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The Challenge of Greening the Existing Residential Buildings in the Egyptian Market Base Case

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Abstract

Existing buildings are the massive percentage of the building stock, and therefore, are the key to improving efficiency; buildings account for an enormous share of the climate change crisis, and approximately 40% of the world total energy consumption (McArthur & Jofeh, 2015).

The Egyptian stock of buildings includes about 12 million buildings. 60% of these buildings are residential. The final electricity consumption of the residential buildings in 2010 was 51370 GWh and increased in 2014 to reach 62441 GWh. Thus the share of total energy consumption was 18.8% in 2010 and increased to reach 21.55% in 2014 ("Technology Roadmap - Energy efficient building envelopes.", 2013). Therefore, the residential sector plays an important role in the mitigation of energy consumption crisis, which is expected to increase.

The research field and initiatives in Egypt on the green buildings and green buildings retrofits are rare and, if existing, are weakly applied. Unlike in developed countries, there is a large research on building retrofits, e.g., the Residential Property Assessed Clean Energy (R-PACE) program and the weatherization assistance program (WAP) of the department of energy (DOE). Both are examples of the incentives to green building initiatives globally.

This paper discusses the challenge of greening the existing residential buildings in Egypt by demonstrating an analysis of the motives and the barriers to applying green measures in the Egyptian market.

The research methodology comprises the analytical-comparative method. In the analytical part; the paper identifies the current situation of the residential sector energy consumption in Egypt, and the benefits of greening existing buildings for tenants, investors, and owners.

In the comparative part, the current situation of Egypt's Green Market Business Case is compared with the international one, discussing the challenge of greening the residential buildings. The paper summarizes the opportunities to improve the building energy efficiency, incentives, and policies that are developed to address significant financial and technical awareness to building efficiency. These policies will help enable critical market actors to make decisions to promote energy efficiency in existing buildings.

Keywords

Existing buildings; Residential buildings retrofits; Egypt green market; Green building barriers; Green building motives

1. Introduction

The current rate of new buildings is considered low compared to the already existing which represent the majority of the building stock, buildings are responsible for a major share of the climate change crisis, and approximately 40% of the world total energy consumption (McArthur & Jofeh, 2015). Reducing energy consumption through retrofitting building is considered a low cost method to increase the efficiency of existing buildings. Sustainable new construction, no matter how energy efficient can't by itself changes the environmental impact of the current built environment. Thus, the building sector has a basic role in climate change impact reduction efforts and in energy consumption conservation; Green building measures can reduce the costs of energy consumption by 30 %, carbon emissions by 35%, water use by 30% to 50%, and reduce waste costs by 50% to 90% (Birk, 2007). The real challenge of greening the existing buildings is to reach the desired achievement while still respect budgets, in addition to handling occupant resistance to the change.

In Egypt, the residential consumption has increased compared to other sectors due to the urban expansion of residential buildings, the excessive use of air conditions in summer, and the use of domestic electrical appliances that is not energy efficient. The overwhelming consumption percentage lies in the existing residential sector, as a result it has the biggest share in energy reduction opportunities, See Figure 1. Accordingly, motives aroused in the building construction sector to limit the increasing energy consumption and greenhouse gas emissions.

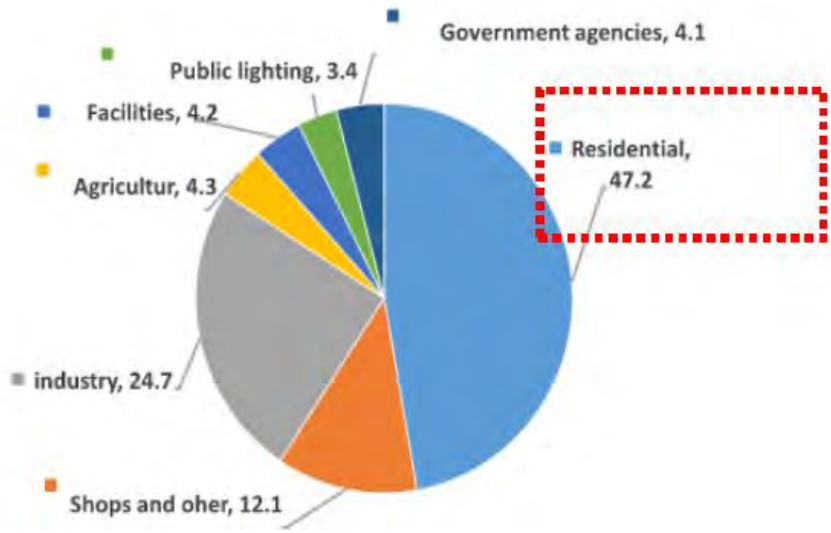

Figure 1. Electricity use by sector in the Egyptian market 2015-2016 ("Egyptian electricity holding company annual reports.").

