etc. which all come at a price. The real trade-off is for longevity of performance, cheaper windows can still meet performance targets but they may wear out quicker that better made products.

What matters: Type of window

Energy

The heat energy (operational energy) lost through a window frame during its lifetime is likely to be greater than the energy used to manufacturer it (embodied energy) It is important to select a frame material with the least thermal conductivity. Wood is the least conductive followed by PVC and metal.

Wood, durability and environmental impact

- The choosing of wood, its treatment and maintenance are crucial in reducing a window frame's environmental impact:
- We only supply FSC sourced timber
- We minimise transport which adds embodied energy. We try and source UK timber whenever possible.
- For both hard and softwoods we ensure that the specification explicitly excludes the use of sapwood.
- Painting wood adds significantly to its environmental impact. We specify either a naturally durable species that doesn't need treating or select a treatment with low impact. If frames are untreated initial colouring will change.
- If the wood is to be treated/painted, ensure that this is done in the factory prior to site. Factory painted frames double the period before the need to repaint.

Design

The design of the sections will have an effect on performance. Design to maximise rapid drainage, maintain dry glazing channels and locate weather seals away from wet areas.

Keep window panes as large as practically possible. Even with wooden frames, the metal spacers between the glass panes act as cold bridges. Large panes have less perimeter length than lots of smaller panes.

And on site ...

Be careful to avoid damage to frames on site. Ensure that they are not used as formwork in wall openings, ask us for our guide to handling, storing and fitting windows.

What matters: Building type

The appearance of windows in an old house often contributes to its character. This is particularly true of historic buildings and buildings within conservation areas. Consultation with a Local Authority planning / conservation officer is recommended at an early stage in order to determine a window treatment strategy.

Existing windows, particularly if they are old, single glazed and air-leaky around their casements and frames, will probably need replacing.

Dealing with more recently installed windows that might be double-glazed, well-made and reasonably air-tight (check pre-refurbishment air-tightness testing), is slightly less straight-forward. The designer will have to plan a treatment of the windows based upon budget, window size (affect on overall heat loss) and ability to carry-out any remedial works such as draught-stripping, replacement of single glazed panes with double glazed, or the addition of secondary glazing.

It will likely prove difficult to balance the appearance of new/renovated windows with the need for energy efficiency – expect compromise!

What matters: Performance

A typical house loses 10% of its heat through the windows. As part of a refurbishment scheme the replacement of existing windows with new high performance windows should be seriously considered.

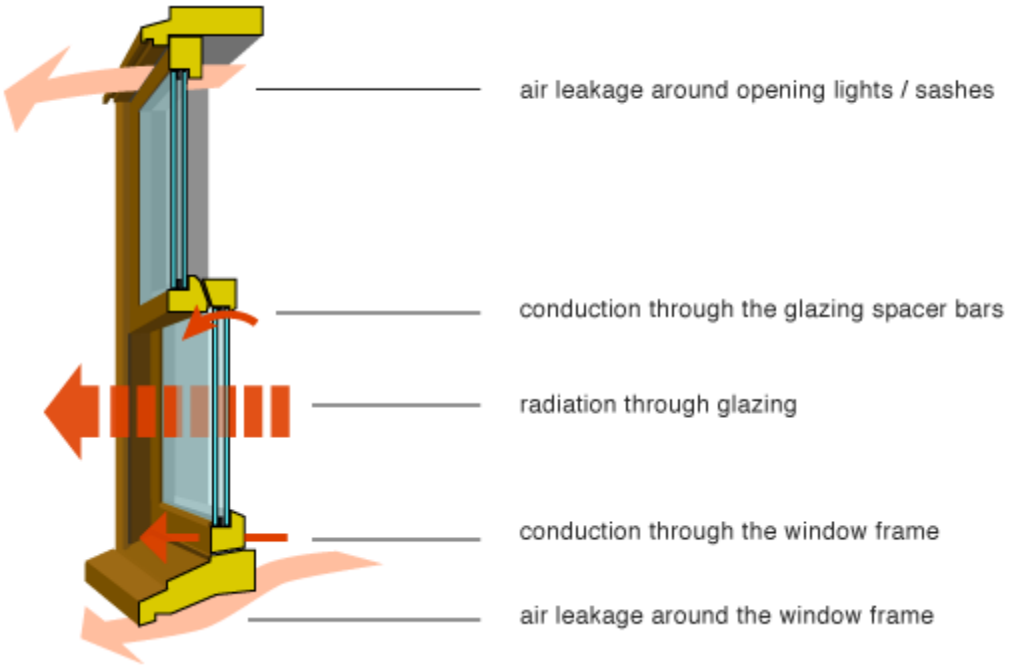
Treatment of windows in historic houses or houses in conservation areas are more problematic. Replacing windows to match the appearance of the existing windows requires careful specification if the windows cannot be upgraded. The designer should co-operate with the local conservation officer to ensure that any compromise between performance and appearance can be optimised.

