SUSTAINABILTY OF NON-CONVENTIONAL ENERGY

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ABSTRACT:

Energy is the primary and most universal measure of all kinds of work by human beings and nature. Energy is a crucial input in the process of economic, social and industrial development. As conventional energy sources are depleting day by day, utilization of alternative energy sources is the only solution. The increased power demand, depleting fossil fuel resources and growing environmental pollution have led the world to think seriously for other alternative sources of energy. Basic concepts of alternative energy resources are related to the issues of sustainability, renewability and pollution reduction. Here we have discussed about various alternative energy resources and their usability for future demands.

Development of any country is directly related to the energy resources present since energy is the backbone of technology. To meet the necessary demands great pressures have been created on the natural energy resources. Thus it is essential for today's world to concentrate on renewable ones to satisfy the demand and conserve our finite natural resources for the generations to come. Since the major energy comes from the finite, non renewable fossil fuels thus it becomes crucial to look for other renewable alternate energy sources such as Solar, Wind, and Biomass etc. In this paper, we will concentrate on those sources of energy and its sustainability in the the near future.

KEYWORDS: Non-Conventional energy, Sustainability, Energy Sources, India, Future.

1. INTRODUCTION:

To begin with, our planet basically runs on energy at this point. That would mean, that its generation is almost as vital as humanity itself. Everything from medicine to even agriculture itself depends on electricity. So generating it is basically a no brainer. There are a wide range of ideas that us humans came up with to generate all this energy. Most of them were invented a long time ago.

One of the first major breakthroughs in electricity occurred in 1831, when British scientist Michael Faraday discovered the basic principles of electricity generation. Building on the experiments of Franklin and others, he observed that he could create or "induce" electric current by moving magnets inside coils of copper wire. The discovery of electromagnetic induction revolutionized how we use energy. In fact, Faraday's process is used in modern power production, although today's power plants produce much stronger currents on a much larger scale than Faraday's hand-held device.

In 1880, coal powered a steam engine attached to the world's first electric generator. Thomas Edison's plant in New York City provided the first electric light to Wall Street financiers and the New York Times. Only a year later, the world's first hydroelectric plant went on-line in Appleton, Wisconsin. Fast-flowing rivers that had turned wheels to grind corn were now grinding out electricity instead. Within a few years, Henry Ford hired his friend Edison to help build a small hydro plant to power his home in Michigan.

Power plants became larger and larger, until we had massive coal plants and hydroelectric dams. Power lines extended hundreds of miles between cities, bringing electricity to rural areas during the Great Depression. After World War II unleashed nuclear power, the government looked for a home for "the peaceful atom". They found it in electricity production. Over 200 nuclear power plants were planned across the country, and homes were built with all-electric heating systems to take advantage of this power that would be "too cheap to meter".

In this perspective, India has been compelled to look towards its vast potential of renewable energy resources long before. Today India has one of the largest programs in the world for deploying renewable energy products and systems. In fact, it is the only country in the world to have an exclusive Ministry for New and Renewable Energy. Realizing the urgent need to utilize the non conventional source of energy, the Ministry has launched one of the world’s largest and most ambitious programs on renewable energy. Based on numerous promotional efforts put in place by Ministry for New and Renewable Energy, significant development is being made in power generation from renewable energy sources.

Reliable and sustainable electricity is currently not perfect; But it is inevitable to achieve. Lots of reasons exist for the existential disaster that unsustainable energy can can bring to humanity. Hence, the following are a few ways that sustainable energy could be achieved.

2. WHY DO WE NEED NON-CONVENTIONAL ENERGY?

The most commonly used source for electricity production today is coal; 41% of all electricity is produced from coal, according to the World Coal Association. Due to its high level of pollution (water and air pollution during mining and air pollution during burning) and often miserable circumstances for miners, we can conclude that this is not a sustainable source for electricity.

