CONCEPTUAL FRAMEWORK & BENEFITS OF ENERGY EFFICIENCY IN BUILDINGS

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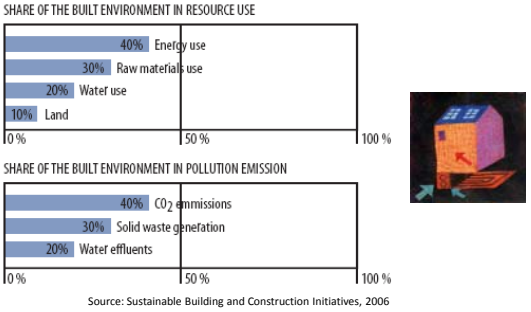
Building, resources and the environment

- **Buildings are highly resource intensive**
  - Raw materials, energy, water
  - Greater demand for resources due to affluence and life style changes
- **30-40% of world's primary energy is used in buildings**
  - Construction
  - Operation & maintenance
- **High growth in demand for new construction**
  - Greenfield projects (ex. Additional 30 billion m² in China by 2020)
  - Demolition of low-rise zones to create high-rise buildings
- **Adverse impacts of buildings on the environment**
  - Contributing to greenhouse gas emissions
  - Depletion of resources & increase in waste generation

Building, resources and the environment



Source: Sustainable Building and Construction Initiatives, 2006

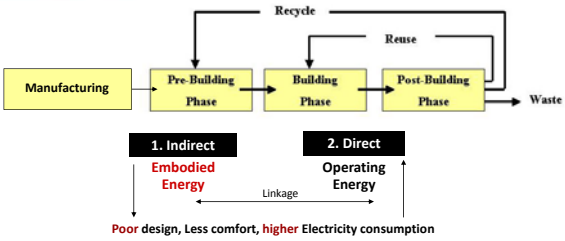
Energy and buildings

Pre-construction	Construction	Operation	Demolition

50-100 years lifetime!

- **During building construction & renovation** (Embodied energy in the building materials, Energy needed during construction & renovation process)
- **During building operation over its life span** (Energy to achieve thermal and lighting comfort, Energy needed for various types of appliances)

Embodied versus operating energy



Poor design, Less comfort, higher Electricity consumption

- Sand to prepare concrete for every million m² of construction kills 100 km² of river beds
- Over 50% building blocks made up of bricks that use valuable top soil and are fired in inefficient kilns

By combining different techniques, small increases in embodied energy can greatly decrease operating and total energy use

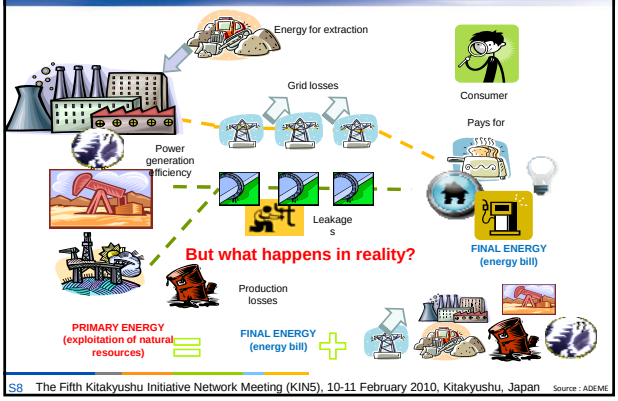
Cost-effective concepts, technologies & products

- **Market is ripe with cost effective concepts, technologies & products**
  - To reduce the need for energy services
    - Optimized design
      - Site planning, shape, orientation, fenestration & shading, natural ventilation, passive cooling, etc.
    - Better implementation
      - Choice of material & technology, optimized insulation of walls & roofs, high performance glazing, artificial lighting & cooling solutions
  - To satisfy the needs with more efficient solutions
    - Improved end-use energy efficiency
      - Better artificial lighting & control
      - Better artificial cooling & control
      - Provision of energy services through alternative means & strategies

Designing sustainable building

- **Overcoming the general perception of sustainable building being more expensive**
  - More emphasis on adopting the right building science and less dependence on high-cost building technologies
  - A better scientific understanding of the way buildings work and avoiding high technological sophistication
- **The main challenge: To do more with less**

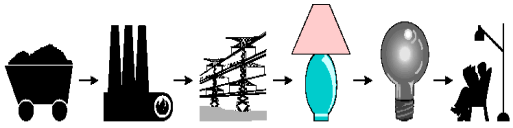
Story of consumption & production



Source : ADEME

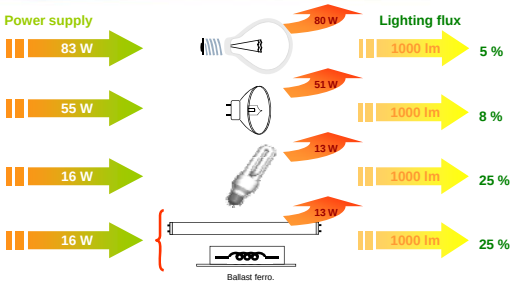
Energy supply to service provision
Example of lighting

Lighting consumes about 19% of the world electricity production (Source: IEA)