Replacement windows

The successful specification of energy efficient windows requires a sound understanding of the dynamics of thermal performance.

Overall energy balance = solar heat gain – heat loss

Windows lose heat in a number of ways:



Around 2/3 of the energy lost from a standard window is through radiation through the glazing. The inside pane of a double-glazed unit absorbs heat from the room and transmits it through conduction and convection (see below) to the cooler outside pane, and so to the outside. The thermal transmittance of a glazing unit, known as the U-value, is expressed in units of Watts per square metre per degree of temperature difference (W/m^2C)

A small amount of heat is lost through convection within the glazing cavity. In some circumstances, particularly in wider glazing cavities, air within the cavity is warmed by the inner pane. The warm air rises and is replaced by cooler air and so sets up a convection current which transfers heat from the inner pane through to the outer pane(s). Convection up to 20mm in double-glazing units particularly with argon gas, which is denser than air, is insignificant; In triple glazing there is an improved performance up to between 18-20mm.

Heat is conducted through the window frame. The rate of conduction (U-value) is governed by the frame material – in general, timber frames perform better than metal in this respect.

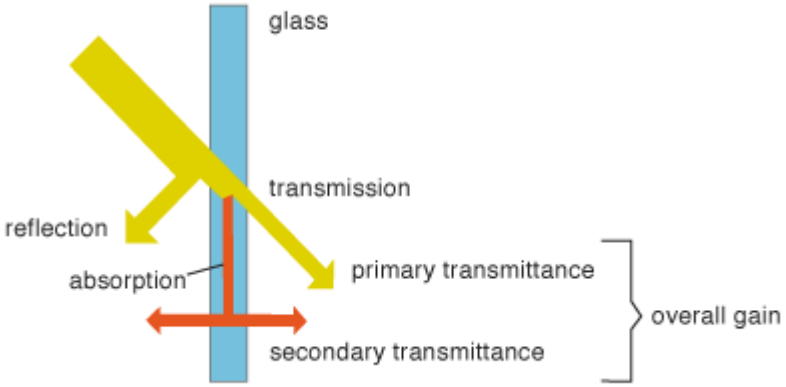
The panes in double glazing are separated and sealed at their perimeter by spacer bars. Usually made from aluminium, they represent a small but not insignificant conduction route.

After radiation, air leakage is probably the biggest contributor to heat loss from existing windows, particularly in older or badly installed windows. In an era when small gaps in the fabric were relied on as a form of background ventilation, air leakage wasn't recognised as being the issue that it has become today. Fixed windows lose less heat and larger windows tend to leak less air per unit area.

The kind of opening method also determines air leakage – traditional sash windows perform the worst whereas simple casements are generally better. Leakage is also common around the frame. A combination of pre-fabricated frames and ill prepared wall openings on site have led to a significant number of badly fitted windows with gaps left over (often big enough to be filled with newspaper).

Heat gain

Though the general balance in the UK is for windows to lose heat, they also, to a varying degree absorb heat and in some instances of high performance windows, there can be a net gain.



Heat is absorbed through glazing in two ways:

- Solar gain directly transmitted (primary transmittance) through the glazing and
- Energy absorbed by the glazing and subsequently transferred inwards by convection and radiation (secondary transmittance).

