Monitoring of Key Project Parameters- Concept to Commissioning of RE Projects

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Summary

Most projects need rigorous planning and execution. Renewable energy projects are no exception and in fact their being highly interdisciplinary science and engineering projects; more comprehensive approach is resorted to. Concept and objectives, resource potential, choice of site specific renewable energy technology, feasibility of scale and capacity, financial viability, sustainability and social inclusiveness are essentially the key project parameters through the process of execution of any renewable energy project today. If one does take care of these key parameters in the very beginning, the "cost and time over-run" of renewable projects can be very well avoided or potential damage of project performance can be minimized. This article is focussing on these project monitoring needs of various renewable energy (RE) projects with specific reference to wind energy in India, especially in the most difficult "post-Corona" worldwide economic recession and investment scenario.

Introduction

The key parameters are often driven by government policies, investor interests, business case in use of electricity and so on. In this article we will run through the various project key parameters which need to be understood as early as in planning stage, so that the Project Management (PM) (Figure 1), can be completed in time, scope and capital investment cost is seamless without "cost and time overruns" (Figure 2).

Figure 1: Positive Returns Only After Project Commissioning

Wind energy projects as of now suffer several blows especially in India, owing to solar competition in the new policy of auctioning and electricity unit price determination by reverse bidding option. Again with the best sites being already occupied in India, lack of old investors' interest to reinvest for repowering in high technology modern large wind turbines, delayed payments from loss making DISCOMs, lack of policies towards innovative cross coupled technologies and renewable hybrids with storage

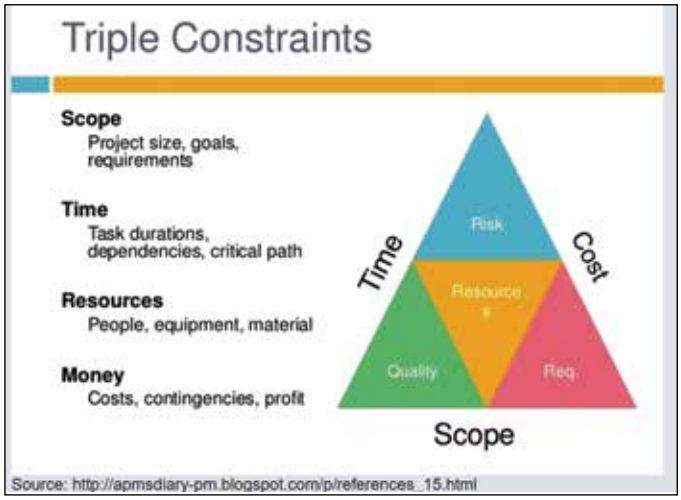


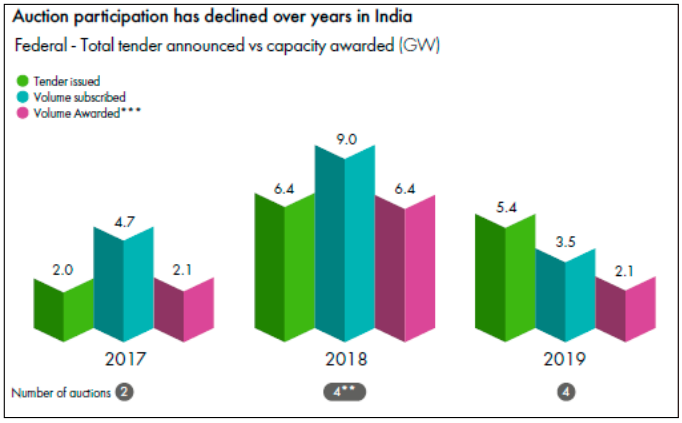
Figure 2: The Project Management (PM) - Triangle Applicable up to Commissioning Phase

assisted 24x7 dispatch of power, are just a few well known barriers for accelerated wind power deployment in India. There are specific societal and several other issues in every new green field project whether onshore or offshore (yet a non-starter of real projects).

Key-Parameter: Concept and Objectives

Historically India as well as rest of the world had promoted wind energy with feed-in-tariff associated with or without accelerated depreciation benefits and PTC (production tax credits). Today's auctioned tariff pricing regime has its own advantages of competitive innovations to attract investors with improved technologies of performance and enhanced profits. The earlier objective and concepts chosen may be captive use in balance sheet financing (profit share invested), today it's mostly energy sales driven and most projects come off from independent power producers or Governmental initiatives for auctioning wind power (Figure 3). So, the objective of a wind farm of the deemed industrial consumer, is literally outsourcing to energy supply companies the power demand for their production.

