Building Energy Efficiency

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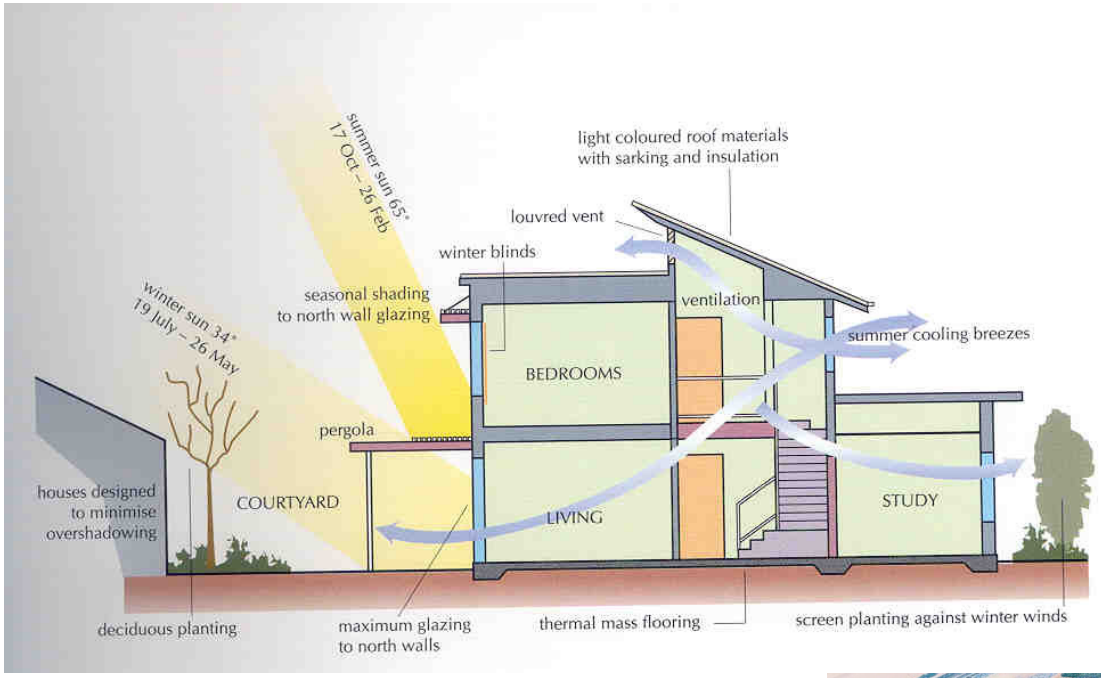
"The world will not evolve past its current state of crisis by using the same thinking that created the situation."

– Albert Einstein

…the world of DESIGN needs some Radical thinking!

Energy Efficient Buildings



Source: masdar city-http://ecocitiesemerging.org/
maplegrovenetzero.wordpress.com

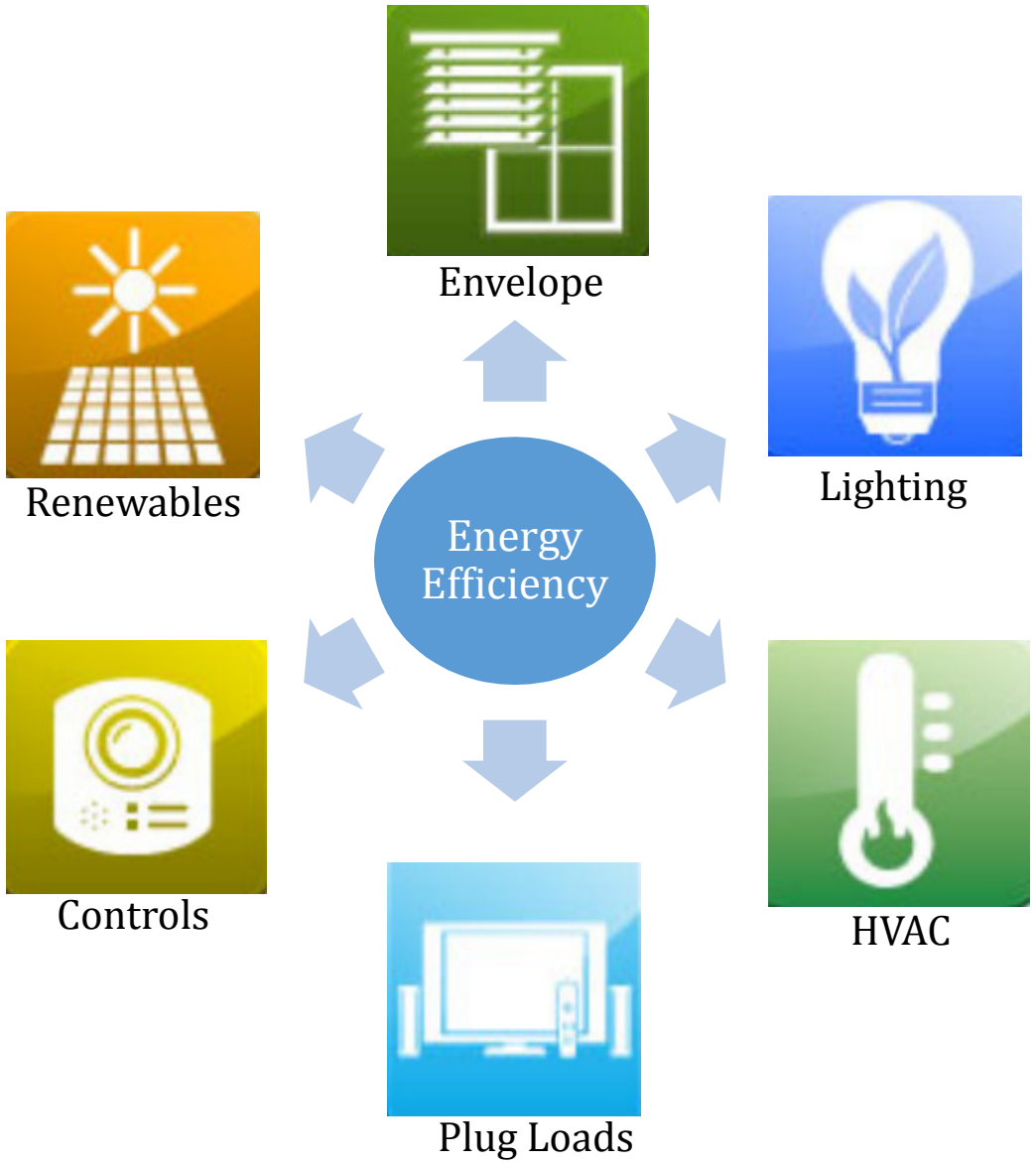
Energy Efficiency in Design and Operations

