"Science Stays True Here"
Advances in Ecological and Environmental Research, 329-337 | Science Signpost Publishing

An Innovative Financial Business Model Leading Stakeholders Towards Energy Efficient Building Envelope Components

Çağlar BEKİROĞLU
Gebze Institute of Technology.

Received: March 08, 2017 / Accepted: April 10, 2017 / Published: August 25, 2017

Abstract: Most green buildings cost a premium of <2%, but yield 10 times as much over the entire life of the building. The stigma is between the knowledge of up-front cost vs. life-cycle cost. The savings in money come from more efficient use of utilities which result in decreased energy bills.

As of necessity for creating successful model belonging to one of building envelope components, energy efficient window system is chosen as pilot project in Turkey. A private bank, company and property investment partnership are 3 main trivets of this business model.

Firstly costs of traditional or "business-as-usual" window system and energy efficient window system, will be compared.

Secondly financial savings on bills including water, natural gas and electricity etc. will be calculated by considering traditional and energy efficient window systems.

Lastly a private bank will be responsible for financial model of the pilot project. The main idea of the pilot project is building energy efficient building envelope components with reasonable up front costs that will be paid back through bills over a period of time.

Key words: Energy efficient building envelope components, financial business model, stakeholder partnership

1. Introduction

Buildings are at the centre of our economic and social lives, providing us shelter, work places and spaces for commerce and leisure. On the other hand, buildings also put a tremendous strain on our environment, being

Corresponding author: Çağlar BEKİROĞLU, Gebze Institute of Technology.

responsible for a significant share of global energy use (approximately 40%), resource consumption (more than 30% of materials use and 20% of water use) and waste generation (30% of solid waste, 20% of wastewater). The building sector is also the source of more than 30% of global greenhouse gas (GHG) emissions, therefore being a crucial sector in combat with climate change ([24] UNEP, 2007).

The sustainable buildings agenda has gained considerable momentum through the development of flagship buildings, all over the world, showcasing the most efficient and innovative solutions found on the market. 2007 report of the Intergovernmental Panel on Climate Change (IPCC) highlighted that the building sector has the greatest potential for reducing GHG emissions at the lowest cost. With proven and commercially-available technologies, the energy consumption in both new and existing buildings, as well as the related GHG emissions, can be reduced by 30-50% without significantly increasing the investment costs of new construction or renovation projects ([14] IPCC, 2007). It is now crucial to mainstream sustainable building practices at a broader scale. Acting now can prevent locking in buildings' potential to contribute to climate change mitigation and sustainable development. Special attention shall be given to find appropriate solutions to target the building market in developing countries, where most of the new construction is taking place.

Countries with rapid population growth and urbanization have additional challenges to face. Housing shortages have lead to the launch of large-scale social housing programmes. Although these programmes deliver a high quantity of housing units at low-cost and provide shelter for millions of families, severe time and budget constraints often lead to low-quality, unsustainable and sometimes buildings harmful for human health. Furthermore, two main preconceptions tend to slow down investments in sustainability in social housing. First, it is often perceived that social housing units already have a low energy consumption, and thus investments in energy efficiency are not justified. Second, sustainable solutions are thought to be far too expensive to include in social housing, as they would increase the unit cost and make them unaffordable for both users and housing authorities. However, under current rapid construction conditions, the high rate of building defects leads to users having to face high operation and maintenance costs. Also, constraints in land use often result in units being located in remote areas, where users have little access to urban infrastructure, and even less to the social and economic opportunities of the city.

