LOW CARBON ENERGY TECHNOLOGIES AND OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT IN LAKE CHAD BASIN

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Outline

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Introduction

- **Low-carbon energy** sources produce low carbon power through processes or technologies that substantially lower amounts of carbon dioxide emissions than is emitted from conventional fossil fuel power generation.

- It includes low carbon power generation sources such as wind power, solar power, Hydro power and, including fuel preparation and decommissioning, nuclear power.[1] Others are geothermal, hydrogen, tidal, biomass.

- The term largely excludes conventional fossil fuel sources, and is only used to describe a particular subset of operating fossil fuel power systems, specifically, those that are successfully coupled with a flue gas carbon capture and storage(CCS) system.

- Over the past 30 years, significant findings regarding global warming highlighted the need to curb carbon emissions. From this, the idea for low carbon power was born.

Introduction cont'd

- The Intergovernmental Panel on Climate Change(IPCC), established by the World Meteorological Organization(WMO) and the United Nations Environment Program(UNEP) in 1988, set the scientific precedence for the introduction of low carbon power.

- The IPCC has continued to provide scientific, technical and socio-economic advice to the world community, through its periodic assessment reports and special reports.[2]

- Internationally, the most prominent early step in the direction of low carbon power was the signing of the Kyoto Protocol which came into force on February 16, 2005, under which most industrialized countries committed to reduce their carbon emissions.

- The historical event set the political precedence for introduction of low carbon power technology.

- The present manner of energy exploitation has contributed tremendously to environmental degradation hence the urgent need to deploy low carbon energy resources for sustainable development.

  The Swedish utility Vattenfall studied full life cycle emissions of nuclear, hydro, coal, gas, solar cell, peat and wind which the utility uses to produce electricity. The net result showed that nuclear power produced 3.3 grams of carbon dioxide per kW-hr of produced power, 400 for natural gas and 700 for coal. [3,4]

Lake Chad Basin Commission

- The **Lake Chad Basin Commission** (**LCBC**) is an intergovernmental organization of countries near to Lake Chad which coordinates actions that might affect the waters of the lake.[5] The organization's secretariat is located in N'Djamena, Chad.

- The LCBC is Africa's oldest river or lake-basin organization. In its founding document (the Convention and Statutes relating to the Development of the Chad Basin) the parties commit themselves to a shared use of the basin's natural resources.

Membership and funding

- Hydrologically, the Chad Basin includes eight countries which are: Chad, Niger, the Central African Republic, Nigeria, Sudan, Algeria, and Libya.

- Cameroon, Niger, Nigeria and Chad are the four countries directly containing parts of Lake Chad and its wetlands that signed the Fort Lamy (today N'Djamena) Convention on May 22, 1964, which created the Lake Chad Basin Commission.

- The Central African Republic joined in 1996, and Libya joined in 2008.[6] Sudan was admitted in July, 2000, but has observer status because it has not ratified the founding convention. Algeria has not participated.

Lake Chad Basin Commission Cont'd

- The other countries with observer status are Egypt - in the neighboring Nile Basin - and the Republic of Congo and the Democratic Republic of Congo which are fed by the Ubangi River being considered for diversion into Lake Chad.

- The member countries fund the commission's US$ 1 million annual budget based on an agreed-upon formula: Nigeria 52%, Cameroon 26%, Chad 11%, Niger 7%, the Central African Republic 4%.

Activities

- The Commission's Basin Committee for Strategic Planning (BCSP), coordinates local activities between the member states.

- The LCBC controls the hydro-active regions in the Chad Basin, called the *Conventional Basin*.

- The initial Conventional Basin consisted of approximately 427,500 km² of the total area of the Chad basin in 1964. The definition says it excluded the majority of the terminal depression consisting of desert that provides little or no effective hydrological contribution to the Conventional Basin.

- This was subsequently expanded to include additional watersheds in northern Nigeria, southern Chad, and northern Central African Republic, with a current total area of 967,000 km².

Lake Chad Basin Commission Cont'd

- Lake Chad is drying up. With only 2500 square kilometers left, its surface area is about 10 percent of
  what it was in the 1960s.

- Nearly 30 million people living in the Lake Chad Basin, mainly farmers, grazers, and fishermen, depend on the basin's ecosystem and natural resources.

- These have been heavily depleted, partly as the result of climate change. In response, the African Development Bank is supporting the US$ 90 million Lake Chad Sustainable Development Support Program.