Design

Operations

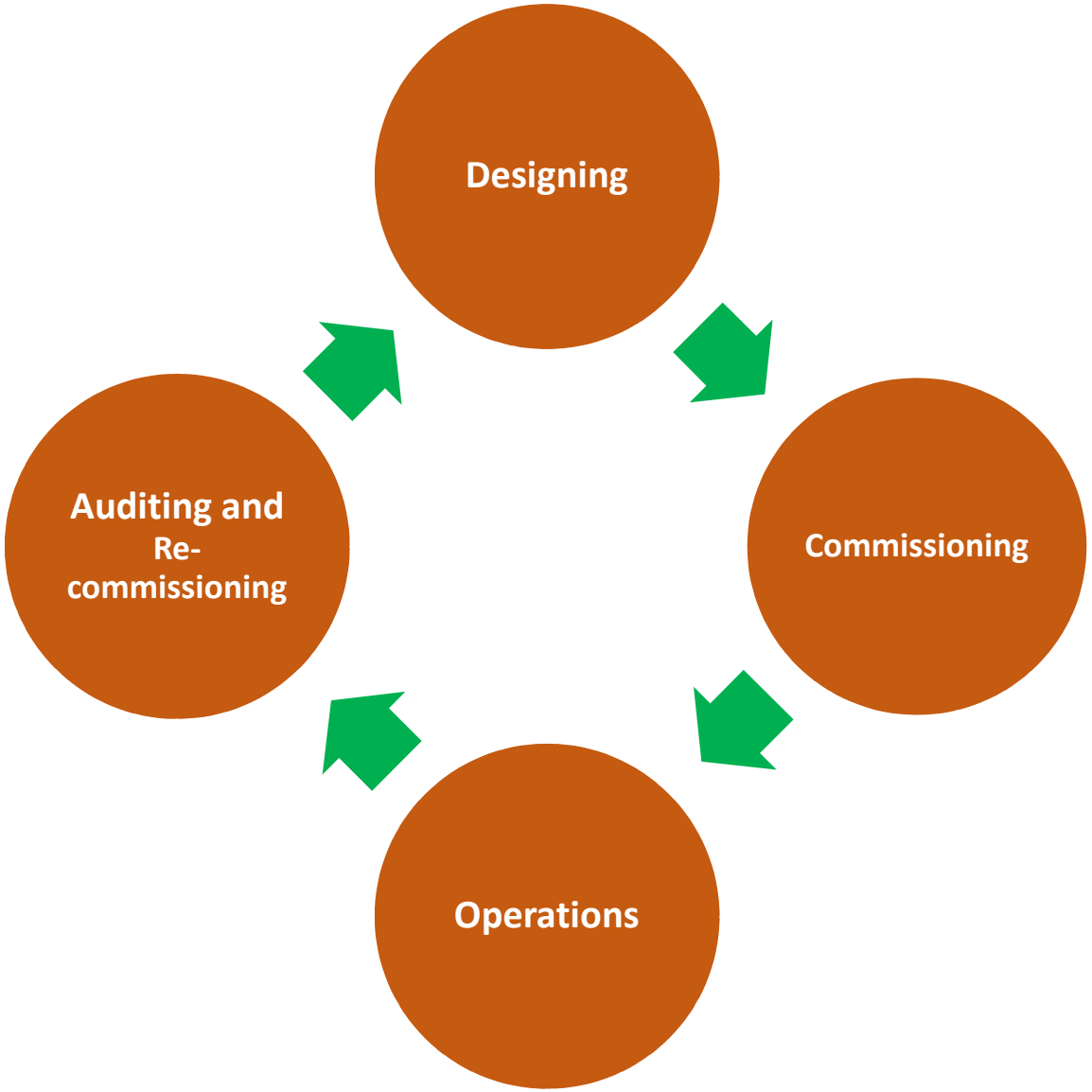
Source : www.freepik.com

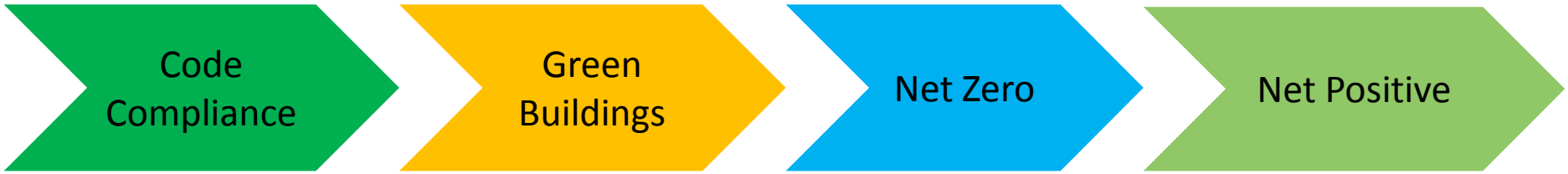
Different Aspects which impact Energy Consumption



Source : www.elementcontrols.com

Feedback


Designing
Commissioning
Operations
Auditing and
Re-
commissioning


Code Compliance
Green Buildings
Net Zero
Net Positive

Net Zero Energy Building

DEFINITIONS

Net zero site energy building

Net zero source energy building

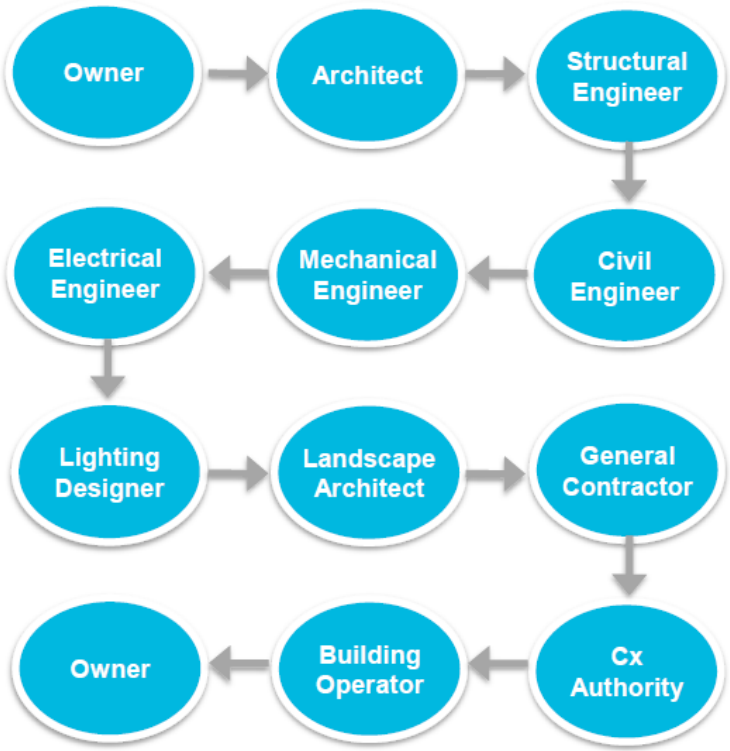
Net zero energy cost building

Net zero energy emissions building

Source: 2013 Yudelson Associates

Do you know any light bulb that operates without power supply???