So while social housing's first and greatest priority should continue to be to provide housing for the low-income population, locally-appropriate techniques, solutions and practices exist that can support this objective and deliver sustainability improvements at low or no-cost. The most critical issue about constructing environmentally friendly buildings is the price. Photo-voltaics, new appliances, and modern technologies tend to cost more money. Most green buildings cost a premium of <2%, but yield 10 times as much over the entire life of the building ([16] Kats et al, 2008). The stigma is between the knowledge of up-front cost vs. life-cycle cost ([3] California Sustainability Alliance, 2010). The savings in money come from more efficient use of utilities which result in decreased energy bills. It is projected that different sectors could save $130 Billion on energy bills ([8] Fedrizzi, 2009). Also, higher worker or student productivity can be factored into savings and cost deductions. Studies have shown over a 20 year life period, some green buildings have yielded $53 to $71 per square foot back on investment ([19] Langdon, 2007). Confirming the rentability of green building investments, further studies of the commercial real estate market have found that certified buildings achieve significantly higher rents, sale prices and occupancy rates as well as lower capitalization rates potentially reflecting lower investment risk ([9] Fuerst and McAllister, 2010a; [20] Pivo and Gary, 2010; [10] Fuerst and McAllister, 2010b).

Developing a local project agenda and identifying priorities related to the local context will lead to the construction of more sustainable housing units without an increased life cycle cost and will even reduce the costs of housing for housing authorities and residents in the long-term. In fact, the long-term social, economic and environmental benefits of using sustainable solutions can strongly improve the quality of life of residents, reduce energy and resource consumption at the national level, improve the climate responsiveness and adaptation of buildings and deliver secondary benefits in terms of social integration, lower health costs and increased performance and productivity.

2. Aims

The proposal focuses on issues of innovation in emerging economies that have the objective of invalidating the following preconceptions which slow down investments in sustainability in affordable housing components:

(1) social housing units have a low environmental impact, not justifying sustainable investments and

(2) sustainable solutions are far too expensive to include in social housing, as they would increase the cost of the unit and make it unaffordable for both users and developers.

Within this context, the research project aims to answer the following key questions:

- Within emerging countries, what are the processes driving innovation around sustainable social housing components?
- Are there regional differences in these drivers?
- What incentives are there for providing sustainable building products and components from the private sector’s perspective?
- How can the governance of sustainable social housing components be harnessed so as to encourage such innovation?

3. Methodological Framework

The methodological framework consists of the following components:

(1) pilot project and

(2) comparative study in order to implement the outcomes of the pilot project in emerging countries

4. Geographical Focus

The geographical area proposed for the pilot project is Turkey due to the following reasons:

Turkey's geology and history of earthquakes provide incontrovertible evidence of the country's significant seismic hazard. The movement of Turkey's Anatolian block relative to the African, Eurasian and Arabian plates causes earthquakes to occur along the plate boundaries, or fault-lines ([21] Scawthorn and Johnson, 2000; USGS, 2000). The 1500 kilometer North Anatolian Fault is the most active fault zone in Turkey and 90% of the population live in seismically hazardous areas ([18] Özerdem and Barakat, 2000).

The propensity of seismic activity in Turkey to cause disaster is recently underscored by descriptions of destruction during the 17 August 1999 Marmara Earthquake. This magnitude 7.4 event is also known as the "Kocaeli" or "Izmit" earthquake. This quake ruptured 110 km of the North Anatolian Fault, shaking a highly developed region of the country and causing at least 18,000 deaths and almost 50,000 hospitalized injuries, mostly in Gölcük, Adapazarı and Yalova. In this earthquake, the majority of the deaths resulted from structural collapses of residential buildings. 77,000 homes and business structures were reported to be destroyed; many more were in need of significant repair ([18] Özerdem and Barakat, 2000; [21] Scawthorn and Johnson, 2000; [22] Sezen et al, 2000; [5] Daley et al, 2001; [6] Durukal et al, 2002; [15] Kasapoglu and Ecevit, 2003).

Technical design flaws, poor engineering and "deficient engineering practice" are directly responsible for structural collapses ([23] Tankut, 2001, p180). The "technically responsible engineers" who must supervise on-site construction work are frequently employed directly by contractors and they are rarely a visible presence on the construction site. These supervisory engineers are moreover required only to report deviations from shop drawings in construction, and are not held responsible for construction problems unless there is evidence of premeditated malice ([11] Gülkan, 2001; [18] Özerdem, 2003). The contracting profession is popularly seen as an easy way to earn a good living; as the Turkish construction industry boomed in the 1980s anyone could easily start a contracting and construction business ([18] Özerdem, 2003).