- This program is designed to increase the volume of water flowing into the lake, re-establish the productivity of the lake's ecosystems by restoring 8000 hectares of sand dunes and combating erosion on 27,000 hectares, and halt the proliferation of the vegetation choking the lake.

- Judicious, integrated management of the basin's natural resources is expected to increase the incomes of the project's target populations, particularly women, by two-thirds and improve food security as well.

Lake Chad Basin Commission Cont'd

The member countries and observer status countries

Lake Chad Basin Commission Cont'd

Area of the active and conventional lake Chad Basin

Country	Surface of Active Basin (km^2)	Conventional Basin (km^2)
Algeria	93.6	-
Cameroon	50.775	56.80
Niger	691.473	162.375
Nigeria	179.282	188.000
C.A.R.	219.410	197.800
Sudan	101.048	-
Chad	1.046.196	381.980

Low Carbon Energy Sources/Technologies

There are many options for lowering current levels of carbon emissions in Lake Chad Basin. Some options come mainly from renewable energy sources, such as wind, hydro and solar power amongst others which produce low quantities of total life cycle carbon emissions.

Nuclear power, produce a comparable amount of carbon dioxide emissions as renewable technologies in total life cycle emissions, but consume non-renewable, but sustainable materials (uranium).

Renewable Energy Sources/Technologies

Renewable energy comes from a source that is constantly renewed and can be replenished naturally in a short period of time. Examples include: solar, wind, biomass, hydropower, geothermal, etc. Less than 2% of the world's electricity comes from renewable resources. [7]

