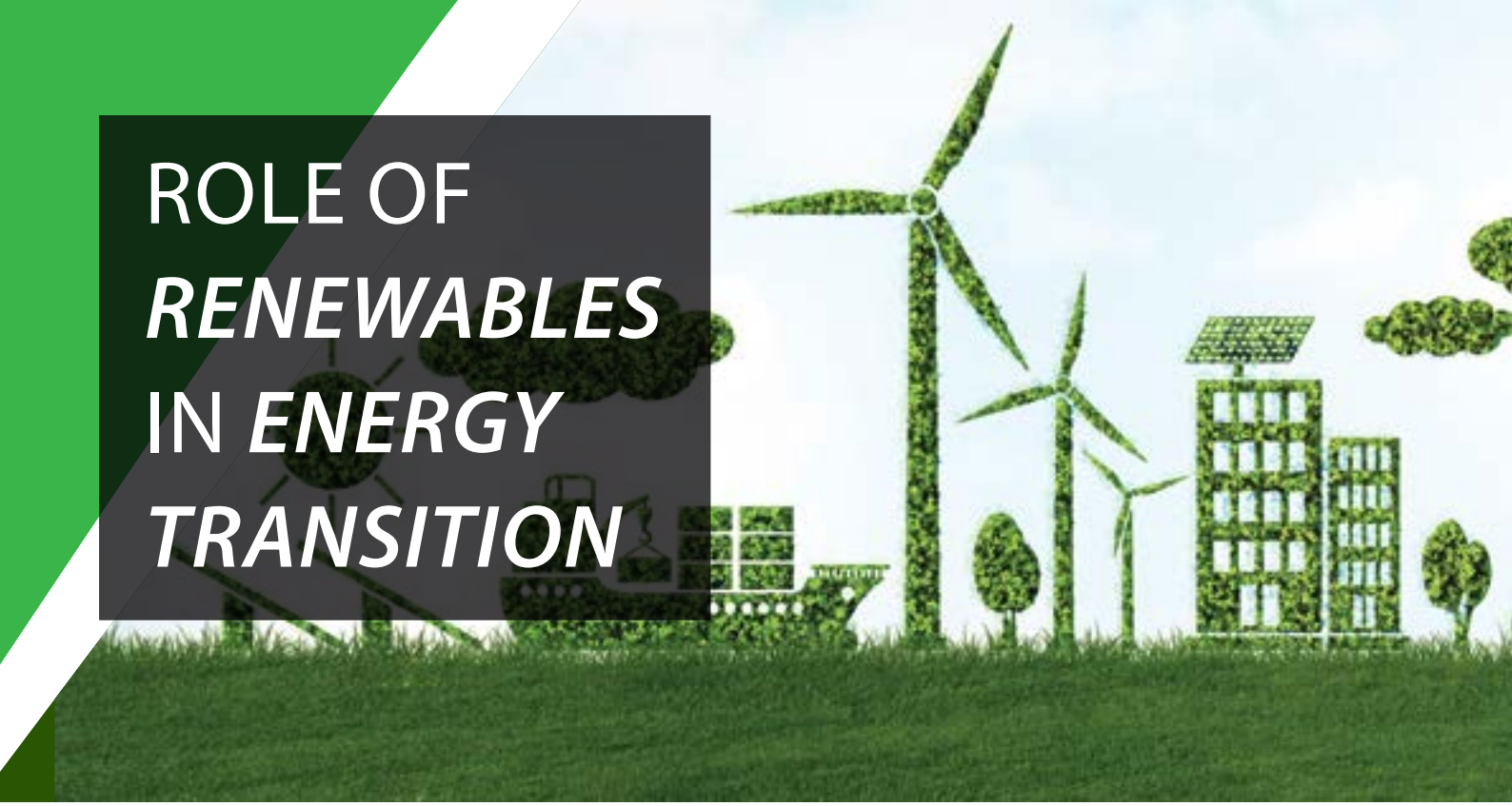
ROLE OF *RENEWABLES* IN *ENERGY TRANSITION*



The World Economic Forum defines an effective energy transition as ***"a timely transition towards a more inclusive, sustainable, affordable and secure energy system that provides solutions to global energy-related challenges, while creating value for business and society, without compromising the balance of the energy triangle"***[1]

As per Intergovernmental Panel on Climate Change (IPCC), United Nations body for assessing the science related to climate change; human activity is likely responsible for about 1˚C of the global warming above pre-industrial levels. They predict that global warming is likely to reach 1.5˚C between 2030 and 2052 if current activities continue[1]. The carbon budget will get depleted in 10-17 years[2] in order to limit global warming within 1.5 ˚C, with the current emission levels. Hence, there is an urgent need to limit CO2 emissions.