Designing Net Zero Buildings through Integrated design approach

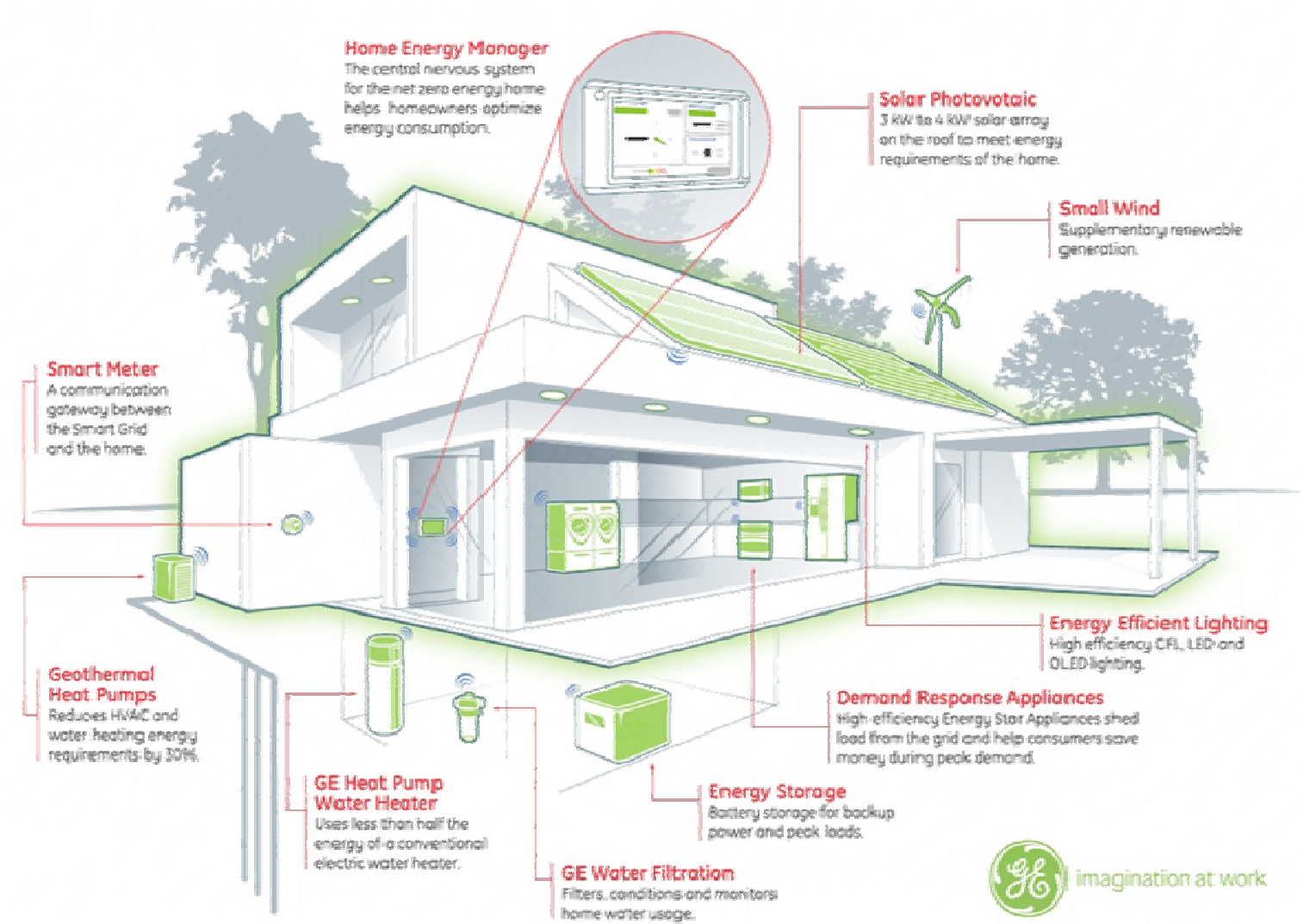


Traditional Process

Integrated Design Approach

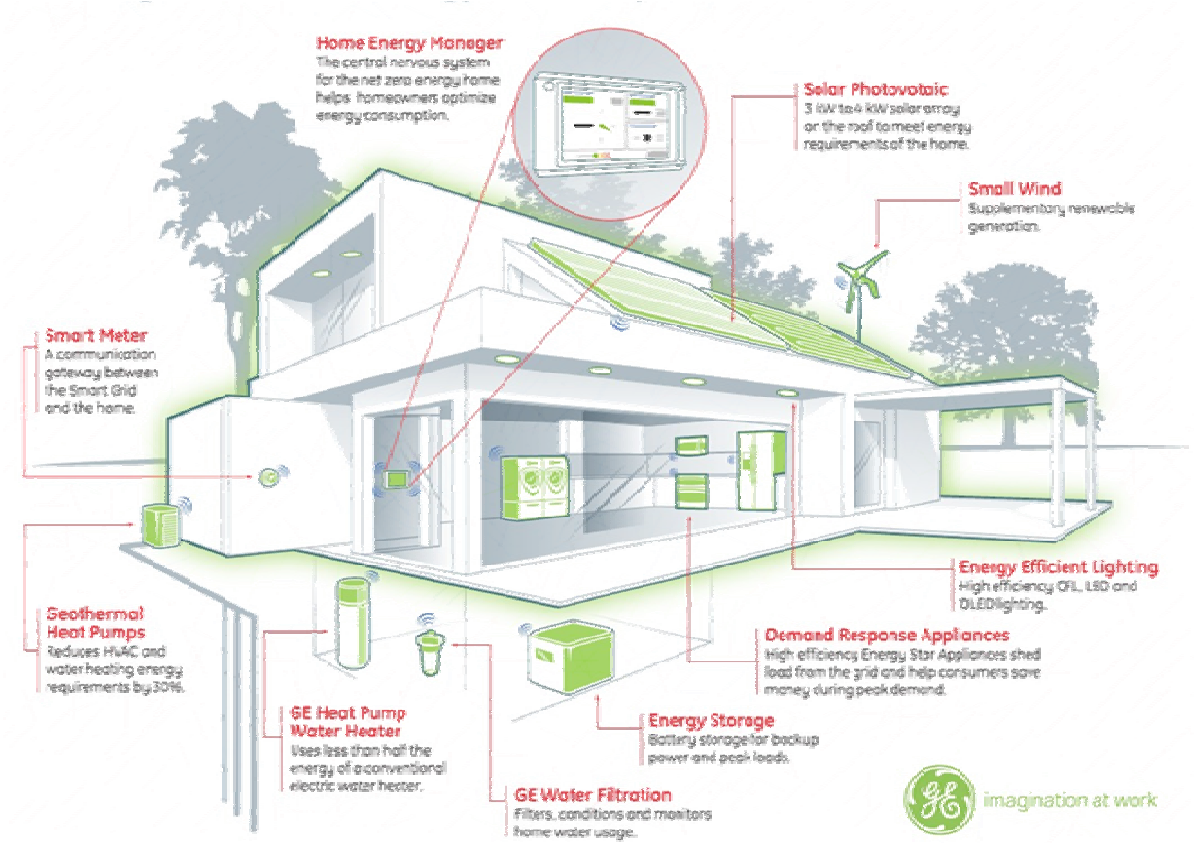
Source: www.wbdg.org

Net Zero Hybrid Buildings/ Systems



Source: http://www.climatetechwiki.org/

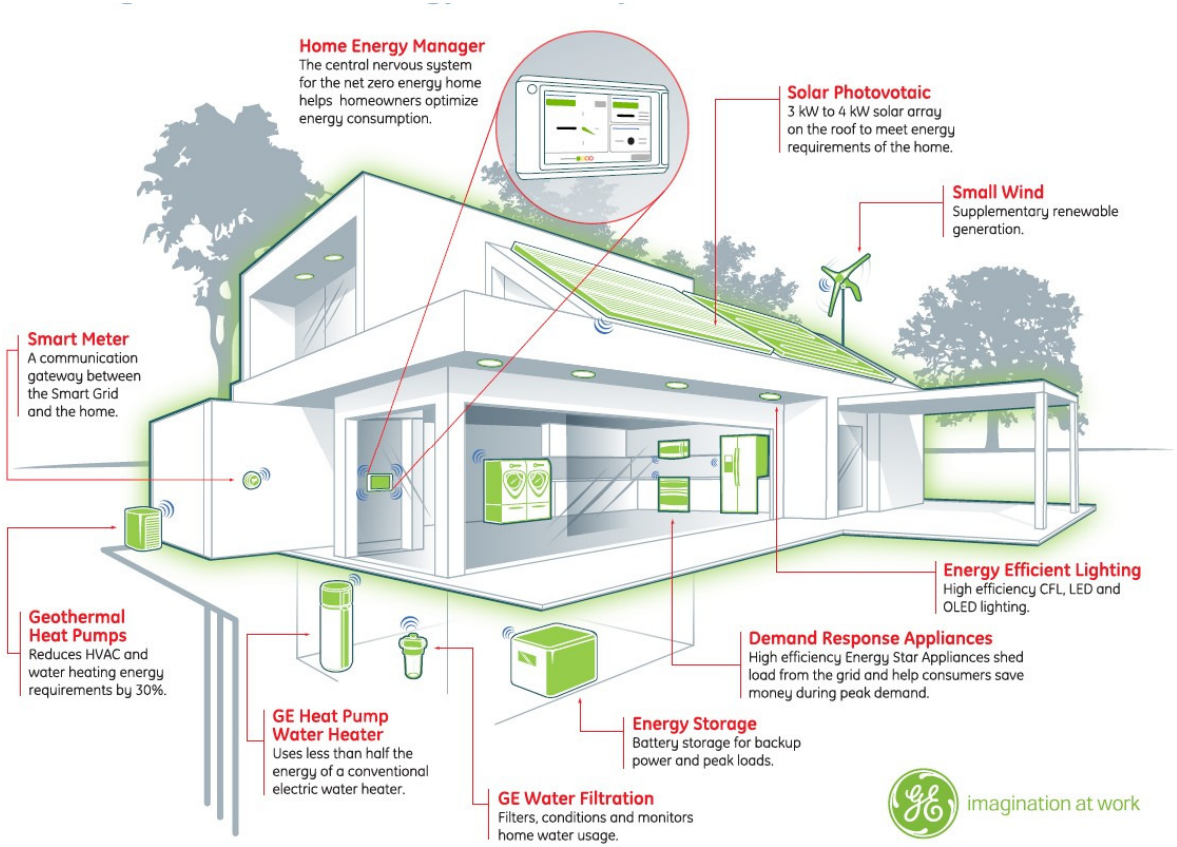
Net Zero Hybrid Buildings/ Systems



Process Loads

Source: http://www.climatetechwiki.org/

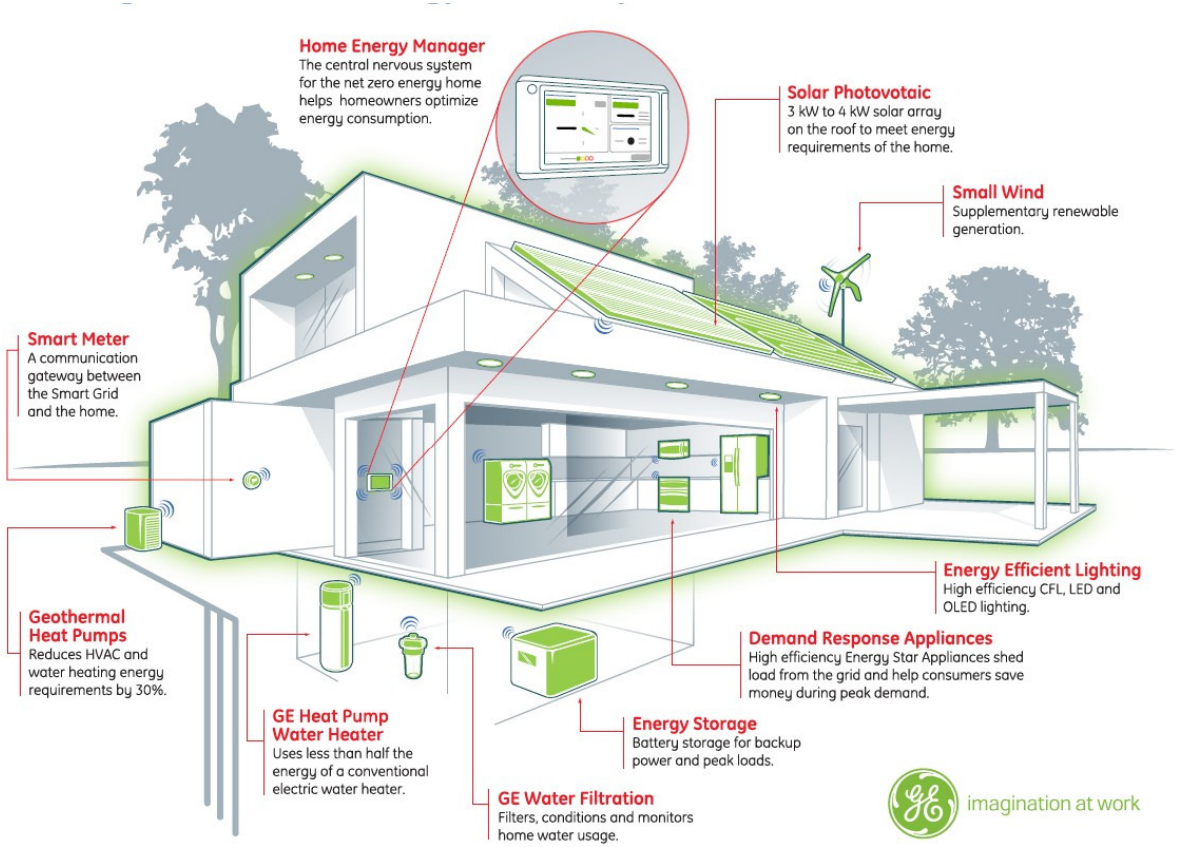
Net Zero Hybrid Buildings/ Systems



Renewables

Source: http://www.climatetechwiki.org/

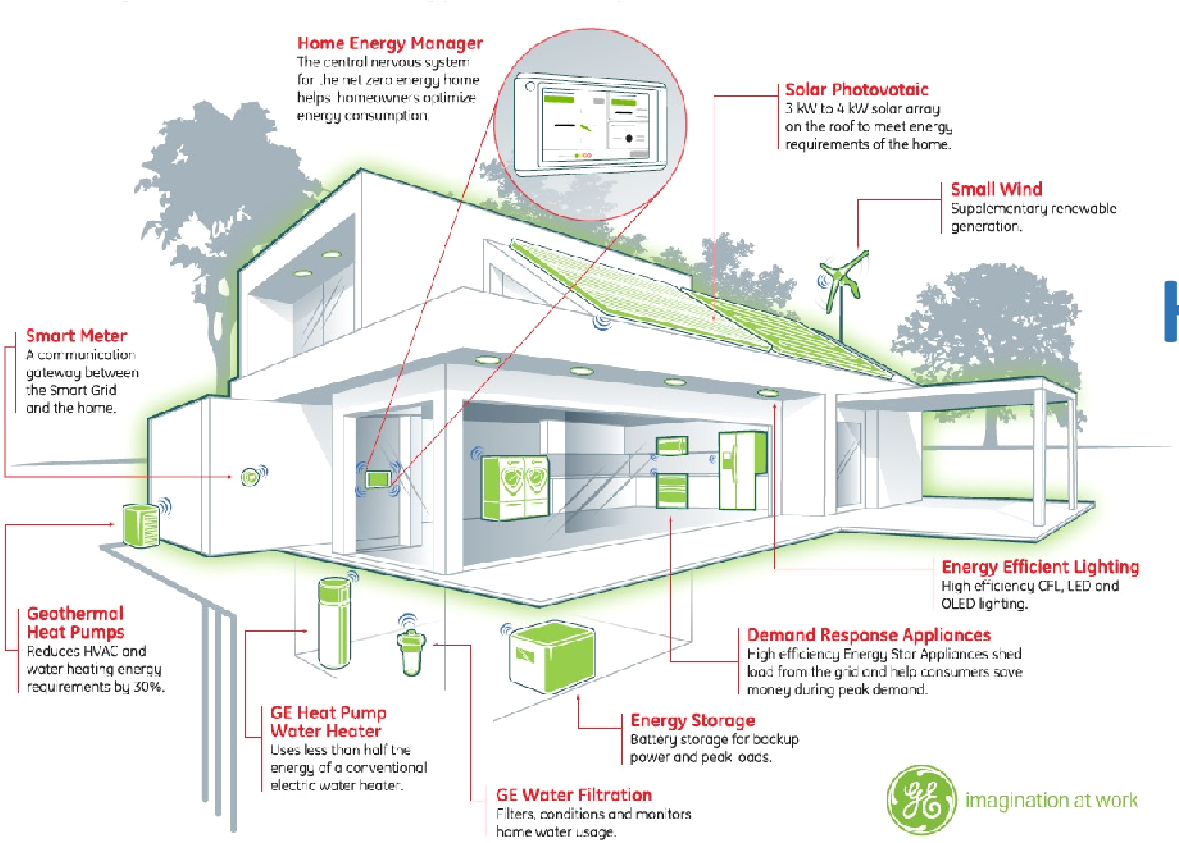
Net Zero Hybrid Buildings/ Systems



Micro climate

Source: http://www.climatetechwiki.org/

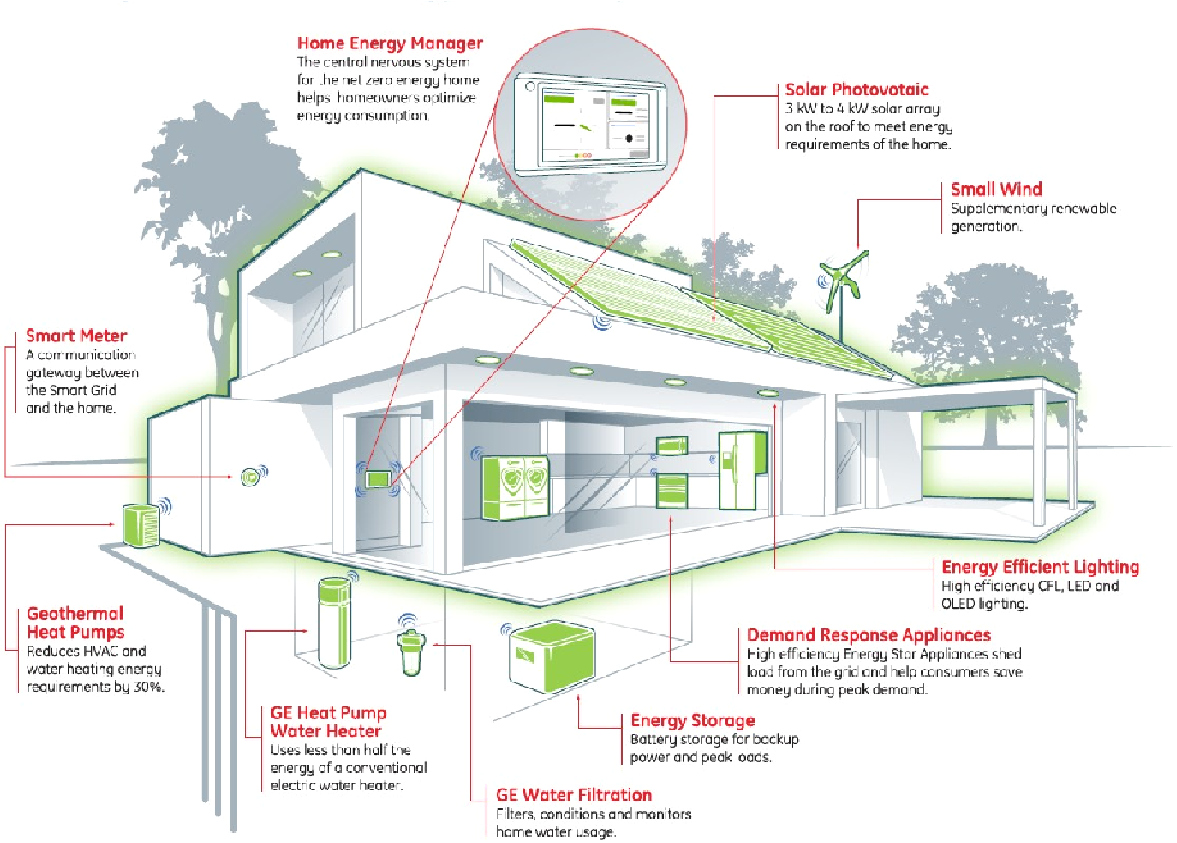
Net Zero Hybrid Buildings/ Systems



Human Comfort

Source: http://www.climatetechwiki.org/

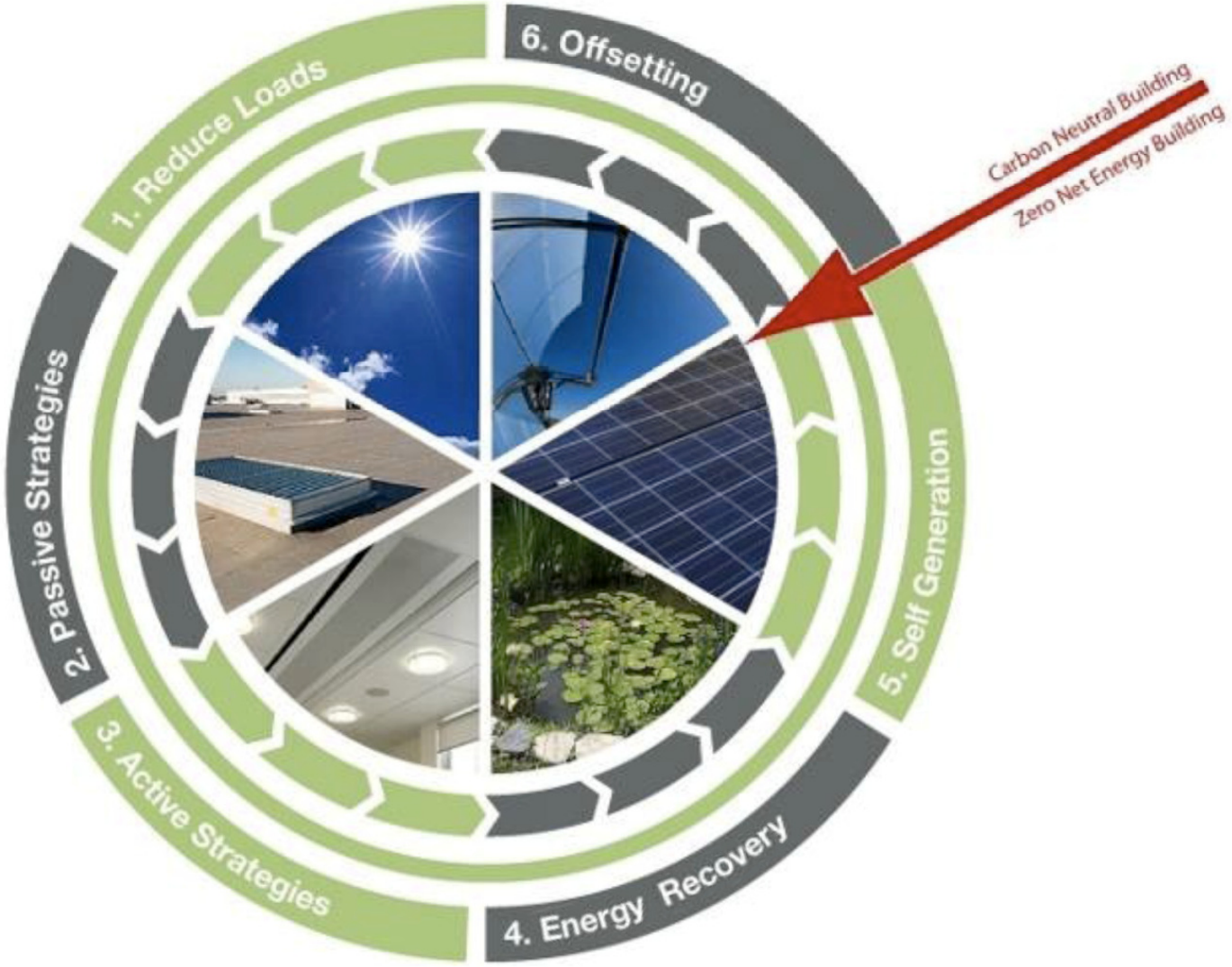
Net Zero Hybrid Buildings/ Systems



Human Behaviour

Source: http://www.climatetechwiki.org/

Integrated Building Technologies



Source: 2013 Yudelson Associates

Life Cycle analysis
And
Triple Bottom Line

Image source:http://www.phlorum.com/

Updating the curriculum

Architectural Curriculum Enhancement for Promoting Sustainable Built Environment in India

Sanyogita Manu, Anurag Bajpai, Satish Kumar, Shruti Narayan, and Ankur Tulsyan,
International Resources Group
Rajan Rawal, CEPT University
Sudha Setty, Alliance to Save Energy

ABSTRACT

