



# Energy Efficiency

Understanding Energy Efficiency Practices in Cambodia

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# Bibliography

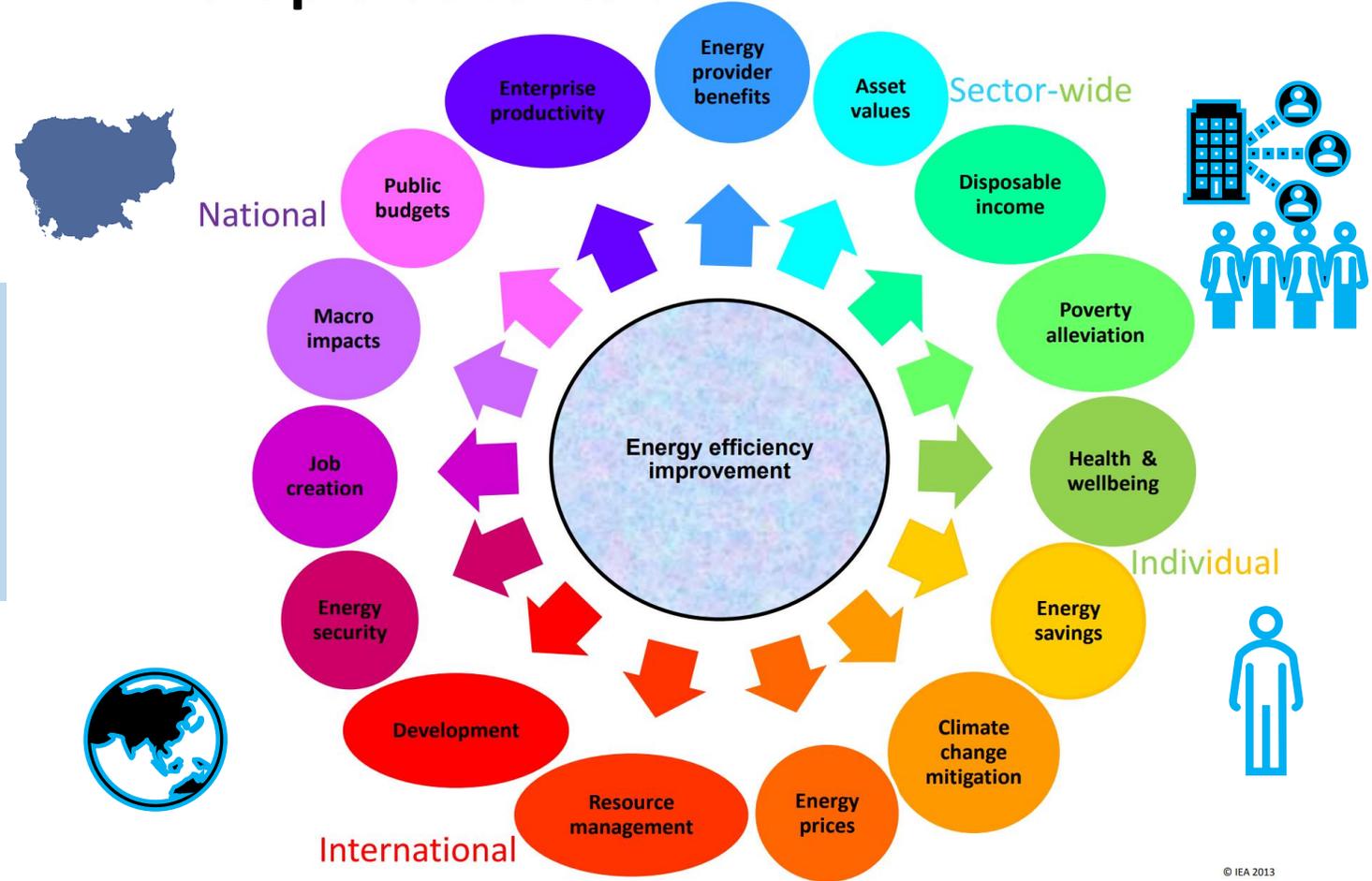


- 2017-present: Head of Energy Technology and Management Research Unit (ETM), Research and Innovation Center (RIC), ITC
- 2010-present: Lecturer and researcher, Industrial and Mechanical Engineering department, ITC
- 2019: Certified Energy Auditor and Manager Trainer
- 2013: Project researcher, Haruki Sato Lab, Keio University, Japan
- Energy audit experiences:
  - Hospital, commercial building, government building, garment factory.

