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Global Energy Demand Consequences Versus Greenhouse Gases Emission

Surendra Kumar Yadav and Govind Chandra Mishra[2]

[1]University Department of Engineering & Technology (SCRIET), CCS University, Meerut-250004, India.
[2]MVN University, Faridabad, Haryana.

Abstract

Renewable Energy has become a priority issue at the national level and has been mainstreamed in national and sectoral policies, strategies, plans and/or roadmaps in most countries through the development of National Energy Policies and Sector Plans with greater emphasis on Renewable Energy setting targets reflecting their commitments to renewable energy development. All of the various means of generating electricity have a role to play in meeting the rapidly increasing demand for this form of energy. Nuclear power plants do not emit any carbon dioxide nor any sulphur dioxide or nitrogen oxides. Pressure to replace fossil fuels has focused more attention on renewable sources - eg solar and wind. There is need to replace pollution causing sources with non-polluting sources to meet global energy demand.

Keywords: Energy; demand; renewable; GHGs; emission.

1. Introduction

The IPCC in 2011 aggregated and harmonized the CO_2 emission findings of hundreds of papers, which were published between 1980 and 2010 [1]. A literature review conducted by the Intergovernmental Panel on Climate Change in 2011, of numerous energy sources CO_2 emissions per unit of electricity generated, found that the CO_2 emission value, that fell within the 50th percentile of all total life cycle emissions studies were as follows [2]. The Intergovernmental Panel on Climate Change states that total life-cycle GHG emissions per unit of electricity produced from nuclear power are below 40 g CO_2-eq/kWh (10 g C-eq/kWh), similar to those for renewable energy

sources [3]. A 2005 study [4], issued by Jan Willem Storm van Leeuwen, reported that carbon dioxide emissions from nuclear power plants per kilowatt hour could range from 20% to 120% of those for natural gas-fired power stations depending on the availability of high grade ores [4].

Greenhouse gases greatly affect the temperature of the Earth; without them, Earth's surface would average about 33 °C (59 °F) colder than the present average of 14 °C (57 °F) [5-7]. Since the beginning of the Industrial Revolution (taken as the year 1750), the burning of fossil fuels has contributed to a 40% increase in the atmospheric concentration of carbon dioxide, from 280 to 392.6 parts-per-million (ppm) in 2012 [8-9]. This increase has occurred despite the uptake of a large portion of the emissions by various natural "sinks" involved in the carbon cycle [10-11]. Anthropogenic carbon dioxide (CO_2) emissions (i.e., emissions produced by human activities) come from combustion of carbon based fuels, principally wood, coal, oil, and natural gas [12-14].

2. Electricity & Greenhouse Gases

Every form of energy conversion, such as turning primary energy into electricity, has some environmental implications. World electricity demand is forecast to double between 2002 and 2030. For instance, while the growth in demand for primary energy in East Asia is around 5% per year, which for electricity is 7-8% per year. In recent years attention has been focused on the climate change effects of burning fossil fuels, especially coal, due to the carbon dioxide which this releases into the atmosphere. Carbon dioxide contributes at least 60% of the human-induced increase in the greenhouse effect. Electricity generation is one of the major sources of this carbon dioxide, giving rise to about 9.5 billion tonnes per year - 40% of it, or about one quarter of the human-induced greenhouse increase. Coal-fired electricity generation gives rise to nearly twice as much carbon dioxide as natural gas per unit of power, but hydro and nuclear do not directly contribute any. If the amount of nuclear power were doubled, emissions from electricity generation would drop by one quarter. Conversely, there is scope for reducing coal's carbon dioxide contribution to the greenhouse effect by substituting natural gas or nuclear power, and by increasing the efficiency of coal-fired generation itself, a process which is well under way.

Nuclear power is well suited to meeting the demand for continuous, reliable electricity supply on a large scale (ie base-load electricity), the major part of demand. Today there is no question about the existence of the greenhouse effect. Without it our planet would be vastly colder (by 33°C on average), and present life forms would be very different. Water vapour is the main greenhouse gas, accounting for some three quarters of the greenhouse effect, and nothing we do is likely to change it very much. But second to that, and much more related to human activity, is carbon dioxide. A major source of this today is the burning of fossil fuels to provide energy, particularly electricity. Human activity, particularly since the beginning of the Industrial Revolution, seems to be turning up the heat. Each year well over 28 billion tonnes of carbon dioxide are put into the atmosphere by human activity. This is only about 3% of

the natural flux between atmosphere and oceans or land. But its balance is critical. Carbon dioxide is responsible for more than half of human-induced global warming effect.

3. Energy Demand In Future

Only 13 percent of global energy demand is met by renewable energy sources. Due to large barriers for renewable energy this share will only increase slightly in the next decades. Bellona has analysed the barriers and the potential for renewable energy. In order to mitigate climate change a global transition from fossil energy sources to renewable energy is required. However, there are large barriers for renewable energy, and according to the International Energy Agency (IEA) renewable energy will only have a small share of the global energy market in 2030. Currently, only around 13 percent of global energy demand is met by renewable energy sources. While a significant increase in renewable energy production is expected in the future, a similar increase is expected in global energy demand. This means renewable energy will maintain only a small part of the total share of energy production towards 2030.