According to GWEC market analysis, there are innovative hybrids and storage based wind solutions, off-grid hydrogen generation, desalination, micro-grid support system, EV charging



** Auctions retendered with changes in design have been considered as single auctions (Applicable on SECI V and Gujarat II)

*** Projects abandoned at a later stage after contract award are a part of volume awarded

Figure 3: Impact of Low Bid-in-Tariff (BiT) in India (GWEC Report 2019)

infrastructures with other renewables should form the new concept and objectives for wind farm developers.

Key-Parameter: Resource Potential

For wind farm developers, resource potential even though seasonal, bankability of data would be higher if several years of wind data can be simulated and long-term prospects scientifically quantified. In the case of solar ground based large MW class grid connected projects, national level well verified and calibrated radiation data would save considerable long-term revenue loss. The National Institute of Wind Energy (NIWE), under the Ministry of New and Renewable Energy and its sister institutions NISE and NIBE provide most of the necessary renewable energy data in India. NIWE's wind solar data for preliminary assessment of wind and solar resource even accessible through mobile app like "SWurja" (Figure 4) are highly useful.

There are several other renewable energy resource atlases

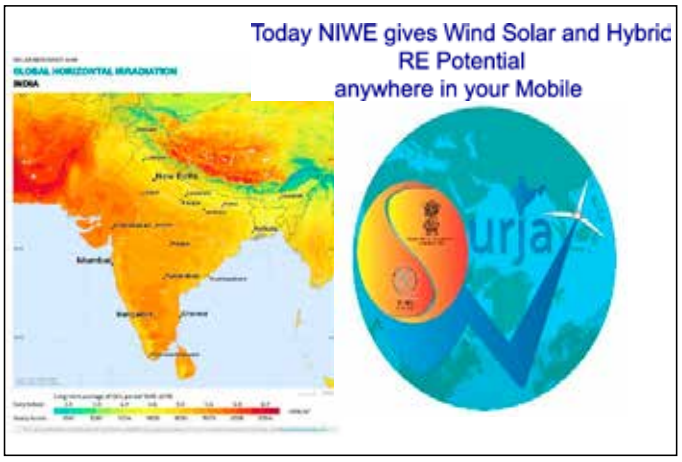


Figure 4: SWurja Mobile App for Ready Reference Potential - NIWE, Chennai

covering the various regions of countries around the world. In the present scenario of renewable energy projects, the so called intermittency needs to be overcome through hybrid projects with appropriate marriage of resource availability based technologies, may be coupled with partial storage systems.

Key-Parameter: Choice of Site Specific RE Technology

Renewable energy technologies have been on the upscale continuously improving in performance and efficiency, in order to mitigate global warming and climate change. Right choice of site specific RE technology/hybrid technologies has become extremely important. For instance, if one goes for wind energy, the first and foremost thing will be to maximize annual energy production (AEP). This needs a perfect matching of wind resource availability and the suitable wind turbine model at the proposed site (Figure 5). Today the level of competition demands to look into much finer aspect of wind conditions, turbulence, active incoming wind sensing pitch regulation systems, innovative blade surface aerodynamic tuning, to have a consistent AEP for the entire design life of 20-25 years and beyond. It is very much essential not to over design wind turbines to cover all weather conditions such as deserts, high altitude mountains, snow loads of cold regions near the poles, and coastal sea or deep ocean wind. If one chooses a universal wind turbine, the cost of machine (capital as well as operational) would be uneconomical when it is selected for a large wind farm.

Key-Parameter: Feasibility of Scale and Capacity

Technical due diligence of renewable energy projects are inevitable mainly because of the need for site specific sizing of the capacity of projects. Techno-economic feasibility of projects is the first step for investment protection. If the land is contiguous large area, very large scale project design is possible earlier, but with the present technologies of IoT (Internet of Things), IIoT (Industrial Internet of things), and ICT (Information and Communication Technologies), even large scales and capacities can be designed with installations spread across continents. Energy asset management has become highly oriented to data science and data analytics.