Factors effecting heat gain

Glazing technology and the 'G-Value'

The 'G-Value' measures the degree to which glazing blocks heat from sunlight. The G-value is the fraction of the heat from the sun that enters through a window. G-value is expressed as a number between 0 and 1. The lower a glazing's G-value, the less solar heat it transmits.

A window's G-value is determined by the type of glass, or combination of types, that make up the glazing unit. (see glazing types below)

In most domestic situations the specification of glazing concentrates on admitting solar energy whilst preventing energy from being re-radiated from inside.

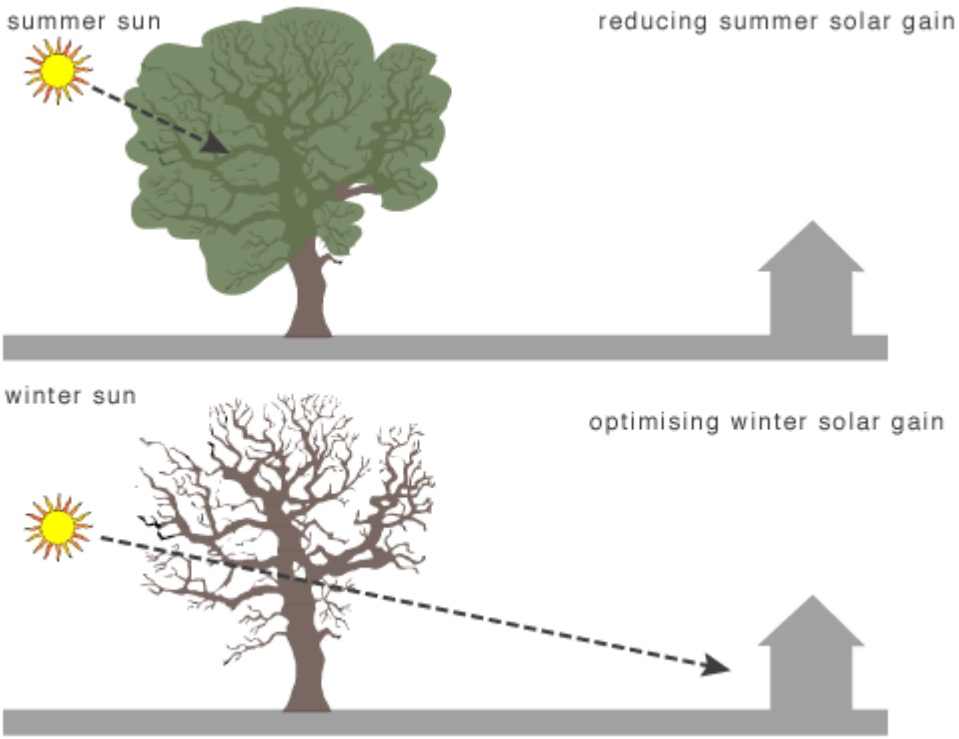
(The US equivalent of 'G-value' is the Solar Heat Gain Coefficient – it differs from the European G-value in using a different value for air mass)

Orientation

In the UK solar energy is gained through southerly facing windows. Peak absorption for windows facing directly to the south will be during the summer months; Likewise East and West facing windows will experience maximum heat gain in the mornings and afternoons respectively during the summer.

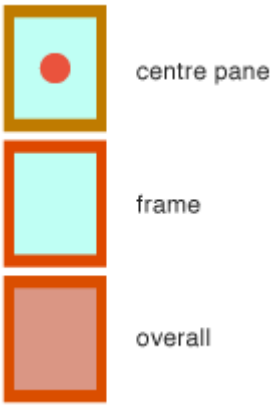
Shading

Shading the window areas during the summer months is usually desirable. Whilst relatively easy to achieve with south facing glazing, the lower angle of the sun makes east and west facing windows more problematic. In these instances, shading might be possible using part of the building fabric (e.g. eaves or proprietary shading devices) but an alternative might be to look at the potential of landscape features such as trees.