The main challenge in retrofitting existing buildings lies in identifying the barriers and obstacles that stands in the way of retrofits, and overcome these barriers through attempts and policies that act as incentives to greening the existing buildings. It also lies in identifying the motives to greening the existing buildings to owners, investors, stakeholders and contractors.

2. Motives to Greening the Existing Residential BMuildings

In the developing countries like the case of Egypt, increased energy cost lately is a major driver to green buildings, especially in the last 10 years. Less emphasis on government regulation indicate the maturity of market, as outside incentives become less important than benefits to the building owner. The Building and Construction Industry (BCI) Australia survey for the Green Building Market Report in 2014 found that the main motives to the involvement in green buildings differs from the building owner, contractor or subcontractor as shown in Figure 2. These motives can be classified into economic, environmental, cultural/social, and political motives.

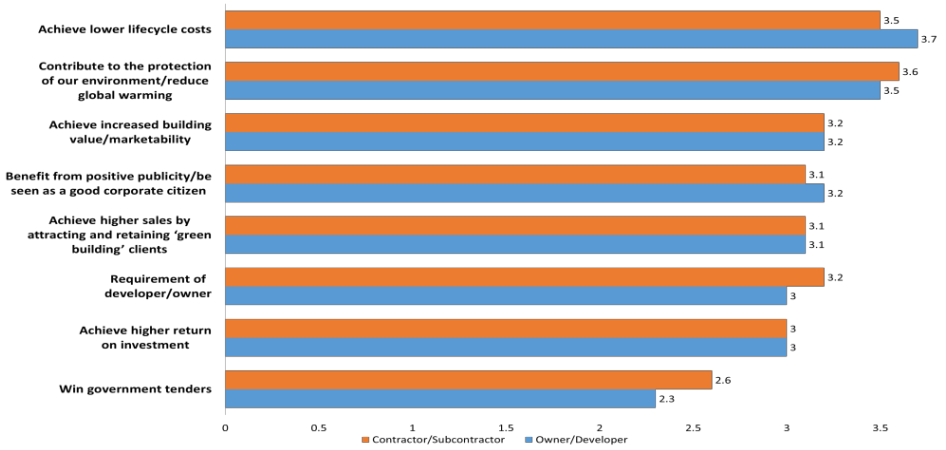

Figure 2. Motivesto involvement in green buildings' market according to (BCI) survey. (Asia,2014)

2.1. Economic Motives

Energy price is of medium concern in the short and medium term. Energy costs are the least controllable; thus rising in energy price is a main economic motive to examine energy efficient buildings more closely. Utility charges are among the top operating costs for buildings, and previous research shows that the energy savings for the green buildings' construction average 30% more than the normal buildings' construction, this is confirmed by a report from McGrawHill, which finds overall operating costs of the green building construction to be lower by 8-9% (Yudelson, 2010). Attractive return on investment (ROI) is certainly important; a number of case studies of LEED-EB (LEED for existing buildings – operation and maintenance) projects indicate that the "payback" on incremental investment can be as low as two years (Kats & Alevantis, 2003). As for the future competitiveness, the removal of subsidies on electricity services in Egypt makes many building owners believe there will be less competitive in future years without a certified or a green building.

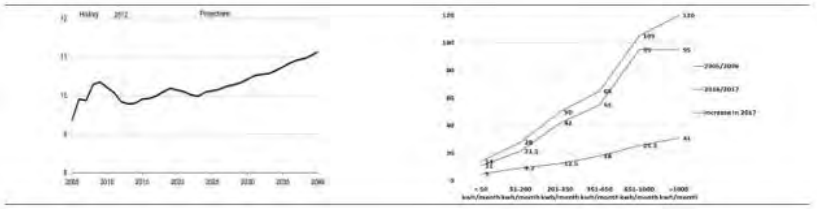

Figure 3. Left: Average residential sector electricity prices in 2012 and projection to 2040 in United States of America (cents per kilowatthour). ("AEO2014 results and status updates for the AEO2015," 2014). Right: Energy Prices Rise (Tarrifs Piaster/KWh) residential sector in Egypt according to 2005-2006 and 2016-2017 annual reports ("Egyptian electricity holding company annual reports").

2.2. Environmental Motives

One of the most important tasks is to reduce greenhouse gas emissions as a quick action for tackling climate change. Studies performed by the Intergovernmental Panel on Climate Change (IPCC), in co-operation with other international firms show that improving the buildings' performance is one of the cheapest ways to reduce greenhouse gas (GHG) emissions, and results in a net economic benefit ("Opportunities and Challenges Commission for Environmental Cooperation", 2008).

Another study performed by the International Energy Agency (IEA) shows that improving the building performance through energy efficiency measures may lead to reduction in carbon-dioxide emission up to two- thirds of the needed reduction globally (Langdon, 2007).