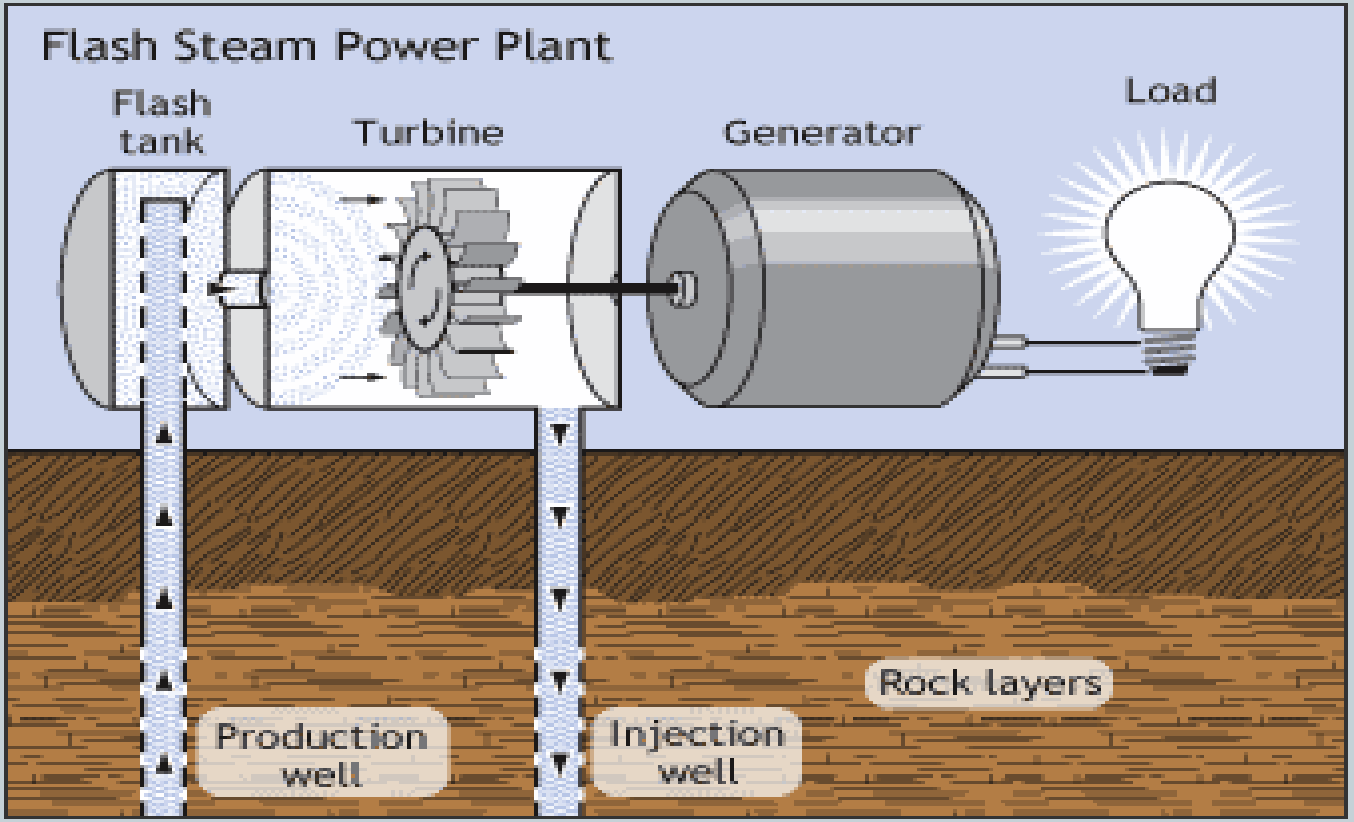
Geothermal –

Geothermal energy comes from the heat stored in the Earth's core, it is clean and sustainable. The ground is a good insulator and stores the heat as energy. Pipes are run through a large area several feet underground. Water is heated as it passes through these pipes. New drilling technologies are being researched and developed to capture the heat in deeper areas. [8]

Low carbon energy sources/technologies Cont'd

- Geothermal electricity is electricity generated from geothermal energy.
- Technologies in use include dry steam power plants, flash steam power plants and binary cycle power plants.
- Geothermal electricity generation is used in 24 countries[8]while geothermal heating is in use in 70 countries.[9]
- Current worldwide installed capacity is 10,715 megawatts (MW), with the largest capacity in the United States (3,086 MW),[10 Philippines, and Indonesia.
- Estimates of the electricity generating potential of geothermal energy vary from 35 to 2000 GW.[10]
- Geothermal power is considered to be sustainable because the heat extraction is small compared to the Earth's heat content.[11]

Low carbon energy sources/technologies Cont'd



How Geothermal Energy Is Captured

Low carbon energy sources/technologies Cont'd

- **Nuclear power**

  Nuclear power's capability to add significantly to future low carbon energy growth depends on several factors, including the economics of new reactor designs, such as Generation III reactors, public opinion and national and regional politics.

- Nuclear power, in 2010, provided two thirds(2/3) of the twenty seven nation European Union's low-carbon energy.[12] For example, France derives 79% of its electricity from nuclear.
- According to the IAEA and European Nuclear Society, worldwide there were 68 civil nuclear power reactors under construction in 15 countries in 2013.[13]

- China has 29 of these nuclear power reactors under construction, as of 2013, with plans to build many more,[14] while in the US the licenses of almost half its reactors have been extended to 60 years[15], and plans to build another dozen are under serious consideration.[16]
- There are also a considerable number of new reactors being built in South Korea, India, and Russia.

Low carbon energy sources/technologies Cont'd

Hydropower

- Hydropower is the energy captured from moving water. It is often used to generate electricity, usually at dams. Hydroelectric plants have the advantage of being long-lived and many existing plants have operated for more than 100 years.
- Hydropower is also an extremely flexible technology from the perspective of power grid operation. Large hydropower provides one of the lowest cost options in today's energy market, even compared to fossil fuels and there are no harmful emissions associated with plant operation.[17]
- Hydroelectric power is the world's largest installed renewable source of electricity, supplying about 17% of total electricity in 2005.[18] China is the world's largest producer of hydroelectricity in the world, followed by Canada.
- However, there are several significant social and environmental disadvantages of large-scale hydroelectric power systems: dislocation of people living where the reservoirs are planned, release of significant amounts of carbon dioxide and methane during construction and flooding of the reservoir, and disruption of aquatic ecosystems and birdlife.[19]
- There is a strong consensus now that countries should adopt an integrated approach towards managing water resources, which would involve planning hydropower development in co-operation with other water-using sectors.[17]

Low carbon energy sources/technologies Cont'd

Wind power

- Worldwide, there are now over two hundred thousand wind turbines operating with a total nameplate capacity of 238,351 MW as of end 2011.[20]
- The European Union alone passed some 100,000 MW nameplate capacity in September 2012,[21] while the United States surpassed 50,000 MW in August 2012 and China passed 50,000 MW the same month.[22][23]
- World wind generation capacity more than quadrupled between 2000 and 2006, doubling about every three years. The United States pioneered wind farms and led the world in installed capacity in the 1980s and into the 1990s.
- In 1997 German installed capacity surpassed the U.S. and led until once again overtaken by the U.S. in 2008. China has been rapidly expanding its wind installations in the late 2000s and passed the U.S. in 2010 to become the world leader.
- Several countries have already achieved relatively high levels of penetration, such as 28% of stationary (grid) electricity production in Denmark (2011),[24] 19% in Portugal (2011),[25] 16% in Spain (2011),[26] 14% in Ireland (2010 to 2014)[27] and 8% in Germany (2011).[28] As of 2011, 83 countries around the world were using wind power on a commercial basis.

