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Meeting Future Energy Needs

1. Introduction

Global energy needs are expected to increase significantly in the coming future. As shown in Figure 1, Energy Information Administration (EIA) of U.S.A. predicts that the global energy consumption will increase from 644 Quintillion Joules in 2020 to 780 Quintillion Joules in 2040 (Capuano, 2018). This increasing demand for energy will lead to a significant increase in greenhouse gas particularly CO_2 emissions, based on the current fraction of fossil fuels usage. Meanwhile, global warming, caused by greenhouse gases, is still a challenge for people because of the increased temperature and the abnormal weather conditions. Figure 2 (Trenberth & Fasullo, 2013) shows that the global temperature is increasing rapidly, mainly due to the increasing CO_2 concentration.

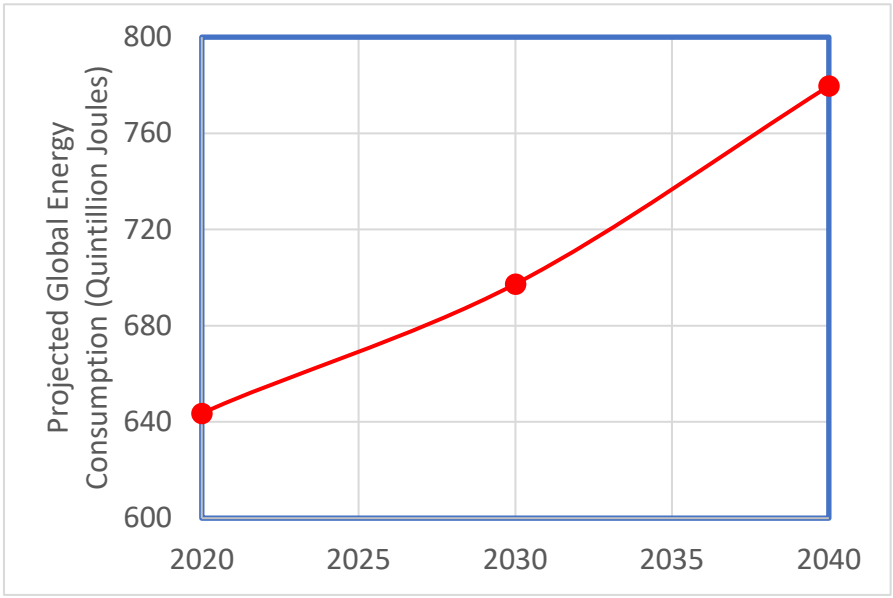

Figure 1. Projected Global Energy Consumption data from Capuano, 2018.

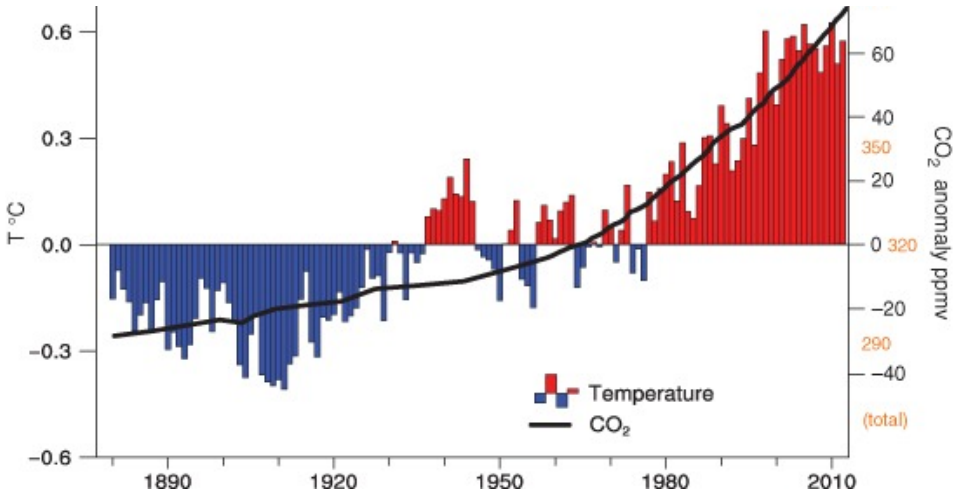

Figure 2. Global Temperature and CO_2 Concentration (Trenberth & Fasullo, 2013)