The power generation sector and transportation sector are the two main sectors which account for about 50% of the total CO2 emissions[1]. Hence, these areas must be looked at critically for implementing the energy transition. However, it does not take away the required attention from the remaining sectors such as iron & steel, cement, heavy transportation, aviation and shipping, where solutions are still evolving.

In the following sections, the discussion on these two significant sectors focuses on how renewables can play a crucial role in the energy transition.

Power Generation:

Fossil fuels continue to negatively impact air, soil and water pollution and contribute to direct CO2 emissions. Hence, renewable energy forms the critical component of a low carbon economy both in the generation and in the end-use application.

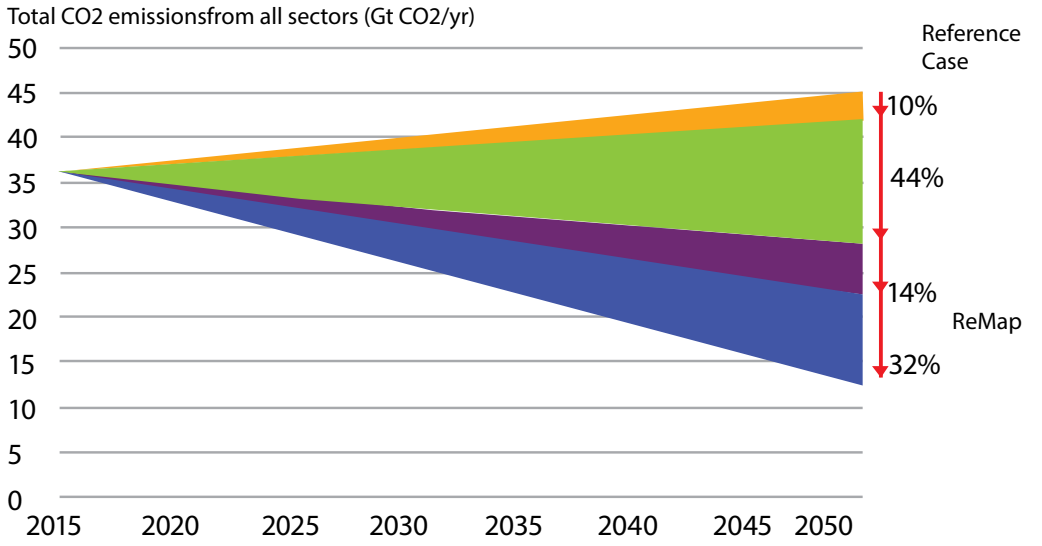
Sustainability is one of the key drivers of the current energy transition that the world is going through. The energy sector is changing its landscape with more renewable generation share boding well for a sustainable future. Solar PV and Wind projects make headlines world over for higher capacities and record-low costs, making them the natural choice for broader adoption, thus paving the way for a smoother and a sustainable energy transition.

1 Fostering effective energy transition, 2020 edition, World Economic forum
2 World Economic Forum, Energy transition 101-Getting back to basics for transitioning to a low carbon economy

2019 has been a record year witnessing drastic change towards sustainability and the emissions from the energy sector has remained more or less flat[1]. While coal-based generation's contribution has reduced by 3%, the renewable-based generation has increased more than the electricity demand growth[1]. Researchers say that global carbon emissions have dropped by an estimated 2.4 billion metric tons this year due to the coronavirus-induced lock downs[3]. Though this is welcome, there is every chance that this value will rebound once we return to normalcy post covid unless urgent action is taken.

Reducing energy-related CO2 emissions to limit climate change is pivotal to the global energy transition. Renewable energy and the adoption of energy efficiency measures can achieve up to 90% of the required carbon reductions, with two-thirds coming from renewable energy alone[4].

It is good news that many of the finance sector asset managers and non-finance sector organisations, including oil and coal companies, are investing in renewable assets as a step towards meeting their carbon neutrality goals.