Our planet is getting increasingly warmer because of the use of fossil fuels. To prevent a run-away tipping point for irreversible climate change, we need to find renewable, non-polluting and non-conventional energy sources and minimize the use of fossil fuels to save our dear planet that is home to more than 7.5 billion people. It is needless to add that we have to save this planet for future generations including our own grand kids and their grand, grand kids.

As per sources, it is proven by Environmental Agency that when a thermal power plant generates 1000MW (3.8 Million Tonnes of Coal required to burn) of power for consumption, it releases *40% ash, 1.8% sulphur(1.3%) and Nitrogen(0.5%) content and 360% of carbon-dioxide.*

The mining of non-renewable energy and the by-products they leave behind causes damage to the environment. There is little doubt that fossil fuels contribute to global warming. When fossil fuels are burned, nitrous oxides causes photochemical pollution, sulphur dioxide creates acid rain, and greenhouse gases are emitted.

A major disadvantage of non-renewable energy is the challenge of breaking humans of their habit of leaning on it. The Union of Concerned Scientists reports it's an uphill battle to sway consumers that the so-called "public goods" of renewable energy, such as reducing pollution for everyone, may not be enough to convince them to pay more for cleaner energy.

As countries disagree through wars and differences, the prices of non-renewable energies such as oil has become a commodity where price fluctuation is always eminent. The burning of fossil fuels continues to rise producing high levels of carbon dioxide (CO2) which climatologists believe is a major cause of global warming.

3. SUSTAINABILITY:

When looking at sustainable electricity resources, we commonly identify four: solar, wind, hydro and biomass. Each of them is renewable, but that doesn't necessarily make them sustainable. Sustainability is determined by three different parameters: environmental sustainability, social sustainability and economic sustainability.

Environmental sustainability means that it doesn't do harm to the environment. That means that we need a positive energy balance to start with. If producing a renewable energy device costs more energy than it produces during its lifetime, it's not sustainable because we're a net consumer of energy. But there's a material side to it as well. Mining coal is bad for the environment, but mining neodymium and other rare earth metals for wind turbines is equally polluting. Let's not close our eyes for what's happening: anything that's mined destroys complete ecosystems. And we can only guess if submerging complete ecosystems by building hydro power dams is less destructive.

Social sustainability is enormously diverse and complex. It entails healthy circumstances for workers and decent wages. But an aspect like local welfare increase (as opposed to multinationals exploiting local communities) should definitely be included as well. There's one overarching aspect on social sustainability – we have one globe where we can provide enough food and energy for everyone. Using the planet's effectively and efficiently is therefore crucial.

Economic sustainability seems easy enough to measure. If a technology can be sold without subsidies it is sustainable, right? But in most countries fossil fuels belong to the most heavily subsidized products. According to the IEA's World Energy Outlook, fossil electricity is still subsidized for over $100 billion worldwide. So, how do renewable energy technologies compete with that when subsidies for renewable sources are only 1/6 of that? And which of these can be called economically sustainable? The one that can be purchased cheapest by consumers?

Sustainability is a very complex word and entails many aspects of which we've only scratched a few to illustrate its diversity.

4. WIND ENERGY:

Wind energy is basically harnessing of wind power to produce electricity. The kinetic energy of the wind is converted to electrical energy. When solar radiation enters the earth's atmosphere, different regions of the atmosphere are heated to different degrees because of earth curvature. This heating is higher at the equator and lowest at the poles. Since air tends to flow from warmer to cooler regions, this causes what we call winds, and it is these airflows that are harnessed in windmills and wind turbines to produce power. Wind power is not a new development as this power, in the form of traditional windmills -for grinding corn, pumping water, sailing ships - have been used for centuries. Now wind power is harnessed to generate electricity in a larger scale with better technology.

India‘s wind power potential has been assessed at 48500 MW. The current technical potential is estimated at about 13000 MW, assuming 20% grid penetration, which would increase with the augmentation of grid capacity in potential states. India is implementing the world's largest wind resource assessment program comprising wind monitoring, wind mapping and complex terrain projects. This program covers 800 stations in 24 states with around 200 wind monitoring stations in operation at present. Wind Electric Generators are being manufactured in the country by a dozen manufacturers through:

(i) Joint ventures or under licensed production.