As the usage of nuclear energy is still controversial (Aref L. et al. 2019) renewable energy is expected to make a great contribution to meet the increasing energy demand while minimizing greenhouse gas emissions. As shown in Figure 3, by 2017, renewable energy accounts for approximately 10.4% of the worldwide energy source (Elavarasan, 2019). It is projected that the renewable energy will account for 31% (Ellabban et al. 2014). This article reviews the main renewable energy techniques currently used, comprising of solar energy, hydropower energy, biomass energy, wind energy and geothermal energy, in terms of their advantages and challenges.

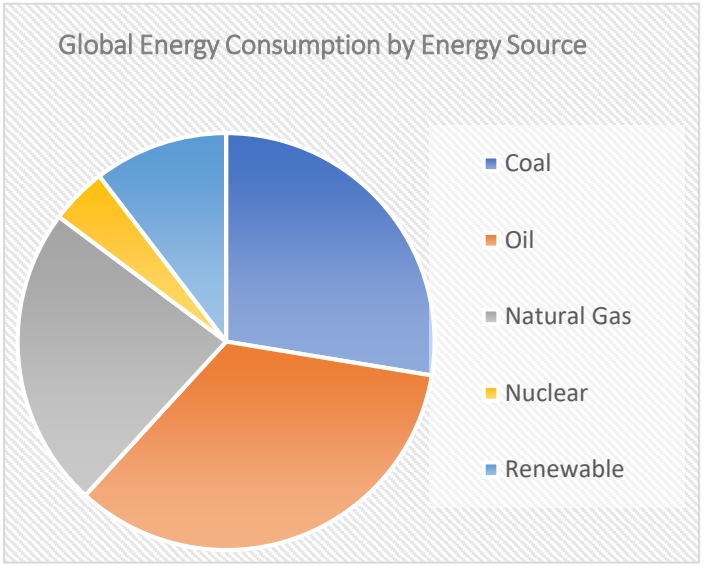

Figure 3. Global Energy Consumption by Energy Source, 2017 data from Elavarasan. 2019.

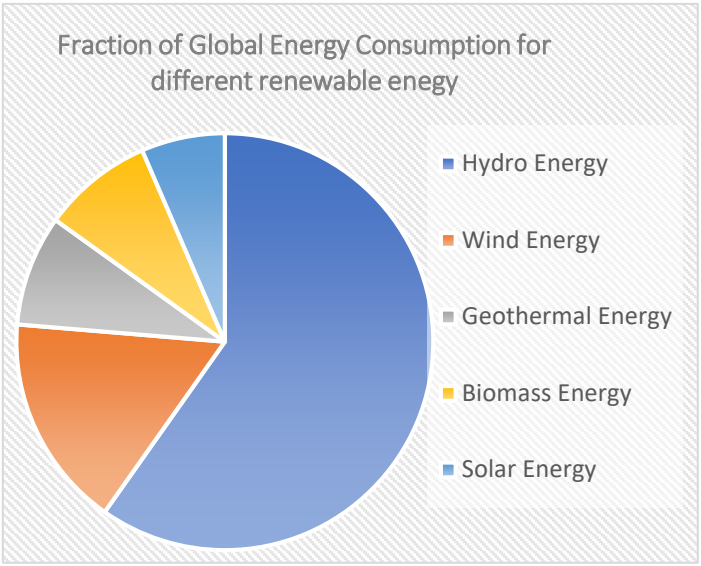

Figure 4. Fraction of Global Energy Consumption for different renewable energy, data from Elavarasan. 2019.

2. Review of Renewable Energy

2.1 Hydropower

Hydropower is the energy obtained from the flowing water by either dam or run of river (ROR) without depleting it (Yuksel, 2010). As shown in Figure 5, about 50% of renewable energy in 2035 will be from hydropower. The advantages of hydropower include relatively low cost, clean environment and safe storage (Ellabban et al. 2014). Hydropower can provide baseload power. However, hydropower plants are limited to places with a water supply and dams have major environmental impacts; hydro plants emit greenhouse gas from decayed plant matter (Muise, 2019).