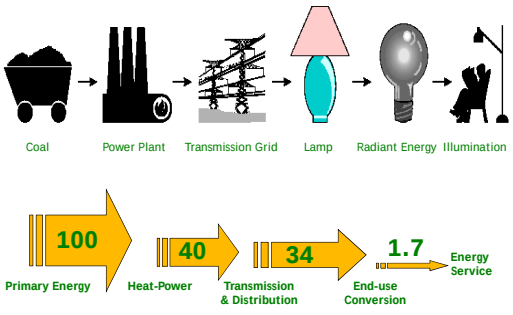
Thermal power plant conversion efficiency	**?**	**40%**
Transmission and distribution losses	**?**	**15%**
Incandescent lamp conversion efficiency	**?**	**5%**

Technological evolution in the past decade
Example of lighting



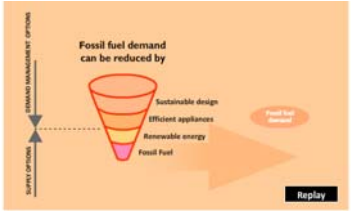
In 1931, Thomas Edison told his friends Henry Ford and Harvey Firestone: "I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that."

Energy supply to service provision
Example of lighting



Roadmap to achieve low carbon green growth

- **Ideal strategy:**
  - → **Demand-side management followed by supply-side options**



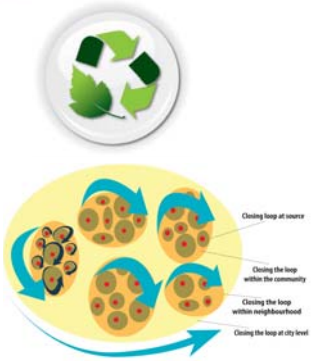
- By 2030, global cost of lighting could be reduced by US$2.6 trillion, resulting in savings of 16 billion tons of CO_2 (Source: IEA)

Story of consumption & lack of systemic thinking

- **Analysis of energy systems to highlight** losses, hidden costs and multiplying costs **that balloon impact of energy use.**
- **Reflection on another aspect—urban consumerism.**
- **Importance of energy efficiency and need for** change in consumerism
- **Impact due of** lack of systemic thinking**, partiality to mega projects and other slips in effective policy making**
  - → Supply of energy and water
  - → Infrastructure for mobility
  - → Disposal of solid waste

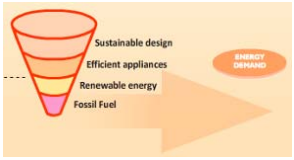
Strategy-based solutions

- **Fundamental to everything is that need is initiated by an** individual
- **Concept of working with** closed loops**, starting at individual level, moving onto** neighborhood and community levels **instead of linear functioning of energy systems**
- **Energy savings within** built environment



Designing sustainable building

- **Overall objective: Lower energy consumption and life-cycle costs**
  - Start with building fabrics to lower energy demand (life span: 50-100 years)
  - Then look for devices to generate energy from renewables (life span: 10-20 years)
- **More capital needed for oversized renewable energy systems for a poorly designed building**



Buildings that are less dependent on energy and water
Designing strategy

- **From high energy consuming buildings to zero-energy or energy-positive buildings**
  - → Objective: Reduce pressure on local grid, avoid investment in new power plants, limit environmental emissions
  - → Strategy: Design buildings to suit the local climate, adopt low-energy service solutions, exploit on- & off-site natural and renewable energies
- **From high water consuming buildings to low-water or water-neutral buildings**
  - → Objective: Reduce pressure on centralized water supply systems, avoid investment in new water supply and sewage networks, limit environmental emissions
  - → Strategy: Design buildings with low-water consuming options and technologies, cut water needs by treating less-contaminated water for other uses, harvest rainwater and exploit ground water sustainably

Role of public authorities
Strategic objectives to promote eco-efficient buildings

- **Public authorities have major influence in promoting resource-efficient and environment-friendly buildings**
  - Own and occupy vast amount of space
  - Can lead the way and set good example for citizens and private developers
- **A strategy based on large-scale operation**
  - **Regulations**
    - Energy regulations for new & existing (rehabilitated) buildings
    - Regular inspection of boilers & air conditioning equipment
  - **Incentives**
    - Tax incentives
    - Bank subsidized loans
    - New financial tools
    - Energy efficiency certificates

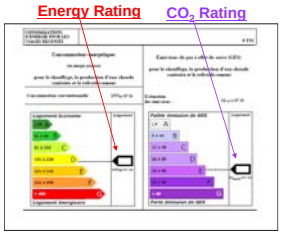
Role of public authorities
Strategic objectives to promote eco-efficient buildings

- **A strategy based on large-scale operation**
  - **Certification & Quality Labels**
    - High Energy & Very High Energy Performance certification
    - High Environmental Quality certification
  - **Awareness raising, training & education**
    - Energy Info Centres
    - Training of building professionals
  - **Research & development, innovation**
    - Design of carbon-neutral buildings
    - Advanced insulation & glazing, & high efficiency appliances
    - Advanced technologies to harness renewable energy
    - Techniques for storage, recovery, heat & cold management

Role of public authorities

Strategic objectives to promote eco-efficient buildings

- **Reduce the energy use of existing buildings**
  - Thermal insulation of opaque & glazed areas
  - High efficiency appliances & use of renewables
  - Energy legislation for rehabilitated buildings
  - Energy performance certificate for buildings



- **Construct highly efficient buildings**
  - Revise legislation every 5 years
  - Use efficient & innovative techniques
  - Achieve passive energy gains & integrate renewables

Eco-efficiency in buildings

Thank you for your attention