Municipalities are responsible for supervising building construction projects under Turkish law, but most have inadequate personnel and resources to fulfill this task. In theory, the system of ensuring adherence to building codes and land use regulations works much as it does in the US and the UK; before a project begins, the architectural, structural and mechanical designs must be submitted to the municipal authority in order to obtain a construction permit. In practice, municipalities have insufficient resources to hire a significant number of technical staff ([23] Tankut, 2001; [11] Gülkan, 2002). As a result, most municipal planning offices employ no structural engineers and stamp plans as “received” without checking the technical considerations of the project ([11] Gülkan, 2001; [12] Gülkan, 2002). Local governments are permitted to shut down construction sites if these plans do not meet their regulations, but problems are more frequently met with an institutional “averting of eyes” ([12] Gülkan, 2002, p20). Furthermore, municipalities are not liable for omissions or mistakes in development, and no legal action against officials has ever been taken ([1] Balamir, 2001; [12] Gülkan, 2002). Municipalities and provinces are also responsible for zoning ordinances, new development and urban plans. Their influence, however, is rarely used to enforce planning regulations for environmental standards and disaster mitigation. Despite its intimate relation to development and urban planning, few local governments have explicitly considered disaster preparedness ([4] Coburn, 1995; [7] Erdik, 1995; [1] Balamir, 2001).

Turkey is a country with a population of 74,724,269 people according to 2011 counting. With an annual population growth over 1.35%, Turkey is expected to have 80.2 million people by 2020 ([17] Kick, 2011). Turkey’s energy expenses vary between $55 billion and $70 billion, increasing by every year. With a gross domestic product (GDP) of $1.116 trillion in 2010, Turkey is the 15th largest economy in the world ([13] IMF, 2011). At the same time, the IMF predicts an average economic growth of 5.4% per year until 2015 ([17] Kick, 2011). For more than a decade, Turkey has enjoyed unprecedented growth that is in many ways unique to Europe. In return, the country’s infrastructure and social services have improved drastically, and major business developments have taken place, especially joint investments with the EU.

In Turkey, around 14 million houses would fail to meet viability criteria and should be reviewed at the earliest possible convenience. The current government has shown its strength and political will on this vital issue and took a crucial decision to renew these buildings. After many heated discussions, the destruction and rebuilding of not only the urban zones but also all other areas from forests to military areas which are declared to be “under catastrophe risk” is at stake with Law No. 6306 on The Transformation of Areas Under the Catastrophe Risk, issued in May 2012. In the context of urban transformation it’s planned to renew 6.5 million houses in Turkey within the next 20 years; only in Istanbul over 400.000 buildings are planned to be demolished and rebuilt.

However, the Turkish government is implementing urban transformation through sudden, top-down decisions that do not sufficiently account for environmental protection or consultations with citizens. In the process, the population’s leanings are largely ignored, making it impossible to nurture civic consensus on the pace and nature of economic development. In addition, there is no systematic monitoring of urban transformation practices and abuses. Few national and international non-governmental organizations (NGOs) are allocating time to the subject, and most of the evidence of abuses comes not from academic or other dispassionate sources but from stakeholders in the process and commentators.

Turkey is not only the country as proposed for the pilot project but also my dissertation empirical research carried out. So the pilot study can be assumed as a continuation of my dissertation ([2] Bekiroğlu et al, 2011).

