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# Integration of Wireless Sensor Network Technologies into Energy Efficient Building with Smart Grid

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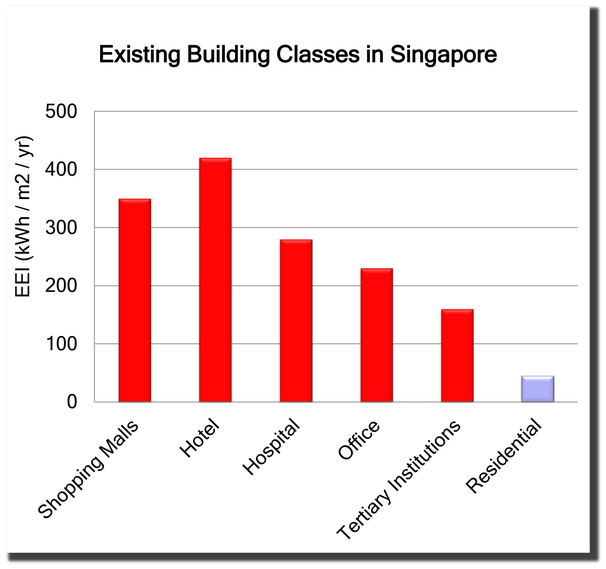
## Motivation

With the vision of sustainable development, IMCSD has set the target of greening at least 80% of Singapore's buildings by 2030.

BCA's 2nd Green Building Masterplan places a special emphasis on greening existing buildings.

In Singapore, buildings account for about 31% (with households, 49%) of total electricity consumption. Potential saving in energy bill can be enormous.




(Source: BCA 2010)

Developing techniques to increase energy efficiency in both existing buildings and new buildings by:

- Integrating with Wireless Sensor Network (WSN)
- Incorporating Smart Grid technologies

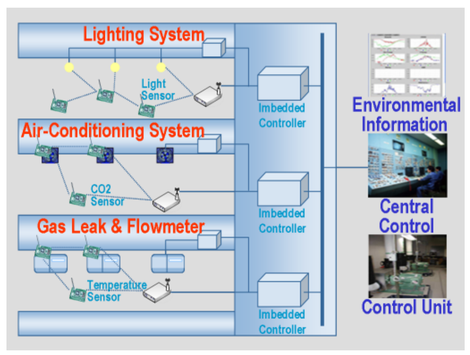
IMCSD - Inter-Ministerial Committee on Sustainable Development
BCA - Building and Construction Authority

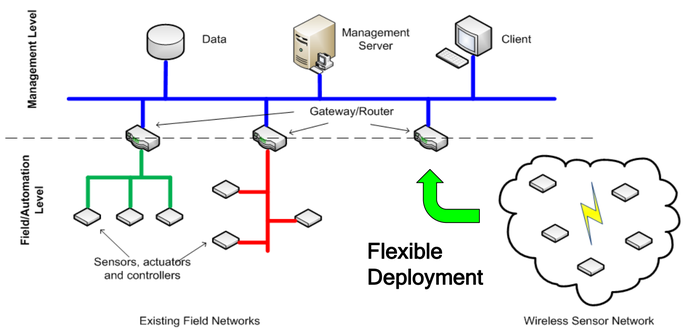
## Integration of WSN into BAS

Building Automation Systems (BASs) are used for managing and controlling electrical and mechanical systems, such as lighting, ACMV, and vertical transportation, in buildings.

Flexibility of WSN-based system makes it a promising solution to augmenting existing buildings' BASs for better sensing capability and facilitating energy-efficient building automation.

Issues of interoperability and interfacing arise when integrating WSN with existing BAS standards such as BACnet, LonWorks, and KNX.




## Design with Smart Grid Framework

Components of Smart Grid relevant to BAS:

- Distributed Energy Resources (DERs): small scale energy generation, e.g. solar panels, fuel-cells, and storage, e.g. batteries, flywheels, chilled water
- Advanced Metering Infrastructure (AMI): monitoring of energy usage at fine resolution within building and interfacing with Smart Grid
- Demand Response (DR)/ Demand Side Management (DSM): balancing power supply and demand

Femtogrid, a single-building version of Microgrid, is an autonomous, self-contained network of power generation, transmission, distribution and storage.

