Climate Change Mitigation: Role of Renewable Energy

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Climate Change Mitigation : Role of Renewable Energy.

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When viewed from space, Earth is remarkably beautiful, and as we know, very hospitable to life. But Human activities are now clearly threatening the very atmospheric life support system of mankind.

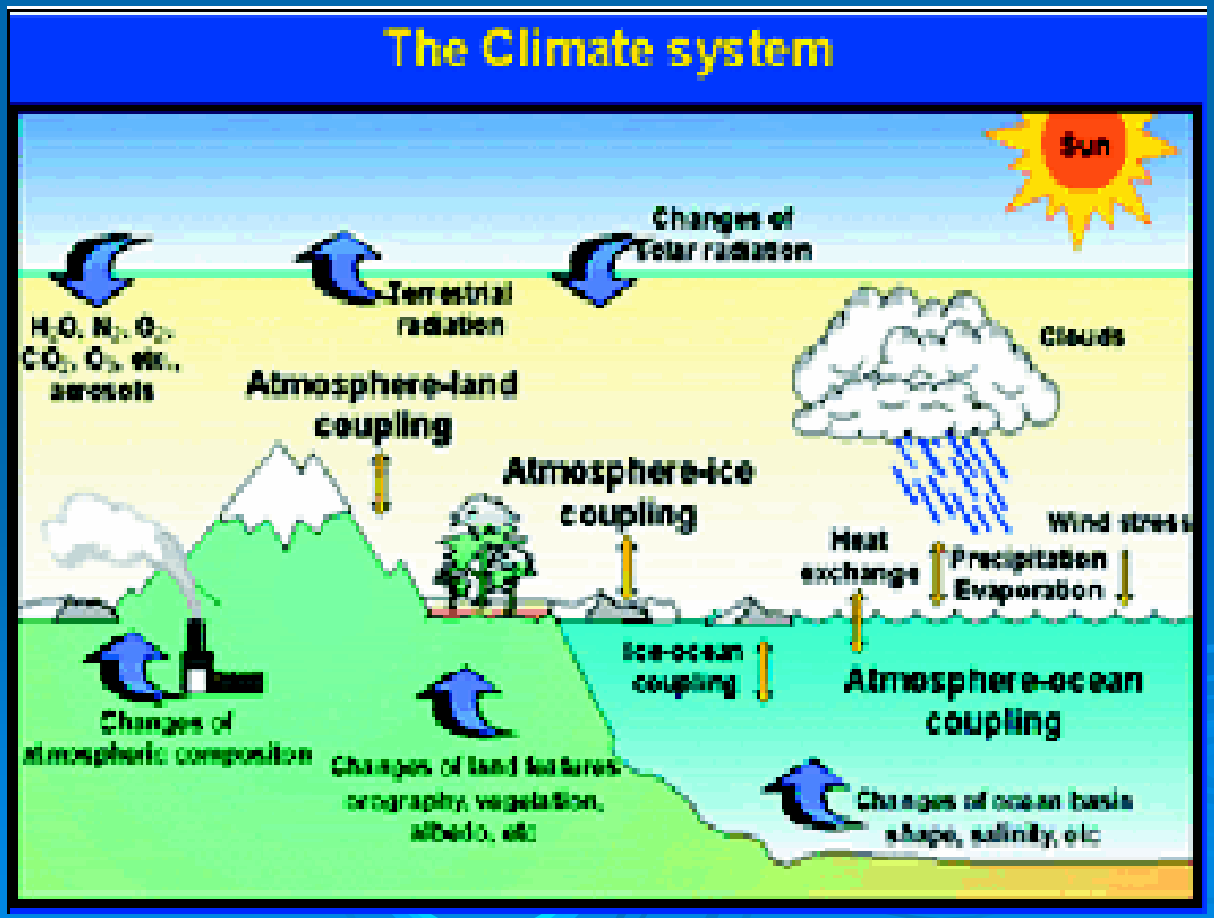
If this goes on, by 2050 we might see:

- Routine health advisory notices warning the public of high radiation
- Major increases in suffering from skin cancer
- Increases in the infectious diseases and decrease in effectiveness of vaccination
- Reduction in the productivity of the oceans
- Erratic change in the world atmosphere and its destructive nature etc

Causes of climate change

Climate system:

The climatic system is driven by solar radiation, atmospheric composition, and interaction with ocean and land process



The earth's climate is determined by the "Earth stored energy" which is the difference in the amount of energy received from the sun and the amount the earth releases back to the space. That is

Earth's "stored" energy + Energy from sun – Energy released to space = The Global energy balance

"Earth's stored energy" contribute to climate change and is called a "C**limate Forcing Process"**

Climate forcing process can be internal or external

External forcing processes include:

- Variation in the amount of energy received from the sun.
- Variations in the earth's orbit around the sun.