# What and Why Energy Efficiency

**Energy Efficiency** simply means using less energy to perform the same task – that is, eliminating energy waste.

## Multiple benefits of EE

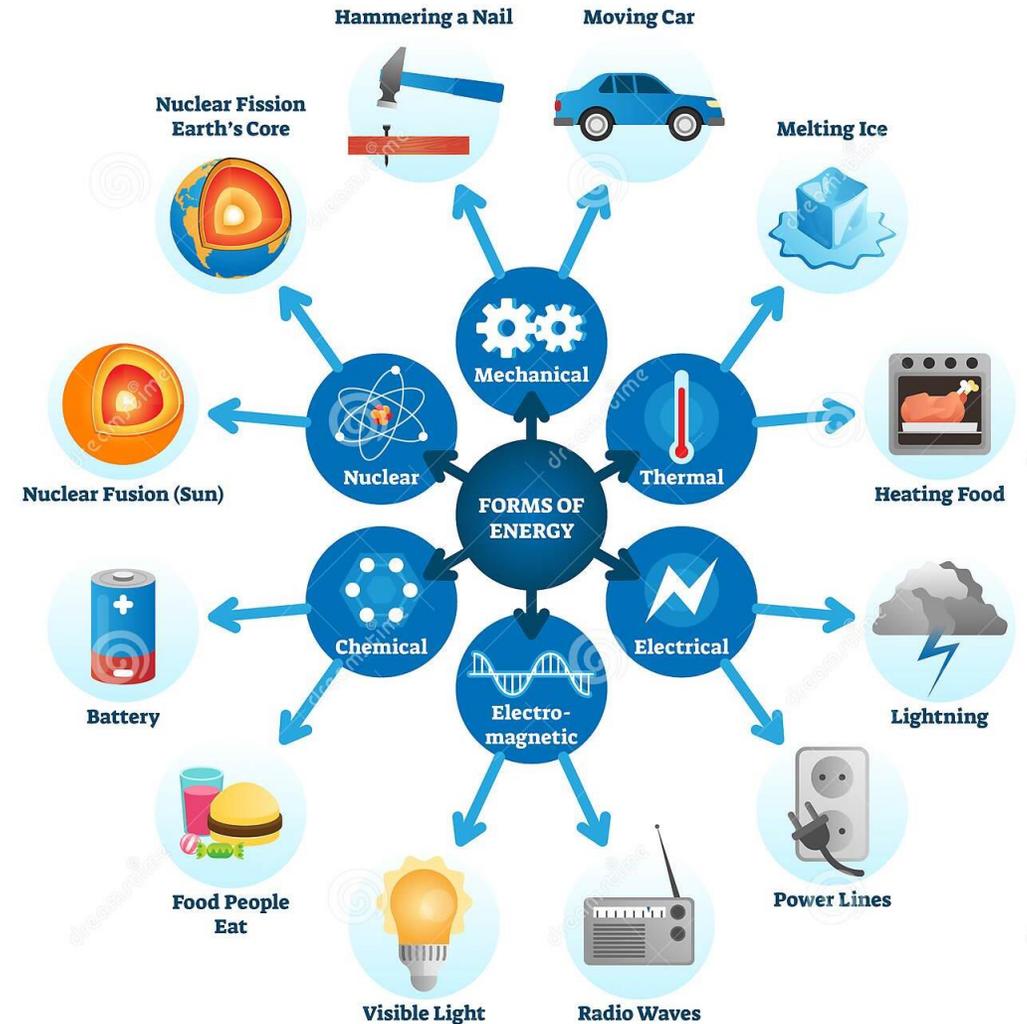


Benefits of EE (IEA, 2013)