Measuring window performance

U-values

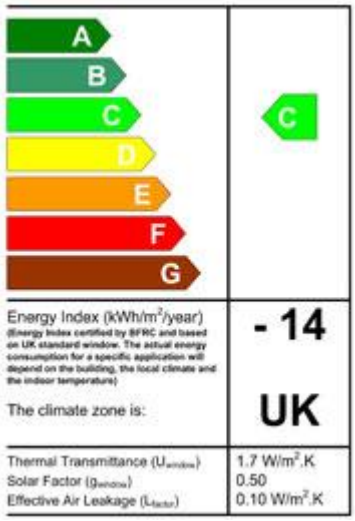


The traditional method of measuring a window's performance is through its U-value. In practice this can often be confusing since there are 3 types of u-value that can be quoted:

- The u-value measured through the centre of a glazing unit alone – 'centre-pane'
- The u-value of the window frame alone.
- The overall u-value of the window including glazing unit and frame. – 'overall'

(Note: it is common for window manufacturers to promote the 'centre-pane' u-value of a window rather than the more realistic 'overall' u-value.)

BFRC Rating system



The u-value method of measuring a window's performance has proven to be something of a blunt tool, ignoring, as it does, other factors such as a window's capacity to transmit solar energy.

This crudeness of measurement has led, in the last few years, to a system developed by the British Fenestration Rating Council (www.bfrc.org) that takes into account the multiplicity of factors determining a windows performance and rates on the basis of a nominal energy balance from A-G. Most importantly for the window specifier, it encourages manufacturers to publish verifiable data on Ux, g-value and air permeability.

Though u-values are still often quoted, the BFRC rating system is gaining popularity through its citing by the Building Regulations in England and Wales

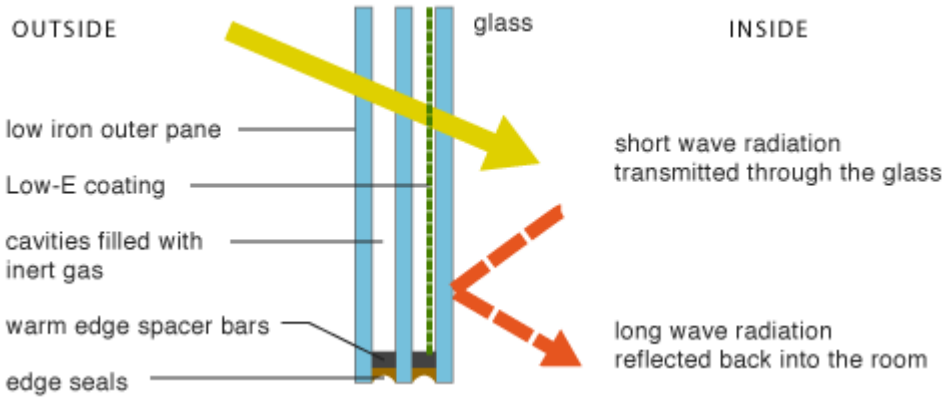
Passivhaus certification

Another useful standard gaining ground is that provided by certification by the Passivhaus Institute. The very high standard requires windows to be triple glazed and achieve u-values of at least 0.8 W/m2C for both the glazing and the frame.

Window technologies- Glazing

'Low-E' Glass

• The most significant development influencing the market has been that of 'Low-E' glass. By coating the face of the inner pane of glass with metal or metal oxide, short wave radiation from the sun is permitted to enter the building, whilst long wave radiation in the form of heat from the inside is reflected back into the room.
• In summer the coatings can contribute to the risk of overheating by slightly reducing the amount of short wave radiation transmitted through the glass.
• Because of the restricting effect of the coating, Low-Glass will always reduce the glazing's G-value.



There are two types of Low-E coatings: hard and soft. The difference between them is their method of application, their transmittance and their durability.

Hard (eg Pilkington K glass): applied during the manufacturing process. Emissivity between 0.15 and 2.0

Soft (eg St Gobain Planitherm Total) : applied after manufacture. Emissivity between 0.05 and 0.10. They produce a lower u value. Soft coatings tend to degrade when exposed to air and moisture, are easily damaged, and have a limited shelf life.