(ii) Subsidiaries of foreign companies under licensed production.

(iii) Indian companies with their own technology.

India has the fifth largest installed wind power capacity in the world. MNES estimates total available wind-generated capacity in India to be at least 20,000 MW. The distribution of wind farms is concentrated in Tamil Nadu and Kutch (Gujarat), those two states accounting for over 750 MW of the installed capacity. The large majority of all wind farms (accounting for 775 MW of the total 19) are commercial undertakings. In Maharastra, four demonstration wind farms are currently operational. One of them being a grid-connected 2.77-MW installation at Chalkiwadi, built and operated by the Maharastra Energy Development Agency.

Reportedly, a total capacity of 17353 MW Wind Power has been established up to 31st March, 2012 in the country, which is about 70% of the cumulative deployment of the grid interactive Renewable Power. The Ministry has informed that against the 11th Plan target of 9,000 MW wind power, the achievement is 10,260 MW. Further, the capacity addition target for wind power for 12th Plan (2012-17) is 15,000 MW. Thus the aggregate capacity of 32553 MW is likely to be harnessed by the end of 12th Plan.

There are no GHGs emissions associated with operating wind turbines, emissions associated with other stages of a wind turbine’s life-cycle, materials transportation, including materials production, on-site construction and assembly, operation and maintenance, and decommissioning and dismantlement. Most estimates of wind turbine life-cycle global warming emissions are between 0.02 and 0.04 pounds of CO_2 equivalent per KWh which is far less as compared to that of natural gas generated electricity (0.6 - 2.0 pounds of CO_2 equivalent per KWh) or coal-generated electricity (1.4- 3.6 pounds of CO_2 equivalent per KWh.

5. SOLAR ENERGY:

Solar energy is the most readily available and free source of energy since prehistoric times. It is estimated that solar energy equivalent to over 15,000 times the world's annual commercial energy consumption reaches the earth every year. Solar energy can be utilised through two different routes, as solar thermal route and solar electric (solar photovoltaic) routes. Solar thermal route uses the sun's heat to produce hot water or air, cook food, drying materials etc. Solar photovoltaic uses sun's heat to produce electricity for lighting home and building, running motors, pumps, electric appliances, and lighting. In solar thermal route, solar energy can be converted into thermal energy with the help of solar collectors and receivers known as solar thermal devices.

The average solar radiation received by most parts of India range from about 4 to 7 kilowatt hours per meter square per day, with about 250-300 sunny days in a year. As can be seen from the solar radiation map above, the highest annual solar radiation is received by Rajasthan (desert area) and the lowest by the North eastern states of India. India has one of the world‘s largest programmes in solar energy which include R&D, demonstration and utilization, testing & standardization, industrial and promotional activities. Processed raw material for solar cells, large capacity SPV modules, SPV roof tiles, inverters, charge controllers all have good market potential in India as do advanced solar water heaters, roof integrated solar air heaters; and solar concentrators for power generation (above 100KW).

India has its potential of energy generation of about 30-50 MW/sq km. of shadow-free area covered with solar collectors for most parts of the country. In solar energy sector, some large projects have been proposed, and a 35,000 km² area of the Thar Desert has been set aside for solar power projects, sufficient to generate 700 to 2,100 GW. According to MNRE, the potential of solar energy is >100000 MW i.e. 30 -50 MW/sq. km and the cumulative deployment of grid interactive solar power up to 31.03.2012 is 941 MW. In July 2009, India unveiled a $19 billion plan, to produce 20 GW of solar power by 2020. On November 18, 2009, it was reported that India was ready to launch its National Solar Mission under the National Action Plan on Climate Change, with plans to generate 1,000 MW of power by 2013. Table-3 furnishes the detailed state-wise solar power capacity in India (as per MNRE).