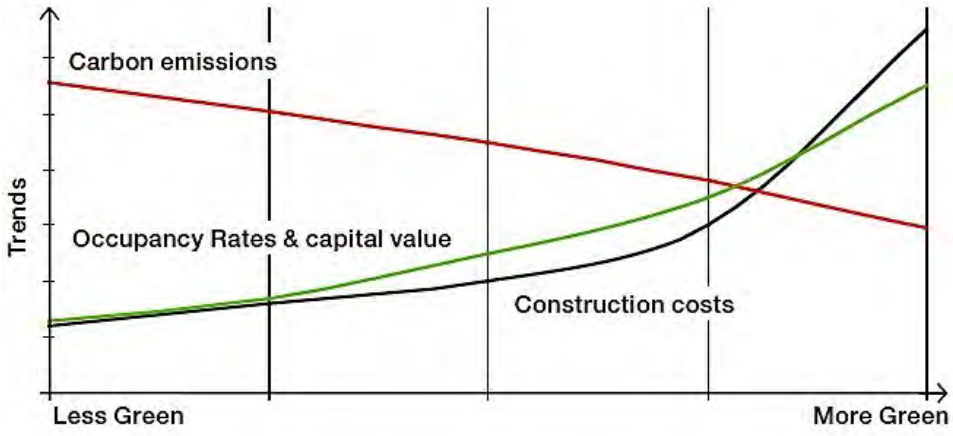

Figure 4. Effect of going green on CO2 emissions, occupancy rates, and construction costs (Langdon, 2007).

2.3. Cultural/Social Motives

Due to the growth in public awareness of climate change and the need to reduce GHG emissions, there is a rapid level of acceptance of green building practices, there is an increase in the numbers of buildings that registered green building rating systems such as LEED; the amount of LEED-certified buildings increased by one billion square feet in 2010, up to eight billion, which indicated a rate of growth by 14% , especially for the LEED certified existing buildings, according to the U.S. Green Building Council (USGBC), the area of LEED-certified existing buildings is more than the area of the LEED-certified new construction by 15 million square feet as cumulative (Katz & Manager, 2011). Figure 5

In Egypt, there are 15 buildings that acquired LEED certifications since (2007-2016) excluding LEED-EBOM, and 26 buildings registered to different programs, including one building registered for LEED v4 O+M EB in New Cairo (“Green Building Information Gateway.”).

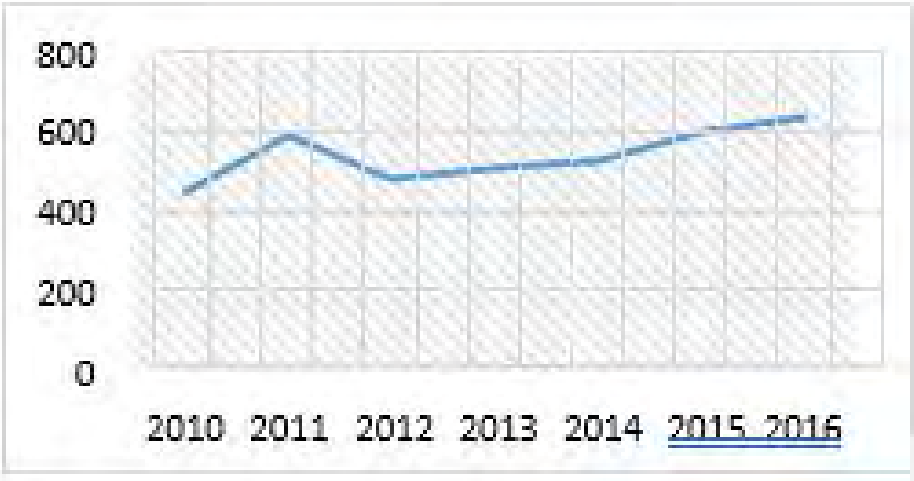

Figure 5. Growth in LEED forExisting Buildings: Operations & Maintenance Certified Space (Yudelson, 2016).

2.4. Political motives

Government regulations have an enormous effect in the construction market. Regulations are generally created to organize how to save or reduce costs of energy and water, and help improve man’s living conditions through government supported research, development, educational programs, and tax shifting. Many governments have

developed legislations to limit environmental impacts of buildings. The use of local codes and legislation programs helped to accelerate the application of green practices in the construction market.

Table 1 summarizes the motives to greening existing buildings from the economic, environmental, cultural/social, and political/governmental aspects according to the international and local market.

Table 1. Motives to greening existing buildings.