Gas filled units

Filling the gap between the glass panes with low conductivity gas such as argon or krypton (as well as the more expensive xeon) at atmospheric pressure improves the window performance by reducing conductive and convective heat transfer. They are mostly used in conjunction with low-emissivity coatings. One drawback though might be the long-term integrity of the fill.

Insulating spacer bars

Multiple glazing units are spaced and sealed by spacer bars around the perimeter of the unit. The traditional material for a spacer bar is aluminium. But as window standards have become more stringent, the heat lost from thermal bridging through the metal has become more significant. Stainless steel spacer bars are an improvement, but better performance is to be had through the use of non-metallic materials such as steel reinforced polymer, glass fibre or structural foam with, typically, a polysulphide seal. This technology is often referred to as 'warm edge'.

• In highly insulated houses, even with warm edge spacers, there will be condensation at the bottom edge of the pane with double glazing. This is because of convection causing colder argon adjacent to the outer pane sinking to the bottom of the unit (In poorly insulated buildings condensation will be at other points). Triple glazing eliminates this problem because of the two cavities.

Low iron glass

Removing the iron content from glass increases its light transmittance and therefore its solar gain. Low iron glass is commonly used in the outer pane of multiple-pane units, low-e glass being used for the inner pane.

Frame design and materials

• Although the window specifier might be handicapped by planning restrictions covering the materials and appearance of replacement windows, window frames must be considered as an important area when considering heat loss.

• Most energy lost through a frame is through conduction. Technological developments have been dedicated to reducing the overall conductivity through improved materials and the combination of materials to produce 'composite frames'.

• From a 'green' designer's point of view, the most important base material is timber. Hardwood frames are preferable and products are available that meet the stringent standards set by the Passivhaus standard. An alternative is to use treated softwood or a wood / aluminium composite where the metal is used on the external face of the frame – thus significantly improving durability.

• Metal windows have improved through the development of increasingly complex sections, the more recent of which contain thermal breaks.

Windows and the BRE 'Green Guide to Specification'

The Green Guide's approach to rating windows is perplexing to many. Though the guide is correct in identifying the primacy of performance over the environmental impact of the materials involved, questions continue to be asked about the veracity of the data that supports PVC windows receiving an 'A' rating (on par with softwood), whilst the arguably more sustainable aluminium / softwood composite windows are awarded a lowly 'D'.

Glazing and comfort

One of the underlying principles of the Passivhaus standard is that of providing 'thermal comfort' to a building's occupants (for more information about the concept of thermal comfort see www.passivhaustagung.de/Passive_House_E/comfort_passive_house.htm).

Comfort criteria dictate that the there should not be more than 4 K between any surface and air temperature. Outside of this margin, extra heat is needed to compensate for the increased feeling of discomfort.

In a building where the walls are well-insulated the temperature difference between the wall surface and room temperature is minimal, but the temperature differences between glazing and room temperature (assuming an indoor room temperature of 21 K) can be significant according to glazing type:

- between single glazing and air temperature can be around 20 deg C

- between double glazing and air temperature will be around 8 deg C

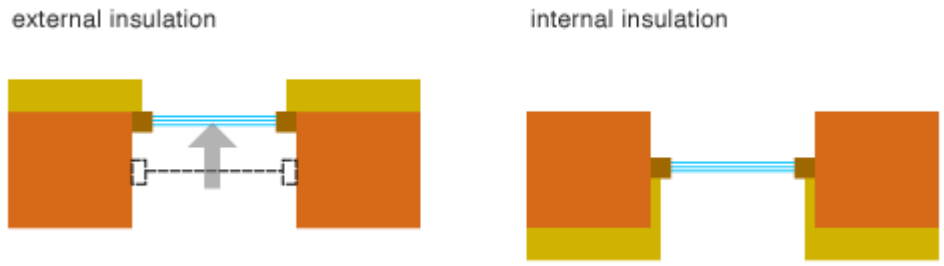
- between triple glazing and air temperature will be around 4 deg C (ie within the comfort zone)

Installation

• Windows should be factory-glazed to avoid performance loss associated with site installation.
• Gaps between the frame and the wall should be sealed with low expanding foam backed-up with a single-sided, pre-folded high-performance adhesive tape (Pro Clima or similar) to provide an airtight bond between the window frame and the wall / vapour control layer.
• Ensure that Low-E glazing is installed the right way around (check the label)
• Check any requirements for safety glazing.