Notes: Includes energy, non-energy use, process and fugitive CO_2 emissions; the Reference Case is most likely case based on current and planned policies and expected market developments; the REmap case is a low-carbon technology pathway that goes beyond the Reference Case for an energy transition to decarbonise the energy system in line with the goal in Paris Agreement of limiting global temperature rise to less than 2°C above pre-industrial levels with a 66% probability; yr = year.

Figure 1: Primary CO2 emission reduction potential by technology 2015-2050[3]
(Renewable energy: 44%, Electrification with renewables: 14%, Energy efficiency: 32% & others: 10%)

3 IRENA Global Renewable Outlook 2020 & Climate policy

4 https://www.dw.com/en/global-carbon-emissions-down-by-record-7-in- 2020/a-55900887 Global Carbon Budget 2020

This should get amplified in the coming years to visualise a perceptible change in the energy sector demography. It is expected that investment from significant Oil and Gas companies will increase tenfold from 2020 to 2050[5].

As per IEA's Market Update on Renewables, Nov 2020 renewables used in electricity generation has shown resilience during Covid and is poised to grow by 7% by the end of the year[5]. Renewable equipment manufacturers and developers have seen better growth in their share value than their other energy sector counterparts[5]. This is commendable considering the present economic uncertainties related to covid and has only reinforced the investors' faith in the renewable sector.

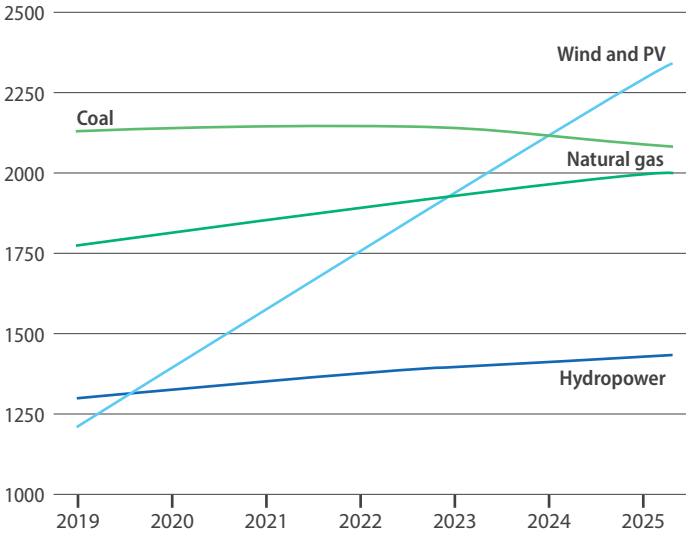


Figure 2: Total projected Installed Power Capacity by fuel and Technology 2019-2025[5]

By 2025, it is not only predicted that the renewable capacity additions will be 95% of the total reserves but also that renewables will surpass coal to become the largest source of electricity. Hydropower would continue to supply half of the renewable power followed by Solar and Wind.

Unlike dispatchable Hydropower, Solar and Wind need to be complemented by energy storage systems to provide continuous power supply. Hence, energy storage systems such as Pumped storage and Battery energy storage system play an essential role in the energy transition by not only supporting renewables reach the desired levels but also in maintaining grid stability.

Pumped storage provides various grid services such as reactive power support, frequency control apart from black-start capabilities. Hence, it becomes the preferred large-scale energy storage solution for ensuring grid stability with increased renewable penetration and can act as a catalyst in the global energy transition.

Better power system flexibility can be achieved by integrating battery energy storage with renewables, in addition to other benefits such as better ramp rate, energy shifting, investment deferral in any distribution system, etc. According to a report by Rocky Mountain Institute, battery storage is expected to enable renewables penetration of 16 to 20% by 2025[6]

Along with renewables, necessary focus needs to be given to improving the energy efficiency of existing assets, which will help in reducing the CO2 emissions and electrification of many end-use applications, including transportation segment.

Transportation:

Light vehicles emit greenhouse gases and also cause air pollution, smog and other health-related issues. Though with improved emission norms, it has reduced; still, there is much ground to be covered.

Globally, the light vehicle population is poised to increase from 1 billion as on date to about 2.5 billion by 2050, resulting in a tripling of energy utilisation and corresponding CO2 emissions[7]. Significant disruption is required in the transportation sector to shift to a cleaner and low emissions trajectory to achieve the global targets on air quality and CO2 emissions.

To reduce the CO2 emissions from this sector, switching to electrification through battery-powered Electric Vehicles (BEV) and Hydrogen Fuel Cell powered Electric Vehicles (FCEV) are the options going forward. It is opined that BEVs will be more economical for the light vehicle segment while there is a need to go in for FCEVs for long-distance, heavy vehicle segment. Further discussions in this article are limited to BEVs (EVs).

