

## LARGE-SCALE IMPLEMENTATION OF ENERGY EFFICIENCY IN BUILDINGS



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The Fifth Kitakyushu Initiative Network Meeting (KIN5), 10-11 February 2010, Kitakyushu, Japan

## Policies and initiatives

### Implementing energy efficiency in buildings

- Regulatory policy instruments
  - Energy efficiency codes & guidelines for new & existing buildings
  - Energy standards & labels for building, materials & equipment
- Best practices & exemplary buildings
  - Government initiatives
  - Private sector initiatives
- Green building rating systems
  - National, regional & international initiatives
  - Promotion of low embodied-energy construction



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## Regulatory policy instruments

- National energy conservation building codes
  - On-going process in several Asian countries since early 1990's
    - Hong Kong, India, Malaysia, Philippines, Singapore, Sri Lanka, Thailand...
  - Mainly for air conditioned commercial buildings, but also for non-air conditioned spaces as well as residential buildings
  - Compliance is mostly voluntary in nature & periodical updating



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## Regulatory policy instruments

- Energy standard & label for building, materials & equipment
  - Labelling of energy efficient appliances
  - Compliance is either voluntary & mandatory
  - Minimum Energy Performance Standard (MEPS)



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## Best practices and exemplary buildings

- Low energy office building: Malaysia



- Key data
  - Gross floor area: 20 000 m<sup>2</sup>
  - Energy performance index: 114 kWh/m<sup>2</sup>/year
  - Addition cost to construct: 5%
  - Annual energy savings: RM 600 000
  - Payback period: 5 years

### Energy efficiency features

- Orientation & building envelope insulation
- Energy efficient lighting, ventilation & office appliances
- Energy management system



Ministry of Energy, Water & Telecommunications, Malaysia

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## Best practices and exemplary buildings

- Zero energy office building: Malaysia



- Key data
  - Gross floor area: 4 000 m<sup>2</sup>
  - Energy performance index: 35 kWh/m<sup>2</sup>/year (excluding solar PV)
  - Energy performance index: 0 kWh/m<sup>2</sup>/year (including solar PV)
  - Addition cost to construct: 21% (excluding solar PV)
  - Addition cost to construct: 45% (including solar PV)



Recently completed Malaysia Energy Centre

### Energy efficiency features

- Building envelope insulation & double glazing
- Almost 100% daylighting & task lighting
- Energy efficient ventilation & floor slab cooling
- Energy efficient appliances

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## Best practices and exemplary buildings



- **Government support for existing residential homes: Thailand**
  - Study the house design
  - Provide advice through expert team for improving energy efficiency
  - Extend financial support up to 30% of the actual improvement
- **Support from national energy agency (DEDE) for the construction of energy efficient new residential homes**
  - Detailed design of 3 types of individual houses of different sizes and costs based on detailed study carried out by experts
  - Construction permit given by concerned authorities in a short time

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## Best practices and exemplary buildings

- **Low-cost energy efficient housing promotion: Thailand**



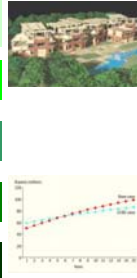
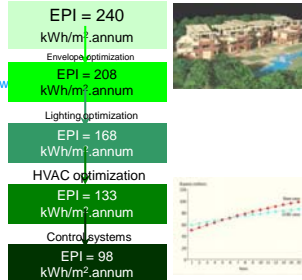
Land area: 13.00 m. x 16.00 m.; Built-up area: 84 m<sup>2</sup> Configuration: 2 bedrooms, 1 bathroom, living room, dining room, kitchen, parking for 1 car; Estimated cost (2004) 700,000 Baht

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## Best practices and exemplary buildings

- **New construction: Indian Institute of Technology, Kanpur, India**

- Energy efficiency features
  - **Building envelope**
    - Cavity wall with insulation
    - Insulated & shaded roof
    - Double glazed & shaded window
  - **Lighting system**
    - Efficient fixtures
    - Efficient lamps
    - Daylight integration
  - **HVAC system**
    - Load calculated with optimized envelope & lighting system
    - Efficient chillers
    - Efficient condensing system
    - Use of geothermal cooling



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## Energy efficiency retrofit in buildings

- **Retrofitting/rehabilitation of government buildings: India**

- Energy audits conducted in important government buildings
  - President's Office & Residence Complex
  - Prime Minister's Office
  - Government Offices (Power, Railways, Telecommunications, Transport)
  - Medical Institute & Hospital Building
  - Airport Terminals
- Assessed energy savings potential
  - Varying between **25 and 46%**
  - Payback period: **1 to 4 years**
- Implementation of recommendations
  - Through Energy Service Companies (ESCOs)



President's Office & Residence Complex

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## Energy efficiency retrofit in buildings