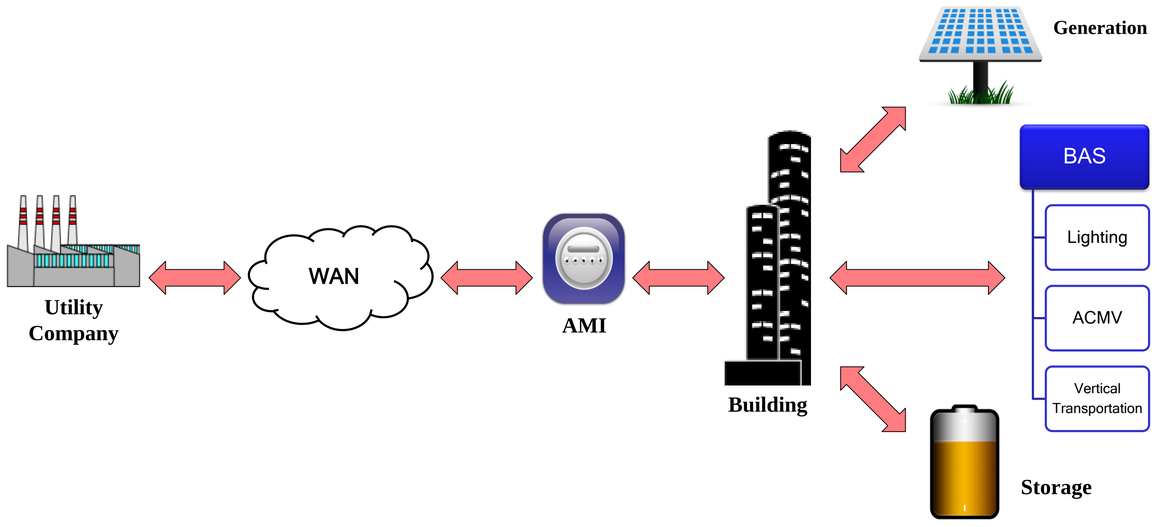
Femtogrid brings about new possibility of energy saving. Together with BAS, it allows a holistic approach in reducing energy bill from the Grid.


## Communication Technologies

Key communication technologies could consist of:

- Wireless: ZigBee, 6LoWPAN/802.15.4g, White Spaces, LED lighting based
- Wired: Power Line Communication

Cognitive radio techniques to combat harsh wireless environment.

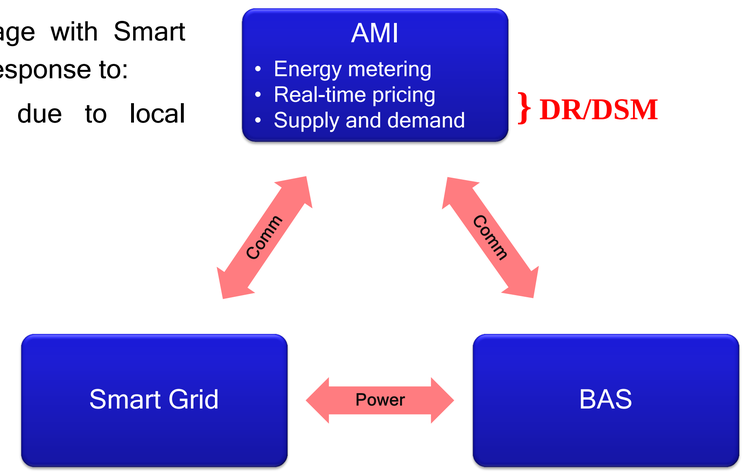



## Optimization of Energy Usage

AMI provides the main communication interface between BAS and Smart Grid. It facilitates DR/DSM, allowing temporary load reduction and load management.

Optimization of energy usage with Smart Grid – power scheduling in response to:

- Generation capacity due to local weather pattern
- Real-time pricing
- Load




## Key Features and Impacts

**Key Features:**

Integration of WSN technologies into BAS.

Incorporation of Smart Grid technologies

- Interface with BAS
- Optimization of energy usage with respect to the building classes

**Impacts:**

Efficient and flexible platform for sensing and control in both existing and new buildings.

Huge energy saving in building operation.

Grid/Electricity Monitoring