Green Buildings

Tool GB 3: Retrofitting of Buildings.

What this tool does: Building and construction technologies for energy-efficiency are important elements of the conversion of homes to become passive (or active) houses. Their quality and efficiency determines whether energy-efficiency targets can be achieved. There is an ever growing market for such products, and users will require guidance and technical support to get best benefits and value for their money.

How does it work?

Retrofitting an existing building can oftentimes be more cost-effective than building a new facility. Since buildings consume a significant amount of energy (40 percent of the many countries´ total energy consumption), particularly for heating and cooling (32 percent), and because existing buildings comprise the largest segment of the built environment, it is important to initiate energy conservation retrofits to reduce energy consumption and the cost of heating, cooling, and lighting buildings. But conserving energy is not the only reason for retrofitting existing buildings. The goal should be to create a high-performance building by applying the integrated, whole-building design process, to the project during the planning or public tender phase that ensures all key design objectives are met. For example, the integrated project team may discover a single design strategy that will meet multiple design objectives. Doing so will mean that the building will be less costly to operate, will increase in value, last longer, and contribute to a better, healthier, more comfortable environment for people in which to live and work. Improving indoor environmental quality, decreasing moisture penetration, and reducing mold all will result in improved occupant health and productivity. Further, when deciding on a retrofit, consider upgrading for accessibility, safety and security at the same time. The unique aspects for retrofit of historic buildings must be given special consideration. Designing major renovations and retrofits for existing buildings to include sustainability initiatives will reduce operation costs and environmental impacts, and can increase building adaptability, durability, and resiliency.

(adapted from: https://www.wbdg.org/resources/retro_sustperf.php)

1Tools for Retrofitting the Buildlng Stock
Source: https://www.bestellen.bayern.de/application/eshop_app000009?SID=1859458724&ACTIONxSESSxSHOWPIC(BILDxKEY:%2703500048%27,BILDxCLASS:%27Artikel%27,BILDxTYPE:%27PDF%27)

Deciding on interventions.

Before making what may amount to a major investment in the retrofit of existing buildings for energy and sustainability improvements, it is important to determine if the investment is worthwhile in perspective with other building conditions. Is the building structurally sound?

Once determined that other building conditions are not impediments to upgrading for sustainability and improved energy performance, have a plan and follow a sequence of activities in order to determine the best options for energy and sustainability improvements.

- First, determine if the existing systems are operating at optimum levels before considering replacing existing equipment with new higher efficiency equipment. This can be accomplished by performing an energy audit. Sometimes, considerable savings in utility costs can be gained by evaluating the performance of the building envelope and existing systems: leaks, clogged/dirty filters, stuck dampers, disabled sensors, faulty or incorrect wiring, or even lack of knowledge on how to properly operate and maintain equipment can all contribute to inefficiencies and increased costs. Audit the performance of the building's water systems as well; since leaking and inefficient systems not only waste water, they also use energy by needlessly running pumps and other electrical equipment.
- Then, if the building is metered, review utility bills from the last two years to determine if consumption (not cost) has risen.
- Next, determine air tightness of the building envelope by examining the building envelope, looking for leaky windows, gaps around vents and pipe penetrations, and moisture intrusion. Upgrading heating and air-conditioning systems without addressing problems with the building envelope will result in less than optimum performance of those systems.

