

# How to assess the thermal performance of windows?

**ENERGY  
BALANCE  
EQUATION**

**SOLAR GAINS - HEAT LOSSES**

## How to optimise energy balances across seasons?



**SOLAR GAINS - HEAT LOSSES**



**SOLAR GAINS - HEAT LOSSES**



# HEATING SEASON

## ENERGY BALANCE

$$B \cdot g_w - A \cdot (U_w + H)$$

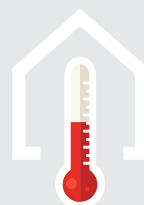
**Solar gains**  
to be maximised

**Heat losses**  
to be minimised

### BUILDING TYPE



- Thermal mass
- Thermal loads
- Occupancy



**Base T°**  
Below which building needs heating

### LOCATION



Window orientation



Local climate



**External T°**



Solar irradiation

Wind



**A**

**Heating degree hours**

How much and how long external temperature is lower than building base T°

**B**

**Usable solar radiation**

### WINDOW PRODUCT



Air permeability class

**L**

Thermal transmittance

**U<sub>w</sub>** or **U<sub>w,eff</sub>**

if shutter used during night

Solar factor

**g<sub>w</sub>**

**H**

**Air infiltration**



# COOLING SEASON

## ENERGY BALANCE




$$Y \cdot g_w - X \cdot (U_w + H)$$

**Solar gains  
to be minimised**

**Heat losses**

### BUILDING TYPE



-  **Thermal mass**
-  **Thermal loads**
-  **Occupancy**



**Base T°**

Above which building needs cooling



**External T°**

### LOCATION



**Local  
climate**



