GEC1010
AY22/23 Sem 2
github.com/securespider

01. Energy

By constant force
work done by a force == force * displacement
$W = FS$

Law of conservation of energy
Energy can neither be created nor destroyed, it can only be transformed from one form to another

Kinetic energy
Formula in linear motion
$K = \frac{1}{2}mv^2$
Formula in angular motion
$\frac{1}{2}I\omega^2$

- I = Moment of inertia of object (dependent on mass distribution of object)
- ω = angular velocity of the rotating object
  - Rad/second
  - $v = \omega * radius$

Gravitational potential energy
$U = mgh$

Power
Rate of doing work or rate of consumption of energy
$P = \frac{\triangle W}{\triangle t}$
Work done, W, by a system in time t

Requirements of an energy system
Energy resource
- Clean energy
  - Wind Energy
  - **Hydro energy** - Come from river and dams
  - Ocean energyOnly refers to energy coming from ocean currents etc
  - Solar energy
  - Biomass
  - Non-Renewables:
  - Geothermal
  - Nuclear
- Fossil fuels
  - Coal
    - Greater carbon content and more impurities - More carbon dioxide and greater air pollution
    - Solid so difficulty in extraction, transportation and use
  - Natural Gas
    - Cleaner alternative
  - Oil

Problems
- Unsustainable - reserves depleting
- Global warming - Enhanced greenhouse effect by earth atmosphere
- Greater absorption of long wavelength IR in earth's atmosphere
- Rising temperature anomaly from 1980-2000
- Global sea level rising
  - Thermal expansion of water
  - Melting alpine glaciers and ice sheets
- Earlier timing of spring events
- Poleward and upward shift in plant and animal species

Solution:
Clean energy
- Replace existing supply of fossil fuels
- Use energy more efficiently and judiciously minimizing environmental pollution

High power

High energy conversion efficiency

Singapore
Singapore uses LNG primarily (95%) piped from indonesia and malaysia
Switching to solar and biofuels to reduce reliance

Energy conservation
- Outdoor LED initative
- Electric car sharing

02.

05. Hydro power

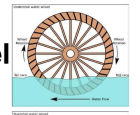
Ocean vs River
River
1. Hydroelectricity

Ocean
1. Tidal power
2. Wave power
3. Ocean thermal

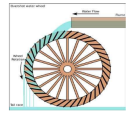
Water wheels
Water mills
- Ancient application for replacing physical labour
- Replaced with water turbines for energy generation

Types of water wheels

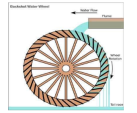
Undershot Water Wheel



Overshot Water Wheel



Backshot Water Wheel



- Undershot
  - Vertically mounted with water flowing at the bottom of the wheel
  - Cheapest and least efficient
- Overshot
  - Falling water on the top of the wheel in direction of rotation
  - Use all water flow for power production
  - Does not require rapid flow of water
  - Uses the difference in weight between the 2 sides of the wheel to turn
- Backshot
  - Introduced behind the apex of the wheel
  - Water flows opposite the direction of rotation
  - Continues to function even when water in wheel put rises beyond height of axle
  - Technique useful for streams that experience extreme seasonal variations in flow

Types of Hydro Power
- Dam based
- Run of the river plants(diversion)
- Pumped storage technology
- Damless hydro power

Principles of power generation
Production of electricity by using gravitational force of falling water
$P = \eta\rho ghQ$
η = efficiency, ρ = density of water, Q = Volume of water flowing per second on turbine, h = Vertical distance between turbine and water surface