International motives			Local motives	
Economic	Motive	Commentary	Motive	Commentary
	Attractive Return on Investment (ROI)	- Many energy retrofits and LEED-EB certifications are showing high rates of ROI for owners. - Achieve an increased building value - Increased marketability. - Achieve higher sale value	Attractive ROI	- Efficient buildings are considered high quality buildings that achieve an increased value
	Responsible Property Investing	- Investors and owners committed to corporate social responsibility (CSR) are asking for certified green buildings, or applying green strategies and measures	Achieve higher sale value	- Increased building value achieve higher prices and higher sale/resale value.
	Future Competitiveness	- Owners with a longer term perspective are concerned that their properties' attractiveness might diminish	Concern about energy prices	- The energy prices in Egypt are increasing and subsidies will be removed in the upcoming years. - Achieve lower running/operational costs.
	Concern about Energy Prices and Future Volatility	- Energy is the largest cost of building operations in addition to that it is the least controllable.		
Environmental	Tackling Climate Change	- Reducing greenhouse gas emissions from buildings, and resource conservation.	Provide a healthier indoor environment	- Higher quality building provide a healthier environment and better quality of life.
	Providing a cleaner and healthier work environment	- Through applying green techniques - Seeking a better quality of life.		
Cultural/Social	Tenant Demand, and Stakeholder Pressure	- Investors, tenants, and communities want green buildings	—	—

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Table 1 continued

	Corporate Sustainability	- Building owners see investing in sustainable measures is an important way to occupy a leadership position	Occupy a leading position in a new domain concerning retrofits and energy efficiency	- Contractors seek new domains and techniques to assure competitiveness.
	Increase of awareness	- Towards the environment and the climate change; thus seeking solution through green buildings	Increase of awareness	- towards energy efficiency and energy use reduction
Political/ Governmental	Mandatory regulations, and introduction of new green codes and standards	- Politicians worldwide seek strategies to encourage greater energy efficiency and more efficient resource utilization through political measures such as subsidies and tax cuts for renewable energies. - Increased energy independence will lead to increased national security - Win more government tenders. - Economic motive in addition to the political and governmental legislations will help application of energy efficiency retrofit measures to grow in a rapid way	- Mandatory programs - New standards and codes	- If existed do not encourage green retrofits for existing buildings. - New standardizations are introduced to some electrical domestic devices that assures efficient energy use.

2.5. The Market Business Case Benefits of Greening Existing Residential Buildings

Retrofits of a building has many benefits to the owner, tenants, investors and contractors. A significant energy and water consumption reduction, as well as the increase the productivity of occupants, in addition to the reduction in the amount of negative impacts of buildings on occupants as a result of enhancing the building's indoor environment quality. Table 2 explains the benefits of green retrofits.

2.5.1. Benefits Directly to the Building Owner

Increased economic and financial benefits are the main drivers to change. The most significant benefits to the building owner are classified into two main categories. First, increased income through higher rental rates, higher occupancy growth, and higher rental growth. Second is lower costs through lower operating cost in the reduction of energy and water use; direct costs are represented in energy and water consumption, security, cleaning, repairs and maintenance. However, this cost category also includes indirect costs such as property taxes, insurance. Owners of green projects reported that; for new constructions, the operating costs was reduced by 13.6%, and for existing constructions, a reduction by 8.5% has been achieved. ("Green Trends Driving Growth Green Outlook 2011", 2011). See Figure 6.

In addition, green buildings offer a healthier living environment; increased air ventilation, improved day light space, and low toxicity finishes, as well as the lower operation costs. This makes green buildings more appealing

to the public. As a result, it is faster to sell and lease compared to conventional buildings in the same area.

