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Cost Analysis for Sustainable Renovation

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The life cycle of a building consists of several phases, mainly classified as the production, construction, use and end-of-life (EOL). At any moment during the life cycle of a building, it can be decided to (1) consolidate, (2) renovate or (3) demolish the building and build a new one. An important issue related to the preferred choice between the three options from an environmental point of view, is how to account for the environmental impact of the existing building. Two main approaches can be distinguished when analysing the renovation of a building: (1) excluding the environmental impact of the existing building from the comparison and (2) using annual depreciation and hence allocating part of the environmental impact of the first phase to the second building life cycle. The two approaches might influence the preferred option and hence a carefully selected methodology is important. In this context, an analysis of both approaches has been made based on a literature study and a case study in the context. Since the current dwelling stock in consists of 32% terraced buildings, of which 65 % is built before 1945

The way investment requirements are calculated in integrated varies. Some obtain them directly as a result of built-in optimization model. Others use ex post allocation techniques to determine investment in various sectors. Still others combine both techniques with "back of the envelope" calculations, especially. The notion of financing is broader than that of investment requirements, as it also encompasses qualitative dimensions such as the type of financing that is required.

Keywords: *Sustainable renovation, Building construction, Green building, LEED certification*

Sustainability development refers to a vibrant process from one state towards another. It means there is no exact description about it, in fact every societies and cities are developing by passing the time in order to become more superior or inferior (United Nation [UN], 2013). Hence our goals including visions, ambitions and technical feasibilities are all subjects to change (Brophy, 2014).

From sustainability point of view, there are factors that must be taken into the thought all together in order to gain the ultimate goal which is known as ‘‘sustained prosperity" relevance to different stakeholders and so their various priorities. Considering of where building design industry meets the sustainability solutions enables building designers to anticipate a larger demand for systematic strategies to improve existing building stock close at hand (Kamari et al., 2017b). If human settlements are to carry out sustainability as a target, it is required to develop methods to set criteria, plan, design, and evaluation. It is also essential having such methods as a scientific basis in terms of assessment between various projects (Nguyen and Altan, 2011), and for considering how they should be developed over time. Estimated to be worth 10% of global GDP (US$7.5 trillion) and employing 111 million people, the building sector is also the single largest contributor to global GHG emissions.

Approximately 60 per cent of the world's electricity is consumed by residential and commercial buildings. An growing population coupled with multiple economic activities, including tourism have given rise to a net increase of 16.1% in the number of buildings from 268,300 in 2000 to 311,500 in 2011 (CSO, 2011).

At the UN Conference on Sustainable Development , Member States called for the prioritization of the sustainable development agenda and the effective allocation of financial resources for it in accordance with national priorities and needs, while introducing efforts towards significant recruitment of resources from a variety of sources and the effective use of financing for sustainable development. Successful change to sustainable development will require regular and aligned actions and outcomes from a variety of sectors. The large majority of resources invested in the economy are private funds or domestic public expenditures. Getting a clear picture of the financing needs for sustainable development in the future presents considerable conceptual and practical challenges.

Clear norms or normative targets have to be decided upon. Various diverse goals and targets give increase to different needs. Importantly, different sustainability goals are connected with different time frames, and this has implications in terms of sequencing of investment and financing needs. Second, it is significantly important to differentiate costs from investment requirements. In many sectors as well as economy-wide, investment required for a conversion of the global economic system towards sustainable development may be high, whereas long-term costs may be low or high. Third, a transition to sustainable development would involve determined action in a variety of sectors. There are many interdependencies, synergies and trade-offs across sectors, which affects investment necessities and financing needs. There is a further conceptual gap between "investment needs" and "financing needs". The latter incorporate the dimensions linked with the practical recruitment of finance for specific projects and programme. Those are usually not examined in models that generate investment needs. Investment necessities for infrastructure control the picture in terms of viability, whatever meaning of infrastructure is used. Investment requirements for the sustainable development respecting agreed climate targets are of the order of trillions US$ per year. Overall, investment requirements for "climate compatible" and "sustainable development" scenarios (which include goals and target related to climate) are of the order of several trillions per year

Sustainable building is considered as a way for the building industry to shift towards protecting the environment. The promotion of sustainable building practices is to pursue a equilibrium among economic, social, and environmental performance in implementing building projects. If we accept this, the connection between sustainable development and construction becomes clear; construction is of high economic importance and has strong ecological and social impacts. With the increasing consciousness on environmental protection, this issue has gained wider attention from building practitioners worldwide. Implementing sustainable building construction practices has been advocated as a way ahead in development economic progression in the building industry while minimizing impact on the environment. In order to reduce these harmful impacts of construction on the environment and to achieve sustainability in the industry, three ideologies emerge: resource efficiency, cost efficiency and design for human adaptation. They form structure for integrating sustainability values into construction projects right from the conceptual stage. The structure has considerable possible to accelerate the understanding and implementation of

sustainability in building construction. It provides a concise overview of sustainability principles, strategies and methods, and focused the need for an integrated and holistic approach for implementing sustainability in building projects. It is proposed to provide a general structure for developing the quality and comparability of methods for assessing the environmental performance of buildings. It identifies and describes issues to be taken into account when using methods for the measurement of environmental performance for new or existing building properties in the design, construction, operation, refurbishment and deconstruction stages. It is not an assessment system in itself but is intended to be used in conjunction with, and complimentary to existing assessment systems such as BREEAM, BEES, LEED, etc.