The world today is grappling with the challenge of balancing development through responsible use of natural resources. The challenge only becomes more pronounced for developing economies like India, where improving the quality of life of the masses needs to be mindful of already starved natural resources. To this effect, the advent of clean energy economy is an imminent solution since it has the potential to respond to the challenges and deliver the projected growth in a sustainable way.

To ensure that India is well prepared to transition to a clean energy economy, it needs to review its economic growth indicators in a holistic fashion. Workforce development is perhaps one of the most critical indicators for economic growth. It not only depends on the number of employed workers but also on the skills that they apply and how these skills evolve with the changing context. Education, a strong building block of workforce development, has an important role to play vis-à-vis its application at various levels in the development of a professional and can play a key role in imparting appropriate and contemporary knowledge through continuous curriculum enhancement to cater to the changing professional requirements, offering refresher courses, professional certification programs, vocational training, and other continuous learning programs. Technical education curriculum that supports the foundation of a profession and the ability to enhance it not only provides the required change for today but also establishes a process of evolution that would be able to respond to any subsequent changes in the future. This paper evaluates the potential of curriculum enhancement in the design and construction industry targeting building design professionals. It will discuss a plan proposed by the USAID supported ECO-III project with the support of Bureau of Energy Efficiency, Ministry of Power (India) that reviews the existing structure of the architectural curriculum in India, identifies methods for enhancement and outlines activities that can help in integrating sustainable design practices with the existing educational framework in partnership with the Council of Architecture.

Recommendations of the paper

- Content development for courses that can teach the sustainable concepts from the first principles (e.g. Building Physics, Building Diagnostics, etc.)

- Structuring of a Design Studio that would encourage the students to use the concepts learned in Climatology, Building Physics, etc. and assist them in incorporating the sustainability principles in the design problem.

- Help create the infrastructure that would allow the students to go out in the field and understand the concept of building performance by taking thermal, lighting, and acoustical measurements and performing analysis and equip the computer laboratories of architecture department with reliable and robust energy, lighting simulation tools and design aids that can assist students in designing and analyzing more complex buildings.

