



Good indoor environment and energy efficiency increase monetary value of buildings



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Investments to good and energy efficient indoor environment are very profitable, according to the latest research findings. Excellent and energy efficient indoor environmental conditions has a significant impact on real estate asset value, occupancy rate and rental yield.

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Energy efficient indoor environment is a common goal for all building project stakeholders. Together with reducing of operation cost, high quality

environment increase value for investor and building owner. At the moment, there is a lack of understanding on how good indoor environment can improve busi-

ness based on earning logics of owners, investors and tenants. Currently a good indoor environment is often fostered by regulations not business interests. Thus, only few investor and owners have realized the potential of sustainable indoor environments for their business. This article aims to provide new insights on the economic value of excellent indoor environment based on recent research results. The results are presented according the following themes and sections: improved asset value, occupancy rate and rental yield. The state of the art of research indicate that excellent indoor environment is hard currency for investors. In fact, based on the findings it could be estimated that asset value of buildings with excellent indoor environment is 10% higher that with the standard buildings and the price premium is likely to significantly increase in the next 5 years. Moreover, in buildings with high quality indoor environment the occupancy rate is approximately 10% higher and the rent is 5% higher that with standard building.

Improved asset value

Building owners and tenants can financially benefit from sustainability and improved indoor environmental quality. For owners, these improvements can result in increased property value such as (Virta et al 2012):

- Reduced life-cycle costs
- Extended building and equipment life span
- Longer tenant occupancy and lease renewals
- Reduced churn costs
- Reduced insurance costs
- Reduced liability risks
- Brand value

Excellent indoor environment quality increases well-being and performance of workers. The effect of room air temperature and indoor air quality is presented in REHVA's design guide (Wargocki and Seppänen 2006). It should be noted that the largest cost of organizations are usually the personnel, which consists of salary, healthcare and social costs. This can be more than ten times greater than workplace related costs. Moreover, according to a recent review of literature by an international expert panel (Sundell et al., 2011) there is strong evidence that higher ventilation rates in offices reduce the prevalence of sick building syndrome (SBS) symptoms of workers. In contrast, low ventilation rates increase short-term sick leaves, inflammation, respiratory infections and asthma symptoms.

Excellent conditions have a significant effect of monetary value of building. Based on the latest research findings,



good indoor environment and energy efficient building proofed by LEED Platinum certificate can increase property value by over 8% (Vimpari & Junnila 2014). In the study, it is argued that green certificates can be valued as real options by identifying the option characteristics. The results are in line with previous research results as summarized in **Table 1**. The range of the sustainability in the literature review is between 3 – 35%. All this indicates that the effect of sustainability on asset value is significant.

The study emphasizes that a clear correlation exists between sustainability and asset value premium. The results have been identified by real estate researchers and practitioners to be the “future of industry”. First time, sustainability has been recognized to influence the real estate and construction (REC) cluster profoundly and also to offer an unprecedented opportunity. In practice, we are already seeing that sustainable buildings liquidity and transaction price upside are growing as increasing number of real estate investors and funds are investing in high performance sustainable buildings.

Investments on sustainability seem to be delayed partly because the justification of the investments with the traditional investment analysis methods, such as discounted cash flow (DCF). Most traditional methods focus on risk assessment and do not account for life-cycle uncertainty of the investment and value of flexibility brought about by good indoor environment design and systems. In fact, indoor environment investment valuation practices are not typically linked with the level of indoor conditions and the respective monetary life-cycle benefits e.g., cost savings and asset value premium. The option pricing theory, specifically real options analysis (ROA) is a potential valuation approach to establish this link and to appropriately value sustainability investments. The approach is less recognized by public but has big potential for REC sector decision-makers. The benefit of ROA is that it accounts for the quality of

indoor environment investment through uncertainty and upside potential for the investment life-cycle.

Higher occupancy

Good indoor environment improves the occupancy of the buildings. Investors can improve the occupancy of buildings by improving user satisfaction of indoor environment and analysing and developing flexibility of the facilities. The effect of renovation on perceived thermal comfort and air quality in four case study office buildings have been studied (Koskela et al. 2013). The perceived conditions were notably better after the renovation. The highest effect was achieved with air quality where the percentage of dissatisfied decreased in three offices from 70% level to 30% level on average. The research indicates that the quality of the indoor air is a significant factor for user satisfaction in facilities.

Moving people is expensive. The cost of a move depends on the extent to which the facility must be modified to accommodate the changes. Often new walls, new or additional wiring, new telecommunications systems, or other construction are needed to complete the move.

In today's work environment, churn is a major issue.

As teams are continuously changing, workplaces need to be flexible and adaptable. Therefore, the focus on systems' and work places' adaptability and flexibility is very important in the design phase. Depending on the selected systems, the cost of modifying a space (50–250 Eur per m²) and the time the space cannot be used (1 hour ... 3 months) varies a lot. These costs can be minimised if adaptability is focused on in systems design and system selection.

