



Climate Change – Integrated Role of renewables and natural gas – The Way Forward

By Deepika Lal

The horrendous impact of climate change on human lives and health is too obvious to need reiteration. All climate indicators continue to break records, forecasting a future of ferocious storms, floods, droughts, wildfires and unlivable temperatures in vast swathes of the planet.

As per the latest report of the WHO, between 2030 and 2050, climate change is expected to cause approximately 2,50,000 additional deaths per year from malnutrition, malaria, diarrhoea and heat stress alone. It further says that the direct damage costs to health are estimated to be between US\$ 2-4 billion per year by 2030 and that the areas with weak health infrastructure – mostly in developing countries – will be the least able to cope without assistance to prepare and respond.

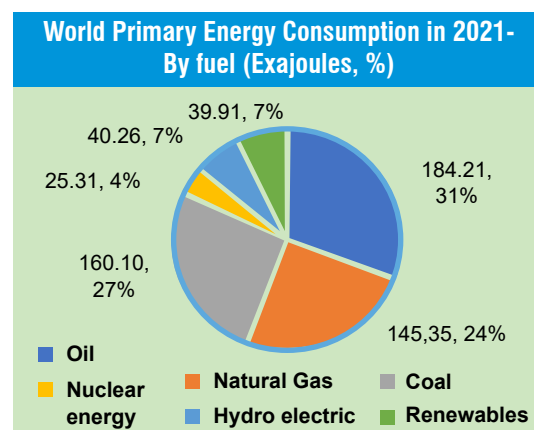
Country	CO ₂ emissions (Million tonnes of CO ₂ equivalent) in 2021
China	12039.8
US	5167.9
India	2797.2
Russia	2172.1

Given this, countries around the world are realising that if you rely on fossil fuels, which are controlled by some totalitarian regimes, it does make you very vulnerable. So, fossil fuels are not the answer, nor will they ever be.

Fossil fuel largest contributor to climate change

The extraction and burning of fossil fuels cause greenhouse gas emissions and are major contributors to both climate change and air pollution.

Of the total CO₂ emissions, a majority is contributed due to energy production. India was the third biggest emitter of CO₂ in 2021, only after China and the US. For example, in India, of the total emissions, 92% was contributed by energy. And therefore, how you generate energy



largely decides its impact on the climate.

Fossil fuels are by far the largest contributor to global climate change, accounting for over 75 percent of global greenhouse gas emissions and nearly 90 percent of all carbon dioxide emissions. In 2021, out of the total world's primary energy generation, fossil fuels accounted for 83% of generation. Oil's share was 31% followed by coal at 27% and gas at 25%. Renewables accounted for only 6.7% (excluding large hydro).

The science is clear: to avoid the worst impacts of climate change, emissions need to be reduced by almost half by 2030 and reach net zero by 2050.

Russia-Ukraine war and its aftermath - Lessons to be learnt

The world's leading economies must use Russia's war in Ukraine as an opportunity to accelerate a transition to renewable energy. Russia's unfortunate invasion of Ukraine has provided a wake-up call that climate

and environmental security are now "totally interlinked" with energy and national security. Europe is facing an energy crisis and a potentially bleak winter as it attempts to wean itself off Kremlin gas supplies, while Moscow has slashed capacity on the main pipeline as revenge for widespread sanctions for its invasion of Ukraine. Germany, Austria and the Netherlands are among a handful of countries to announce emergency restarts of coal-fired power stations, while some governments are preparing to ration gas supplies ahead of the coming winter.

Transition to renewable energy is the key to the solution

To tackle climate change and avoid overdependence on few countries for our energy requirements, we need to end our reliance on fossil fuels and invest in renewable energy that is clean, accessible, affordable, sustainable, and reliable. Let's understand how renewables make a better option than fossil fuels.

What makes Renewable a better option?

Renewable energy sources – which are available in abundance all around us, provided by the Sun, wind, water, waste, and heat from the Earth – are replenished by nature and emit little to no greenhouse gases or pollutants into the air.