Low carbon energy sources/technologies Cont'd

Solar power

- Solar power is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP).

- Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaics convert light into electric current using the photoelectric effect.[29]
- Commercial concentrated solar power plants were first developed in the 1980s. The 354 MW SEGS CSP installation is the largest solar power plant in the world, located in the Mojave Desert of California.

- Other large CSP plants include the Solnova Solar Power Station (150 MW) and the Andasol solar power station (150 MW), both in Spain.

- The over 200 MW Agua Caliente Solar Project in the United States, and the 214 MW Charanka Solar Park in India, are the world's largest photovoltaic plants.

Low carbon energy sources/technologies Cont'd

Tidal power

Tidal power is a form of hydropower that converts the energy of tides into electricity or other useful forms of power. The first large-scale tidal power plant (the Rance Tidal Power Station) started operation in 1966. Although not yet widely used, tidal power has potential for future electricity generation. Tides are more predictable than wind energy and solar power.

Biofuels –

Biofuels, including ethanol and biodiesel are clean-burning, biodegradable and made from renewable resources. In addition to being used as fuel for transportation, biofuel can be converted to other useful forms of energy, including methane gas and heat. Ethanol is added to the gasoline in car to obtain E5 or E 10, while biodiesel is added to diesel to obtain B10 and B20.

Hydrogen –

Hydrogen is the simplest and lightest element known to exist, with only one proton and one electron per atom. It is an energy carrier, not an energy source—it must be produced from compounds that contain it. It is the most abundant element in the universe and is the source of the energy we receive from the sun, which is essentially a giant hydrogen gas ball. This radiant energy from the sun is important because it provides light and heat and makes plants grow.

Low carbon energy sources/technologies Cont'd

Carbon capture and storage

- Carbon capture and storage captures carbon dioxide from the flue gas of power plants or other industry, transporting it to an appropriate location where it can be buried securely in an underground reservoir.

- While the technologies involved are all in use, and carbon capture and storage is occurring in other industries (e.g., at the Sleipner gas field), no large scale integrated project has yet become operational within the power industry.

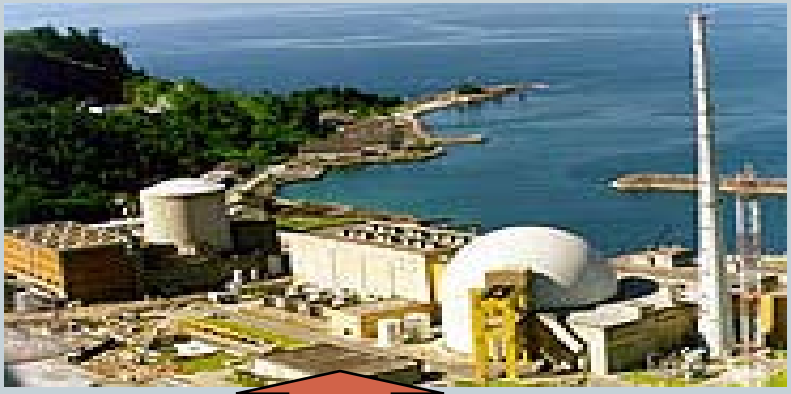
- Improvements to current carbon capture and storage technologies could reduce CO_2 capture costs by at least 20-30% over approximately the next decade, while new technologies under development promise more substantial cost reduction.[30]

Low carbon energy sources/technologies Cont'd

Hydropower

SHP: 3,500 MW
Large Hydro:11,500 MW

Uranium



Total reserves:
Not Yet Quantified

Wind

(2-4) m/s at 10m height
(main land)

Biomass

Excess of 1.2m
Tonnes/day

Solar

3.5-7.0 kWh/m²/day

Environmental Impact of energy exploitation/use

All energy sources affect the environment. There is no such thing as a completely "clean" energy source. Some energy sources have a greater impact than others. Energy is lost to the environment during any energy transformation, usually as heat. Fortunately, the energy industry has become increasingly aware of the importance of environmental protection and is working to reduce its long-term impact.

