CLIMATE CHANGE SEMINAR
MITIGATION - ENERGY SECTOR

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What I plan to discuss ... 

- Why energy sector is targeted when we discuss global warming/climate change?
- How the energy sector can help reduce the impact of climate change?
- What we have been doing at AIT?
- Discussion
Only about 0.2% of Earth's total carbon - about 48,500 billion tonnes - is judged to be above the planet's surface, in: **Atmosphere - 750 GtC**; Ocean - 40,000 GtC; Biosphere - 610 GtC; Soil -1,600 GtC; and **Fossils – 5,000 GtC.**

About two-thirds of the total are contained within the core.
Carbon + oxygen to give Carbon-di-oxide

Hydrogen + oxygen to give Water

These conversions produce
Heat → industries, buildings, electricity, transportation
Electricity → the most versatile energy carrier

HEAT
Fossil fuels contribute to about 75%, while renewables contribute about 15%.

World primary energy consumption grew by 2.2% in 2017, up from 1.2% in 2016 and the highest since 2013.

BP, 2018
Energy is the major contributor. Hence, the interest.

Source: Emissions Gap Report, 2019
THE MAJOR EMITTERS

Source: Emissions Gap Report, 2019

We can debate...
WHERE WE ARE, AND WHAT IS THE TARGET?

The future does not look bright, unless ..

Source: Emissions Gap Report, 2019
RESULTS OF CARBON EMISSION

Atmospheric CO₂ at Mauna Loa Observatory

Scripps Institution of Oceanography
NOAA Earth System Research Laboratory

Note: We have only one planet

Global average temperature 1850-2015

data: HadCRUT4, courtesy of UK Met Office
SOME HAPPENINGS IN THE ANTARCTIC

Change in height of ice
1992 - 2017 (metres)

Amundsen Sea

Thwaites Glacier

Source: Tom Slater, CPOM
SOME HAPPENINGS IN THE ANTARTIC

But, this is not new ..
A GREAT deal has been written on the influence of the absorption of the atmosphere upon the climate. Tyndall in particular has pointed out the enormous importance of this question. To him it was chiefly the diurnal and annual variations of the temperature that were lessened by this circumstance. Another side of the question, that has long attracted the attention of physicists, is this: Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere? Fourier maintained that the atmosphere acts like the glass of a hot-house, because it lets through the light rays of the sun but retains the dark rays from the ground. This idea was elaborated by Pouillet; and Langley was by some of his researches led to the view, that the temperature of the earth under direct sunshine, even though our atmosphere were present as now, would probably fall to $-200^\circ$ C., if that atmosphere did not possess the quality of selective absorption.

Source:
https://www.tandfonline.com/doi/abs/10.1080/14786449608620846
How much is AIT’s CO2 emissions due to its electricity use?

Choice:

(a) 800,000 kg per month (10,000 tons per year)
(b) 550,000 kg per month (7,000 tons per year)
(c) 370,000 kg per month (4,500 tons per year)
(d) 14,000 kg per month (200 tons per year)
(e) 120,000 kg per month (2,500 tons per year)
CONSIDER (Y)OUR DAILY ACTIVITIES

6 am

• Water for personal use – needs to be pumped, (electrical)
• Food – to be cooked (thermal energy) or stored in refrigerator (electrical)
• Travel – by vehicles – oil/gas (thermal) or (electrical)
• Lighting – lamps (electrical)
• Comfort – air conditioning (electrical)
• Work – computers (electrical)
• Entertainment – travel or music (thermal or electrical)
• Sleep - air conditioning or fan (electrical)

10 pm
Energy services include lighting, cooking, heating and cooling, water pumping, refrigeration, transportation and communication.

The energy resource could be from both conventional, fossil fuel-based energy systems and those fueled by renewable sources of energy.