● It is present everywhere

About 80 percent of the global population lives in countries that are net-importers of fossil fuels - that's about 6 billion people who are dependent on fossil fuels from other countries, which makes them vulnerable to geopolitical shocks and crises.

In contrast, renewable energy sources are available in all countries, and their potential is yet to be fully harnessed. The International Renewable Energy Agency (IRENA) estimates that 90 percent of the world's electricity can and should come from renewable energy by 2050.

● Renewable energy is cheaper

Renewable energy actually is the cheapest power option in most parts of the world today. Prices for renewable energy technologies are

dropping rapidly. The cost of electricity from solar power fell by 85 percent between 2010 and 2020. Costs of onshore and offshore wind energy fell by 56 percent and 48 percent respectively.

Falling prices make renewable energy more attractive all around – including low- and middle-income countries, where most of the additional demand for new electricity will come from.

● Renewable energy is healthier

The unhealthy levels of fine particulate matter and nitrogen dioxide originate mainly from the burning of fossil fuels. In 2018, air pollution from fossil fuels caused \$2.9 trillion in health and economic costs, about \$8 billion a day.

● Renewable energy creates jobs

Every dollar of investment in renewables creates three times more jobs than in the fossil fuel industry. According to IEA, the transition towards net-zero emissions will lead to an overall increase in energy sector jobs.

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The world is moving towards renewable!

World over, wherever there has been a decrease in CO₂ emissions, it is attributed to the increased use of natural gas or renewables, which support utilisation of both as potential enablers of a transition to a lower-carbon future. And therefore, many European nations have pledged to rapidly boost their efforts to deploy more renewables into the grid over the coming decade to make sure they have home-grown clean energy.

Countries such as Sweden, Finland, Germany, Portugal and Brazil are much ahead in developing their renewable energy programmes and are also already reaping benefits in terms of reduced CO₂ emissions and a cleaner environment. They have 40-60% of their energy production from renewable sources. In terms of overall absolute generation, China leads the world (due to its sheer size) as the biggest renewable energy producer followed by the US and Germany.

Share of Non-fossil & Gas in primary energy consumption in 2021 (%)				
Non-fossil				
Country	Hydro	Renewables	Gas	Total
Finland	12.77	21.84	6.35	40.96
Sweden	29.47	21.45	2.06	52.98
Portugal	11.67	21.03	22.07	54.77
Brazil	27.2	19.02	11.59	57.81
Germany	1.42	18.03	25.78	45.23
India	4.26	5.05	6.32	15.63
Total Renewable energy generation in 2021 (TWh)				
Country	Wind	Solar	Others	Total
China	655.6	327.0	169.9	1152.5
US	383.6	165.4	75.5	624.5
Germany	117.7	49.0	50.9	217.6
India	68.1	68.3	35.5	171.9
Total				
World	1861.9	1032.5	762.8	3657.2

Some of the renewable initiatives by countries around the world

USA: Hydrogen and offshore wind are driving the renewable interests in the US. It is deploying billions of dollars for the advancement of green and blue hydrogen, clean hydrogen network and R&D for clean hydrogen manufacturing and recycling.

China: The biggest energy-consuming country on the planet, China, aims to reach carbon neutrality by 2060. The country looks to peak its carbon emissions by as early as 2030 and has announced it will prioritise geothermal, hydrogen and tidal energy and will increase the development of large, integrated wind and solar project campuses.

UK: Thanks to several policy decisions and major moves in its private energy sector, the UK has made huge progress in the renewable sector. Through its Energy Security Strategy, the country set an ambition for 95% of the UK's electricity generation to be low-carbon by 2030, increasing to 100% by 2035. Notably, the government classifies renewables and abated natural gas as low-carbon energy sources. The UK also aspires to host at least 50GW of offshore wind capacity, 10 GW of green and blue hydrogen production by 2030.

GERMANY: Germany aims to achieve 100% green power by 2035. Germany has had a spectacular solar energy growth, with a capacity of roughly 60 GW in 2021 and it aims to triple its solar and wind expansion by 2028.