The most relevant sources of renewable energy are wind, solar, biomass, hydro, wave, tidal and geothermic heat. Common denominators for all these sources are the realizable potential being far below the theoretical potential. An assessment of the potential of energy production using renewable energy sources must be based on a barrier analysis, as well as an analysis of the environmental impact from each of the different technologies. An increased implementation of renewable energy productions is slowed down by economic, technical, land use, social and environmental barriers. Especially the technical, environmental and social barriers related to renewable energy sources indicate the continued domination of fossil energy sources also in 2030. According to the International Energy Agency, IEA, only 16 percent of global energy demand in 2030, can be covered by renewable sources. A widespread effort could result in a share of renewable energy beyond the estimates by the IEA, this would require new financial incentives as well as other measures to reduce particularly the economic barriers related to renewable energy production. The limited potential for renewable energy is a strong indication that energy production from fossil fuels with CO_2Capture and Storage (CCS) is an important option for reducing global CO_2 emissions and mitigating climate change.

4. Policy & Actions

Governments have taken action to reduce GHG emissions (climate change mitigation). Assessments of policy effectiveness have included work by the Intergovernmental Panel on Climate Change [15], International Energy Agency [16-17], and United Nations Environment Programme [18]. Policies implemented by governments have included [19-21] national and regional targets to reduce emissions, promoting energy efficiency, and support for renewable energy. GHG intensities are subject to uncertainty over whether they are calculated using market exchange rates (MER) or

purchasing power parity (PPP) [22]. Calculations based on MER suggest large differences in intensities between developed and developing countries, whereas calculations based on PPP show smaller differences. Land-use change, e.g., the clearing of forests for agricultural use, can affect the concentration of GHGs in the atmosphere by altering how much carbon flows out of the atmosphere into carbon sinks [23]. Accounting for land-use change can be understood as an attempt to measure "net" emissions, i.e., gross emissions from all GHG sources minus the removal of emissions from the atmosphere by carbon sinks. There are substantial uncertainties in the measurement of net carbon emissions [24]. Additionally, there is controversy over how carbon sinks should be allocated between different regions and over time. For instance, concentrating on more recent changes in carbon sinks is likely to favour those regions that have deforested earlier, e.g., Europe.

5. Conclusions

Global demand for energy has risen inexorably in the last 150 years in step with industrial development and population growth. The main share of global energy (about 80% at present) is supplied by coal, oil and gas - the 'fossil fuels' that formed long ago from the carbon-rich remains of dead plants and animals. Hunger for energy is predicted to continue to rise, by at least 50% by 2030, as developing countries like China and India seek to fuel their rapid economic growth. Concern has also grown in recent decades about environmental impact. Mainstream climate scientists warn greenhouse gas emissions, caused by burning fossil fuels and other human activities, must be substantially reduced to avoid dangerous climate change. That's a 40% jump in global energy demand by 2030. Electricity demand is growing twice as fast, projected to be 76% more than we use now. The rate of growth in energy use slows over the projection period, reflecting moderate population growth, an extended economic recovery, and increasing energy efficiency in end-use applications. Renewables (barring hydroelectric) are not expected to achieve a significant market share within the next 25 years. There is need for exploring new and reneeable energy sources with respect to low emission of green house gases (GHGs).

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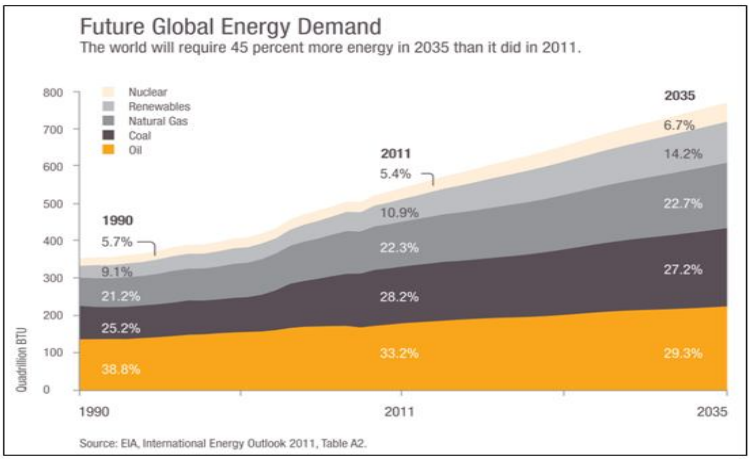
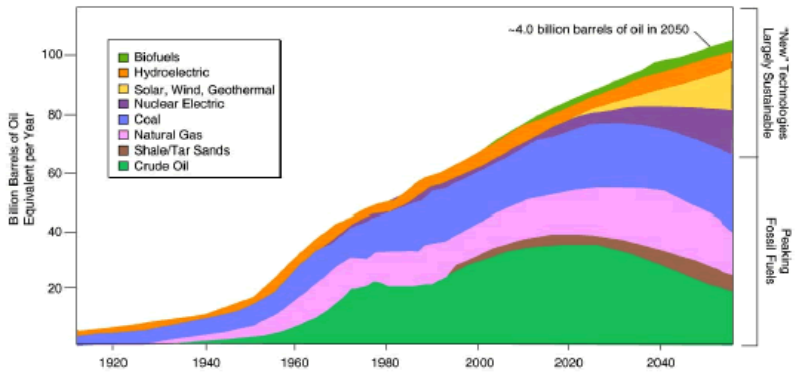


World Energy Demand—Long-Term Energy Sources



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