So, what are these resources?
GHG MITIGATION OPTIONS

• Approaches:
  • Prevent
    • Reduce energy demand
  • Cure
    • Efficient use of energy resources/technologies
    • Use (increased) of renewable resources
    • Fuel switching
    • Carbon removal

• Future
  • Technologies Innovate and Adapt
  • Behaviour
  • ICT use

• How to go about?
  • Policies to favour renewables, energy efficiency
  • Prices (subsidies and taxes)
  • Technology improvements (RD and D)
  • Institutions and capacity; awareness
REDUCE ENERGY DEMAND/USE

• Don’t use when it is not necessary
  • Switch off
  • Keep envelope (building) closed when using air conditioners
  • Use bicycle for shorter distances

• Share, whenever possible
  • Car sharing
  • Public transport
  • Individual vs Community

• Design considering environment (local)
  • Using passive (or less active) systems
  • Glass buildings and overhangs
  • Material and fabrication methods
The lighting energy system is grossly inefficient, and so there is huge scope for improving energy efficiency.

(Input) Coal energy = 329 W/lamp
(Output) useful energy (light) = 10 W/lamp

Source: Mohanty, 2017
ENERGY EFFICIENCY: CASE OF LIGHTING

From incandescent lamp to Compact Fluorescent lamp

- Coal energy = 83 W/lamp

75% less energy by switching from incandescent to CFL

From Compact Fluorescent lamp to LED lamp

- Coal energy = 48 W/lamp

90% less energy by adopting LED

Source: Mohanty, 2017
Switch from fossil to renewable alternative

Solar PV energy = 18 W/lamp

Further loss reduction by adopting Solar-PV energized LED

Source: Mohanty, 2017
To transport a 70 - 200 kg object(s) we use a 1400 kg device...

Source: Mohanty, 2017
Cogeneration also known as combined heat and power, makes use of heat which is normally a by-product of electricity generation in a power plant.

Bangkok Suvarnabhumi airport electricity and cooling system uses natural gas (primary); diesel (secondary)

- 50 MW (2 x 20 MW Gas turbines and 1x15 MW steam turbine)
- Cooling
Optimized energy concept concourses

- Solar reflection 60%
- Absorption 36.5%
- Transmission 3.5%
- Absorption 28%
- Transmission 2%
- Solar reflection 70%
- Low-e coating

Reduced long wave radiation

Supply air 18°C, 4 ac/h
Floor surface 21°C

T_{air} = 24°C
T_{operative} = 27°C

13°C

Floor cooling

Source: Simmonds et al, 2000


Source: Emissions Gap Report, 2019
GHG MITIGATION AT AIT

• Education and training to students (courses in Energy and CCSD; and research (thesis/research study) – Contribution in the region and worldwide

• Participation in research (projects) and assisting the region (RETS in Asia, ARRPEEC, RE Policy (Thailand), LCC, Technology Needs Assessment)

• In Campus
  • Improving energy efficiency – building design
  • Renewables use
  • Daylighting
  • Car pooling
  • Bicycle use
  • Reducing paper use
  • Solar PV in Community farming
TOWARDS ZERO ENERGY BUILDING

- Installed capacity: 12kW
- Start date: October 2019
- Average daily generation: About 50 kWh
- Share of PV to total: 40% and 65%
ROOF TOP SOLAR

Installed capacity: 50 kW
Start date: 08/04/2016
Average daily generation: 200 kWh
Average daily consumption: 1,200 kWh
Share of PV to total: 16%
Energy Building 1

Saving: 30 kWh/month

Roof top of Energy Building 1

(a) Turn off LED
(b) Turn on LED
(c) Light pipe
CAR POOLING: TRIPS TO TALAT THAI MARKET
Eggplant, tomato, chili, okra, Indian spinach, water spinach (morning glory), French bean, onion, corn, pumpkin, lettuce, watermelon, snake gourd, ridge gourd and bitter gourd.
Energy conservation and efficiency in Buildings: Experience at AIT

- Replacing fluorescent with CFLs
- Replacing lamps with efficient reflectors
- Use of pull switches; sensors
- Payback period < 1 year
- Illuminance better and above norms
Improving Energy Efficiency Using IoT and AI

Smart meter connected to the mains

Smart plugs connected to devices

Television

FAN

Fridge

Microwave

Washing machine

Rice cooker

Smartrun and connected to devices, monitoring energy consumption.
• Our current energy consumption pattern is unsustainable.
• We don’t have much breathing space.
• All have to take part
• Technology, behaviour are the key – through policy or otherwise
• Options are everywhere – how we do it is the key.