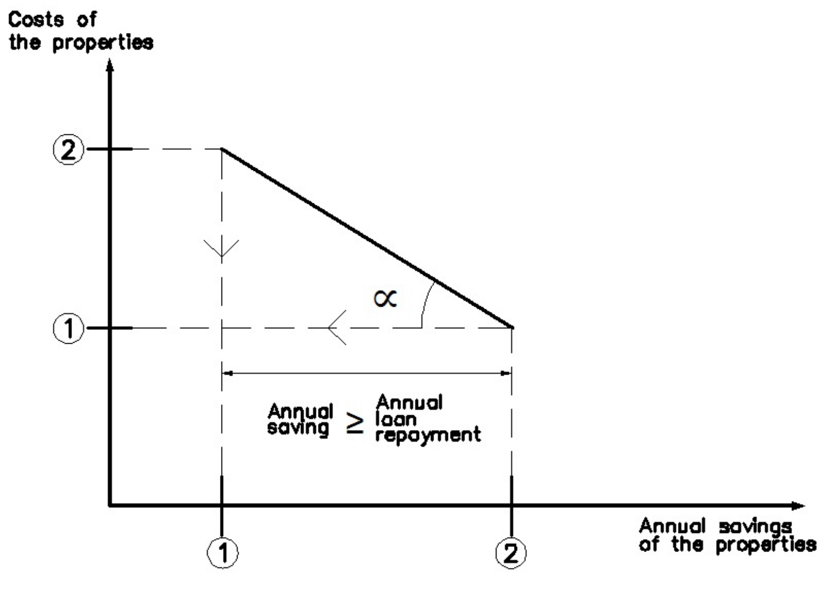
5. Pilot Project

As shown in the following research model schema, firstly costs of traditional or "business-as-usual" window system and energy efficient window system, will be compared

Secondly financial savings on bills including water, natural gas and electricity etc. will be calculated by considering traditional and energy efficient window systems.

Lastly a private bank will be responsible for financial model of the pilot project. The main idea of the pilot project is building energy efficient building envelope components with reasonable up front costs that will be paid back through bills over a period of time. This is unlike a conventional loan because if you move out of the property the bill stays with the property where the savings are occurring and not with the bill payer. The expected financial savings must be equal to or greater than the costs attached to the bills.

RESEARCH MODEL GRAPH



1 : Traditional or "business-as-usual" window system ,

2: Energy efficient window system.

ROI = Return on Investment = Tangent alpha = (ΔCosts)/ (Δ Annual savings)

6. Comparative Study

Dissemination and publication of the pilot project outcomes will be reference study for other emerging countries such as China, India and Brazil. Comparative study of stakeholders between Turkey and other emerging countries will highlight the following consequences:

(1) The pilot project is directly applicable in most of these emerging countries and

(2) Some parts of the pilot project should be modified in order to apply it in the rest of these emerging countries.

References

[1] Balamir, Murat, 2001, “Recent changes in Turkish disasters policy: a strategical reorientation,” in Paul R Kleindorfer and Murat R. Sertel (eds.), Mitigation and Financing of Seismic Risks: Turkish and International Perspectives, Kluwer Academic Publishers, London.

[2] Bekiroğlu, Ç., Erdil, O., Alpkan L., (2011), “Variables perceived by managers as antecedents that lead firms to environmental management: An empirical research in the Turkish construction sector”, Journal of Global Strategic Management (JGSM), December 2011, Volume 5, Number:1, ISSN:1307-6205.

[3] California Sustainability Alliance, Green Buildings. Retrieved June 16, 2010, fromhttp://sustainca.org/programs/green_buildings_challenges.

[4] Coburn, Andrew, 1995, “Disaster prevention and mitigation in metropolitan areas: reducing urban vulnerability in Turkey,” in Ronald Parker, Alcira Kreimer and Mohn Munasinghe (eds.), Informal Settlements, Environmental Degradation and Disaster Vulnerability, World Bank, Washington.

[5] Daley, W Randolph, Adam Karpati, Mani Sheik, 2001, “Needs assessment of the displaced population following the August 199 earthquake in Turkey,” Disasters, vol. 25, no. 1.

[6] Durukal, E, E Uskan, K Sesetyan and MB Demircioglu, 2002, Earthquake Risk Assessment for Industrial Facilities in Istanbul, Bogazici University.

[7] Erdik, Mustafa, 1995, “Istanbul: Emergency Action Plan,” in Ronald Parker, Alcira Kreimer and Mohn Munasinghe (eds.), Informal Settlements, Environmental Degradation and Disaster Vulnerability, World Bank, Washington.

[8] Fedrizzi, Rick,"Intro – What LEED Measures." United States Green Building Council, October 11, 2009.