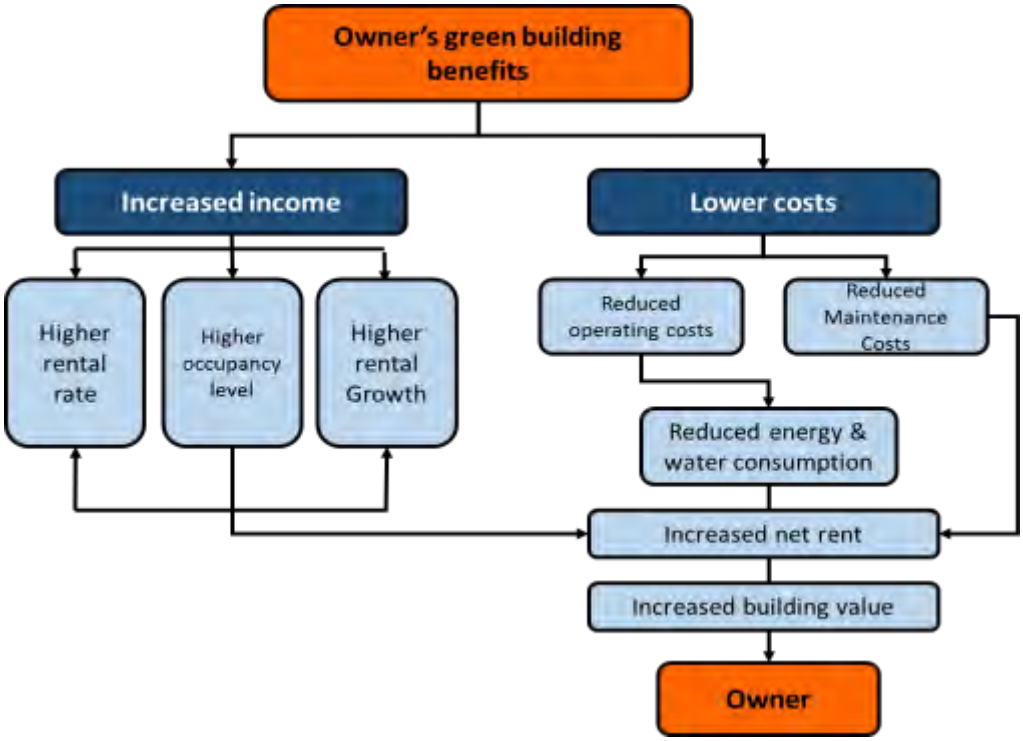

Figure 6. Owner's green building benefit.

2.5.2. Benefits Directly to the Tenants

Tenants are placing a higher value on the intangible benefits, which include higher personal productivity, and better indoor environmental quality, in addition the tangible benefits represented in lower operational costs.

2.5.3. Benefits Directly to the Investors

Green buildings create more desirable living conditions, offer a suitable return on investment. The following opportunities have been identified for investors:

- Capital cost savings: optimization of the building systems can lead to savings in capital cost. For example, using a downsized HVAC systems through energy efficient design.

- Enhanced building value: Green buildings have an increased ability to rent and sell space based on their enhanced indoor environment quality, lower operating costs and enhanced marketability. For new construction, value increases 10.9%, as for existing buildings the value increases 6.8% ("Green Trends Driving Growth Green Outlook 2011", 2011).

2.5.4. Benefits Directly to the Contractors

Contractors involving in the green market will have a unique reputational position based on retrofitting existing buildings, this will increase the market demand for that certain contractor.

Table 2. Benefits of green retrofits.

Business case benefits of green retrofits	
Tenants	- Potential for reduction in operational costs - Good indoor environment as a result an increased productivity. - improved comfort - Enhances sustainability goals reputational image
Owners	- Reduction in operating costs - Improved efficiency results a longer equipment life due to “right-sizing” .(less need for refurbishment) - Higher rents - Greater occupancy - lower tenant turnover - enhanced marketability
Investors	- Improved long-term value through reduced performance risk - Higher resale value
Contractors/	-Reputational position for contractors
Subcontractors	-Opportunity to be recognized as the energy efficiency expert in your local community.

3. Barriers to Greening Existing Residential Buildings

Green buildings have many benefits to the owners, tenants, investors and contractors. Governments and the public realize these benefits as well as the urgent need for more sustainable-conscious building practices. But it isn’t the mainstream due to some barriers. These barriers reduce the growth rate of green building renovations and make them more costly as follows:

3.1. High Initial Cost

The green building construction costs are basically less if performed during the initial design stages, but green retrofits that has to be integrated to an already existing building may have higher costs. In addition, costs of green building technologies, and materials are high and require long payback periods, so traditional applications replace green practices.

3.2. Lack of Awareness

Lack of awareness of the benefits that green buildings provide was an important obstacle that discourages green construction. This shows the need for education about both the financial and non-financial benefits of green construction. The regulations and codes of building design are complex and difficult to understand, clients are not able to comply with it.

3.3. Split Benefits

The individual who pays the bill is not always the same who benefits. As a result, the investor may lose his interest in paying for green practices when the tenant or the owner gets all the benefits. On the other hand, tenants may not be willing to pay for retrofits in a resident that is not their own.

3.4. Risk and Uncertainty

The developer may concern about the reliability of green building practices, uncertainty over the costs of developing a green building, over the economic benefits of greening existing buildings, building performance over time, and worry about the payback period.

3.5. Lack of Experienced Workforce

In-experienced workforce may increase the risk of inexperienced service providers. Lack of applications of green retrofits in projects leads to low practices and may lead to low quality retrofits integration as well.

3.6. Lack of Product Information

Information available on green building systems, products and their application is not widely spread and need a big research support consuming time and effort. The lack of these information may cause developer to depend on specialized consultant, or use the conventional building products.

3.7. Availability of Products or Technologies

Some products with special technologies and specifications may not be available to be installed in the desired buildings, in accordance traditional products are installed in projects. Imported products and materials require additional prime cost and time.

3.8. Lack of Coordination in Government Policies Affecting Buildings

Building codes may unintentionally require application of environmentally harmful features, or may ban the use of materials that are not widely used.

3.9. Lack of Research Investments

In Egypt, there is not a reliable source of information to know the real amount funding for green building practices, and if it existed or not. In the United States, a study shows that from 2002 until 2005, the funding for green construction research reached $193 million a year, which represents only 0.02 % of the estimated annual funding of building construction research budget (Baum, 2007).

3.10. Organizational Dynamics

In a multitenant building, it takes participation from nearly all the tenants to achieve a green certification (for example LEED-EBOM), and that can be very difficult to achieve. Even in a single tenant building; getting everyone to provide data, and cooperate during the performance period for the project can often be quite difficult.