The economical feasibility of facilities' flexibility was studied in renovated buildings (Vimpari et al. 2014). The main finding of that study is that real option analysis can be used for assessing the monetary value of service flexibility over the investment life-cycle. In the empirical case, value of service flexibility for the investor and tenants was analyzed and the results were utilized building briefing stage by setting the cost and profit target values for room programme and building design. Service flexibility was very profitable in certain sections of the case building, which was a 12 000 sqm office building built in the 1970s. The present value of the pay-off from flexibility ranged from negative 58 €/sqm to positive 130 €/sqm depending on the tenant. The results demonstrate that real option analysis is a

Table 1. Asset value results from literature (adopted from: Sayce & Lorenz 2011).

Study / authors	Country	Property Type	Credentials	+/- Magnitude	Impact on
Brounen and Kok. 2010	The Netherlands	Residential Homes	Energy Performance Certificate (Class A. B. C)	+2.8%	Selling price
Eichholtz. Kok and Quigley. 2010	USA	Office Buildings	LEED	+11.1%	Selling price
Fuerst and McAllister. 2008	USA	Office Buildings	LEED	+31% – 35%	Selling price
Salvi et. al. 2008	Switzerland	Residential Homes	MINERGIE Label	+7%	Selling price

Table 2. Occupancy and energy efficient buildings; results from literature (adopted from: Sayce & Lorenz 2011).

Study / authors	Country	Property Type	Credentials	+/- Magnitude	Impact on
Fuerst and McAllister, 2010	USA	Office Buildings	LEED	+8%	Occupancy Rates
Pivo and Fischer, 2010	USA	Office Buildings	Energy Star, close distance to transit, location in redevelopment areas	+0.2% – 1.3%	Occupancy Rates
Wiley, Benefield and Johnson, 2008	USA	Office Buildings	LEED, Energy Star	+10 – 18%	Occupancy Rates
MIT, 2012	USA	Office Buildings	Design flexibility	30%	Occupancy Rates

Table 3. Rental yield and energy efficiency (adopted from: Sayce & Lorenz 2011).

Study / authors	Country	Property Type	Credentials	+/- Magnitude	Impact on
City of Darmstadt, Rental Index, 2010	Germany (Darmstadt)	Residential multi-family houses	Primary energy value below 175 kWh/m ² a	+0,50 €/m ²	Rental Price
Pivo and Fischer, 2010	USA	Office Buildings	Energy Star, close distance to transit, location in redevelopment areas	+4.8% – 5.2%	Occupancy Rates
Salvi et. al, 2010	Switzerland	Residential Flats	MINERGIE Label	+6%	Rental Price
Wiley, Benefield and Johnson, 2008	USA	Office Buildings	LEED	+7% – 17%	Rental Price

useful tool for investors to deal with the major uncertainties related to user function changes and shorter lease lengths. It can be used to for example increase office building occupancy through sensible flexibility investments in a retrofit project.

In general, the occupancy in flexible facilities is higher. The costs of flexibility can be justified and the value of the flexibility is 1–8% (**Table 2**). In general, if it is plausible that the tenant will change in facilities near future, it is highly profitable to invest in flexibility.

Rental yield

In the facility management, the main concern of the net operation income is to reduce running costs. Beside the improved occupancy and asset value, excellent indoor environment affects rental yield. According the research results, better building rent ability and lower maintenance costs can be achieved through good and energy efficient indoor environment. Good indoor environment and energy efficiency attract tenants.

A study of the preferences of corporate occupiers in relation to their occupied offices indicates high impact on rent (Karhu et al. 2012). The results show that location achieved the highest importance, even though it was asked only in terms of environmental sense. The energy efficiency of a building was ranked second. The indicative results suggest that the line of industry and the position of respondent seem to effect to the importance of the preferences as well.

Facility management services may decrease annual maintenance costs over 15% (Aaltonen et al. 2013). A study shows that high quality facility management (FM) services that improves indoor environment and

energy efficiency has an affect on rental yield. The results indicate that FM service processes have both direct and indirect influence on the building environmental performance metrics. The case building was a 16,300 square meter office building that hosts a staff of 800. The results show that by relatively light changes and modifications to the FM service processes, quite extensive environmental benefits can be achieved. Monetary savings from electricity reduction were approximately 32,000 € and from heating energy reduction 35,500 € during one year.

The results are in line with the literature review results (**Table 3**). The review depicts that with the high performance building is possible to get 5–10% higher rent.

This article provides new insights on the economic value of excellent indoor environment based on recent research results. The state of the art of research indicate that excellent indoor environment is hard currency for investors. In fact, based on the findings it could be estimated that asset value of buildings with excellent indoor environment is 10% higher that with the standard buildings and the price premium is likely to significantly increase in the next 5 years. Moreover, in buildings with high quality indoor environment the occupancy rate is approximately 10% higher and the rent is 5% higher that with standard building. ■

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For more information: indoorenvironment.org and rym.fi

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