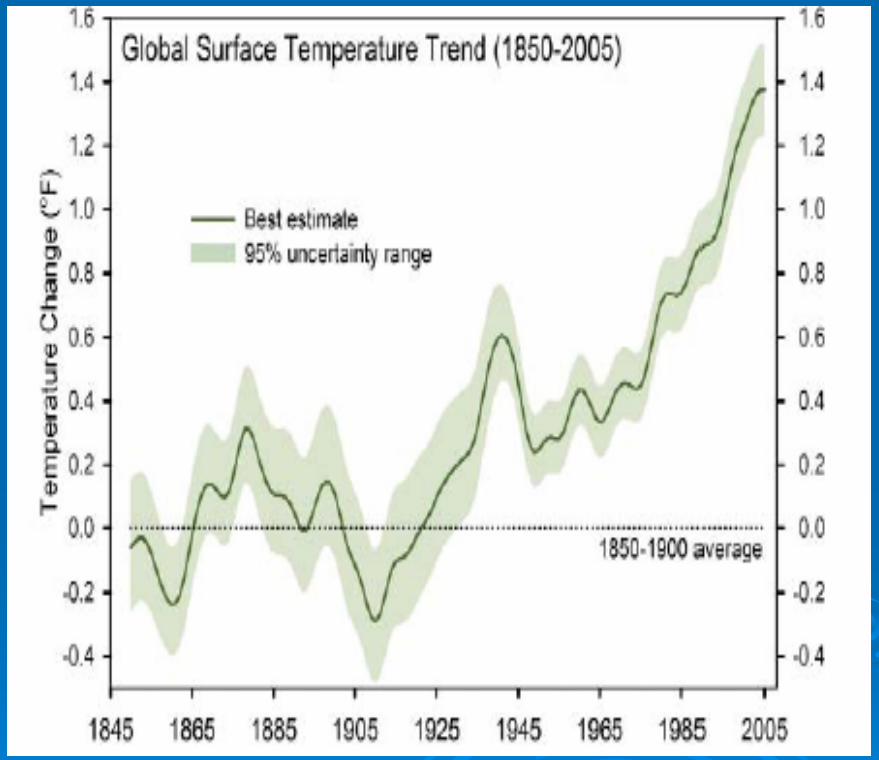
Internal climate forcing processes include:

- Oceans
- The atmosphere
- Water cycle
- Clouds
- Ice and Snow
- Land surface
- Impact of large volcanic eruptions and collisions
- Man made pollution.

Global temperature

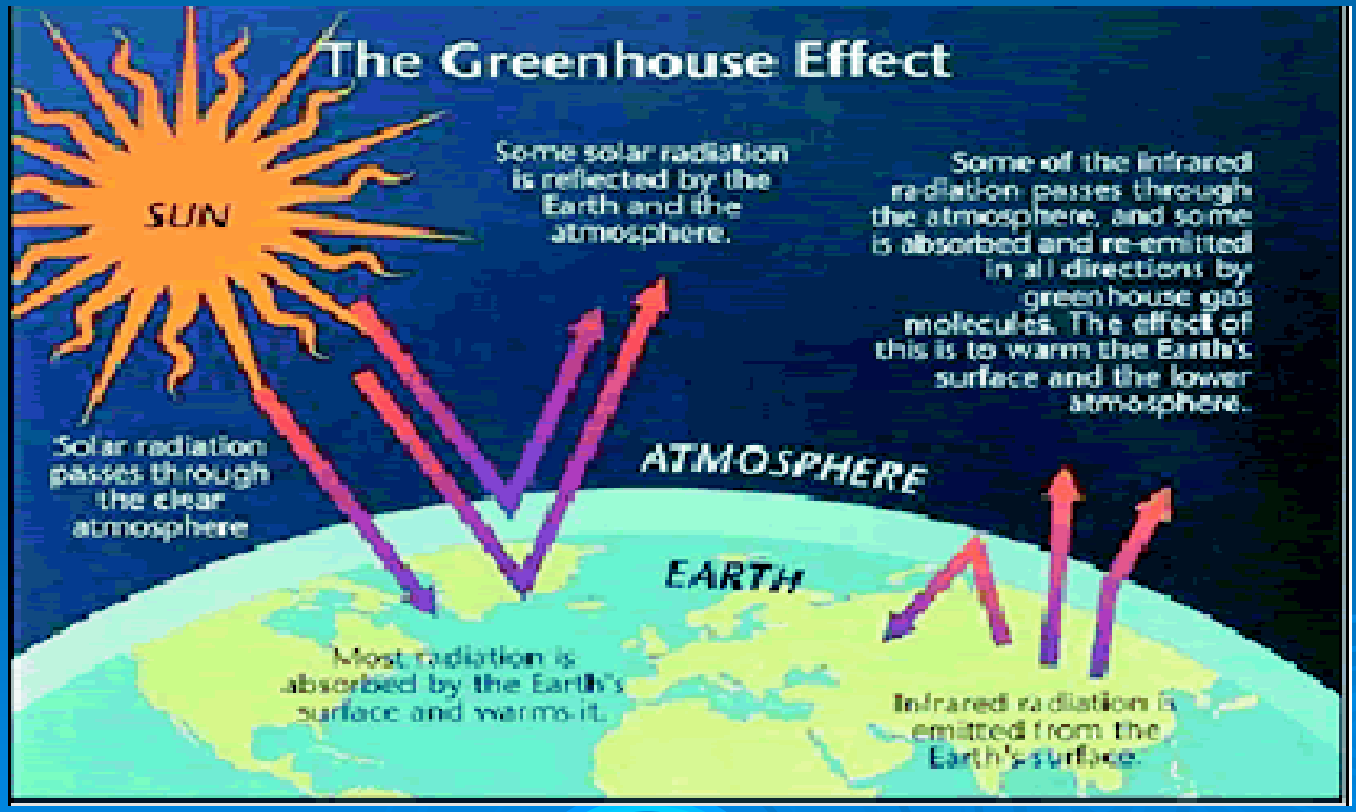
Recent decades have seen record high average global surface temperature