FRANCE: France has set ambitious 2050 renewables targets, with a short-term target of 32% renewables in the energy mix by 2030. It plans for 100GW of renewable power installed capacity which includes 40GW of offshore wind projects.

Indian Renewable Scenario

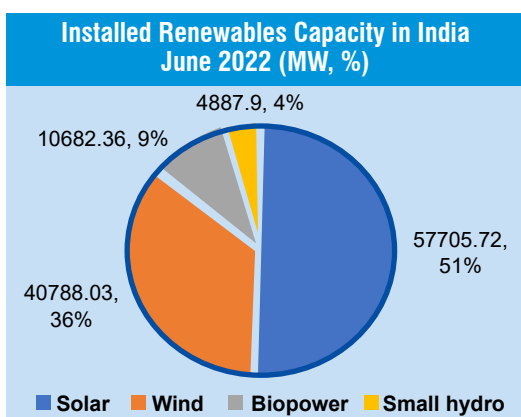
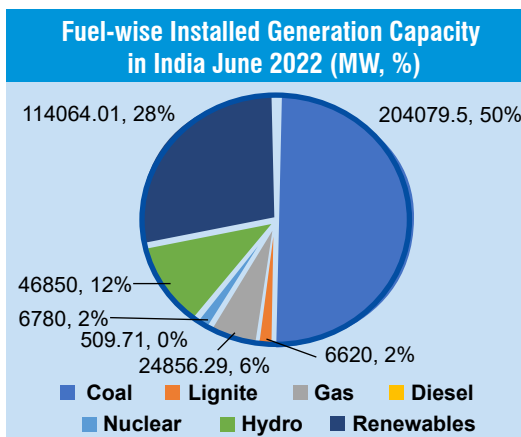
India has the third largest electricity generating capacity in the world (after China and US), however, we continue to languish at the bottom half of the table when it comes to per capita consumption; against a global per capita average of 3615 Kwh, India's per capita consumption was only 1231 Kwh in the year 2021.

However, Indian per capita consumption is poised to increase significantly in the coming years. Strong economic growth in India is escalating energy demand. Increasing urbanisation and rising income levels are responsible for an increased demand for electrical appliances, i.e., increased demand for electricity in the residential sector. The increased demand for materials for buildings, transportation, capital goods, and infrastructure is driving the industrial demand for electricity. Increased mechanisation and the shift to groundwater irrigation across the country are pushing the pumping and tractor demand in the agriculture sector, and hence the large diesel and electricity demand. The penetration of electric vehicles and the fuel switch to electric and induction cook stoves will drive the electricity demand in the other sectors.

A good part of India's growing energy demand can be met with renewable energy. Renewable is estimated to increase substantially given the Indian government's clear focus on clean energy and its commitment to climate change. Given this, the country could potentially increase its share of renewable power generation to over one-third by 2030.

The current electricity generation capacity as of June 30, 2022, is 403760 MW of which renewable (excluding large hydro) is 114064 MW and its share in the total installed electricity generation capacity in the country is 28 per cent (as of June 30, 2022). This has steadily increased over the past few years.

Solar and wind energy contribute 57706 MW and 40788 MW respectively to this renewable basket and theirs is the most remarkable story in India's power sector in recent years as they have rapidly increased their share in the overall



energy mix in recent years while coal and hydropower capacity growth has slowed.

This rapid growth reflects government policy support and falling equipment costs. Due to constant government support in this sector, FDI inflow in the Indian non-conventional energy sector stood at US\$ 10.28 billion between April 2000 and June 2021. Also, more than US\$ 42 billion has been invested in India's renewable



energy sector since 2014.

Some of the policy actions that have facilitated the growth of grid-connected renewables in the past few years include reverse auctions resulting in progressively falling prices, lower corporate tax rates for developers, renewable purchase obligations mandating utilities to procure a certain minimum purchase of renewable power, investment in transmission infrastructure, and support for solar parks that help reduce project development and land acquisition risks.