Barriers can be overcome by means of some of the motives either environmental, cultural, economic, or governmental, Table 3 summarizes the barriers classified into economic, technical, cultural, and governmental.

Table 3. Barriers to greening existing buildings.

Barriers to greening existing buildings	Commentary	International Barriers	Local Barriers

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Table 3 continued

Economic/Financial	Financial consideration of green buildings	- Some lack of funding or financing difficulties - High cost of green systems, materials, and technologies - The investor may lose his interest in paying for green practices when the tenant or the owner gets all the benefits	- Relatively low energy prices despite the increase in tariffs. - Lack of funding or financing difficulties - High cost of green systems, materials, and technologies - Long payback periods - The investor have no interest in paying for green practices - Tenants not willing to pay for retrofits in rented residents. - Lack of Research Investments - Lack of funding programs concerning retrofits in buildings
Technical	Technical issues concerning systems, implementation, and maintenance	- lack of experienced workers - Risk and uncertainty - Lack of products information	- Unavailability of green technologies as the majority are imported - Periodical maintenance is sometimes ignored in projects. - lack of experienced workers - Lack of product information - Risk and uncertainty
Cultural/Social	The country's culture affects its market and thus accepts certain products and rejects others	- Client knowledge barrier to codes and regulations - Organizational dynamics- lack of collaboration	- Lack of environmental concern and awareness - Resistance to change - Lack of awareness of the benefits of green building. - client knowledge barrier to codes and regulations - Organizational dynamics-lack of collaboration - Intangible benefits affects tenants willing to apply retrofits
Political/ Governmental	Governments play very significant roles in the upgrading /downgrading of green buildings	-Lack of coordination in government policies affecting buildings	- Lack of coordination in government policies affecting buildings - lack of a government policy framework for energy efficiency - The absence of an enforcement of regulations - Corruption and other problems - The supervision and monitoring systems are weak - The lack of appropriate incentive programs for green buildings systems and technologies

4. Procedures and Programs/Policies to Encourage Green Practices

Regulations, codes, standards, obligations, certifications, and incentives are considered a main motive to reach the goals for the greenhouse gases reduction. Today, the majority of the energy regulations hardly focus on energy efficiency aspects that can achieve low operating costs and short payback periods. These are some of the procedures to encourage green practices shown in (Figure 7).

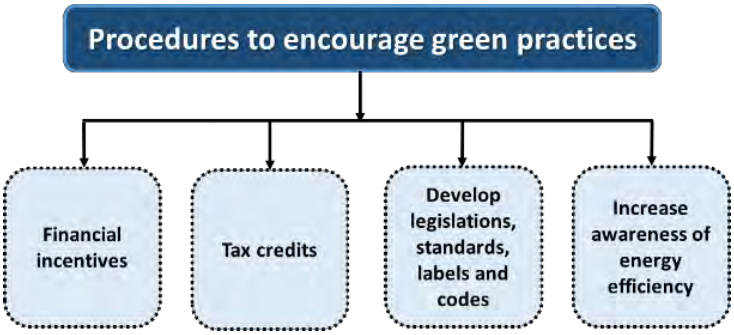

Figure 7. Incentives and procedures to encourage green practices

4.1. Financial Incentives

Financial incentive programs are the main motive that encourage stakeholders in the market to apply green practices. The incentives for the implementation of energy efficiency and retrofit measures is based on amount of electricity/water saved. Financial incentives may include low interest/long term financing. Locally, the introduction of these programs is still ignored and not applied. However, many programs are being applied globally, there are wide financing for energy efficient retrofits options, some of them are:

-Specialty Home Energy Loans: in U.S.A, programs offer loans at low interest rates to energy efficiency products locally available.

- Power Saver Loan: a program designed for energy retrofits up to $25,000 with terms up 15 to 20 years. (“Energy Incentive Programs, California — Department of Energy,” 2015)

- The KfW Bank program: since 2011, in Germany, the KfW bank offer loans of 2.9 billion euros for the retrofit of existing residential building, as a result, investments reached 3.9 billion euros (Georg, 2011). The return on investment for each one Euro was 3 Euros received by the German Federal Government. This programs affected the labor market, as the sales due to the increased demand for retrofit products increased, and increased the employment opportunities.

4.2. Tax Credit Incentives

The energy efficient building tax deduction has proved its efficiency to encourage the application of green retrofits. It is widely spread in Germany, USA, Italy (Neuhoff, Stelmakh, Amecke, Novikova, Deason, Hobbs, & Initiative, 2012), and others. But locally it has not been applied yet to any building types. The following are examples of tax credit programs:

- Tax incentives program: Italy offers tax credits to houses for installing single retrofit measures, for example: heat insulation in walls, roofs, basements, and windows. Tax credits may cover 55% of the energy cost with a limit to the maximum value according to a specified criteria (Neuhoff, Stelmakh, Amecke, Novikova, Deason, Hobbs, & Initiative, 2012).