Biofuels: Biomass, Ethanol and Biodiesel

- Since plants absorb carbon dioxide as they grow, crops could counteract the carbon dioxide released by cars. They are also renewable, and can be planted to replenish supplies. It takes a tremendous amount of energy to grow crops, make fertilizers and pesticides and process plants into fuel. Also, fossil fuels provide much of the energy in biofuels production, so biofuels may not replace as much oil as they use for now.

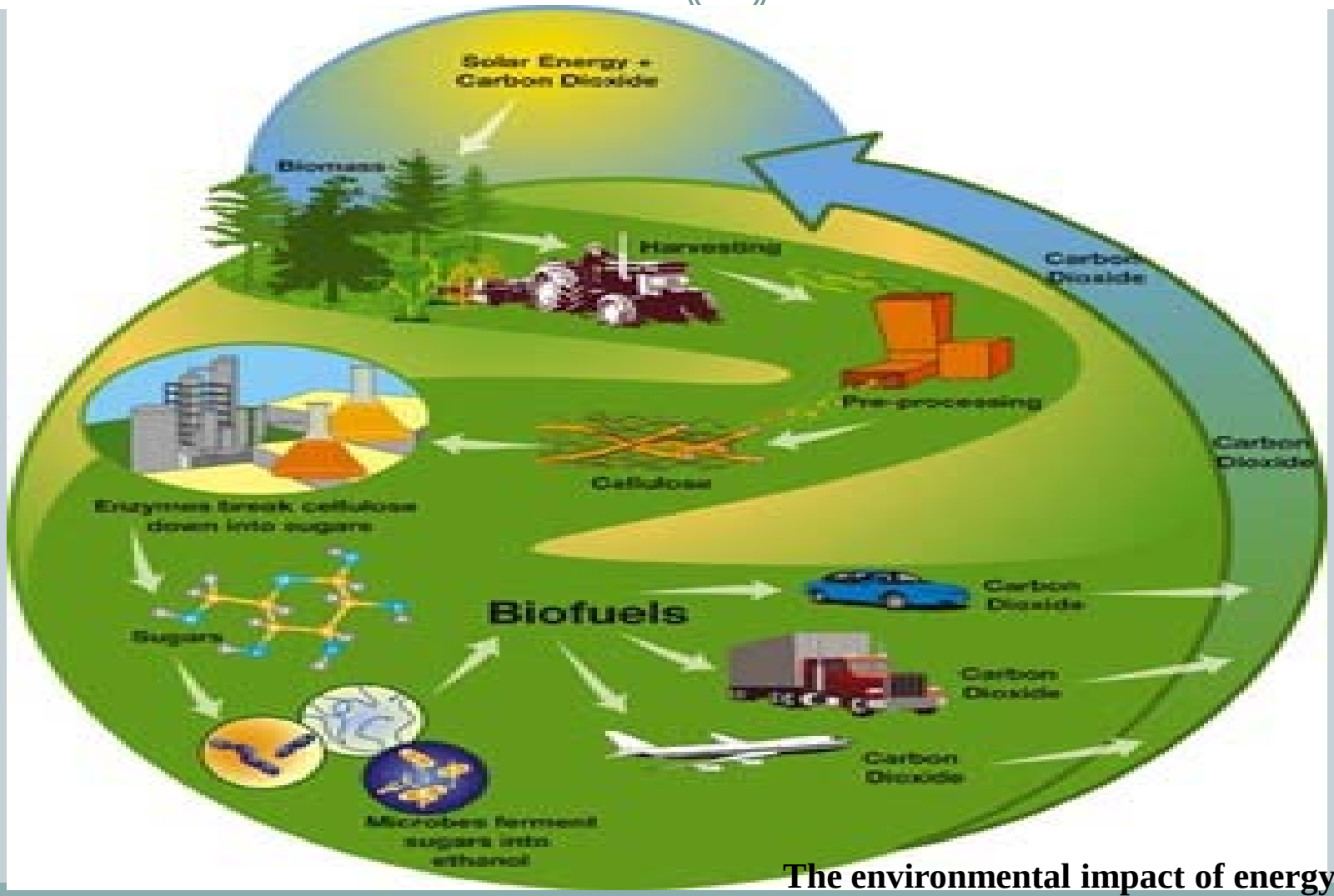
Environmental Impact by energy source cont'd

- Biomass creates harmful emissions like carbon dioxide and sulfur when it is burned, but causes less pollution than fossil fuels. Even burning wood in a fireplace or stove can create pollutants like carbon monoxide. Burning municipal solid waste, or garbage that would otherwise go into a landfill, can also cause potentially dangerous emissions. Disposing of the resulting ash can also pose a problem, as it may contain harmful metals like lead and cadmium.