The government has further set a target of achieving 450 GW of installed electricity capacity from non-fossil sources by 2030 while 60.66 GW of renewable projects are under various stages of development apart from the existing capacity. More and more companies are lining up their investments in the sector looking at the strong support and vision of the government. NTPC is expected to commission a 447 MW, India's largest floating solar power plant, in Ramagundam, Telangana soon. Newer

Some successful collaborative examples between natural gas and renewable

- In the US, coal plants supply less than 20% of the electricity, down from about a half a decade ago. Over the same time, the share of gas has doubled to about 40% while trying to increase its renewable capacity which has also more than doubled to about 20% now since it is using more of gas (with half less emissions than coal) as a backup for its renewable power.

- Electricity providers, world-over, are developing innovative new ways to maximize the synergies between natural gas and renewable energy. One new approach is the development of hybrid gas-renewables “power parks,” where gas and renewable facilities are located in the same area to provide round-the-clock electric generation. US’s Florida Power and Light has generated clean electricity since 2010 using solar energy during the day and natural gas at night.

- Egypt's energy policy is demonstrating that there is a basic compatibility between developing domestic natural gas resources and developing renewable energy sources. New offshore natural gas discoveries, fiscal reform, renewable energy resources development, and the construction of electricity interconnections all made it

possible for Egypt to turn into a self-reliant clean energy consumer. Egypt's surplus electricity prompted the development of electricity interconnections to Europe, the Middle East, and sub-Saharan Africa. While initially most of the electricity exports sold via the interconnections will be generated from natural gas, commonly referred to as “gas-by-wire,” these interconnections are sparking further investment in renewable energy development, having established the transmission infrastructure for an electricity export market.

- In Thailand, heavy reliance on natural gas for electricity generation enables the country to integrate utility-scale solar onto its flexible power grid.

- Heavy reliance on natural gas for electricity generation in Brunei and Singapore enables future investments in offshore wind power generation. This boosts the potential of Brunei and Singapore in becoming flexible trading hubs for electricity and gas infrastructure. Besides, the existing natural gas supporting infrastructure which includes storage, transportation, and distribution can facilitate the integration of gaseous types of renewable fuels such as biogases.

cleaner sources of renewable energy are also being explored such as biogas, waste to energy, Hydrogen etc. Plans are on to set up about 5,000 compressed biogas plants by 2023.

Natural gas as a companion for renewable

The demand for electricity will grow significantly in India. As renewables continue to provide a greater share of India's electricity generation, with the government announcing a renewables target of 450 GW by 2030, a greater amount of backup capacity from other power sources will be needed. As increased capacities of wind and solar power are added to the electric grid, diverse sources of backup capacity, mostly natural gas, will be needed to operate the grid reliably.

Natural gas and renewable energy have a synergetic relationship; each facilitates the other. World over energy leaders have expressed support for new natural gas capacity to facilitate the development of wind and solar power. The two forms of energy appear complementary in many respects: natural gas electricity generation enjoys lower capital costs and variable fuel costs, while renewable energy generators have higher capital costs but generally zero fuel costs, excluding bioenergy. Both forms of energy support a future orientation towards an environment that utilises clean energy supply and use, including distributed generation and home vehicle fuelling.

NGS therefore, suggests in India we must attempt to make serious efforts to identify how natural gas and renewable energy could work together in order to complement each other. Renewable in conjunction with natural gas should be encouraged as a reliable and sustainable source of electricity.

Natural gas is the leading choice for on-site power generation because of its environmental

benefits and the existing natural gas supply infrastructure. There are a number of ways in which natural gas may be used on-site to generate electricity and as back-up support to renewable. Fuel cells, gas-fired reciprocating engines, industrial natural gas-fired turbines, and micro-turbines are all popular forms of using natural gas for back-up support to renewable as well as on-site electricity needs. Natural gas is also one of the leading energy sources for distributed generation which would require separate research.

What makes natural gas an ideal companion for renewable?