Sample B.Arch Curriculum

SEMESTER-1

COURSES
Basic Design
Architectural Drawing and Graphics-I
Building Construction- I
Building Materials - I
Structural Mechanics - I
Introduction to Art and Architecture
Computer Applications-I
Workshop- I

SEMESTER-2

COURSES
Architectural Design-I
Architectural Drawing and Graphics - II
Building Construction - II
Building Materials - II
Structural Mechanics - II
History of Architecture - I
Surveying and Leveling

SEMESTER-3

COURSES
Architectural Design – II
Architectural Drawing and Graphics - III
Building Construction III
Structural Mechanics - III
History of Architecture – II
Building Services-I
Climatology

SEMESTER-4

COURSES
Architectural Design – III
Building Construction-IV
Design of Structures - I
History and Theory of Architecture-I
Building Services-II
Landscape Design and Site Planning
Computer Applications-II

SEMESTER-5

COURSES
Architectural Design – IV
Building Construction-V
Design of Structures - II
History and Theory of Architecture-II
Building Estimating Costing and Specifications
Environmental Studies
Computer Applications-III

SEMESTER-6

COURSES
Architectural Design – V
Working Drawings and Details
Architectural acoustics
Building Codes and Bye Laws
Building Economics and Sociology
Human Settlements and Town Planning
Barrier Free Built Environment

SEMESTER-7

COURSES
Advance Design Studio • Advance Architectural Design (Design Studio) • Building Construction Management (Design Studio) **Landscape Architecture** (Design Studio) **Interior Design** (Design Studio)
Advanced Construction and Materials
Advanced Structural Systems
Green Buildings and Infrastructure
Advanced Services
Pre Thesis Seminar

SEMESTER-8

COURSES
Design Thesis
Professional Practice
Elective-II • **Architectural Illumination (Elective – II)** • Architectural Journalism (Elective – II) • Furniture and Product Design (Elective – II) • Disaster Resistant Architecture (Elective – II)

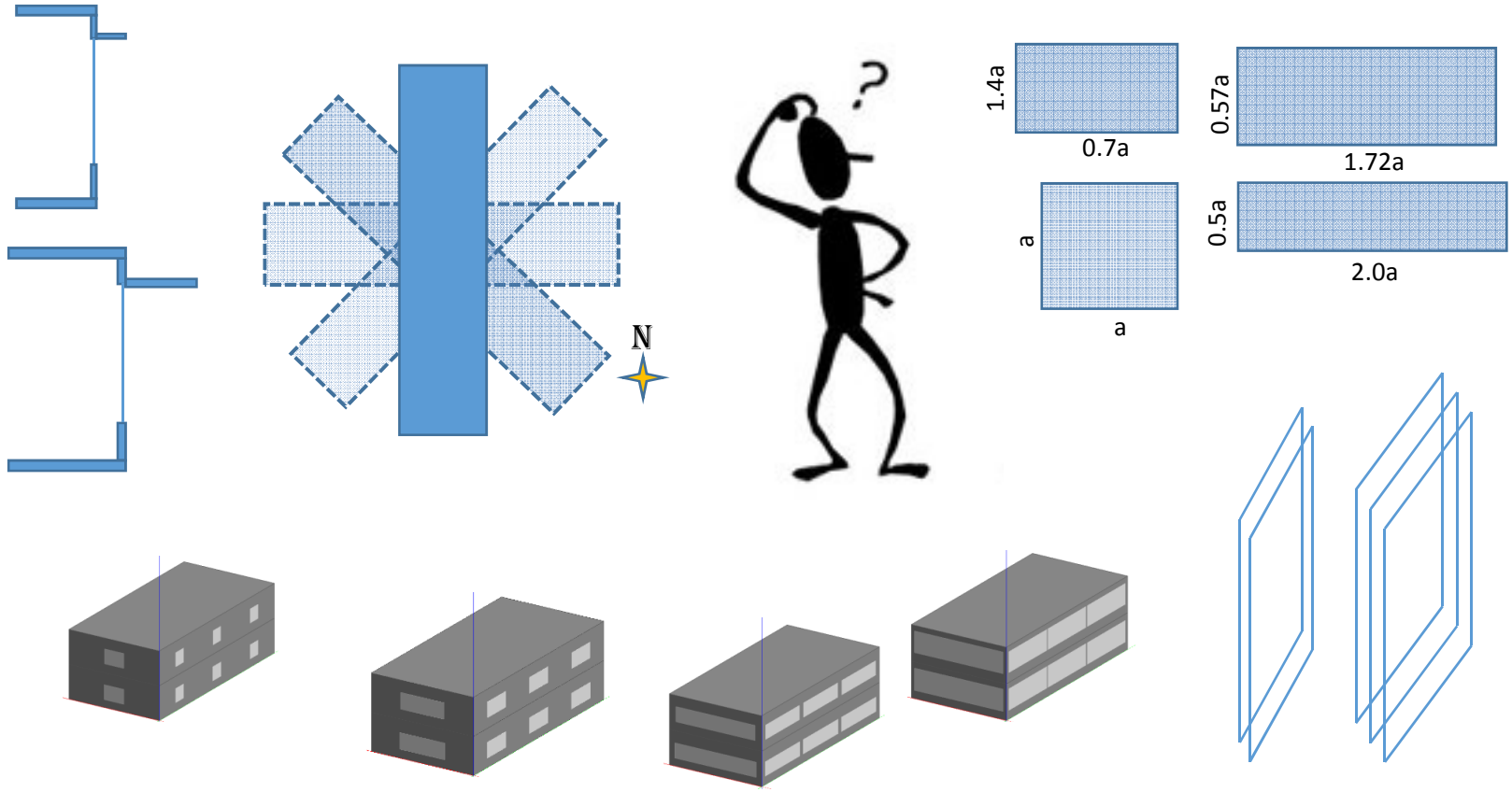
Recommended inclusions in the curriculum

- Course on **Building Physics**
- **Building Materials** course to include Thermal Property -special emphasis on Glass and Insulation
- Course on **Byelaws** should include **Energy Codes**
- **Renewables** to be given emphasis especially **BIPV**
- Designing For **Micro-climate** and **Climate Change**
- Course On **Integrated Building Design** closely tied up with Studio
- **Building Services** course to include **Energy Simulation**
- Course on **Building Automation** and **Advanced Building Systems**
- Course on **Building Diagnostics**

Research at IIIT Hyderabad

Early Design Optimisation Tool - eDOT

Variables



Set Up Screen

	Min	Max
Orientation (Dg)	0	90
Aspect Ratio	1	4
Overhang (m)	0	2
WWR (%)	10	90

Glass Type

1. Double Glazed - Blue
2. Single Glazed - Green
3. Double Glazed - Grey
4. Single Glazed - Neutral

Weather

Location: Hyderabad

Fixed Geometry and Envelop Parameters

Floor Area: 984 Sqm Number of Floors: 1

Roof Albedo: High

Shading control: No Shading Control

Lighting

Daylight control: ON

HVAC

System Type: Central Variable Air Volume

Simulate

Interactive Visualisation Screen

Orientation (Dg) 0 | 30 | 60 | 90

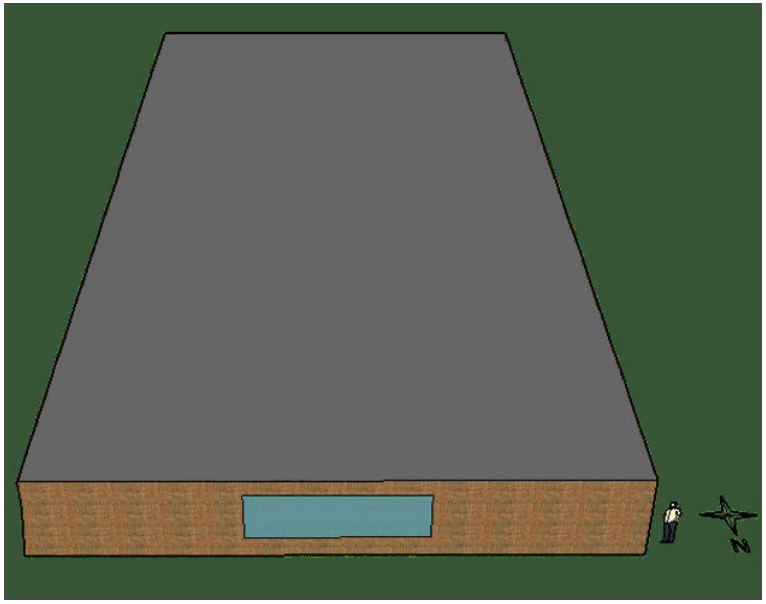
Aspect Ratio 2 | 1 | 3 | 4

Overhang(m) 0 | 0.5 | 1 | 1.5 | 2.0

WWR 10 | 30 | 50 | 70 | 90

Glass Type 1 | 2 | 3 | 4

1. **Double Glazed - Blue**
2. Single Glazed - Green
3. Double Glazed - Grey
4. Single Glazed - Neutral