In the past century, global surface temperature increased by about 1.40F. In past quarter century the lower atmosphere warmed by 0.22 - 0.340F per decade, equivalent to 2 -30F per century (Christy and Spencer 2005; Mears and Wentz 2005). The 20 years include 18 warmest year on record (Hardley centre 2005).



Green House Effect

The **greenhouse effect** is a natural phenomenon whereby certain gases in the earth's atmosphere, known as **greenhouse gases,** absorb heat that would otherwise escape to space



Source: United States Global Change Research Information Office, United States Global change Research Program, 1996. http://www.gcrio.org/ocp96/p30box.html

Greenhouse gas and their sources

- Water vapor (H2O) and carbon dioxide (CO2) are the two largest contributors to the greenhouse effect
- Methane (CH4), nitrous oxide (N2O), chloro-fluorocarbons (CFCs) and other greenhouse gases are present only in trace amounts, but can still have a powerful warming effect due to their heat-trapping abilities and their long residence time in the atmosphere.
- Without the greenhouse effect, Earth's average temperature would be -0.4°F (-18°C), rather than the present 59°F (15°C).
- Nearly one-third of human-induced nitrous oxide emissions are a result of industrial processes and automobile emissions

Effect of global warming

The predicted effects of global warming on the environmentand for human life are numerous and varied that can not be attribute to a specific natural phenomena to long-term causes, but some effects of recent climate change may already be occurring

- Rising sea levels, glacier retreat,
- Arctic shrinkage,
- Altered patterns of agriculture
- Extreme weather events,
- Increase of tropical diseases,
- Changes in the seasonal patterns in ecosystem,
- Drastic economic impact

Effect of global warming …. Cont'd

Effects on weather

Global warming is responsible for natural disasters such as extreme weather.

Worldwide, the proportion of hurricanes reaching categories 4 or 5 has risen from 20% in the 1970s to 35% in the 1990s

Increased evaporation

As the climate grows warmer, evaporation will increase due to warmer oceans. This will cause heavier rainfall, with more erosion. This erosion, in turn, can in vulnerable tropical areas (especially in Africa) lead to desertification due to deforestation.

Effect of global warming …. Cont'd

Destabilization of local climates

The first recorded South Atlantic hurricane, Catarina, which hit Brazil in March 2004

In the northern hemisphere, the southern part of the Arctic region has experienced a temperature rise 1 °C to 3 °C (1.8 °F to 5.4 °F) over the last 50 years.

Canada, Alaska and Russia are experiencing initial melting of permafrost.

