



Course: Sustainable Energy Technology
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Title: Renewable Energy Technologies- L3

Dr. Mahmoud Ismail

Renewable Energy Technologies

Energy-related environmental problems

An obvious replacement for oil would be biofuels such as: ethanol, methanol, biodiesel, and biogases.

Hydrogen is another clean transportation alternative for the future especially if it could be produced economically from renewable energy sources.

Three environmental problems are internationally known:

Acid precipitation, the stratospheric ozone depletion, and global climate change

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Acid Rain

Acid rain is a form of pollution depletion in which SO₂ and NO_x produced by the combustion of fossil fuels are transported over great distances through the atmosphere, where they react with water molecules to produce acids

It causes damage to ecosystems .

The solution to the issue of acid rain deposition requires an appropriate control of SO₂ and NO_x pollutants.

These pollutants cause both regional and transboundary problems of acid precipitation.

Recently, attention also has been given to other substances, such as volatile organic compounds (VOCs), chlorides, ozone, and trace metals that may participate in a complex set of chemical transformations in the atmosphere, resulting in acid precipitation and the formation of other regional air pollutants.

It is well known that some energy-related activities are the major sources of acid rain. The more energy we expend, the more we contribute to acid precipitation.

Therefore, the easiest way to reduce acid precipitation is by reducing energy consumption.

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Ozone layer depletion

The ozone present in the stratosphere, at altitudes between 12 and 25 km.

It plays a natural equilibrium maintaining role for the earth through absorption of ultraviolet (UV) radiation (240–320 nm) and absorption of infrared radiation.

A global environmental problem is the depletion of the stratospheric ozone layer.

It is caused by the emissions of chlorofluorocarbons (CFCs), halons (gaseous organic compound with chlorine or bromine used in fire extinguishers).

Ozone depletion can lead to increased levels of damaging UV radiation reaching the ground, causing increased rates of skin cancer and eye damage to humans, and is harmful to many biological species.

Energy-related activities are only partially (directly or indirectly) responsible for the emissions that lead to stratospheric ozone depletion.

NOx emissions also play a role in ozone depletion.

In 1993, the size of the ozone hole over Antarctica was 3 million km²

In 1998, the size of the ozone hole was 25 million km².

In 2012 it is 18 million km²

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Global climate change (Green House Effect)

The term greenhouse effect has generally been used for the role of the whole atmosphere (mainly water vapor and clouds) in keeping the surface of the earth warm.

GHGs such as CO₂ and several other gases, like CH₄, CFCs, Halons, N₂O, ozone, and Peroxy acetyl nitrate (photochemical smog) produced by the industrial and domestic activities can contribute to this effect.

This will result in a rise of the earth's temperature.

Increasing atmospheric concentrations of GHGs increase the amount of heat trapped (or decrease the heat radiated from the earth's surface), thereby raising the surface temperature of the earth.

The earth's surface temperature has increased by about 0.6 C over the past century, and as a consequence the sea level is estimated to have risen by perhaps 20 cm. These changes can have a wide range of effects on human activities all over the world

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Global climate change (Green House Effect)

Predictions show that if atmospheric concentrations of GHGs, mainly due to fossil fuel combustion, continue to increase at the present rates, the earth's temperature may increase by another 2–4 C in the next century.

If this prediction is realized, the sea level could rise by 30–60 cm before the end of this century.

The impacts of such sea level increase can easily be understood and include:

Flooding of coastal settlements,

Displacement of fertile zones for agriculture to higher latitudes,
and

Decrease in availability of freshwater for irrigation and other essential uses.

Thus, such consequences could put in danger the survival of entire population.

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Renewable Energy Technologies

Renewable energy technologies convert natural phenomena into useful forms of energy.

These technologies use the sun's energy and its direct and indirect effects on the earth:

Solar radiation, wind, falling water, biomass, gravitational forces (tides), and the heat of the earth's core (geothermal) as the resources from which energy is produced.

Most of these resources are intermittent and have distinct regional variability.

Renewable energy systems can have a beneficial impact on the environmental, economic, and political issues of the world.

The benefits arising from the renewable energy systems are:

Energy saving, generation of new working jobs, and decrease in Environmental pollution.

All renewable energy sources combined account for only 22.5% share of electricity production in the world (2010), with hydroelectric power providing almost 90% of this amount.

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Renewable Energy Technologies (Benefits)

1. Social and economic development. Production of renewable energy, particularly biomass, can provide economic development and employment opportunities, especially in rural areas,
2. Land restoration. Growing biomass for energy on degraded lands can provide the incentive and financing needed to restore lands rendered nearly useless by previous agricultural or forestry practices.
3. Reduced air pollution.
4. Abatement of global warming.
5. Fuel supply diversity.
6. Reducing the requirement for transmission lines

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The socioeconomic benefits of solar technologies

1. Increased regional and national energy independence,
2. Creation of employment opportunities,
3. Restructuring of energy markets due to penetration of a new technology and the growth of new production activities,
4. Diversification and security (stability) of energy supply,
5. Acceleration of electrification of rural communities in isolated areas,
6. Saving foreign currency

The negative environmental aspects of solar energy systems include:

1. Pollution stemming from production, installation, maintenance, and demolition of the systems,
2. Noise during construction,
3. Land displacement
4. Visual intrusion.

Solar PV panels have come down in cost from about \$30/W to about \$0.8/W in the past three decades. At \$0.8/W panel cost, the overall system cost is around \$2.5-5/W (depending on the size of the installation), which is still too high for the average consumer.

Solar thermal power using concentrating solar collectors (\$0.12–\$0.16/kWh) has the potential to go down to \$0.05/kWh