Energy (KWh/sqm)

500

100

Interactive Visualisation Screen

Orientation (Dg) 30 — 0 60 90

Aspect Ratio 2 — 1 3 4

Overhang (m) 0.5 — 0 1 1.5 2.0

WWR (%) 30 — 10 50 70 90

Glass Type 2 — 1 3 4

1. Double Glazed - Blue
2. **Single Glazed - Green**
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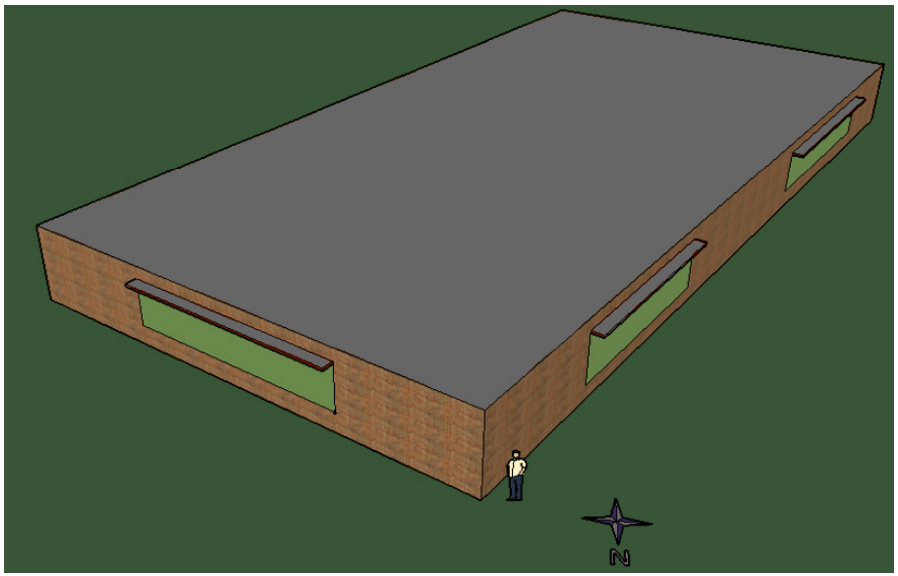
4. Single Glazed - Neutral



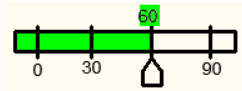
Energy (KWh/sqm)

500

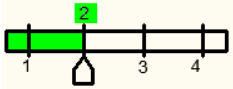
100

Interactive Visualisation Screen

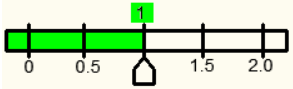
Orientation (Dg)



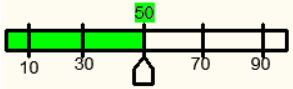
Aspect Ratio



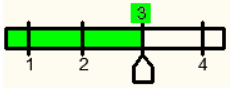
Overhang (m)



WWR (%)



Glass Type



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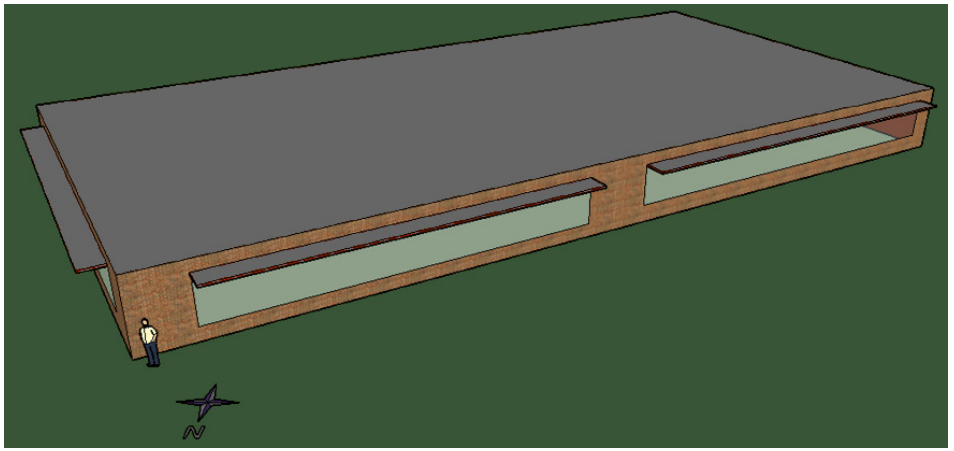
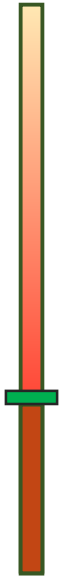
4. Single Glazed - Neutral



Energy (KWh/sqm)

500



100

Interactive Visualisation Screen

Orientation (Dg) 90 — 0 30 60

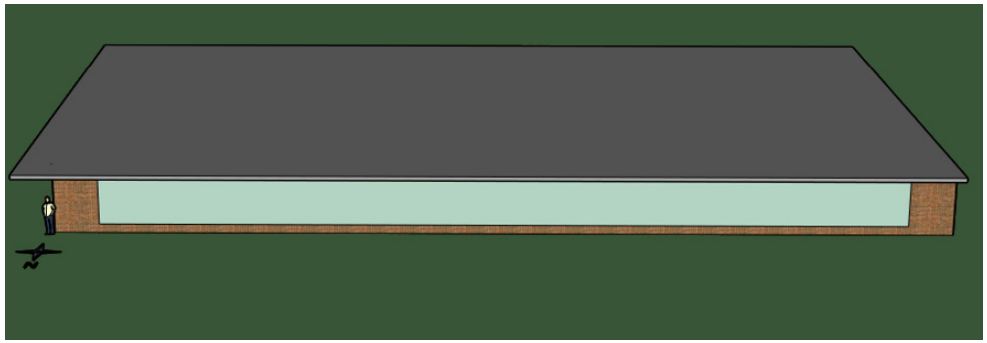
Aspect Ratio 2 — 1 3 4

Overhang (m) 1.5 — 0 0.5 1.0 2.0

WWR (%) 70 — 10 30 50 90

Glass Type 4 — 1 2 3

1. Double Glazed - Blue
2. Single Glazed - Green
3. Double Glazed - Grey
4. **Single Glazed - Neutral**



Energy (KWh/sqm)