- Ethanol is often added to gasoline, and while these mixtures burn cleaner than pure gasoline, they also have higher "evaporative emissions" from dispensing equipment and fuel tanks. These emissions contribute to ozone problems and smog. Burning ethanol also creates carbon dioxide.

- Biodiesel creates less sulfur oxides, particulate matter, carbon monoxide and hydrocarbons when burned than traditional petroleum diesel. But biodiesel creates more nitrogen oxide than petroleum diesel.

Environmental Impact by energy source cont'd



The environmental impact of energy sources

Environmental Impact by energy source cont'd

Coal

Coal mining has the potential to harm air, water and land quality if it is not done with proper care. Acidic water may drain from abandoned mines underground, and the burning of coal causes the emission of harmful materials including carbon dioxide, sulfur dioxide and mercury. "Clean coal" technology is being developed to remove harmful materials before they can affect the environment, and to make it more energy-efficient so less coal is burned.

Geothermal

Geothermal power plants have relatively little environmental impact—they burn no fuel to create electricity.

These plants do create small amounts of carbon dioxide and sulfur compounds, but geothermal emissions are far smaller than those created by fossil fuel power plants.

Hydropower

While hydropower does not cause water or air pollution, it does have an environmental impact: Hydroelectric power plants may harm fish populations, change water temperature and flow (disturbing plants and animals) and force the relocation of people and animals who live near the dam site. Some fish, like salmon, may be prevented from swimming upstream to spawn.

Environmental Impact by energy source cont'd

- Hydropower plants can also cause low dissolved oxygen levels in the water, which is harmful to river habitats. Reservoirs may also lead to the creation of methane, a harmful greenhouse gas. [31]

Petroleum (Oil and Gas)

- Great strides have been made to ensure that oil and gas producers make as little impact as possible on the natural environments in which they operate. These include drilling multiple wells from a single location to minimize damages to the surface, using environmentally sound chemicals to stimulate well production and restoring the surface as nearly as possible to pre-drilling conditions (as required by landowners and State or Federal Agencies, who often must approve the company's completion of restoration activities).

Environmental Impact by energy source cont'd

- When many people think of oil and the environment, they think of oil spills. The reality is that the exploration and production of oil rarely create an oil spill. For decades, the offshore oil and gas industry has had a strong safety and environmental record in operating in the Gulf of Mexico, with less than 0.001 percent of the oil produced in Federal waters spilled since 1980. The Deepwater Horizon event is a stark reminder of the risks and challenges in offshore operations.

- Most oil spills occur primarily during transportation, mostly involving the tankers that are used to move oil from where it is produced to where consumers need it. But oil spills from transportation have declined significantly during the past few years, and the growing use of double-hulled tankers provides extra protection.

- Another source of oil spills during transportation is pipelines. Unfortunately, a major reason for spills from pipelines in developing countries is civil unrest. Urban runoff and natural seeps are large sources of oil pollution. Urban runoff comes from rain washing away oil drips from cars or machinery and people pouring used oil into the gutter and using other improper disposal methods. When burned, petroleum products emit carbon dioxide, carbon monoxide and other air toxins, all of which have a negative effect on the environment.

Environmental Impact by energy source cont'd

Solar

Solar energy produces no air or water pollution or greenhouse gases. However, it has some indirect impacts on the environment. For example, the manufacturing of photovoltaic cells (PV) produces some toxic materials and chemicals. Ecosystems can also be affected by solar systems.

Water from underground wells may be required to clean concentrators and receivers, and to cool the generator, which may harm the ecosystem in dry climates .

Uranium (Nuclear Energy)

Nuclear power plants produce no air pollution or carbon dioxide, but they do produce byproducts like nuclear waste and spent fuels. But some spent fuel are highly radioactive and must be stored in specially designed facilities.

