Is The Future Greener?

Once the globe was pristine. As the civilisation on the earth progressed, the destruction of the nature began. With advent of industrial revolution during the mid-19th century, the destruction of nature accelerated. The industrial revolution brought in changes from hand production methods to machines, new chemical manufacturing and iron production processes, the development of machine tools and the rise of the factory system leading to increased dependency on the use of coal fired steam power. Further, the steam powered Locomotives and electric power generation station started in the UK in 1804 and 1880 respectively. Carl Benz first drove an internal combustion engine powered three-wheeled vehicle in 1885. Henry Ford revolutionised the mass production of automobiles beginning in the year 1908. As the industrialisation progressed, construction of factories and creation of road and rail infrastructure all began. This industrial and economic growth started driving increased consumption of fossil fuels for energy generation and also led to deforestation for land and wood. The great 19th Century naturalist John Muir often lamented humanity's widespread desecration of nature. "In the noblest forests of the world, the ground, once divinely beautiful, is desolate and repulsive, like a face ravaged by disease," he wrote. "The same fate, sooner or later, is awaiting them all, unless awakening public opinion comes forward to stop it."

At present, the world's population is around 7.5 billion and it is growing at the rate of 1.11 percent. The Gross World Product (GWP) is USD 127 trillion (PPP) and it is growing at the rate of approximately 3%. The total installed capacity of electricity in the world at present (2016) is around 16000 GW. Out of 16000 GW, 67.5% of the power is being generated using thermal power stations (coal 41.5%, oil 22.1%, and gas 3.9%). The fossil fuels also supply thermal power to transport sector as well as industrial and domestic sector. The fossil fuels produce carbon dioxide when combusted, in addition to carbon monoxide, oxides of nitrogen and water vapour. The total carbon dioxide emitted in the world due to human activity comprises 33% from thermal power plants, 34% from transport sector and 33% from industrial and domestic sector. The world pumped 39.8 billion tons of carbon dioxide during 2014 and it is 2.3 % more than the previous year. Carbon dioxide remains in the atmosphere from about fifty up to two hundred years before it is ultimately absorbed by the oceans and other carbon 'sinks'.

The concentration of carbon dioxide is around 410 ppm on volume basis as on 2014 and it is equivalent to 3200 giga tonnes of Carbon dioxide. As around 40 billion tonnes of carbon dioxide is being pumped into the atmosphere annually, there is an annual increase in carbon dioxide concentration by 2 ppm. Atmospheric concentration of carbon dioxide could increase to 415-480 ppm by 2050, rising to 460-560 ppm by 2100. It is considered that beyond 450 ppm of carbon dioxide concentration in atmosphere could lead to dangerous consequences as the global temperature rise would be approximately 2^0C. Carbon dioxide is a greenhouse gas. The cover of carbon dioxide in atmosphere acts as a glass house trapping terrestrial radiations resulting in global warming. The average temperature of earth is considered as 14 or 15 degree Celsius based on reference. According to an ongoing temperature analysis conducted by scientists at NASA's Goddard Institute for Space Studies (GISS), the average global temperature on Earth has increased by about 0.8° Celsius (1.4° Fahrenheit) since 1880. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.20°C per decade. The Global warming is leading to coastal flooding; severe droughts, increase risk of wildfires; forests, farms, and cities will face troublesome new pests, heat waves, heavy downpours, and increased flooding. All these factors will damage or destroy agriculture and fisheries. Disruption of habitats such as coral reefs and Alpine meadows could drive many plant and animal species to extinction. Allergies, asthma, and infectious disease outbreaks will become more common due to

increased growth of pollen-producing ragweed, higher levels of air pollution, and the spread of conditions favourable to pathogens and mosquitoes.

By burning fossil fuels, not only billion tonnes of carbon dioxide is pumped to the atmosphere influencing effects of global warming but billion tonnes of water vapour is also pumped into the atmosphere. For every kg of bituminous coal burnt roughly 0.4 kilograms of water vapours are produced. The condensed water vapour returns to earth as rain water. If the climate changes, the distribution and cycling of water vapour changes as well.