- **Case study: French initiative in China**

- **General objective**
  - Reduce GHG emissions by improving **energy efficiency & environmental quality** in the construction sector
- **Specific objectives**
  - Carry out energy efficient & environmentally sound **exemplary operations**
  - Ensure **dissemination** at the provincial & national level
    - **Policies & regulations**
    - **Methodologies & tools**
  - Transfer **know-how & products/technologies** adapted to the Chinese market

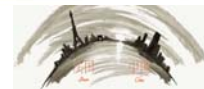


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## Energy efficiency retrofit in buildings

- **Case study: French initiative in China**


- **Activities and partners**
  - **Activities prior to dissemination**
    - **Promoters, construction & industrial committees**
  - **Support to technical & industrial partners**
    - **Training centers, universities, enterprises & manufacturers**
  - **Assistance to develop standards, regulations & training**
    - **Committees, Ministry of Construction, Technical Centers, World Bank**
  - **Communication at the local & national levels**
    - **Ministries, committees, promoters, enterprises & manufacturers**
  - **Evaluation**
    - **Ministry, FFEM (French Global Environment Facility)**



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### Energy efficiency retrofit in buildings

- Case study: French initiative in China
  - 4 Operations, 3 climatic zones
    - Harbin / Heihe
      - Rehabilitation of 6 buildings (20 500 m<sup>2</sup>)
      - Construction of 20 rural houses
      - 50% heating energy savings (65% in 2 buildings)
    - Beijing
      - Construction of 240 000 m<sup>2</sup> of residential & commercial buildings
      - 65% & 75% energy savings for commercial & residential buildings, respectively
    - Shanghai
      - Construction of 61 000 m<sup>2</sup> of residential & commercial buildings
      - 65% heating & cooling energy savings



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### Energy efficiency retrofit in buildings

- Case study: French initiative in China
  - Rehabilitation of apartments in Heilongjiang
    - Products targeted
      - Insulating external façade at low cost
      - Water resisting products for terrace roof
      - Insulating products for terrace roof
      - Plastic joinery with double glazing
      - "Assisted" natural ventilation systems
      - Radiator plumbing
      - Heating substation control/programmer
      - Circulating pumps
      - Three-way motorized valves
      - Heat meters
      - Insulating products for piping
    - Industrial stakes
      - Existing building stocks in cold climatic zones:
      - 50 million m<sup>2</sup> of existing accommodations to be rehabilitated in Harbin during the next decade



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### Energy efficiency retrofit in buildings

- Case study: French initiative in China
  - Construction of new housing - Sun Star City (Beijing)
    - Products targeted
      - Process of insulating external façade
      - Water-resisting products for roof terraces
      - Products for insulating roof terraces
      - Efficient joinery & glazing
      - Mobile blinds for solar protection
      - "Assisted" natural ventilation systems
      - Mechanical ventilation systems
      - Radiator plumbing
      - Automatic heating substations
      - Efficient gas fired boilers
      - Controllers/programmers
      - Heat meters
      - Insulating products for piping
      - Central air conditioning systems
      - Efficient system for lighting management
      - Water saving systems
      - Integrated system for rainwater harvesting
    - Industrial stakes
      - About 8 million m<sup>2</sup> of new construction per year in Beijing




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### Energy efficiency retrofit in buildings

- Case study: French initiative in China
  - Construction of new housing - Pi Lin Wan (Shanghai)
    - Products targeted
      - Process of insulating external façade
      - Water-resisting products for roof terraces
      - Products for insulating roof terraces
      - Efficient joinery & glazing
      - Mobile blinds for solar protection
      - "Assisted" natural ventilation systems
      - Mechanical ventilation systems
      - Efficient reversible air conditioners (COP > 2.3 in cooling)
      - Central air conditioning systems
      - Efficient system for lighting management
      - Water saving systems
      - Integrated system for rainwater harvesting
    - Industrial stakes
      - About 15 million m<sup>2</sup> of new construction per year in Shanghai
      - 85% of households already own air conditioners




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### Energy efficiency retrofit in buildings

- Case study: French initiative in China
  - Assistance to China
    - Support to local & national authorities
      - Improvement of norms & regulations
      - Defining a new pricing for heating & financing of rehabilitation
      - Certification of products & labeling of buildings
      - Methodology for environment management
      - Training in China & France
    - Assistance for industrial partnerships
      - Presentation of suitably adapted products to the promoters
      - Preparation of guides for using new products
      - Technical training sessions
      - Market analysis for energy efficiency & environment quality in buildings
      - Analysis of new financing mechanisms



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### Best practice and exemplary buildings

- Private sector initiative in India
  - T-ZED Homes (Bangalore)
    - 91 homes- 76 apartments, 15 independent homes on 5 Acres Residential campus
    - Swimming pool, Library, Eco-mart, Amphitheatre, Kids play area, Squash court and Gym






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### Best practice and exemplary buildings

- Private sector initiative in India: T-ZED Homes
  - Total no of homes based on the carrying capacity of the land
  - East-West orientation
  - Non ODS based centralized air-conditioning
  - Home automation system
  - Urban farming