Solar power generation do not emit any global warming emissions directly associated with generating electricity from, there are emissions associated with other stages of the solar life-cycle, including materials transportation, maintenance, and decommissioning, manufacturing, installation, and dismantlement. Calculations of life-cycle emissions for photovoltaic systems are between 0.07 and 0.18 pounds of CO_2 equivalent per kilowatt-hour.Most estimates for concentrating solar thermal plants produce 0.08 to 0.2 pounds of CO_2equivalent/kWh.

6. GEO-THERMAL ENERGY:

Geo-thermal power plant (known as hydrothermal plants) are located near geologic “hot spots” where hot molten rock is close to the earth’s crust and produces hot water or other regions of hot dry rock. Geothermal plants differ in terms of the technology they use to convert the resource to electricity and the type of cooling technology they adopt (water-cooled and air-cooled). Environmental impacts varies depending on the conversion and cooling technology adopted.

This is the energy, which lies embedded within the earth. According to various theories the earth has a molten core. The steam and the hot water come naturally to the surface of the earth in some locations of the earth. Two ways of electric power production from geothermal energy has been suggested. In one of this heat energy is transferred to a working fluid which operates the power cycle. This may be particularly useful at places of fresh volcanic activity, where the molten interior mass of earth vents to the surface through fissures and substantially high temperatures, such as between 450° C to 550° C can be found. In the other, the hot geothermal water and or steam is used to operate the turbines directly. At present only steam coming out of the ground is used to generate electricity, the hot water is discarded because it contains as much as 30% dissolved salts and minerals and these cause serious rust damage to the turbine.

Geological Survey of India (GSI) has identified about 340 geothermal hot springs in the country. The rough estimates based on GSI studies indicate that energy generation potential is 10,000 MW. These springs are perennial and their surface temperatures range from 37° C - 90° C which is suitable for direct heat applications and reservoir temperature 102° C – 260° C. So far the Ministry has been able to undertake only shallow bore hole drilling at some of the geothermal fields. These geothermal resources are distributed in the States of Andhra Pradesh, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Maharashtra, Orissa, Uttarakhand and West Bengal.

In a geothermal energy plant, approximately 10% of the air emissions are CO_2 , and a smaller amount of emissions are CH_4, a more potent global warming gas. There are a still some emissions associated with plant construction and surrounding infrastructure as well as drilling and pumping water into hot rock reservoirs. Putting these all into account, in the entire life-cycle global warming emissions for geothermal plant generated electricity are between 0.6 and 2 pounds of CO_2 equivalent per KW-Hr.

7. ENERGY FROM WASTES(BIO-MASS):

Biomass power plants share some similarities with fossil fuel power plants: both involve the combustion of a feedstock to generate electricity. The feedstock of biomass plants can be sustainable harvested, while fossil fuels are exhaustible.Harvesting of biomass for producing electricity are diverse; including energy crops (like switch-grass, giant miscanthus), agricultural waste,forest products and waste,urban waste, and manure. Both the type of feedstock and the manner in which it is developed and harvested significantly affect land use and life-cycle global warming emissions impacts of producing power from biomass.

The rising piles of garbage in urban areas caused by rapid urbanization and industrialization throughout India represent another source of non-conventional energy. An estimated 50 million tones of solid waste and approximately 6,000 million cubic meters of liquid waste are generated annually in the urban areas of India. Good potential exists for generating approximately 2,600 MW of power from urban and municipal wastes and approximately 1,300 MW from industrial wastes in India. A total of 48 projects with aggregate capacity of about 69.62 MW have been installed in the country thereby utilising only 1.8% of the potential that exists.

The MNRE has been implementing a programme for Energy Recovery from Urban and Industrial Wastes. The MNRE has reported that about 50 million tons of solid waste (1.40 lakh tons per day) and 6000 million cubic meters of liquid waste are generated every year by 423 Class I cities. This translates into a potential for generation of nearly 2600 MW of power from urban wastes in the country. The estimated potential for recovery of energy/generation of power from solid and liquid wastes being generated in various industrial sectors is about 1300 MW and is expected to increase to about 2000 MW by 2017. As on 31st March, 2012 a capacity of 90 MW has been installed. Ministry informed that about 80 projects for energy recovery from variety of industrial waste with an aggregate capacity of 145 MW have been installed in the country.