The sustainability requirements are to a greater or lesser amount interconnected. The challenge for designers is to convey together these diverse sustainability necessities in original ways. The new planed approach must be familiar with the impacts of every design option on the natural and cultural funds of the local, regional and global environments. These sustainability necessities will be appropriate throughout the diverse stages of the building life cycle, from its design, during its useful life, up until organization of the building waste in the destruction stage. This structure lays the foundation for the growth of a decision support tool to help improve the decision making procedure in implementing sustainability in building projects. The full decision support tool will be described in the model currently being developed for use in the building industry.

THE COST OF SUSTAINABLE DESIGN, CONSTRUCTION, AND CERTIFICATION

When the idea of green building began to penetrate mainstream awareness, there was a common perception that green was more expensive. The technologies being implemented were new and not widely obtainable or mass manufactured, architects who focused in sustainable design were few and thus able to charge a premium for their services, and contractors who were unfamiliar with changes in the construction and administration process experienced inefficiency and output losses and may also have charged a premium for the load. cost of commissioning and other soft costs incurred in order to acquire documentation, and the total preliminary cost of the building was likely indeed higher than that of conventional construction. Construction costs are often categorized as either ‘soft costs’ or ‘hard costs’. Hard costs include ‘bricks-and-mortar’ direct expenditures connected with the building itself, such as materials, equipment, and building labor. Soft costs include all other expenditures associated with the construction project, such as architect, engineer and consultants fees, government fees (such as plan checks and permitting), taxes, costs of financing, and interest. Land costs may be treated as hard costs, or may be recorded independently. Initial building costs account for about just 2% of the total, while operations and maintenance costs equal 6%, and personnel costs equal 92% percent

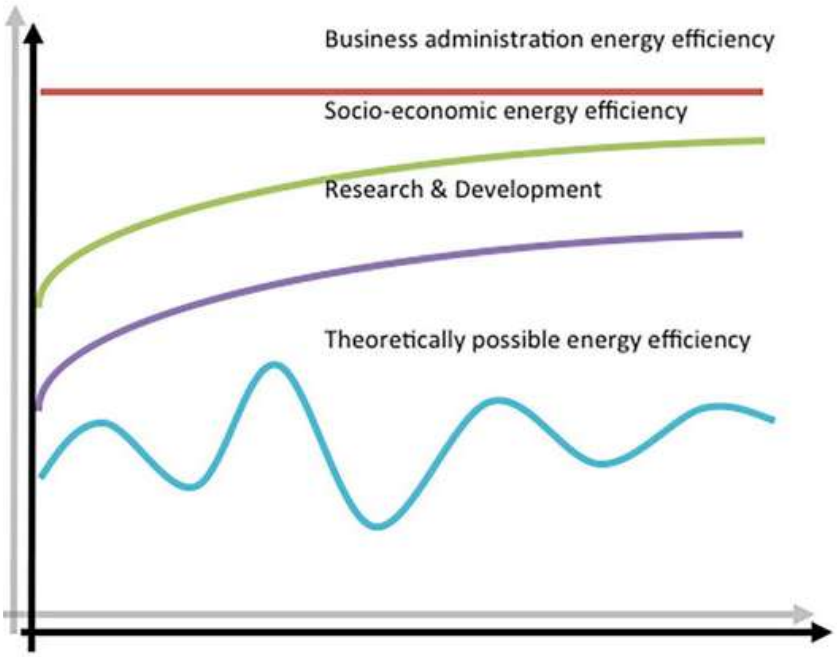
Various consultancies and the USGBC have been productive in generating published material, all vociferously supporting the end that the costs of conventional and sustainable construction are with time approaching parity – while at the same time particularly excluding design and documentation costs and noting that “…comparisons of this type [using an average square foot cost method] cannot be considered dependably meaningful to assess what

if any cost impact there might be for incorporating LEED and sustainable design" . In disparity, diverse public and private sources cite a range from 2% to 8% in the enlarged initial cost of demonstrable buildings, while at the same time acknowledging "inadequate methods exist to decide the accurate cost by using a accurately controlled study approach thereby assuring the accurateness of the actual percentage change in value" .

However, there is data and anecdotal proof to support the observation that, in the near-decade since the inception of the LEED certification system, manufactured costs for mechanism installed in green buildings have reduced, progress continues in building technology advancement, product reliability is improving, and lower pricing is becoming a reality in the marketplace. The premium paid to contractors, architects and engineers for LEED expertise, and thus the overall cost of building green, is also moving back with time as the knowledge curve flattens .

