Very ambitious technical key objectives for new window concepts were defined by the EeB Smart Windows Program EeB.NMP.2012-5 in the Seventh Framework programme:

* Energy savings over live cycle up to 15%
* Weight reduction up to 50%
* Insulating window with 0,3 W/m²/K at VLT > 50%

The HarWin approach to fulfil these goals is based on material development for both: the window glazing and the frame.

Weight and energy demand reduction over the life cycle is achieved by selection of lightweight materials with low embodied energy and by simultaneous improvement of the mechanical and thermal as well as optical performance of these materials by utilization of most advanced strengthening methods for glazing and frame, and by reduction of thermal conductivity of polymer-glass composites.

Energy harvesting is based on use of Phase Change Materials (PCM) in the glazing as additional thermal mass and new glass with Luminescent Down Conversion (LDC) properties to increase the Visible Light Transmission (VLT).

With thin glass laminated panes reinforced with new polymer-glass composite materials performance figures of U-value (0.4 W/m²/K) and VLT (75%) comparable or even superior to existing triple glazing can be achieved at almost 50% lower weight.

The new extremely stiff and thermally insulating frame, based on polymer foam core-glass fiber reinforced polymer skin materials offers additional embodied energy savings due to weight reduction by a factor of 5-10 as compared to existing polymer/metal or metal frame.

In addition to development of new materials also simulation methods have been developed for the next generation of light weight windows, which due to their modular structure also enable extension of window functionality, like wavelength specific energy management, including wave length conversion with coatings but also with a new active luminescent glass and with PCM (phase changing materials).

A data base and a simulation tool which is including End of Life (EoL) recycle ability of materials were developed for LCEA analysis of HarWin windows. Furthermore, a HarWin window module for building performance simulation has been implemented into existing sophisticated building performance software (Virtual Environment, IES, UK). Extensive characterisation of optical and thermal properties of HarWin windows enabled the implementation of a data base for the new materials into a cost analysis tool, which is used to validate the cost saving potential of the new window materials.

The benefits of the light weight glazing and frame materials in terms of energy and cost savings and in particular for refurbishment of old buildings were clearly demonstrated. For energy harvesting with the help of PCM a thorough analysis of inorganic and organic materials has been accomplished, showing the superiority of organic materials for achievement of high light transmission. Even thin layers of PCM have proven to offer energy savings for cooling in certain climatic zones.

For harvesting the UV part of sun radiation for increased VLT a new Luminescent Down Conversion glass has been developed which converts UV radiation into visible range of wavelengths with almost 30% photonic efficiency.