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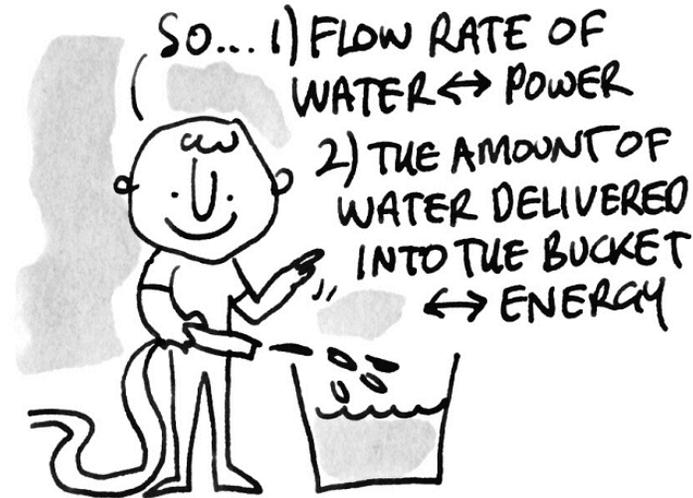
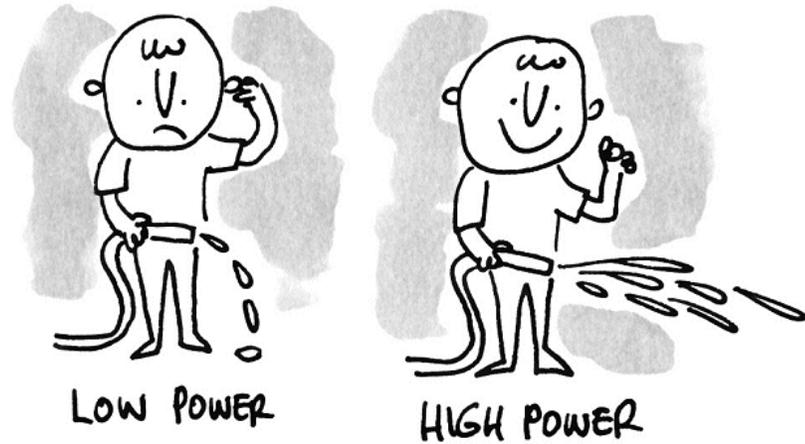
# Forms of Energy

- Energy:
  - Kinetic Energy: energy of movement
  - Potential Energy: stored energy



| Energy Equivalents    |                       |
|-----------------------|-----------------------|
| 1000 joules (J)       | 1 kilojoule (kJ)      |
| 1 kilowatt-hour (kWh) | 3,600,000 J or 3.6 MJ |

# Power and Energy



<https://www.solarquotes.com.au/good-solar-guide/power-energy-difference/>

- Power: How Fast (Demand)

- Energy: How Much (Consumption)