- The renewable resources' abilities to generate power vary by season, day, and even by hour. Solar and wind are "intermittent" resources – they are only available when the sun is shining or the wind is blowing. Sustained reliability is in question. Forecasts often differ from the weather actually experienced and therefore, it is uncertain how much power renewables will be able to provide to the electric grid on any given day.
- To ensure that electricity is available on a reliable basis, operators of the electric grid need backup sources of power to account for the variability and uncertainty associated with renewable energy. This is particularly critical during periods when electricity is in peak demand during excessive heat or cold.
- Natural gas serves as the ideal backup source of electricity to support renewable energy because of its flexibility, reliability and clean



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Matrix of Selected Characteristics of Natural Gas and Renewable Energy relevant to India				
	Natural Gas	Wind	Solar	Bioenergy
Resource Distribution	Relatively diverse for domestic conventional, import of LNG	Diverse but often far from load centres	Diverse	Diverse
Capital Cost	Moderate, stable	Moderate, some fluctuation	Relatively high, declining	Moderate-high, stable
Fuel Cost	Variable-currently high	None	None	Moderate
Output	Dispatchable; flexible	Variable & somewhat predictable	Variable, mostly predictable	Dispatchable power & fuel
Carbon Impact	Less than half that of coal	Very Low	Very low	Depends!
Environmental & Social Concerns	Relatively clean burning fossil fuel, land and water use in case of shale / CBM	Some opposition to siting; no combustion emissions; low water use	Some opposition to siting of large projects for ecosystem reasons; no combustion emissions or water use for PV	Concern over ecosystem impacts for many biofuels, water use

energy. Gas-fired generators/engines can turn on and off very quickly – typically in as little as 10 minutes – and thus provide a flexible and reliable power source to accommodate fluctuating weather patterns.

- Operators of the electric grid will need to rely most heavily on gas generators to compensate for the variability of renewables in the future.

Challenges & Way Forward

A shift away from conventional energy requires a kind of investment never seen before. Technological development, infrastructure, public sentiment, and policies will be fundamental in improving renewable space in any country.

- First, we must make renewable energy technology a global public good, including removing intellectual property barriers to technology transfer.
- Second, we must improve global access to supply chains for renewable energy

technologies, components and raw materials. In 2020, the world installed five gigawatts of battery storage. We need 600 gigawatts of storage capacity by 2030. Clearly, we need a global coalition to get there. Shipping bottlenecks and supply-chain constraints, as well as higher costs for lithium and other battery metals, are hurting the deployment of such technologies and materials.

- Third, we need fast-track approvals for renewable projects and more effort to modernise electricity grids.
- Fourth, the world must shift energy subsidies from fossil fuels to protect vulnerable people from energy shocks and invest in a just transition to a sustainable future.
- We need to triple investments in renewables. This includes multilateral development banks and development finance institutions, as well as commercial banks.
- Global transition away from fossil fuels could trigger financial challenges for India and other developing countries such as

Russia, Brazil and China because of their high dependence on revenues from fossil fuels. Though India is a net importer of petroleum products, it earns substantial revenues — via cesses and taxes — from the consumption of petrol, diesel and oil. These kind of shortfalls in public revenues have to be planned well ahead in advance to stop any impact on economic growth.

- Changes in transport need to go hand in hand with changes in the wider energy system. Natural gas or renewable energy-fuelled electric buses have great potential not only for reducing CO₂ emissions but also for improving air quality and noise protection in cities. Therefore, in the transport sector, with the advent of electric vehicles, more electricity will need to be generated from gas or renewable sources to mitigate the effect on climate.
- In India specifically, despite explosive renewable growth in the past few years, there are still important structural, regulatory

and institutional challenges that could hamper further growth. The challenges include the poor financial position of many state distribution companies, difficulties in obtaining access to finance and in acquiring land, grid congestion, and uncertainties over grid infrastructure development. The expansion of rooftop solar has lagged behind the growth in utility-scale projects, constrained by higher costs and the lack of attractive financial models for consumers. Despite an identified potential of 10 GW to 20 GW, offshore wind has not yet taken off in India owing to the high cost of capital and supply chain and infrastructure bottlenecks. Also, growth in the share of wind and solar PV in the Indian power system needs to be accompanied by a strengthening of grid infrastructure.

Let us all agree that a rapid renewables revolution is necessary. As we wean off fossil fuels, we have to remember to use resources that do not burn climate and support renewables.