According to the International Energy Agency, limiting the global temperature increase to less than 2°C will require at least 20% of all road transport vehicles be electrically driven by 2030 (approximately 300 million vehicles)[6].

5 IEA Renewable Market Update, 2020

6 https://science.thewire.in/economy/energy/can-battery-storage-propel-indias-energy-transition/

7 UN environment programme https://www.unenvironment.org/explore-topics/transport/what-we-do/electric-mobility/electric-light-duty-vehicles

By reaching 60% battery, electric and plug-in hybrid vehicles (electric and internal combustion engine) on the road, more than 60 billion tons of CO2 could be saved between now and 2050[6].

IRENA analysis shows that EVs have significant growth potential:

- The number of electric passenger cars could increase from 2 million in 2016 to 200 million in 2030.
- Electric two/three-wheeled vehicles could outnumber four-wheeled vehicles, with as many as 900 million on the roads by 2030.
- Electric buses/ light-duty vehicles could exceed 10 million by 2030[8]

In 2017, Electric Vehicles Initiative (EVI) governments launched the EV30@30 campaign to speed up electric vehicles' deployment and target at least 30 per cent new electric vehicle sales by 2030[7]

There are studies which state that EV adoption in China could increase the smog generation by three to five times as compared to fossil-fuel driven vehicles primarily because of its dependence on fossil fuel-based generation[9]. This is true in many other countries, including India, where around 61.8% of installed capacity (as of November 30, 2020) is from fossil fuel-based generation[10]. The power required for EV charging should be derived from renewable sources to the maximum possible extent as fossil fuels will defeat the whole objective of carbon-free mobility.

However, with India poised to surpass it's Renewable Energy (RE) target of 175 GW by 2022, more renewable energy penetration is expected.

EVs can be considered as flexible energy demand that can be powered by renewable sources such as solar and wind as their charging can be aligned with the availability of the sources. Some utilities in the US offer customers incentives for adopting EV charging at stipulated time of the day when Solar / Wind resources are available.

EVs can act as important source/sink for the variable renewable energy sources. Introducing EV in a grid could lead to congestion in distribution lines and transformer overloading. However, these can be mitigated by resorting to their integration with distributed renewable energy sources.

Renewable integration with EV is more relevant in the case of distributed generation, where EV, along with the distributed generation together contribute to meeting the load demand and variations over the day. Since EVs are not only consuming power (Grid to Vehicle, G-V), they are also capable of supplying power to the grid (Vehicle to Grid, V-G) through their batteries and hence play an active role in grid management[11]. As power generated from renewable sources are not dispatchable on their own, in conjunction with EV, they together participate in better grid control. Hence EV and distributed renewable generation can be seen as complementing each other.

Way Forward

Though there can be regional / country-specific challenges, some of the common factors that can support increased renewable penetration are:

- Commitment from countries towards net-zero emissions
- Investments
- Adoption of sustainable policy by corporations/ organisations
- Supportive government policies to attract investment
- Power system flexibility
- Transmission corridor availability
- Supportive cutting-edge technologies
- Widespread adoption of energy storage solutions

8 IRENA https://www.irena.org/transport/Electric-Vehicles
9 World Resources Institute https://www.wri.org/blog/2019/11/4-emerging-ways-pair-electric-vehicles-and-renewable-energy#:~:text=EV%20charging%20can%20be%20paired,with%20or%20without%20managed%20charging
10 Ministry of Power website https://powermin.nic.in/en/content/power-sector-glance-all-india

11 Electric vehicles integrated with Renewable Energy sources for Sustainable mobility by Michela Longo, Federica Foiadelli and Wahiba Yaici

As Electric mobility provides ample avenues for linking renewables and the transportation sector, the following aspects can help in better RE penetration:

- Regulated EV charging so that they do not destabilise the grid
- Attractive tariff schemes to utilise maximum RE generation
- Better forecasting tools both for predicting RE generation and EV charging demand
- Improved scheduling tools for optimum load management
- Smart charging facility at the consumer end

In advanced countries such as the US and in Europe, many of these features are already in place and in India, as the Electric mobility is still in a nascent stage, these aspects can be incorporated taking learnings from other countries and may help in contributing for a faster and smoother transition to a low carbon economy.

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