In addition to the fuel waste, much of the equipment in the nuclear power plants become contaminated with radiation and will become radioactive waste after the plant is closed. These wastes will remain radioactive for many thousands of years, which may not allow re-use of the contaminated land.

Nuclear power plants use large quantities of water for steam production and for cooling, affecting fish and other aquatic life. Likewise, heavy metals and salts can build up in the water used in the nuclear power plant systems.

Environmental Impact by energy source cont'd

When water is discharged from the power plant, these pollutants can negatively affect water quality and aquatic life. However the safety of nuclear power in terms of lives lost per unit of electricity delivered is better than every other major source of power in the world.

Wind

Wind is a clean energy source. It produces no air or water pollution because no fuel is burned to generate electricity.

The most serious environmental impact from wind energy may be its effect on bird and bat mortality.

Wind turbine design has changed dramatically in the last couple of decades to reduce this impact.

Turbine blades are now solid, so there are no lattice structures that entice birds to perch.

Also, the blades' surface area is much larger, so they don't have to spin as fast to generate power. Slower-moving blades mean fewer bird collisions.

Mitigative measures on environmental degradation

Environmental Protection

Producing the energy that drives the world's economy has an impact on the environment, but energy companies and governments work to make that impact as small as possible. Industry practices of safe operations and environmental protection have evolved significantly in the past few decades. Technology improvements assists to conduct many aspects of our operations far more efficiently now than just a decade ago.

This efficiency translates to smaller "footprints" (the amount of surface area disturbed), less waste generated, cleaner and safer operations and greater compatibility with the environment.

Energy companies have developed and implemented sophisticated management systems that spell out the procedures required by employees and contractors to operate safely and to protect the environment. Over the past few years, these management systems have been extended to include social responsibility and ethical considerations.

The energy industry has shown repeatedly that energy production and environmental protection are not mutually exclusive. For example, the industry can produce the oil and gas needed to give consumers the freedom and mobility they demand and the warmth and light needed to survive while preserving the natural beauty of the environment.

Emissions from fossil fuel production and use may be contributing to the greenhouse effect of the atmosphere. As a start, they are managing their own use of energy. They use technology to convert waste heat into energy, reducing energy consumption and emissions.

Mitigative measures…. Cont'd

Many traditionally oil and gas companies are also exploring (and in some cases marketing) alternative energy sources such as solar power, biofuels, geothermal energy and wind power.

They are setting goals for themselves and using new emissions estimation and tracking tools to assess if their goals are being met, and they are reporting their progress to the public.

Finally, they are partnering with major universities and research institutions by investing hundreds of millions of dollars in climate change research to improve the understanding of global warming and to advance the technologies that will help combat it.

Mitigative measures cont'd

Carbon Capture

This is known as carbon sequestration, the carbon capture process traps and stores carbon dioxide after it is produced so the gas never enters the atmosphere. Carbon dioxide build-up in the atmosphere could possibly cause global warming and ocean acidification if it is not trapped and stored.

Carbon Capture and Storage (CCS) plays a critical role in fighting climate change by reducing CO_2 emissions while energy demands continue to rise globally. Oil companies have been using carbon capture for decades to enhance oil recovery.

Other Mitigative Measures

- The following are other measures to mitigate energy pollution;
- **Conservation:** reducing the use of resources through energy conservation.
- **Efficiency:** carrying out the same activity, but doing so more efficiently, thus reducing resource use and emissions of Air Quality (AQ) and climate-active pollutants. Energy efficiency can also play a major role, for example, through improving the insulation of building and using energy efficient appliances (CFLs, LEDs).
- **Abatement:** the application of a technological approach to reducing emissions through deforestation and reforestation.
- **Fuel switching:** substituting a lower emission fuel for a higher emission fuel so as to remove greater amounts of carbon dioxide from the atmosphere.
- **Demand management:** implementation of policies or measures which serve to control or influence the demand for a product or service.
- **Behavioural change**: changing the habits of individuals or organizations in such a way as to reduce emissions e.g. travelling by train instead of by air.
- These measures can be brought about in many different ways including through legislation, fiscal instruments, voluntary agreements and ongoing technological change.

Opportunities for low carbon energy technologies

Low carbon investment opportunities

- The future emissions pathway illustrates that greenhouse gas emissions are likely to increase significantly over the next twenty years. This is illustrative of some of the aspects of unsustainable growth including continued unsustainable use of natural resources, and increase dependence on and inefficient use of fossil energy.