Thermal bridging

Thermal bridging around wall openings is a constant issue. When replacing existing windows, limiting the extent of thermal bridging should be a priority. The general strategy is to bring the window into line with the insulation layer. As part of the upgrading of a solid wall the treatment of the window opening will be determined by the location of the insulation.



External insulation

If possible, it is desirable to bring the window forward to align with the insulation layer to a point where the insulation can overlap the frame.

Internal insulation

The lining, together with the vapour control layer should be returned into the window reveal to be tightly butted and sealed against the window frame.

Composites

The creeping up of energy standards in recent years has been met with a degree of ingenuity amongst the manufacturers of advanced window systems. Its long been understood that different frame materials possess different strengths and weaknesses. For example, metal windows are renowned for their durability but not for their energy efficiency, whereas for, say, softwood windows, the opposite is true. By combining the relative strengths of different materials in one product, very high levels of performance are being achieved.

Perhaps the most successful combination so far in the development of composites has been that of aluminium-clad softwood cores. Although relatively new on the scene aluminium-clad timber frames are expected to have lifetimes of in excess of 40 years. PVC by comparison is around 25 years.

We all come across terms used to describe the performance of windows, building shell (of which they form part) and insulation (which they also contribute) but does it really help make deciding any easier? Most modern double glazed performance windows will achieve a U Value of 1.3 this is in line with regulations and expected levels of performance, but it can be seriously improved upon. Before we go any further it is worth pointing out that windows can have U values attached to different parts and so the frame can be given a U value as can the glazing – sometime s called a centre pane U Value. What is important here is the overall window's U Value. We are here to help you choose energy efficient windows and doors as a rule of thumb, the lower the *U* Value, the more energy efficient the window or door. However the windows and doors should match the overall performance level of the building. You can also use asses a window's efficiency is through its energy rating. Windows are rated between A-G in a similar way to your fridge or freezer, with A rated products providing better performance than those rated G. You can find out more on the Energy Saving Trust website.

Replacement windows

Building Regulations dictate that replacement windows should achieve a minimum U Value of 1.6 w/m2k (or an energy rating of C or better) and replacement doors 1.8 w/m2k so always ensure you buy products with this minimum performance rating.
All our windows and composite door sets are available in this range, with our highest performing window reaching a *U* Value of just 0.7 w/m2k.

New build

The requirements for new build are based on the overall performance of the entire building and we need this information to ensure we supply you with the correct product

What matters: Glossary

U-value (thermal transmittance)

Thermal transmittance is a measure of the overall rate of heat transfer, by all mechanisms under standard conditions, through a particular section of construction. This measure takes into account the thickness of each material involved and is calculated from R-values (where U=1/R) of each material as well as constants accounting for surface transmittance (Rsi and Rso, inner and outer surfaces respectively) and also for a small standard air gap (Rso). Thermal transmittance is measured in W/m^2K

R-value The capacity of a material to resist the transmission of heat. The R-value is calculated by combining the lamda value (thermal conductivity) and the thickness of the material. Hence $R=t/\lambda$, where 't' is the thickness. Units are measured in m^2K/W. Used in connection with insulation, the higher the R-value, the more effective the insulation. The R-value is also used to calculate the U-value (thermal transmittance) where U = 1/R

y-value A notional additional U-value, spread uniformly over the whole thermal envelope.