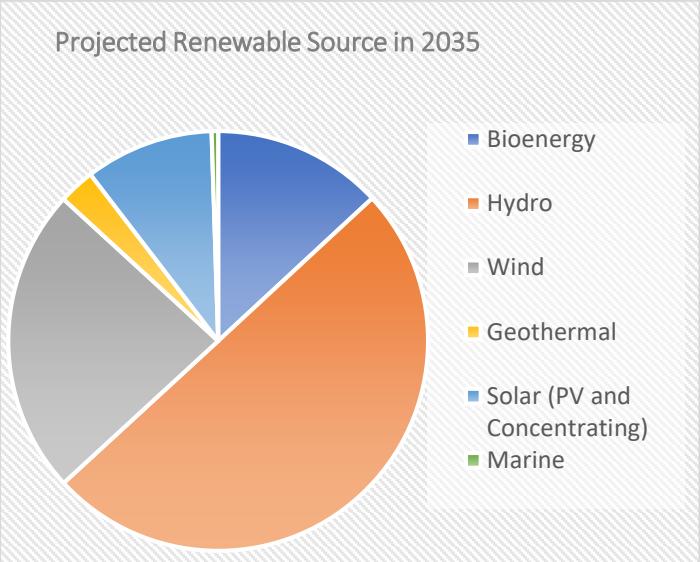

Figure 5. Projected Renewable Source in 2035, data from Ellabban et al. 2014.

2.2 Solar Energy

Solar power is the conversion of energy from sunlight to electricity, by solar photovoltaics or concentrated solar thermal (Kabira et al. 2018). The advantages include infinite energy supply, no emission of greenhouse gas and pollution. The disadvantages are the relatively high price, lower efficiency compared with fossil fuels and intermittency. Batteries or other energy storage technology are required to solve the problem of intermittency.

2.3 Wind Energy

Wind energy employs air flows through wind turbines to convert the energy of wind to electricity. As shown on Figure 5, it is expected that approximately 25% of renewable energy will be wind energy. The advantages of using wind power include a free source of energy, pollution – free and is inexpensive to construct windfarms (Elen, 2019). The disadvantages include high wind speed required, windfarms destroying landscape imagery and wind turbines producing raucous noise (Elen, 2019). Another challenge is intermittency and energy storage technology are required to overcome the issue.

2.4 Biomass Energy

Biomass energy is from combustible fuels which are from biomass, such as food crops, wood, grass, parts of plants and algae. As shown in Figure 5, biomass will account for approximately 15% of renewable energy in 2035 (Ellabban et al. 2014) The advantages of biomass are that it can be used to burn waste products. The challenge is air pollution and emissions from combustion. Some biomass fuels have a fairly high cost, such as the algae.

2.5 Geothermal Energy

Geothermal energy is thermal energy generated and stored in the Earth (Carlson, 2019). The advantage of geothermal energy is reliability and consistency. The challenges include that some geothermal plant construction can be quite expensive. Geothermal energy might accidentally release greenhouse gas and hydrogen sulphide.

2.6 Marine Energy

Marine energy is the energy from the natural rise and fall of the tides. Marine energy is quite efficient as it is an ideal energy resource for island countries and it captures the energy that would, otherwise, not be collected. The disadvantages are that construction of tidal plants can be costly, marine energy is opposed by some environmental groups as having a negative impact on wildlife and it takes up lots of space unwater and is difficult for shipping to move around (Kabeya, 2019).

3. Conclusion

Renewable energy will play an important role to meet future energy needs. The hydropower is expected to account for nearly half of the renewable energy in 2035. However, hydropower needs to have water resources nearby for a hydroplant to be constructed. Wind and solar energy will account for about 35% of the renewable energy used in 2035. The challenge for solar and wind energy is intermittency. Energy storage is needed to overcome the intermittency issues. Biomass, that accounts for a 15% of renewable energy in 2035 shown in Figure 5. However, it still emits greenhouse gases. Geothermal only accounts for less than 5% for renewable sources in 2035 and it still emits greenhouse gases.

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