$$\text{Energy} = \text{Power} \times \text{Time (Units are Wh or kWh)}$$

# What is Efficiency?

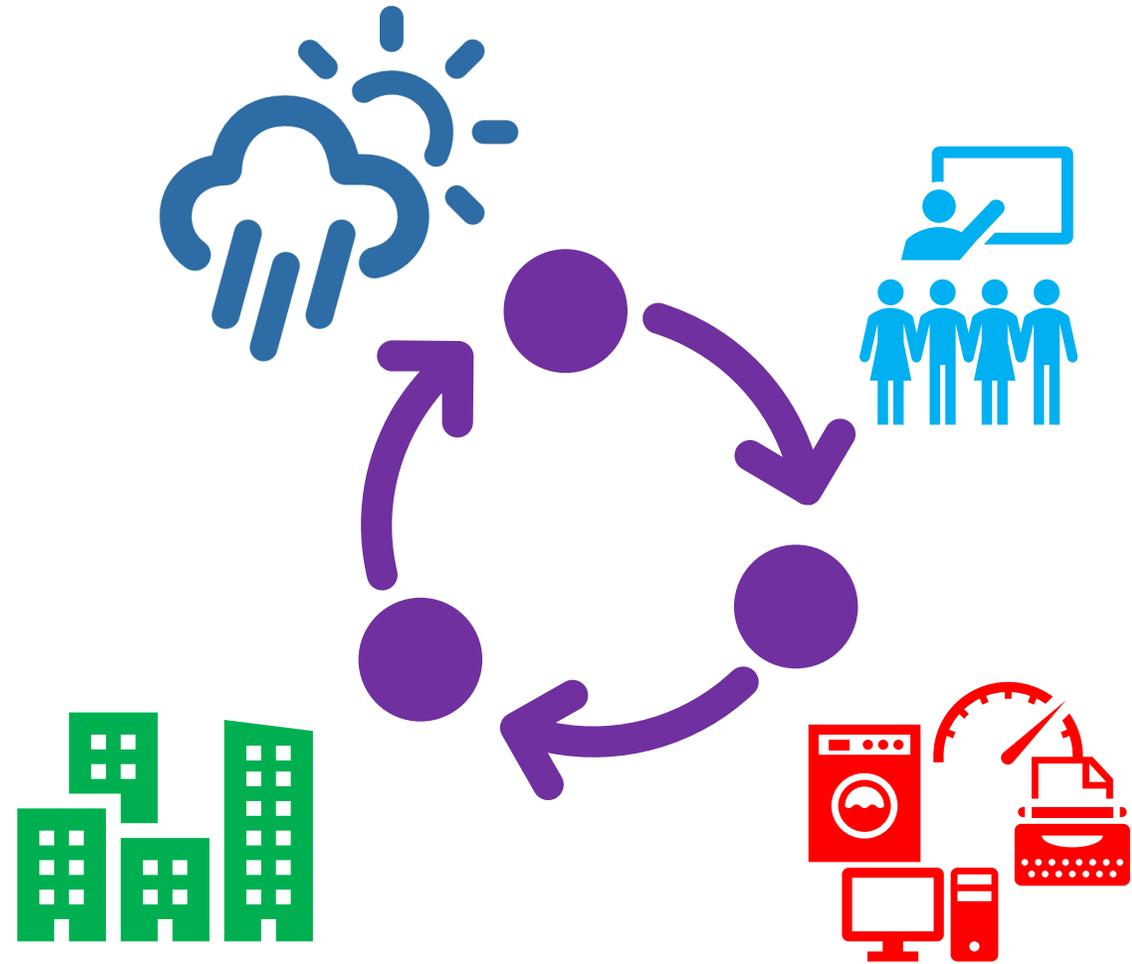
$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} \times 100\%$$

| Device          | Efficiency | Input       | Output     |
|-----------------|------------|-------------|------------|
| Electric Heater | 100%       | Electricity | Heat       |
| LED Lamp        | 30% - 40%  | Electricity | Light      |
| Motors          | 50 – 95%   | Electricity | Mechanical |
| Pumps/ Fan      | 20 – 60%   | Electricity | Flow       |
| Air Compressor  | 5 – 15%    | Electricity | Air        |

# Energy use drivers

- Climate
- Facility size and age
- Schedules
- Equipment type
- Building design
- Processes
- Organizational culture
- Behavior

Source: DME Building EA Course



# Energy Efficiency Standards and Labeling

- Three main types of EE Standards

- Minimum Energy Performance Standards (MEPS)
- High Energy Performance Standards (HEPS)
- Class Average Standards

- Two main types of EE Labels

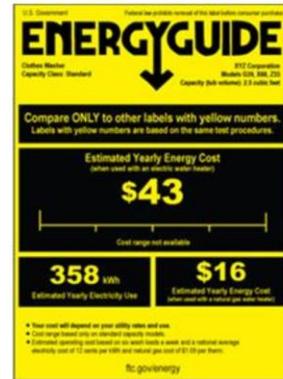
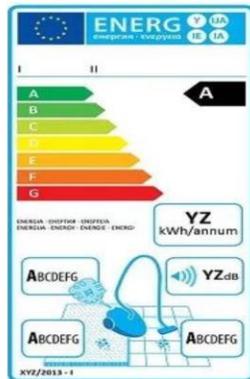
- Comparative Labels: EU Energy Label, US EnergyGuide, Thai Energy Label
- Endorsement Labels: US Energy Star, Korean High-efficiency Certification

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Ministry of Mines and Energy

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# Lighting EE opportunities

- **Low cost**

- Better switching- zoning, more switches and levels
- Occupancy sensors and timers
- Reduce overall level and use task lights