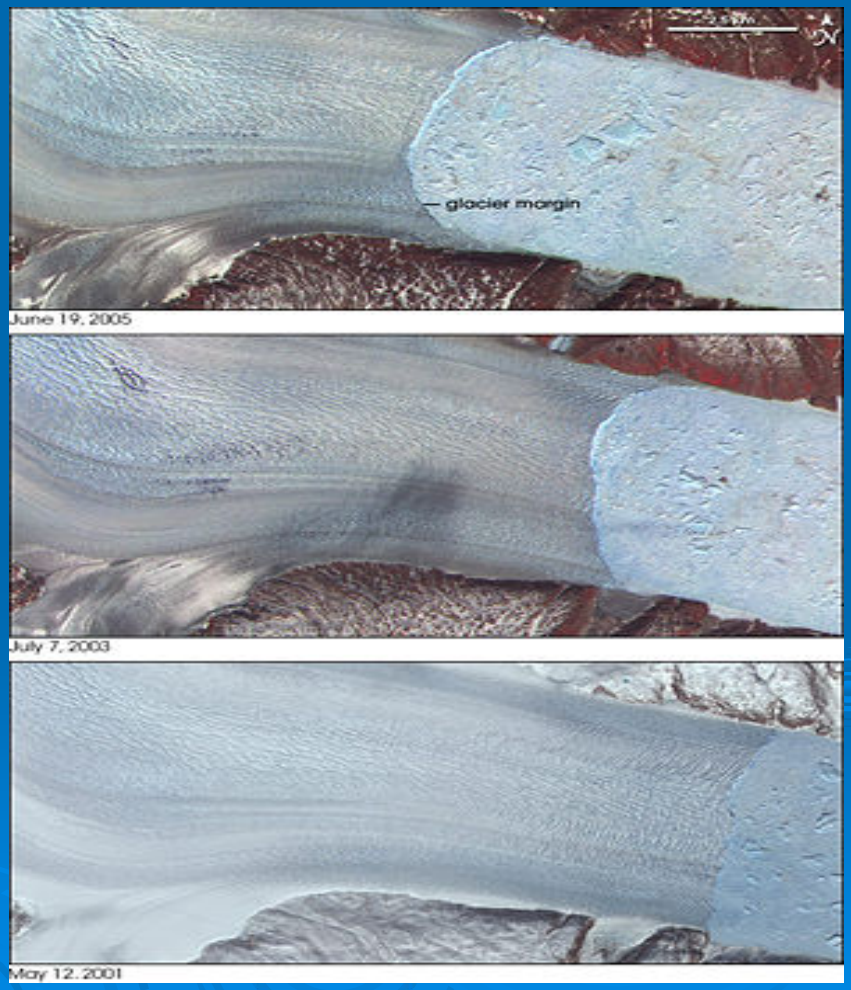
Effect of global warming …. Cont'd

Glacier retreat and disappearance

Glacier worldwide has decreased by 50% since the end of the 19th century

Currently glacier retreat rates and mass balance losses have been increasing in the Andes, Alps, Himalayas, Rocky Mountains and North Cascades

The loss of glaciers not only directly causes landslides, flash floods and glacial lake overflow, but also increases annual variation in water flows in rivers. Glacier runoff declines in the summer as glaciers decrease in size, this decline is already observable in several regions



Retreat of the Helheim Glacier, Greenland.

Effect of global warming …. Cont'd

Sea level rise

- **Sea level has been rising 0.2 cm/year**
- **With increasing average global temperature, the water in the oceans expands in volume, and this will submerge low lying area like Bangladesh, Maldavis etc.**

Other consequences

Effect on agriculture, Ecosystems, Environment, Health etc.

Mitigation of Climate Change

The UN General Assembly held its first-ever thematic debate on climate change from 31 July to 2 August 2007. The debate focused on the latest scientific assessments of climate change, as well as the two components of the response to the phenomenon: adaptation and mitigation

In her opening speech at the start of the event, President of the General Assembly Sheikha Haya Rashed Al Khalifa said that "how we protect our environment, secure our planet and safeguard our future, for our children and generations to come, is one of the greatest challenges of our time", adding that political action is needed. "We cannot go this way for long. We cannot continue with business as usual. The time has come for decisive action on a global scale," emphasized Secretary-General Ban Ki-moon in his opening remarks, adding that his personal priority is to work with Member States to ensure the United Nations plays its role to the fullest.

Robert Socolow, professor of Mechanical and Aerospace Engineering at Princeton University, outlined ways that nations could cut their use of fossil fuels and therefore reduce carbon emissions. Compared to 50 years ago, when there was less than 2 billion tons of carbon entering the atmosphere each year, "today we are taking about 7 billion tons of carbon out of the ground every year

Yvo de Boer, Executive Secretary of the United Nations Framework Convention on Climate Change (UNFCCC), said “To get the emissions down is the whole issue of mitigation", said Mr. de Boer, "we have to stop the emissions growth in the next 15 years to avoid the problem getting out of control". Thus, a major energy system is highly required.