Thermal bridge A thermally conductive material which penetrates or bypasses an insulation system; such as a wall tie, metal fastener, concrete beam, slab or column. Thermal bridging lowers the overall thermal insulation of the structure by creating areas where heat loss is greater in one area than it is for another. The effect is to reduce the overall u-value of the construction element. The heat loss per unit length of thermal bridge is known as the Ψ-(psi) value and is measure in W/mK.

Thermal conductivity (K-value) A measure of the rate at which heat is conducted through a particular material under specified conditions.

G-value Measures the degree to which glazing blocks heat from sunlight. The G-value is the fraction of the heat from the sun that enters through a window. G-value is expressed as a number between 0 and 1. The lower a glazing's G-value, the less solar heat it transmits.

k-value (or λ lambda value) The k- value, otherwise known as the thermal conductivity or lambda value, of a material to lead or to resist heat transfer. When used in reference to insulation, the lower the k-value, the better the insulation.

Composite window Any window construction that incorporates engineered components of different materials designed (amongst other reasons) to reduce U Values, minimise thermal bridging, increase longevity or minimise maintenance.

Performance window Any window that has demonstrable performance properties, in short a devalued and redundant term to describe any window

Now unless you are an architect or building professional you will not necessarily be any better equipped after reading that to buy a window than you were before. What is important is that there is a genuine link between price, performance and quality. As we saw at the beginning of this guide the window market is highly competitive so there may not be a huge difference between ranges when compared by a well-defined and specific application e.g. aluminium clad timber, triple glazed Passiv Haus windows, but there can be a vast difference in performance and quality if you use price only as a comparator. This is why we recommend that you establish the type of window you can have first. This little bit of filtering will narrow down your possibilities into what you can have for example you may be in a conservation area or a listed building which may restrict the style or type of window. You will also need to match the performance of the window to the fabric of the building and finally there may be regulatory restrictions.

Did the glossary help? Many of these terms are frequently used by professionals between themselves, most self-builders will not have had training or possess degrees in architecture and construction that will allow us to make any real sense of these terms. We (Ecomerchant) would always advise the application of common sense within the envelope of professional services (after all you are paying them to know this for you) and the use of plain language to explain the why and the benefits. Just because we can gain an understanding of the concept of U Values doesn't mean that we will create a better building.

What matters: Building Regulations

Building Regulations define the minimum standards of design and building work for the construction of buildings. They are designed to ensure the health and safety of those in and around buildings, provide for energy conservation and access and facilities for disabled people.

To ensure compliance, we recommend using an experienced professional who can offer up-to-date advice on each individual situation, or contact your Local Authority Building Control Department.

Building Regulations have nothing to do with the quality of neither the products used nor the quality of the installation

U Values

Whole product *U* Values are used to assist in the correct selection of the windows needed on your build, Ecomerchant can suggest ways of lowering (improving) the U Value

There are a total of 14 parts to Building Regulations. You can view the latest approved documents on the Building Regulations website

Building regulations that cover windows are changing at the time of writing the changes for windows are summarised below

2010 Building Regulations (England & Wales) Current at the time of writing

The 2010 regulations require that:

- Windows have a maximum U Value of 1.6 W/m2K or better, or a Window Energy Rating of 'C'.
- Doors (England & Wales) have a U Value of 1.8 W/m2K or better
- (Doors (Scotland) have a U Value of 1.6 W/m2K or better)

2013 Building Regulations – coming into effect in April 2014

Changes to the Building Regulations in England in 2013 are *likely* to require either window U

- Values of 1.4 W/m2K or a 'B' Window Energy Rating.
- Doors are likely to have to meet a U Value of 1.4 W/m2K or better or a 'D' Energy Rating.

For windows the following regulations may also apply:

Part B - Fire safety

In first floor habitable rooms, for example bedrooms, windows must be wide enough to provide a means of escape. In some situations there may be a requirement for fire resisting windows.

Part E - Resistance to passage of sound

Removing a ventilator in the head of a window and changing the glass spec will significantly improve acoustic performance. Generally an acoustic engineer report would be required to ensure complete compliance.

Part F - Ventilation

Background ventilation in windows (headline ventilators) is one of four systems which can be used to comply.