Specific Challenges in RE implementation Methodologies

An excellent overview is presented in an exhaustive report on concept to operation of renewable energy projects by Sargent and Lundy in a NREL (National Renewable Energy Laboratories, USA) report (Figure 6). Even planning for onshore wind and offshore wind projects have significant changes in project activity planning and execution. For instance, the wind turbine cost in the onshore may be 60% of total project cost, while the same in offshore installations may be 30% of total project cost or even less. The offshore wind projects' wind turbine support platform, erection and commissioning may have a large fraction of EPC-contracts close to 60%. In the context of renewable energy

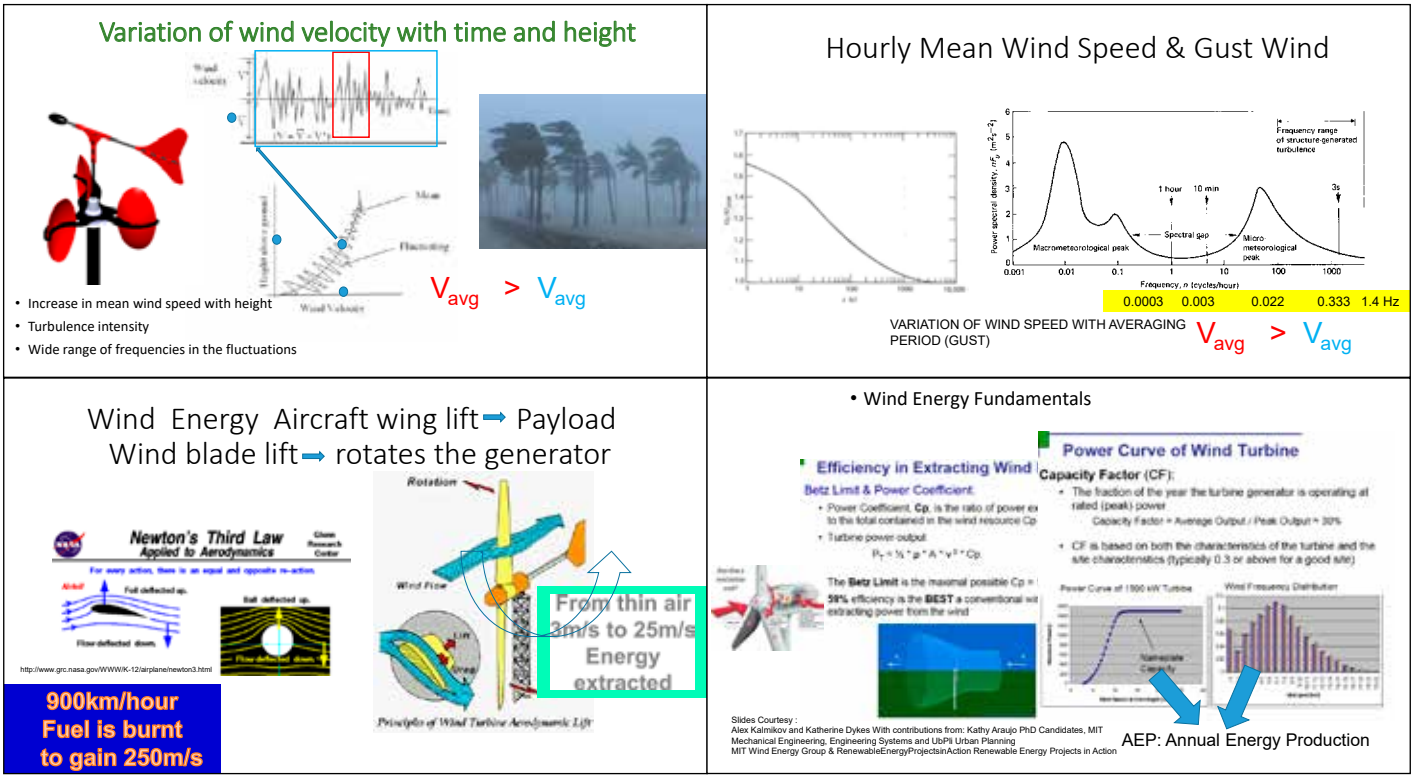


Figure 5: Wind Conditions for Maximizing Annual Energy Production from Wind at a Site

projects feasibility of large Giga Watt scale projects will show significant cost reduction, as expensive special installation ships hiring hours can be minimized. Simulation studies on Micrositting of wind turbines in a wind farm cluster are a must to maximize energy production.