- **High cost**

- Upgrade to more efficient fixture
- Use a more effective fixture layout
- Use a more efficient light source



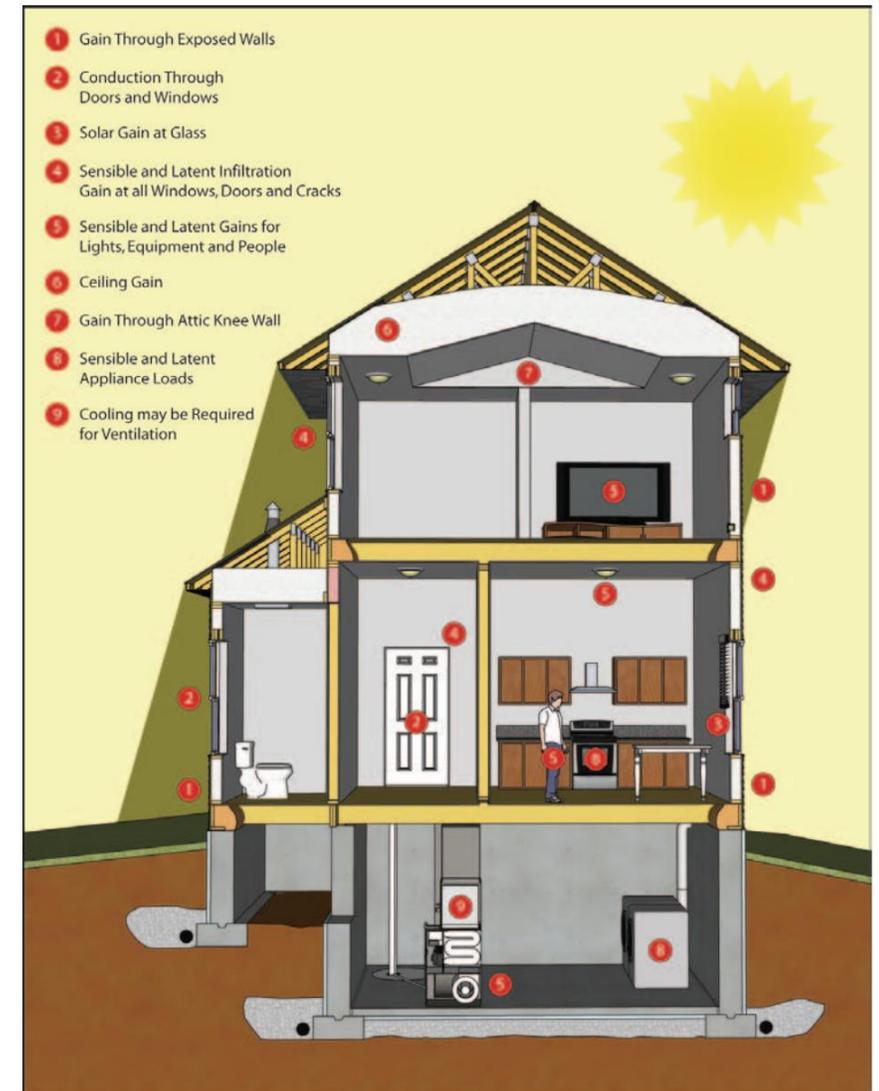
Source: DME Building EA Course

Images source:  
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# Reduce cooling Energy

- Maintain the indoor temperature as high as possible
- Use insulation to reduce heat gain
- Use energy efficient or low-E glass for windows
- Reorganize activities inside the building to reduce gain. The corridors should be located along the north face and the conditioned spaces along the south face
- Don't cool unoccupied area

Source: DME Building EA Course



Source: US Department of Energy

# EE Opportunities in Cooling System

- **Reduce heat loss/gain by:**
  - Conduction –add insulation
  - Convection – minimize air infiltration
  - And radiation – replace or improve windows, use shading
- **Strategy:**
  - Eliminate waste – ensure building need is exactly met by the energy system
  - Maximize efficiency – select best technology, improve operational and maintenance practices
  - Optimize energy supply- select most economical energy source, utilize waste heat

Source: DME Building EA Course

# Thank you.

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