Technical and economic analysis of the viability of advanced shading technologies

Authors: Gwenn Boisard

E-mail: gwenn.boisard-lecoat@epfedu.fr

Address: Sustainable Building Design Lab (SBD)
Quartier Polytech 1
Allee de la Decouverte 9
4000 Liege, Belgium
www.sbd.ulg.ac.be
Tel: +32 43.66.91.55
Fax: +32 43.66.29.09

ABSTRACT

Because of their huge energy consumption, buildings are under the scope to reduce their impact on climate change. The present study analyze advanced shading systems on technical and economical aspects to reveal if it is interesting and consistent to invest in theses technologies for residential houses. The simulation on DesignBuilder, based on EnergyPlus, of a passive house with advanced shading devices allowed us to study the energy consumption related to the thermal performance. The results of the study could lead, for buildings designer and investors, to a better understanding and better investment in shading devices.

KEYWORDS

Resilient cooling, energy consumption saving, sustainable buildings, solar protection, shading investment

PROBLEM

The building sector is a major factor on the world energy consumption, hence, it is a major element on the climate change that happen nowadays. Mitigate his impact is essential but the investment of materials and technologies reducing the energy consumption of the building could be huge, and sometime not really effective or insightful. Buildings must deal with a great factor in indoor environment quality, the solar radiations. If the buildings are not well design, it could lead to huge increase of energy consumption and discomfort hours during the whole year.

OBJECTIVE

- Assessment of advanced shading systems in thermal performance and energy saving
- Assessment of the investment viability of advanced shading systems

AUDIENCE

Investors, House owner, Policymakers, Buildings Designer

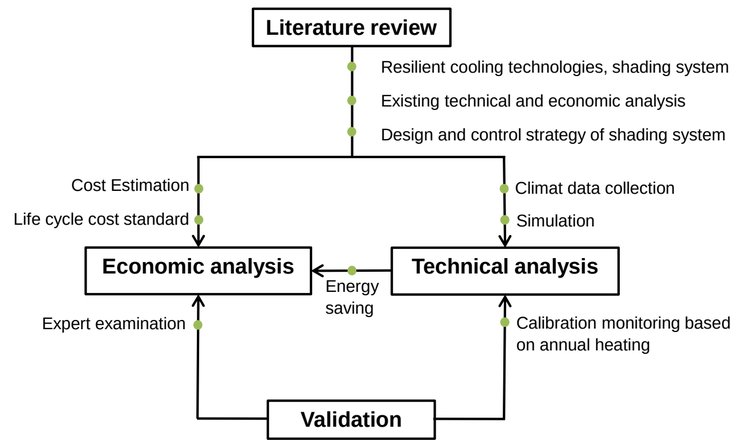
RESEARCH QUESTION

What is the viable investment in advanced shading system related to existing ones based on its thermal performance and its economic assessment ?

ORIGINALITY

According to the literature review, none of technical and economic analysis studied advanced technologies in Belgium. That could lead to a better understanding of their impact on the buildings, and therefore, lead to better choices during the design process. It could became also arguments to convince investor to trust the impact of advanced shading devices, thereby lead to a greater reduction of building energy consumption.

METHODOLOGY



RESULTS

Table 36: Annual energy consumption comparison

Annual Energy Consumption (kWh/m²)												
	SageGlass DGU	DGU, LT = 40%, g = 0.24	DGU Delta (%)	DGU, LT = 60%, g = 0.28 + external shading	DGU Delta (%)	DGU, LT = 17%, g = 0.2 + external shading	DGU Delta (%)	Externally ventilated facade	DGU Delta (%)	SageGlass TGU	TGU, LT = 53%, g = 0.24 + external shading	TGU Delta (%)
London	49.57	58.34	18%	56.27	14%			52.19	5%			
Frankfurt	66.75			70.03	5%			70.58	6%	59.37	63.17	6%
Madrid	57.85			64.33	11%	68.26	18%	62.47	8%			
Copenhagen	65.56			68.52	5%			69.73	6%	59.27	64.80	9%

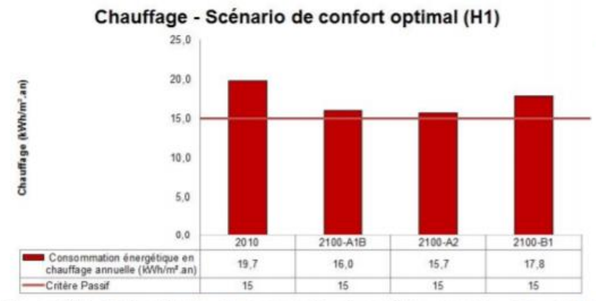


Figure 105 : Scénario H1 - Consommation énergétique en chauffage totale dans l'année

Table 6
Difference in investment costs **dIC** between advanced window systems (Cases 2, 3 and 4) and the reference window system (Case 1) for Helsinki climate.

Name of case	Description	dIC (€/window m²)
Case 2	EC window without self-cleaning feature	−44
	EC window with self-cleaning feature	45
Case 3	PV window without self-cleaning feature	0
	PV window with self-cleaning feature	89
Case 4	Vacuum window without self-cleaning feature	27
	Vacuum window with self-cleaning feature	116

Table 3.15 Net Present Value of an EER standard of 2.92 W/W

Discounted at 6% to year 1998 from 2000 to 2020	**China** *Thousand Yuan*	**U.S.** *Thousand dollars*
Total Operating Cost Savings	11,773,644	1,418,511
Total Equipment Costs	8,251,382	994,142
Net Present Value	3,522,262	424,369
Benefit to Cost Ratio	1.43	1.43

CONCLUSION

The study well show the impact of advanced shading system to reduce the energy consumption and increase the thermal comfort when it is well designed. The study highlight that the “first technology” appears to be efficient but the price of the market does not suit the additional investment for the owners. Instead, the “second technology” is less efficient but the additional investment corresponds with the actual market price.

Resources

- Camille, G. (2008) Bâtiments d’aujourd’hui, Climat de demain : Évaluation de l'impact du réchauffement climatique sur le confort thermique et l'efficacité énergétique d’un bâtiment résidentiel passif existant en Belgique (Master thesis)
- Sudip Kumar, P., Kari, A., Juha J., & Kai, S. (2016). Energy performance and economic viability of advanced window technologies for a new Finnish townhouse concept. Applied Energy, 162, 11-20.

SBD LAB
Sustainable Building Design Lab

LIÈGE université