Energy efficiency is central to climate change mitigation.

Renewable Energy

Global climate change mitigation depends greatly on the increase use of energy efficiency and renewable energy technologies in all countries of the world.

In 2006, about 18 percent of global final energy consumption came from renewable

Example of renewable energy are Solar, Wind, Ocean, Hydropower, Biomass, Geothermal resources, Biofuels and Hydrogen derived from renewable resources

Wind Power

Wind power is the fastest growing of the renewable energy technologies, though it currently provides less than 0.5 percent of global energy. Over the past decade, global installed maximum capacity increased from 2,500 MW in 1992 to just over 40,000 MW at the end of 2003, at an annual growth rate of near 30 percent

Offshore wind turbines near Copenhagen

Solar Energy

"solar energy" refers to energy that is collected from sunlight.

Solar energy can be applied in many ways, including

11 MW solar power plant near Serpa, Portugal.

- **Generate electricity using photovoltaic solar cells.**
- **Generate electricity using concentrated solar power.**
- **Generate electricity by heating trapped air which rotates turbines in a Solar updraft tower.**
- **Heat foodstuffs, through solar ovens.**
- **Heat buildings, directly, through passive solar building design.**
- **Heat water or air for domestic hot water and space heating needs using solar-thermal panels.**
- **Heat and cool air through use of solar chimneys.**
- **Generate electricity in geosynchronous orbit using solar power satellites.**
- **Solar air conditioning**

Water power

- **Hydroelectric** energy is a term usually reserved for large-scale hydroelectric dams. Examples are the Grand Coulee Dam in Washington State and the Akosombo Dam in Ghana.
- **Micro hydro** systems are hydroelectric power installations that typically produce up to 100 kW of power. They are often used in water rich areas as a Remote Area Power Supply (RAPS). There are many of these installations around the world, including several delivering around 50 kW in the Solomon Islands.
- **Damless hydro** systems derive kinetic energy from rivers and oceans without using a dam.
- **Wave power** uses the energy in waves..
- **Tidal power** captures energy from the tides in a vertical direction. Tidal stream power captures energy from the flow of tides, usually using underwater plant resembling a small wind turbine.
- **Ocean thermal energy conversion (OTEC)** uses the temperature difference between the warmer surface of the ocean and the colder lower recesses. To this end, it employs a cyclic heat engine.
- **Deep lake water cooling**, although not technically an energy generation method, can save a lot of energy in summer. It uses submerged pipes as a heat sink for climate control systems. Lake-bottom water is a year-round local constant of about 4 °C.
- **Blue energy** is the reverse of desalination.

Biofuel

Plants use photosynthesis to grow and produce biomass. Also known as biomatter, biomass can be used directly as fuel or to produce liquid biofuel. Agriculturally produced biomass fuels, such as biodiesel, ethanol and bagasse (often a by-product of sugar cane cultivation) can be burned in internal combustion engines or boilers. Typically biofuel is burned to release its stored chemical energy.

Liquid biofuel

Liquid biofuelis usually either a bioalcohol such as ethanol fuel or bio-oil such biodiesel and straight vegetable oil. Brazil is one of the largest producer of ethanol fuel from sugar cane, ethanol now provides 18 percent of the country's automotive fuel.

Biogas

Biogas can easily be produced from current waste streams, such as: paper production, sugar production, sewage, animal waste and so forth. When a biogas plant has extracted all the methane it can, the remains are sometimes better suitable as fertilizer than the original biomass.

Biomass

Solid biomass commonly usually used directly as a combustible fuel. Its form and sources include wood fuel, biogenetic portion of municipal solid waste, or the used portion of field crops. Cow manure contains two thirds of the original energy consumed by cow. Energy harvesting via a bioreactor is a cost effective solution to the waste disposal issues faced by dairy farmer, and can produce enough biogas to run a firm.

Future potential of Renewable Energy

Geothermal energy

Geothermal energy is obtained by tapping the heat of the earth itself, usually from kilometer deep into the earth's crust. It is estimated that Iceland's geothermal energy could provide 1700MW for over 100 years, compared to current production of 140 MW. The world's largest geothermal power station installation is The Geysers in California with a rated capacity of 750 MW.

Krafla Geothermal Station in northeast Iceland

Conclusion

Climate change is one of the most serious threats to our environment, including human health, our seas and coast. It may alter nearly every physical and chemical property of our surroundings.

The importance of carbondioxide emissions as an environmental issue of international concern has grown substantialyy since 1992.

Global climate change mitigation depends greatly on the increase of energy efficiency and renewable energy technologies in all countries.