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### Best practice and exemplary buildings

- Private sector initiative in India: T-ZED Homes

#### Comparative Energy Consumption in Basement retaining walls

Material	Energy Consumption (GJ)
Dry stone masonry	1563
RCC Wall	26507

Energy saved = 24 944 GJ

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### Best practice and exemplary buildings

- Private sector initiative in India: T-ZED Homes

#### Comparative Energy Consumption in External Walls

Material	Energy Consumption (GJ)
SSB + Laterite	3641
Concrete Block	6437

Energy saved = 2 796 GJ

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### Best practice and exemplary buildings

- Private sector initiative in India: T-ZED Homes

#### Comparative Energy Consumption in Internal Walls

Material	Energy Consumption (GJ)
Concrete Block 10 cm	5512
Fired Brick	38212

Energy saved = 32 700 GJ

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### Best practice and exemplary buildings

- Private sector initiative in India: T-ZED Homes

#### Comparative Energy Consumption in Internal Flooring

Material	Energy Consumption (GJ)
Wooden + Natural Stone Flooring	3163
Vitrified Tiles	5252

Energy saved = 2 090 GJ

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### Best practice and exemplary buildings

- Private sector initiative in India: T-ZED Homes

#### Comparative Energy Consumption in Swimming Pool structure

Material	Energy Consumption (GJ)
SSM Wall with Raft	1010
RCC Structure	3629

Energy saved = 2 619 GJ

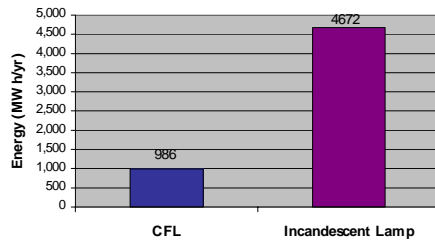
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## Best practice and exemplary buildings

### Private sector initiative in India: T-ZED Homes

Comparative Energy consumption by Home Lighting



Energy saved = 3 687 MWh/Yr

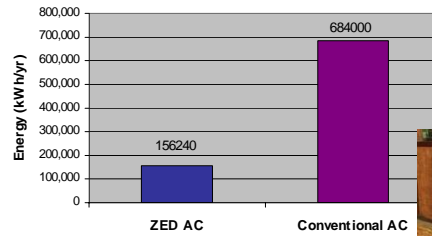


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## Best practice and exemplary buildings

### Private sector initiative in India: T-ZED Homes

Comparative Energy Consumption by AC



Energy saved = 527 760 kWh/yr



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## Best practice and exemplary buildings

### Private sector initiative in India: T-ZED Homes

#### Z-AC (air conditioning)

- 100% Fresh air based
- Better IAQ due to more efficient filter
- Non ODS centralized chillers; Ammonia based chiller plant that works on the principle of heat exchange
- Thermal storage tank which feeds the plant when optimum temperature is reached.
- Cooling towers aid in ventilation during cooler months.

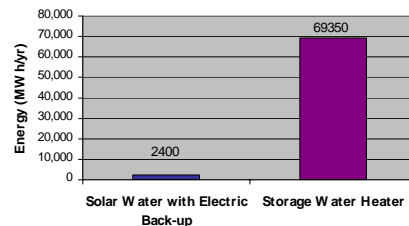


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## Best practice and exemplary buildings

### Private sector initiative in India: T-ZED Homes

Comparative Energy Consumption in Water Heating



Energy Saving 66 950 MWh



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## Best practice and exemplary buildings

### Private sector initiative in India: T-ZED Homes

#### Water supply

- T-ZED campus daily water requirement is 70,000 liters against the regular apartment need of 180,000 liters\*
- 100% waste water is recycled, reducing fresh water need by 60%, or only about 7 million liters/annum
- 3/7<sup>th</sup> of the water need met by rainwater harvesting (3 million liters/annum)



\* Energy consumption to supply water from city Municipal mains is 1kWh per 1000 liters

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## Green building rating systems

### Impacts of integrated, whole building design practices

- Cost effectiveness & resource conservation
- State-of-the-art strategy for sustainable site development, water savings, energy efficiency, materials selection & indoor environmental quality
- Increased first costs recovered within reasonable time period
- Boost in employee productivity & occupants' health, safety & well-being
- Increased property value & high value for tenants
- Goodwill & publicity in the community
- Benefit to the communities - reduced need for resources & lower waste disposal costs - contributing to local economic development

#### Several green building rating / certification initiatives

- Green Building Challenge (Canada), HQE (France), GRIHA (India), LEED (USA), ...
- Green Globe for hotels & resorts

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## Green building rating systems

### ■ LEED certified platinum buildings: India



ITC's Platinum rated office building



WIPRO's platinum rated development centre



CII's platinum rated Green Building Centre

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## Low embodied-energy construction

### ■ Initiatives of Auroville Earth Institute, India



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## Large scale implementation of Energy efficiency in buildings

**Thank you for your attention**



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