To make the globe greener for the future, use of renewable energy sources like solar photovoltaic, solar thermal, wind and biofuels are being encouraged across the world. The globe at present may need 50 000 GW of power to meet all its energy needs. It is envisioned that the future transportation is all electric. There will be electric cars replacing gasoline and diesel powered cars, hyper loops meeting intercity travel requirements, every house hold draw electric power from its roof top installed photovoltaic and wind mill power plants, electric and thermal power for commercial establishments are drawn from central solar and wind power plants. There will be battery stations instead of petrol bunks supplying stored energy. According to a report from the International Energy Agency (IEA), 2016 was a record year for electric vehicle (EV) sales. More than 750,000 EVs were sold worldwide last year, compared to 547,220 sold in 2015. There are more than 2 million electric vehicles on the road around the world. In 2014, the total world demand for electricity was 23,537 TWh, or 0.045TWh per minute. If we took the world's entire battery production capacity in the year 2014 we could store 11 minutes and 27 seconds of global electricity demand. Lead-acid batteries (the typical 12 volt accessory battery in most motor vehicles) would contribute the majority of this capacity, providing 10 minutes and41 seconds of electricity, while lithium-ion batteries would contribute 46 seconds.

In future, all most all the engineering systems will be intelligent, making decisions using data science, machine learning, deep learning and artificial intelligence based algorithms and Internet of things. The autonomous cars are the result of availability of such algorithms and technologies. Intelligent robots will be doing the tasks which men and women usually perform. Not only manufacturing industries, health and agriculture sectors use Robots abundantly in the immediate future. Most of the construction and manufacturing will be done using 3D printers. We may all experience, altogether a different way of producing engineering products in future. Elon Musk who is pioneering electric car, hyper loop, and solar city has already become an icon. The whole engineering education may have to be reoriented to educate and train graduates to meet the new challenges.

At present (2016) the installed Solar Photovoltaic power is more than 303 GW, around 2% of total electric power installed capacity of the world with China leading the table with 79 GW. The standard sizes of photovoltaic panel used are of 1.65 m x 1 m in domestic sector and 2m x 1 m in commercial sector. For every kW of electricity, normally 5.3 square meter of panel surface is required. It is a rough estimate that 9 500 square km of solar panel surface area is required to meet the Global energy needs. If the cost per kW is approximately USD 2000, the total cost for installation of solar power will be USD 100 000 billion. If the World could achieve this scenario, there may not be considerable increase in the Global temperature. However, complete replacement of consumption of fossil fuels by use of solar power could lead to change in present weather map of the world. The change in weather map could lead to change in the rain fall pattern as well even the rain fall may come down. The change in weather map and rain fall pattern may disturb the present status of the civilised world as the agriculture, vegetation, animal and aquatic life all may get affected. In addition, the continued deforestation will add to the woes.

Another important energy source being encouraged is wind. Wind turbines take energy from the atmosphere and turn it into electricity; with industrial grade turbines being built at a terrific rate, scientists have been trying to assess exactly what the effects are both at local and at global levels. Some of the effects predicted are couple of percent changes in rain and a few tenths of a degree of temperature increase. Extraction of wind energy may vary the rain fall pattern in a given geographical region.

Now that the impacts of solar and wind turbines on climate are becoming better understood, more comprehensive studies of complete future energy systems are needed. It is necessary to know, what combination of wind power, solar power, nuclear power and fossil fuel power, together with what combination of measures to remove carbon from the atmosphere, will result in the lowest overall environmental and social impacts.

In addition to carbon dioxide, methane, fluorocarbons and nitrous oxide also act as green house gases. Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills. Methane is a more potent greenhouse gas than CO_2, there is over 200 times more CO_2 in the atmosphere. Hence the amount of warming methane contributes is 28% of the warming CO_2 contributes. "A United Nations report has identified the world's rapidly growing herds of cattle as the greatest threat to the climate, forests and wildlife. Livestock are responsible for 18 per cent of the greenhouse gases that cause global warming, more than cars, planes and all other forms of transport put together. Burning fuel to produce fertiliser to grow feed, to produce meat and to transport it - and clearing vegetation for grazing - produces 9 per cent of all emissions of carbon dioxide. And their wind and manure emit more than one third of emissions of another, methane, which warms the world 20 times faster than carbon dioxide."

Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for stratospheric ozone-depleting substances (e.g., chlorofluorocarbons, hydrochlorofluorocarbons, and halons). These gases are typically emitted in smaller quantities, but because they are potent greenhouse gases, they are sometimes referred to as High Global Warming Potential gases ("High GWP gases").

Green living is about saving energy and keeping carbon footprint in check. In addition, the world should become a place worth living for every citizen with least threat to civilisation. Achieving green living demands higher levels of global knowledge, understanding, thinking and commitments from every citizen of the globe. The solution to a complex global warming problem will be possible only when all the national leaders come together and make sound and implementable progressive decisions for further growth of this civilised world. One of the objectives of G20 is to achieve global economic stability and sustainable growth and should never be compromised. According to Christine Lagarde, of the International Monetary Fund (IMF) “It’s a collective endeavour, its collective accountability and it may not be too late.”

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