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UNIVERSITY OF
CAMBRIDGE
Department of Engineering

# A Design and Optimization Tool for Adaptive Building Skins for High Performance Buildings

**Level** | *PGR*

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**Overview** | *In the context of the 20-20-20 policy, the 2010 EPBD recast and the introduction of the Zero Energy Building concept, there is a significant stress on reducing the building energy demand to the highest extent. In doing this we face conflicting and transient requirements as far as the building envelope is concerned, e.g. maximising natural light transmittance whilst minimising unwanted solar heat gain in the cooling season or minimising heat loss in the heating season while avoiding overheating risk in summer. Adaptive facades, which are able to regulate the heat and mass transfer through the building envelope by adapting their physical characteristic to changing boundary conditions, can outperform state-of-the-art static façade at reducing energy demand while maintaining the required level of indoor environmental quality. The design and the operation of a dynamic façade is influenced by several and sometimes conflicting factors, such that a more holistic approach is needed in the evaluation of their performance and in the optimization of the design.*

*Adaptive building envelope concept*
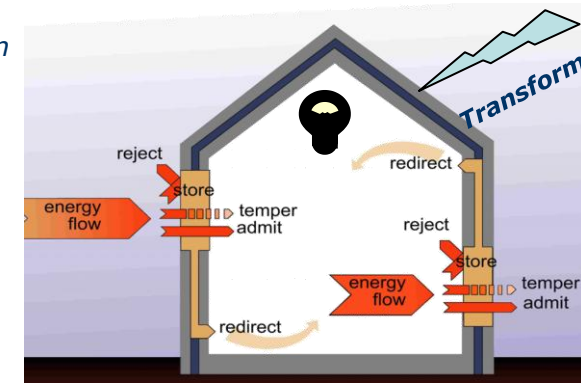


*Adapted from IEA ECBCS Annex 44 (2010)*

*Ideal adaptive glazing and expected energy saving impact*
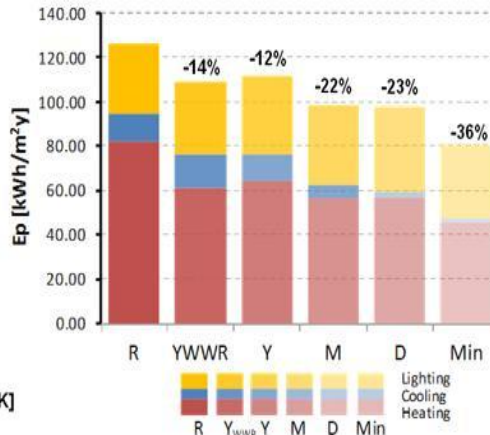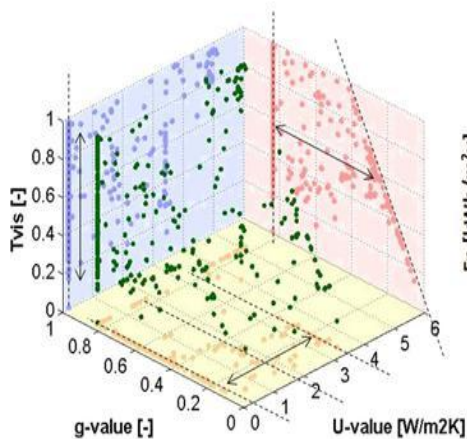


**Outcomes & Impact** |
● *Develop a frame-work representation for the evaluation of existing and future generation adaptive facade technologies which accounts for social, environmental and economic impact;*
● *Develop and validate a general simulation model for adaptive facades in an available free-ware tool;*
● *Develop a multi-objective optimisation model that integrates that can be used for design and optimisation of existing and new adaptive façade technologies and concepts.*

**Work involved** | *The research focuses on design and optimisation of adaptive facades for high-performance buildings. The economic and environmental values will be investigated using third-party software. Development of concepts for next generation adaptive facades will be achieved by performing multi-objective optimisation for a high level of environmental value.*

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