- Member countries of the Chad Basin Commission, however, could look to adopt a more sustainable growth strategy, reducing future emissions, and benefiting from carbon financing and the many associated co-benefits.
- *Opportunities for Low Carbon Investment*

Four broad drivers that could make investments in low carbon projects of interest are:

- *Carbon financing* opportunities, providing investment and financing from projects or programmes that reduce CO2 emissions.
- Strong *policy co-benefits,* where low carbon investments are aligned to current or planned policies.
- *Strengthening development and growth*, where low carbon investments could actually stimulate new economic sectors and reduces costs e.g. through energy efficiency measures.
- A*daptation synergies,* where these investments align with actions needed to enhance climate resilient growth.

Opportunities for low carbon energy technologies Cont'd

- Biofuels as an alternative to transport fuels have the potential to reduce reliance on expensive imported fuels, develop new export markets and stimulate the rural economy.

- However, how the industry is structured to realise benefits to rural communities is critical, as would its perceived sustainability and necessary positive co-existence with food agriculture production.

- There is potential opportunities for other renewable including wind, solar and geothermal. However, investors will need to be incentivised through the tariff structure and be able to effectively use the carbon financing mechanisms.

- Promotion of solar home systems is already being developed in member countries ; mitigating the problems of affordability will be key to seeing this technology disseminated widely in rural areas.

Challenges

- While wind, solar and biofuels appear to be among the most promising, significant breakthroughs are still required to make them viable sources of future energy supply.
- The wind blows where and when it wants. Similarly, the sun only shines during the day. There is the challenge of renewable energy transportation from one location to the other and also effective storage system.
- The challenge will be to bridge these supply limitations with a 24-hour demand for electricity throughout the world. This means making the electricity grid more efficient and streamlined while developing storage systems to allow wind and solar energy to be saved for times of peak use.
- Currently, much of our electricity comes from burning coal in power plants, releasing large quantities of carbon dioxide and other gases. Despite advancements in “clean coal” technology, alternatives to coal will surely be part of tomorrow’s solution.
- New technologies are beginning to unlock vast reservoirs of natural gas in North America, making it both a cheap and clean alternative to coal.
- Natural gas is also more easily transportable over long distances and releases less pollutant for the same amount of energy produced. It is likely that meeting tomorrow’s energy needs will require not just one but all of these alternatives working alongside traditional fossil fuels.

Conclusion

- Energy exploitation, production and utilization have been major sources of environmental pollution. Various sources of energy impact differently on the environment.
- The conventional energy sources, compromising mainly of the fossil fuels pollute the environment immensely through the emission of CO_2, NO_x, SO_2, etc.
- The consequences of environmental degradation of the conventional energy sources compelled some countries and industries to look into low carbon energy sources such as solar, wind, hydro, geothermal, etc.
- The renewable energy sources are sustainable and contribute minimally to environmental pollution.
- Nigeria has embraced renewable energy resources exploitation and deployment to address mostly street lighting, water pumping and mini-grid solar electricity supply to some rural areas in Nigeria.
- The country has drafted the Renewable Energy Master Plan (REMP) derived from the National Energy Policy (NEP) of the country to address sustainable energy exploitation to combat climate change.

Recommendations

Low-Carbon Investments

- Full analysis of baseline projections, low carbon options, impacts of climate change on energy and low carbon options, costs and potential for prioritisation and development of strategy for mechanisms.
- Facilitate carbon finance opportunities in voluntary and compliance carbon markets (VCM and CDM)
- Prioritize forestry, agriculture, transport and electricity generation low carbon measures, considering short-term opportunities but also longer term areas where potential .'lock-in.' and identify alternatives.
- Improve sectoral co-ordination.
- Look for synergistic adaptation – low carbon project opportunities, e.g. agro-forestry and sustainable land-use

Climate resilience & co-benefits

- Climate risk screening of low carbon growth pathways
- Consideration of energy demand (cooling) and supply (hydro, fossil stations) effects from climate change, with associated adaptation (diversity, demand management).
- Analysis of potential impacts of climate change on forestry (REDD) and introduction of monitoring and move towards early adaptation.
- Explore opportunities in case studies of major low carbon strategies such as geothermal, biofuels and on-farm carbon management and how they might be scaled up to achieve both reductions in future emissions and adaptive development.

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THANK YOU