500

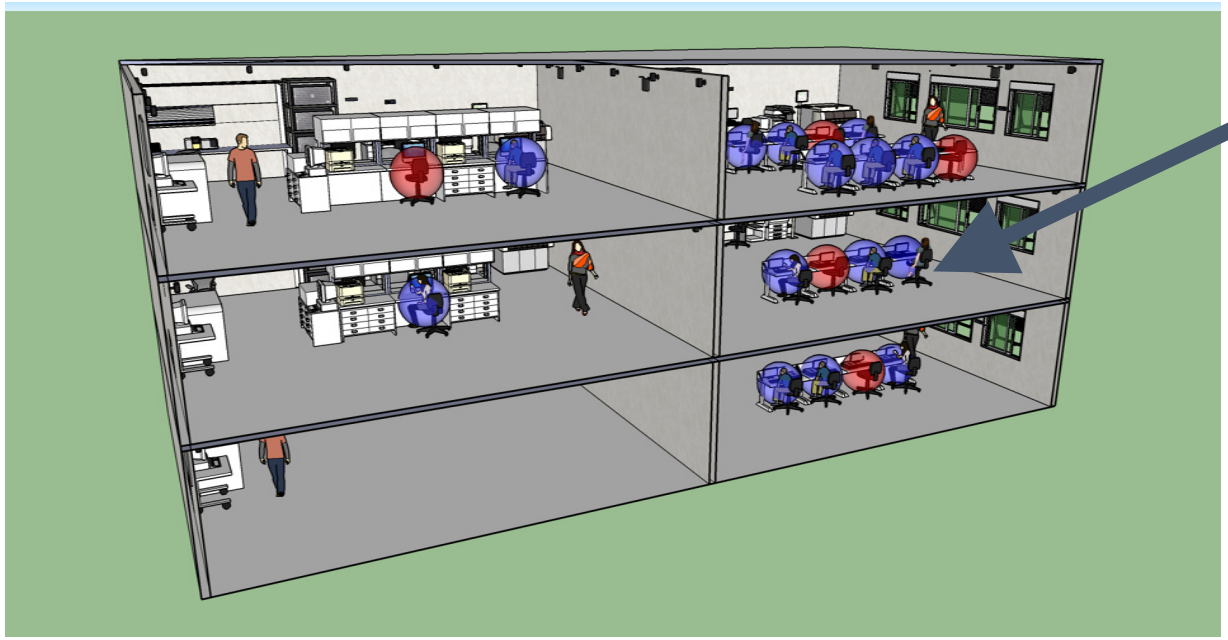
100

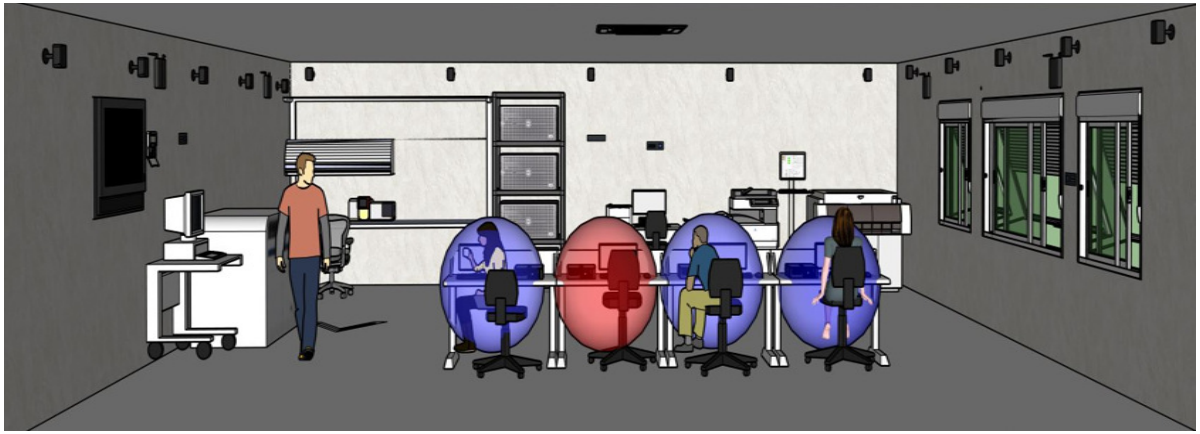
tegrated Workstation Controls Hub

Challenge

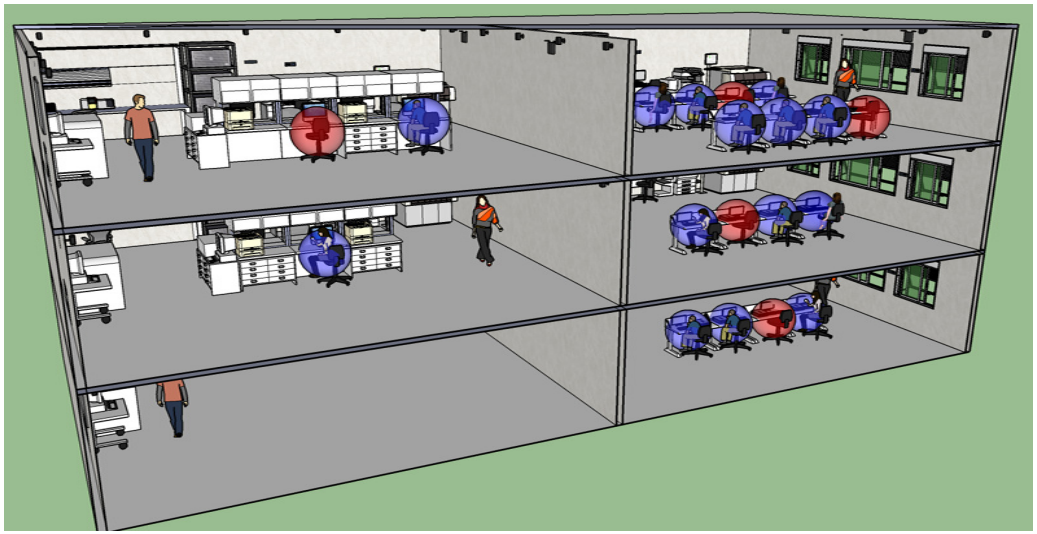
Manage power use at workstation, zone, and building level, while still giving individual occupants control.

Demonstrate that control of many workstation-level loads can noticeably reduce zone power by at least 10%



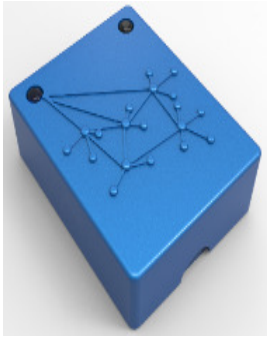


Workstation	Zone
Networked plugstrip	Shades
Personalized fan / radiant cooling/ heating	Zone HVAC
Task light	Ambient light
Battery storage	Battery



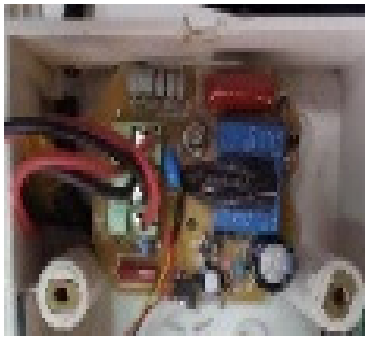
BLE smart motion sensors development

BLE Motion sensor



BLE IR Bridge

BLE Remote



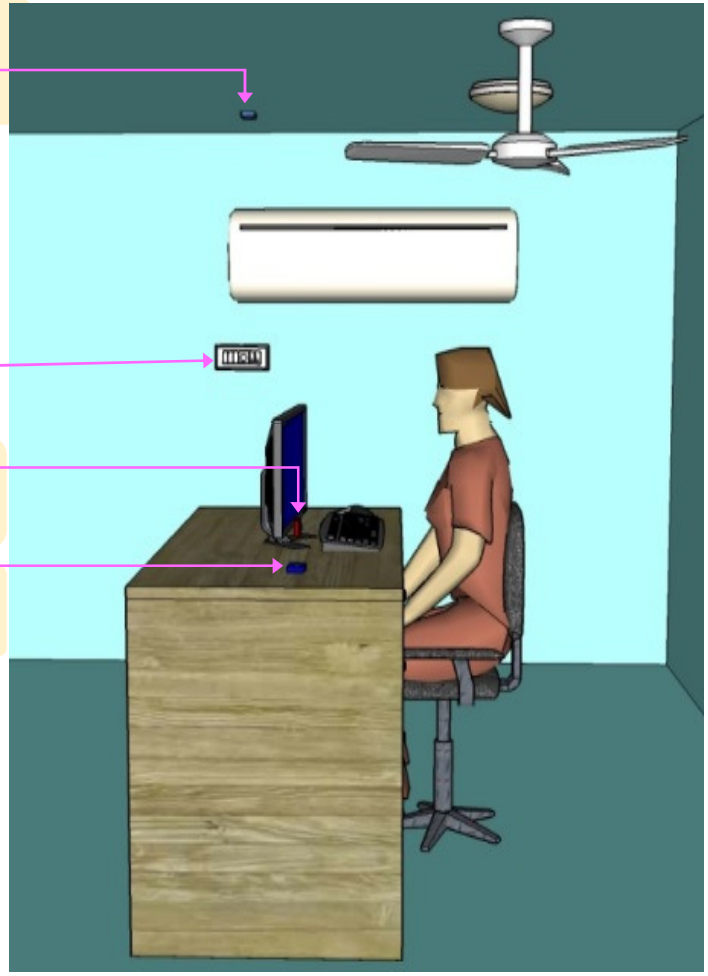
BLE Relay

BLE IR Bridge (for AC)

BLE Relay
(for lights & fans)

BLE Sensor

BLE Remote



THANK YOU

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