Part K - Protection from falling collision and impact

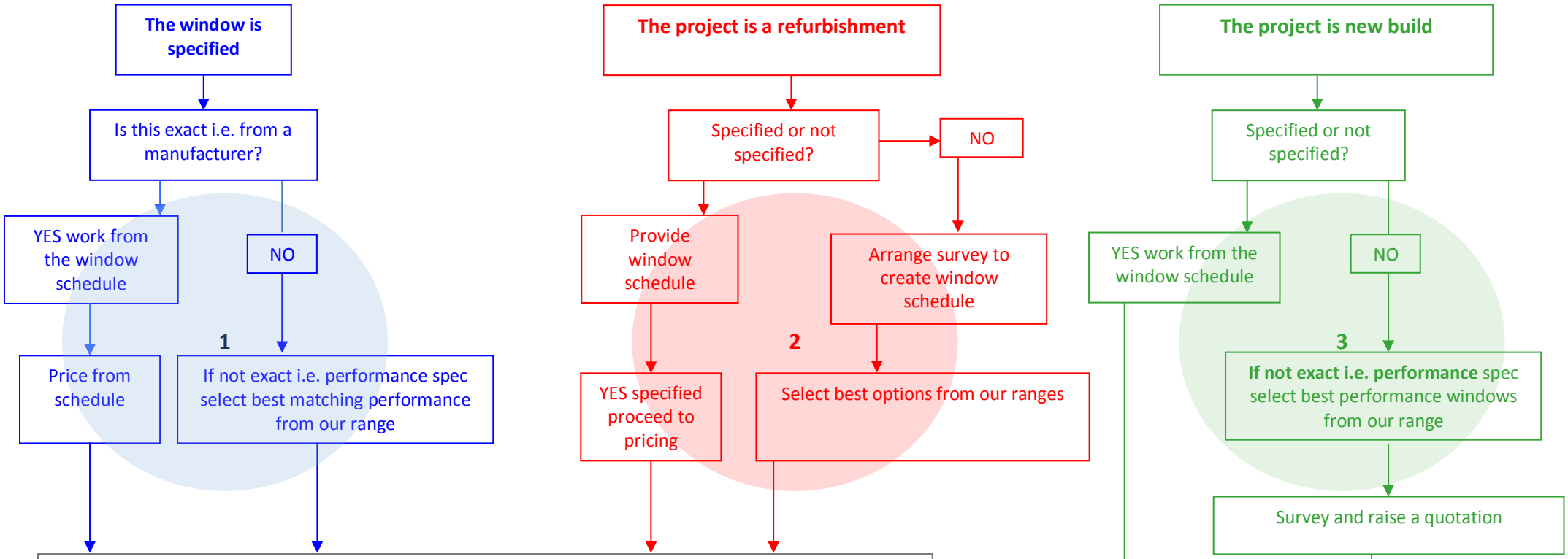
Windows should not open onto walkways in or around buildings and containment is required by the use of guarding/glazing in some situations, particularly where the window sill is below 800mm from floor level.

Part L - Conservation of energy fuel and power

Windows need to provide minimal heat loss ensuring lower energy use thereby reducing CO2 emissions. A *U* Value is a measurement of heat loss and it is this, along with the way windows are fitted, that will ensure compliance. Alternatively, windows are now also given energy ratings from A-G in a similar way to your fridge or freezer, where A rated products give better thermal performance than those rated G. Building Regulations now require replacement windows to be C or better.

Part N - Glazing in relationship to impact, opening and cleaning

Glass must be toughened or laminated in certain locations and if it does break then it must do so without causing injury. Reversible windows must also be fitted with restrictors.



The Ecomerchant Promise

- All quote requests will be dealt with within 5 working days
- Prices will be returned within 5 working days when submitted with a complete schedule
- Where circumstances allow we will always give you more than one option (or range) to choose from
- We are here to provide technical and installation support, we are always happy to talk you through any concerns you have
- We only sell UPVC free windows
- All timber windows are FSC or PEFC accredited
- All our quotations are written in straightforward English and describe exactly what we will do for you within the price quoted.