8. HYDROGEN ENERGY AND FUEL CELLS:

In both Hydrogen and Fuel Cells electricity is produced through an electro-chemical reaction between hydrogen and oxygen gases. The fuel cells are efficient, compact and reliable for automotive applications.Hydrogen gas is the primary fuel for fuel cells also. Fuel cells can be very widely used once they become commercially viable. Hydrogen has high-energy content, when burnt, it produces only water as a by-product and is, therefore, environmentally benign. At present hydrogen is available as a by-product from several chemical processes, plants or industries.

9. BOTTLE-NECKS AND CONSTRAINTS AGAINST SUSTAINABILITY:

There are several hurdles concerned with the development of non-conventional/renewable energy sectors in developing countries. These are:

A. Non-conventional/renewable energy technologies are capital intensive and require high initial investment.

B. The power purchase policy has not been encouraging for private entrepreneurs and suitable policy initiatives.

C. Technologies for several non-conventional/renewable energy sources have not fully stabilised.

D. The cost of non-conventional/renewable energy gadgets/ devices such as solar cooker, biogas, solar geysers, solar lanterns etc., is high.

E. Fiscal incentives namely 100% depreciation attracted several private investors.

F. Adequate number of professionally skilled manpower has not been developed in the non-conventional/renewable energy sector.

10. STEPS TO IMPROVE SUSTAINABILITY:

For development, dissemination and better and efficient use of renewable energy technologies in the country, following steps may be suggested:

A. Setting up biomass/solar/wind power generation systems and energy saving in every government office to encourage and inspire people.

B. Strenuous exaltation of non-conventional/renewable energy by government agencies, public sector, corporate, academic institutions etc.

C. Foundation of national-level body to increase awareness of non-conventional/renewable energy at comprehensive level.

D. Research and development of non-conventional/renewable energy technologies get provided the financial support and sponsorship.

E. Development of technically trained man-power for non-conventional/renewable energy sectors.

F. Establishing aspiring goals and targets for power generation non-conventional/renewable sources.

G. Making it compulsory to install solar water heating systems for all urban residential and commercial establishments.

H. Imperative non-conventional/renewable energy systems provision for new residential, commercial and industrial buildings.

I. Restricting use of large battery energy storage systems and promoting use of biofuels in vehicles.

J. Abrogating duties / taxes on import of small-scale non-conventional/renewable energy generating equipment and providing manageable loans for setting up non-conventional/renewable energy enterprises.

K. Handsome incentives and subsidies for installation and successful operation of non-conventional/renewable energy equipment and additional incentives for buyers and manufacturers of renewable energy equipments in rural areas.

L. Cultivation of energy crops on marginal and degraded land.

11. CONCLUSIONS:

The sustainable economic development and growth of any country are closely related to the development and security of its energy sectors. Concerning the finite and limited reserves of conventional energy sources and their impact on environment, a great emphasis should be given to the development of non-conventional energy sectors and their proper utilisation for the benefit and betterment of mankind. Such initiatives would also be helpful to create many employment opportunities at all levels, especially in rural areas. Thus, main streaming of non-conventional and renewable energy technologies is becoming very essential for the developing countries.

In India, there is great scope for the development of non-conventional and renewable energy sectors. India is the only country that has an exclusive Ministry for New and Non-conventional Energy Sources. India possesses the largest decentralised solar energy programme, the second largest biogas and improved stove programmes, and the fifth largest wind power programme in the world. However, India Government and different NGOs have spread their hands to promote the development of non-conventional energy sectors in India by implementing different policies and strategies. These include innovation and basic research in non-conventional/renewable energy technologies, establishing courses on non-conventional/renewable energy in higher education, resolving the barriers to development and commercial deployment of biomass, hydro-power, solar and wind technologies, promoting the development and manufacture of small wind electric generators, and enhancing the regulatory/tariff regime in order to main stream non-conventional and renewable energy sources in the national power system.