In some industries, specifically carpeting and furniture, substantial demand for green products has affected the manufacturing process and even the customer relationship (through cradle-to-grave recycling). Throughout the design and construction phases, documentation and specific tasks are required, including charrette, energy modeling, tracking of water use, waste production and recycled content, and various construction submittals. A "charrette" is a meeting or series of meetings that involves stakeholders and government from multiple disciplines, collaborating on a design solution.

Commissioning is a LEED requirement for certification, although whole-building Commissioning involves a third-party engineer to inspect building systems and make sure that they perform according to the design specifications, often conducted after construction or systems installation but prior to final occupancy. Systems that require commissioning may include mechanical, electrical, plumbing, controls, fire management, audio-visual installations and elevators. The process includes documentation, testing and inspection at startup, correction of deficiency, performance verification, reporting, operator training, and supply of operation and maintenance manuals. "Commissioning is one of the mainly important soft costs that can be incurred on a LEED project." Early commissioning may also affect in lower change order expenses. Re-commissioning could be required to evaluate the efficiency of ongoing maintenance, or if there is a modify in the way that the building is used after occupancy (churn naturally results in incompetence of systems that were not designed for a particular pattern or purpose, although flexibility is often a hallmark of sustainable building, which by design lessens the impact of reconfiguration). "Churn" or "churn rate" is the frequency with which building occupants and their possessions (including furniture and equipment) are moved from one place to another. The rate includes occupants who depart the facility and are replaced by other occupants, and may include adaptation of tenant improvements or layout to accommodate change.



APPROACHES TO SAVING 'GREEN' WHILE BUILDING GREEN

It is obvious that the cost of obtaining each certification point may vary, depending upon the choice of design item to be included. Obviously each design element requirements to be carefully measured in terms of its impact to the overall project and certification points, when point optimization is a goal. A reasonable policy, then, is to first follow points that have no monetary impact, followed by other points in chronological order by cost. Other strategies may include leasing equipment instead of purchasing, and installing products that multitask. When investigating new technologies that promise savings by design, the designer should cautiously consider the dependability of the product and warranties, best replacement cost offset the initial cost and projected lifecycle cost savings. elegant expenditures include design fundamentals that not only meet certification requirements but are also required by local building codes or reflect soon-to-come regulatory changes such as non- CFC-based refrigerants. Renewable energy programs are by description low cost since energy is generated not purchased. And, as always, early decision-making is less costly than late change – green building practices and participation by professionals with experience in LEED construction should be incorporated at the outset of the project. Not only does a LEED-certified consultant gain the building one certification point, but the consultant's very involvement may result in lower costs per certification point.

It would appear that some owners, considering the cost of administration, commissioning, and certification, are choosing to apply green building principles during the design phase but are omitting the steps required to formally obtain the USGBC plaque – a fraction (approximately one percent) of private-sector projects have applied for certification.

One way to offset costs is to take advantage of various incentives and programs that are available. A sampling of options found in the US includes the following:

- Rebates for use of Energy Star rated products, US Environmental Protection Agency (EPA) program.
- Rebates or reduced utility rates for commissioned buildings.
- Solar tax credits.
- State tax abatement credits for certification.
- Equipment pilot programs.
- Department of Energy (DOE) research grants.
- Focus on Energy's incentive and renewable energy grants.
- US Environmental Protection Agency's (EPA) Green Lights program.
- Country Water Works Association's Water saving program.
- Waste disposal
- Grants for energy modeling, commissioning and related costs.
- Preferred zoning considerations.
- Expedited permit reviews.
- Green Building Loan Fund
- Reduced insurance premiums for commissioned buildings. And,
- Energy service company financing and installation.

The diagram illustrates how different perspectives affect what is considered to be profitable and viable. There is a theoretical level never reached. In many cases not even the business economic level is reached. Examples of barriers to energy efficiency are lack of competence and lack of resources within the organization and that the issue is not prioritized by management

CONCLUSION

There is an immeasurable amount of different kinds of tools available for costing of sustainable renovation of buildings. The tools have special aims and uniqueness, spanning a wide range of environmental evaluation tools or certifications (e.g. BREEAM, LEED, SB Tool), process guidance tools (e.g. Soft cost and hard cost trategies), tools for choosing particular energy efficient solutions (e.g. EnerGo) or environmentally sound materials (e.g. Baubook). Nationally developed financial supporting tools exist in many countries and more are being developed. Different stages in the project planning process need different cost assessment tools. Most tools available tend to be most useful in a various stage of the planning process. The cost of using assessment tools differ from freely downloadable calculation methods to costs of accredited consultants and certification. Currently several research projects are looking to develop a common methodology for assessing the costing environmental aspects of buildings and data validity and reliability of the selected key indicators and criteria for benchmarking. The international standardization body, CEN, is developing a harmonised methodology for the assessment of financial tools works. This work will affect the future development and use of assessment systems. National and regional assessment tools should preferably have the as similar characteristics as possible. There are a number of templates and guidance available providing a concept for developing national or regional costing assessment tools. They provide a common format for assessments, with the possibility to adapt the content according to national or regional circumstances. Several tools,

many targeting energy efficient buildings, have been developed with funding during the last 10 years.

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