[9] Fuerst, Franz; McAllister, Pat. Green Noise or Green Value? Measuring the Effects of Environmental Certification on Office Property Values. 2009. [4] Retrieved: November 5, 2010a

[10] Fuerst, Franz; McAllister, Pat. An Investigation of the Effect of Eco-Labeling on Office Occupancy Rates. 2009.[6] Retrieved: November 5, 2010b

[11] Gülkan, Polat, 2001, “Revision of the Turkish Development Law no. 3194 governing urban development and land use planning,” in Paul R Kleindorfer and Murat R. Sertel (eds.), Mitigation and Financing of Seismic Risks: Turkish and International Perspectives, Kluwer Academic Publishers, London.

[12] Gülkan, P, 2002, “Setting the stage for urban risk mitigation: seismic risks and compulsory insurance policy issues in Turkey,” Second Annual IIASA-DPRI Meeting, Integrated Disaster Risk Management: Megacity Vulnerability and Resilience, available online:www.metu.edu.tr/home/wwwdmc/Files/Reports/Conferances_Meetings/Luxemburg_paper_July_02._1.PDF.

[13] International Monetary Fund, World Economic Outlook, 2011

[14] Intergovernmental Panel on Climate Change (IPCC), (2007). Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. [Metz, B., O.R. Davidson, P.R. Bosch, R. Dve, L.A. Myer (eds.)], Cambridge, U.K. and New York, NY, USA, Cambridge University Press.

[15] Kasapoglu, Aytul, Yildiz Ecevit and Mehmet Ecevit, 2004, “Support needs of the survivors of the August 17, 1999 earthquake in Turkey,” Social Indicators Research, vol. 66.

[16] Kats, Greg, Leon Alevantis, Adam Berman, Evan Mills, Jeff Perlman. The Cost and Financial Benefits of Green Buildings, November 3rd, 2008.

[17] Kick, C., “How is 100% Renewable Energy Possible for Turkey by 2020?”, July 2011.

[18] Özerdem, Alpaslan and Sultan Barakat, 2000, “After the Marmara earthquake: lessons for avoiding shortcuts to disasters,” Third World Quarterly, vol.32, no. 3. Özerdem, Alpaslan, 2003, “Disaster as manifestation of unresolved development challenges,”in Mark Pelling (ed.), Natural Disasters and Development in a Globalizing World, Routledge, London.

[19] Langdon, Davis. The Cost of Green Revisited. Publication. 2007.

[20] Pivo, Gary; Fisher, Jeffrey D. Investment Returns from Responsible Property Investments: Energy Efficient, Transit-oriented and Urban Regeneration Office Properties in the US from 1998-2008. 2009.[5] Retrieved: November 5, 2010.

[21] Scawthorn, C. and G.S. Johnson, 2000, “Preliminary report: Kocaeli (Izmit) earthquake of 17 August 1999,” Engineering Structures, vol. 22.

[22] Sezen, Halil, Kenneth J Elwood, Andrew S Whittaker, Khalid M Mosalam, John W Wallace, and John F Stanton, 2000, “Structural engineering reconnaissance of the August 17 1999 Earthquake: Kocaeli (Izmit), Turkey,” PEER Report, Pacific Earthquake Engineering Research Center, Berkeley, University of California.

[23] Tankut, Tugrul, 2001, “Structural and educational dimensions of earthquake damage mitigation in Turkey,” in Paul R Kleindorfer and Murat R. Sertel (eds.), Mitigation and Financing of Seismic Risks: Turkish and International Perspectives, Kluwer Academic Publishers, London.

[24] United Nations Environment Programme (2007). Buildings and Climate Change: Status, Challenges and Opportunities. Lead authors P. Huovila, M. Ala-Juusela, L. Melchert, and S. Pouffary. Sustainable Buildings and Climate Initiative, Paris. Available from:

[25] USGS, 2000, “Implications for Earthquake Risk Reduction in the United States from the Kocaeli, Turkey, Earthquake of August 17, 1999,” US Geological Survey Circular, available online: pubs.usgs.gov/circ/2000/c1193/c1193.pdf.