- Residential Property Assessed Clean Energy (R-PACE) program: building owners can be funded when applying energy efficiency, renewable energy production, and water conservation practices, by means of assessment collected with the property taxes based on the (R-PACE) program structure.

- The Energy Investment Tax Credit (ITC) program: A 10% tax credits is provided for retrofits in the building envelop, a 30% tax credit is provided for the application of a residential solar systems, or a small wind turbine. The owner can request the tax credits to be added to his personal income taxes. Owners have

4.3. Develop Legislations/Programs, Standards and Building Codes

The effectiveness building energy legislations varies from country to another. In the developing countries, energy standards are often less effective than expected, mainly due to some difficulties in enforcement to apply these legislation, difficulties in compliance, or due to corruption and other issues. And the monitoring of the implementation of these legislations is poorly documented. The following represent some examples globally and locally.

Globally:

- The department of energy's (DOE) weatherization assistance program (WAP): the program offers free installation of energy efficiency practices, for houses that meet specified income rate criteria that are approved by (DOE)

- Home energy labeling programs: The Home performance is assessed using an assessment tool that scores the performance from 1-10 points, (10) is the best score of energy efficiency according to (DOE) program.

Locally:

- Develop an energy specification standards for electrical appliances: Home appliances such as electric fans and televisions have new standards for energy efficiency and a monitoring system ("Egyptian electricity holding company annual reports.").

- Egyptian Green Building Council: The Egypt Green Building Council has been established in 2009, it developed the Green Pyramid Rating System (GPRS). The first edition was published in December 2010 (Bassili & Emeritus, 2013). The initial response by the construction industry to establishing a rating system was positive for several reasons including the development of logical and incentive system that would encourage compliance and reward efficiency. But unfortunately, no buildings were awarded the GPRS, and no buildings are willing to register, instead LEED certification is the proper option for buildings that desire green permits.

- The energy efficiency improvement and greenhouse gas reduction project: executed by the Egyptian Electricity Holding Company, and the Ministry of Electricity, supported by the United Nations Development Program in 1999 (Akker, 2010). The project's main objectives is to reduce the long term greenhouse gas emissions, mainly this will be achieved through higher efficiency of equipment.

- The ministry of housing utilities and urban communities issued a ministerial ruling -482/2005- on 20/12/2005 for the enforcement of energy efficiency code for residential buildings (Akker, 2010).

4.4. Increase the Awareness of Energy Efficiency

According to the Egyptian ministry of electricity, there are limited initiatives to encourage the efficient use of energy in residential buildings. Lighting is the biggest consumer of energy in almost all sectors. Therefor the Egyptian Electricity Holding Company has cooperated with the "Improving Energy Efficiency of Lighting and Building Appliances" Project to encourage the use of efficient lighting products as a prior choice for residential buildings.

- Efficient lighting initiative: In 2015, a contract to supply - (sell or deliver) - the residential buildings with 13 million LED lamps, achieving an energy saving of 1124 Million KWh and fuel saving of 276 Ktoe/year ("Egyptian electricity holding company annual reports.").

- Spread awareness through brochures, seminars, different events, campaigns and energy efficiency tips, in all Governorates

- Digital campaigns through face book, Twitter, YouTube and "Waty EL Watt" slogan.

5. The Egyptian Green Market Business Case

The following table explains the residential Egyptian green market current situation compared with the global market.

Table 4. Comparative Analysis of Egypt's Green Market Business Case Current situation.

	Commentary	Egypt	Worldwide
Approaches (Initiatives) to Green Buildings and Greening (Retrofitting) Existing buildings)	Are the actions taken by government or NGOS (Non-Governmental Organizations) to encourage retrofits of buildings and increase awareness	- Establishment of the Egyptian Green Building Council. - Developing the Green Pyramid Rating System (GPRS). - Arising of NGOS i.e. Egyptian Society for Energy in Buildings & Environmental Design Research (EEER) - IBPSA - Egypt first Conference about Building Simulation Contributions to Built Environment, Cairo2013 - Go Green Expo on 25-26 May 2013, first green solution exhibition. - Energy Efficiency Improvement and Greenhouse Gas Reduction Project - Develop an energy efficient standards for electrical appliances - Efficient lighting initiative	- The KfW incentives (Germany) - Federal legislation (USA) - United states green building council (introducing LEED program) - Energy investment tax credit (ITC) - Residential PACE programs - Different funding programs There are many other initiatives and programs that are not mentioned.
Incentives	i.e. Tax reductions, funding programs, and loan programs to push the establishment of building retrofits.	- There is no specific incentive program to mention; thus it needs to be established to refresh the green market in Egypt	- Federal Legislation (USA) - Incentive Schemes for Existing Buildings in Germany. - Other incentives around the world
Codes	Government legislations and specifications	- Building legislations and codes do not encourage people to follow green architecture. Actually in some cases, the legislation discourages people to follow any green concepts. - If existed; not efficient enough, or not applied at all.	-International Green Construction Code (IGCC) -ASHRAE Standard for High-Performance Green Building -Other codes all over the world.