**Window orientation**

**Solar  
irradiation**



**Wind**



**X**

**Cooling degree  
hours**

How much and how  
long external  
temperature is higher  
than building base T°

**Y**

**Solar radiation  
leading to  
overheating**

### WINDOW PRODUCT



**Ventilative cooling**

**Air permeability  
class**

**L**

**Thermal  
transmittance**

**U<sub>w</sub>**

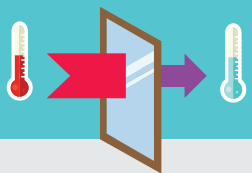
**Solar factor**

**g<sub>w</sub> or g<sub>w,eff</sub>**

if shading used during day

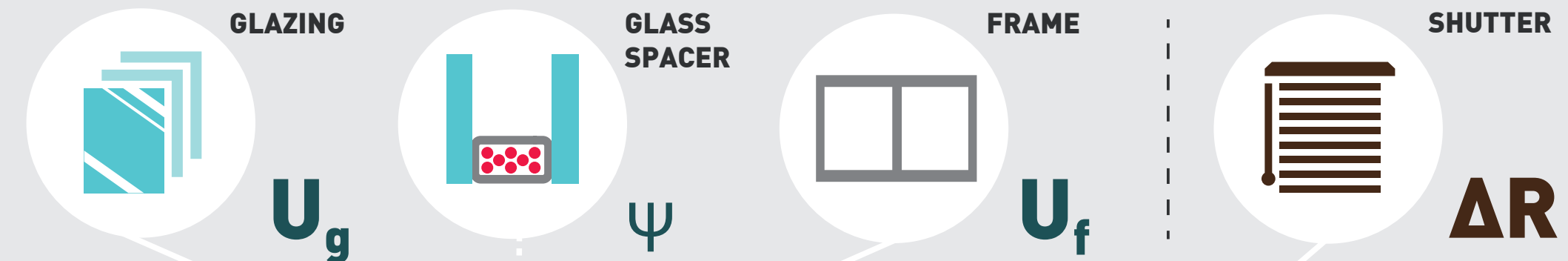
**H**

**Air infiltration**



# THERMAL TRANSMITTANCE U

## COMPONENTS



## WINDOW

Window without shutter

$U_w$