Sustainability and Energy-Efficiency Strategies

- Recommission all energy and water systems to determine they are operating at optimum performance; then upgrade energy and water systems to minimize consumption.
- Develop a plan to optimize the recycling and reuse of demolition debris and construction waste to minimize waste sent to landfills.
- Evaluate occupancy patterns, then apply daylight, HVAC (heating, ventilation and air conditioning) and lighting sensors in appropriate locations. Incorporate energy efficient-lighting into the project as appropriate for the tasks and functions of the spaces.
- Determine if natural ventilation and fresh air intake are feasible alternatives to reduce heating and cooling loads.
- Investigate renewable energy options that can offset the purchase of fossil fuel-based energy.
- Consider solar shading devices for windows and doors, including those that generate electricity by photovoltaic (PV) devices.
- Replace existing windows with high performance windows appropriate for climate and exposure. If building requires security upgrade, evaluate blast resistant windows and films. If building is located in a high noise area, evaluate windows that also include adequate exterior to interior noise reduction.
- Analyse the benefits of distributed generation if the building is in a campus cluster or can share the on-site energy produced with adjacent buildings.
- Balance the project's sustainable goals with its security goals including protecting the building and its occupants from natural and man-made disasters.
- Certain site renovations can improve the energy performance of the building including reducing the heat island effect.

- Determine if a cool roof or green roof are cost-effective ways to reduce heat island effect and storm water runoff.
- Employ green building rating systems for existing buildings like (DGNB, LEED, BREEAM, Chinese Star-Rating System, or other) to gage the building's level of performance.
- For historic buildings, update systems appropriately to maintain a balance between the need for energy and water savings with the character of the original building fabric.
- Take the opportunity afforded by the building renovation to incorporate sustainable operations and maintenance practices and switch to green cleaning products and methods.
- To ensure a newly renovated building continues to perform as designed, measure the performance of the building regularly.
- If not already metered, plan on installing meters for electric, gas, water and other utilities. Smart meters and submeters are preferable to monitor real-time consumption, control demand and increase tenant accountability (cost control). (adapted from: https://www.wbdg.org/resources/retro_sustperf.php)

Technologies.

The technologies in support of Passive and Active House concepts can be grouped into the following categories:

- Technologies of the building envelope – walls, doors, windows, roofs, foundations and flooring.
- Special technologies:
  - Green roofs
  - Energy efficient heating technologies.
  - Energy efficient cooling technologies.
  - Warm water technologies.
  - Decentralized renewable energy sources.
  - Energy-efficient lighting.
  - Energy efficient heating, ventilation and air conditioning (HVAC).
  - Energy efficient water devices.
  - Software to monitor in-door air quality and use of home appliances.

Literature / further information:

UK Green Building Council. 2014. A housing Stock fit for the future: Making energy efficiency a national infrastructure priority. London.

http://www.ukgbc.org/sites/default/files/A%2520housing%2520stock%2520fit%2520for%2520the%2520future%2520-%2520Making%2520home%2520energy%2520efficiency%2520a%2520national%2520infrastructure%2520priority.pdf

GIZ. 2012. *Handbook on Energy Efficiency Retrofitting of Existing Residential Buildings.* Beijing. http://low-carbon-urban-development-germany-china.org/wp-content/uploads/2015/11/Guideline-on-Energy-Efficiency-Retrofitting-of-Existing-Residential-Buildings-EN.pdf

Anders, S., Church, D., Jansen, F., Zhang, K. Deutsche Gesellschaft fuer Nachhaltiges Bauen. 2015. Enabling Measurable Sustainable Design – the DGNB System for Districts and Industrial Locations. In: *Green Building* 2015. Beijing. pp.22-23.

CBRE. *Retrofitting Existing Buildings: The Low Cost, High Volume Solution to Climate Change.* Sustainability Asia Pacific. Vol. 4. http://www.cbre.com.hk/AssetLibrary/sustainability_issue4.pdf

NCC. *Solution: Energy Retrofitting of Existing Buildings.*

https://stateofgreen.com/en/Profiles/NCC-Construction/Solutions/Energy-Retrofitting-of-Existing-Buildings

Paradis, R. 2012. Retrofitting Existing Buildings to Improve Sustainability and Energy Performance. https://www.wbdg.org/resources/retro_sustperf.php)

United States Environmental Protection Agency. 2008. *Energy Star - Building Upgrade Manual*. https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_Full.pdf

Credentials; Tool GB 3: Retrofitting of Buildings. Drafted and compiled by Florian Steinberg, EC Link. Copy edited by Kosta Mathéy. June 2018