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Table 4 continued

Awareness	The owners, tenants, investors need to know the benefits of green retrofits in buildings.	- Limited awareness programs exist and public respond to it is not enough. - Most of the efforts focus only on lighting efficiency, ignoring all other opportunities - Public awareness needs to focus on green building benefits especially economic benefits through: - Conferences, seminars and workshops at universities. - Public media - Regular magazines and newspapers	- Strong awareness of Green buildings and green strategies; thus the number of certified green building in increasing every year. - Green buildings is gaining a strong reputation among owners and investors due to tenant demand - Tenants and owners want green, environmental responsible buildings
Green Technologies and strategies	Green technologies applied to conserve energy and water consumption. Or generate energy through renewable resources (i.e. solar panels)	- Almost all the new technologies of green buildings are imported at high value (i.e. Photovoltaic panels) - High initial cost - Availability problems - Passive strategies rarely applied in existing buildings	- Annual Exhibitions for green technologies and its application, and implementation-Training programs for workforce on the new strategies - Availability of material with certain specification for green building (i.e. LEED specifications) - Environmental product declarations (EPD) are introduced in the European market and spreading worldwide, it shows the products impact on environment so that it is easy to choose the suitable product. - LEED updated its credits to comply with the EPD.
Application of retrofits	Application of energy conserving methods in residential buildings	-There is a lack of trained and experienced workers -There is not any contractor or construction companies specialized in building retrofits to implement green technologies after auditing the energy consumption of the building.	-Specialized offices and companies are available. -Auditing companies are available to assess the building's situation and apply the appropriate retrofits (either deep or standard retrofits)

6. Conclusion

The research field and initiatives in Egypt on the green buildings and green buildings retrofit are rare, however, there are initiatives and standards starting to take actions towards green buildings and greenhouse gas reductions.

Legislation is a must to ensure the enforcement mechanisms to adopt the energy efficiency building codes in Egypt.

Existing building retrofit technologies can be classified into three main categories:

- Demand side management: retrofits that conserve energy i.e. insulation, window retrofits, and cool roof.

- Supply side management: retrofits that involve production of energy in buildings i.e solar systems.

- Energy consumption patterns “Human factor”: which is a new factor introduced in the operating phase of the building, requires awareness to the different daily activities that consume energy.

Codes and specifications in Egypt have to be implemented and executed roughly regarding energy efficiency in buildings, because the majority of the opportunities lies in building retrofits.

Opportunities to improve the existing buildings’ energy efficiency, in developed and developing countries are alike. Policies are developed to overcome the barriers to building efficiency either financial, institutional, or technical. These policies can be classified into the following categories:

- Energy efficiency improvement: owners and investors have to set targets for energy consumption reduction in action.

- Policies that increase awareness: like public awareness campaigns. - Financial incentives: tax reductions, government risk mitigation guarantees, loan funds. - Technical market development: through developing the green industry, and market by setting a

- medium/long- strategic plan to ensure that local manufacturers are able to produce appliances that comply with the efficiency standards. - Human resource development: through workforce training programs and developing the expert skills working in the building sector.

- Develop energy efficiency codes, standards, and labels: Develop legislations for monitoring labeling in domestic appliances and equipment. Develop a structured program criteria to show the minimum levels of energy efficiency to be applied to existing buildings as well as new construction.

Figure 8 illustrates a SWOT analysis (strength- weakness-opportunities and threatens) of the Egyptian green market base case, to know where we are and start to take actions to catch up the international trend in green business.

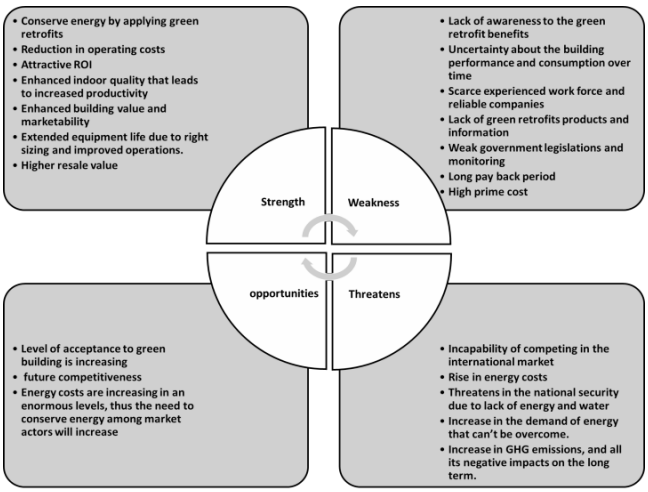

Figure 8. SWOT analysis to the Egyptian green market base case.

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