Window with shutter closed

$U_{w,s}$

## OPERATION

Time share during heating season

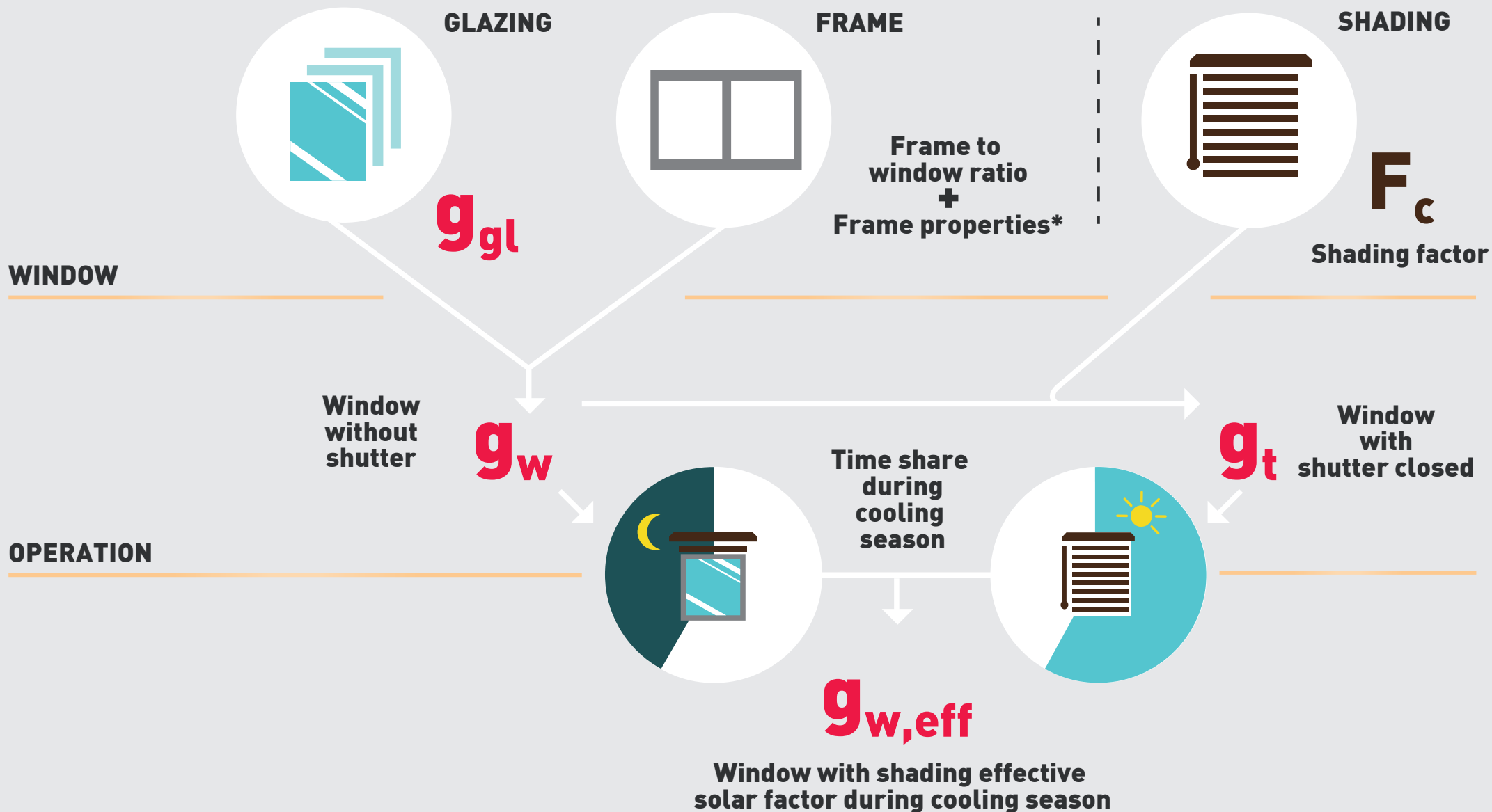
$U_{w,eff}$

Window with shutter effective thermal transmittance during heating season



# SOLAR FACTOR $g$

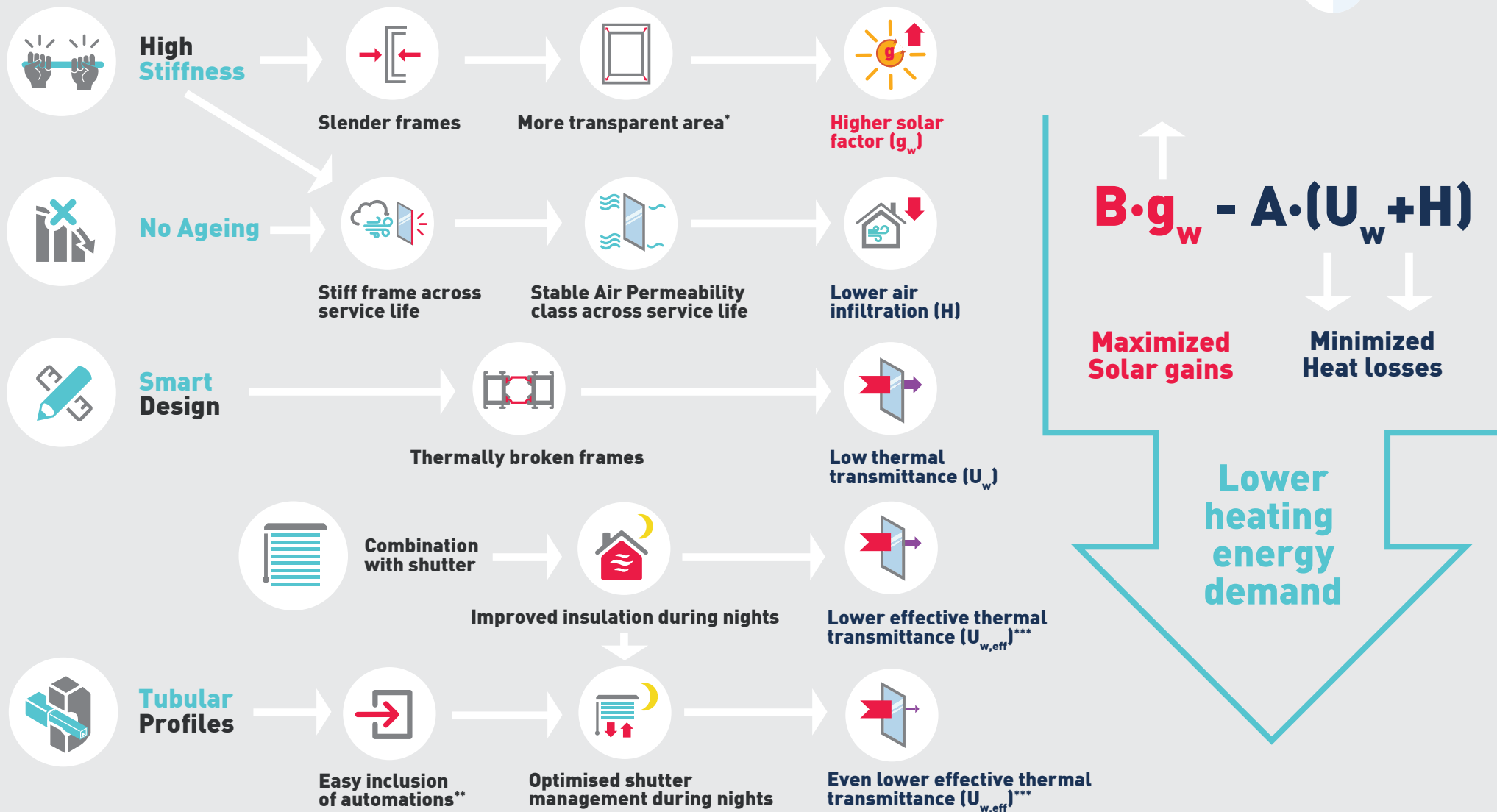
## COMPONENTS



\*Not included in EN yet, only in XP 50-777 in France

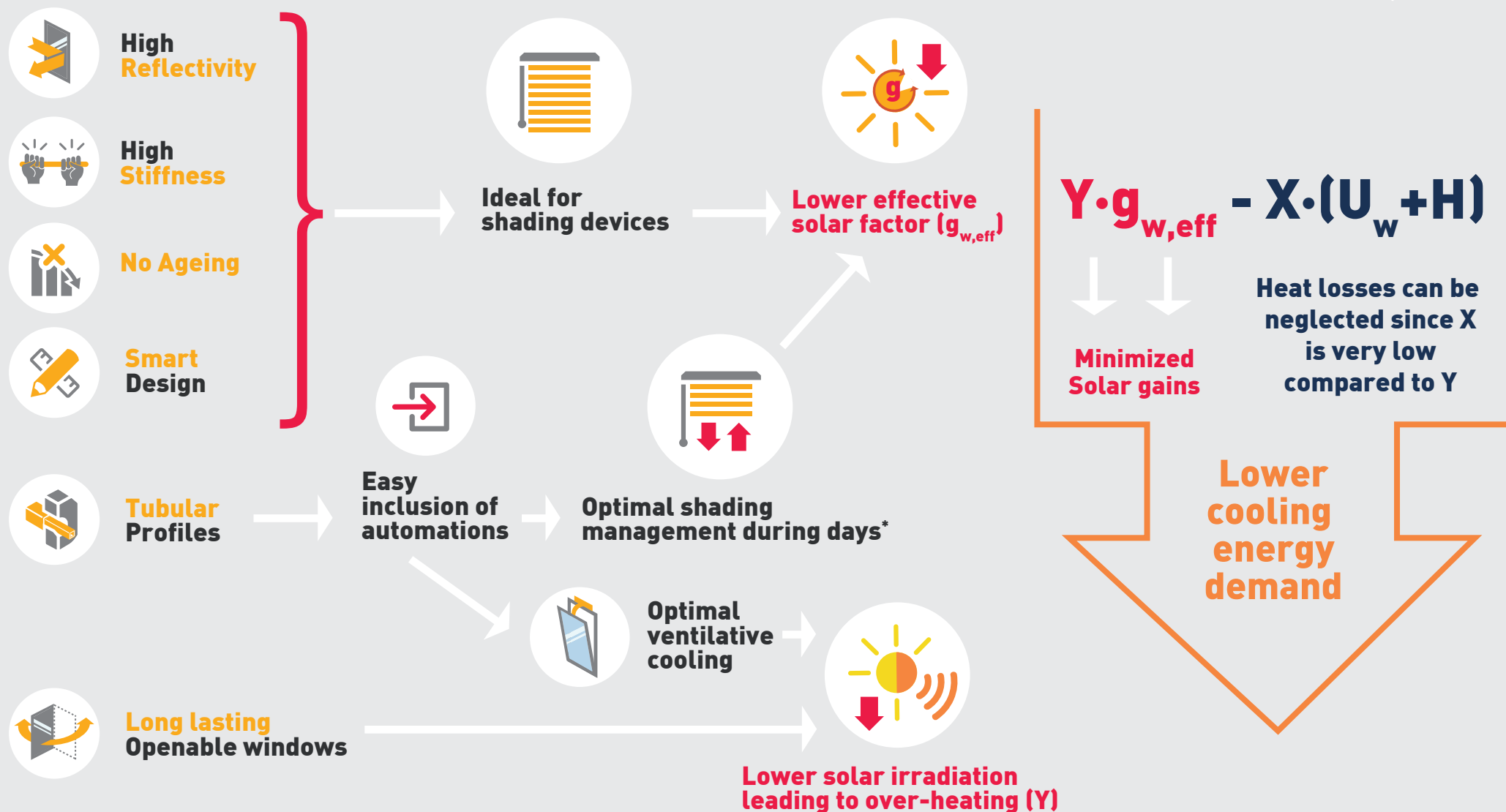
# HOW DOES ALUMINIUM IMPROVE THE ENERGY BALANCE OF WINDOWS

## HEATING SEASON



# HOW DOES ALUMINIUM IMPROVE THE ENERGY BALANCE OF WINDOWS

## COOLING SEASON



\*Not in energy balance formula but with the shading management natural daylight can be optimised.