Large scale solar PV (photovoltaic) or solar thermal projects need sizing capacity of inverters modular upgradability of the plant, DC cabling loss minimization, effective maximum power point

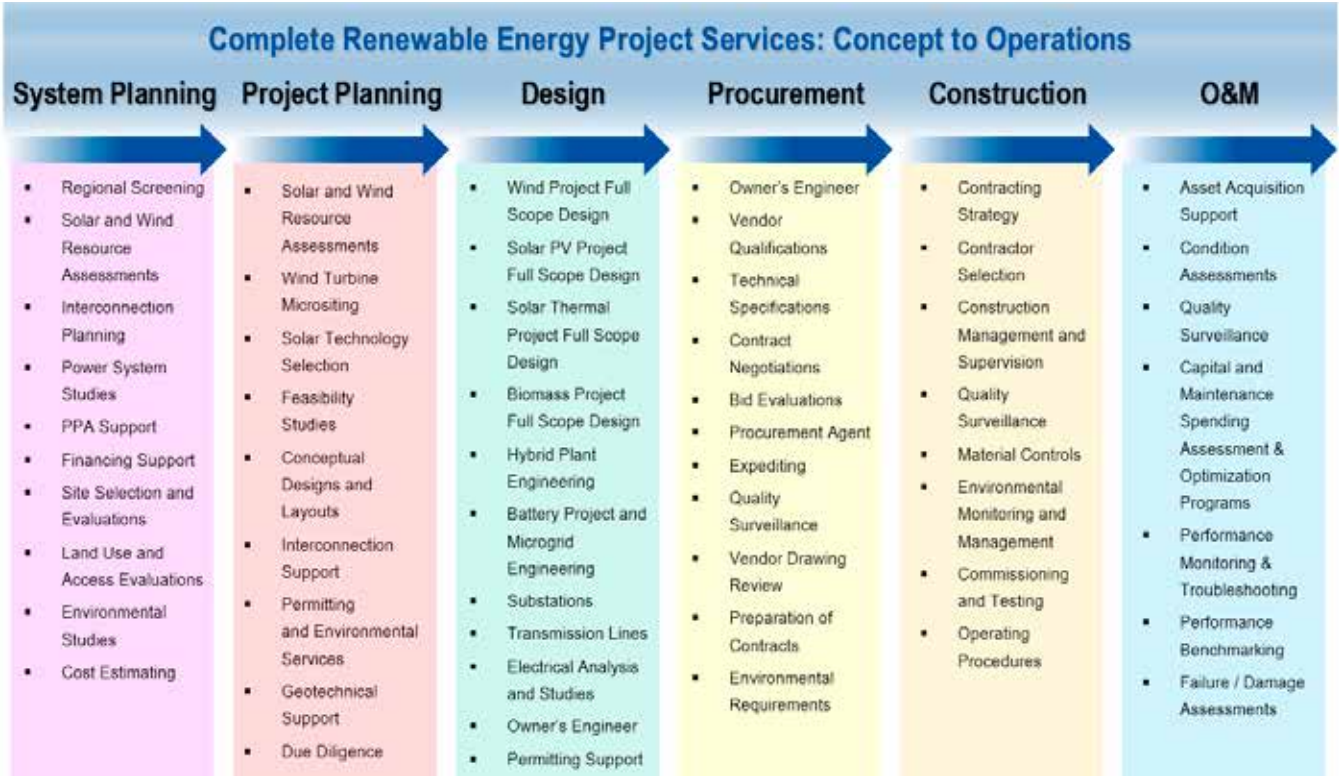


Figure 6: Project Phases for Renewable Energy Development Source: NREL 032-007, Sargent & Lundy

tracking for improved energy production would be very much essential right in preliminary feasibility of scale and capacity of the proposed plant. If solar plant has to provide energy in the night additional capacities with managed storage infrastructures should be established.

The feasibility studies of scale and capacity should adequately address the future concerns of possible hybrid integration from cross coupled technologies to cater to E-vehicle charging, battery swapping, and desalination water, hydrogen generation and storage or even load demand needs of micro grid operation.

Operational phase of renewable energy projects specially wind & solar should have sufficient data flow infrastructure for real time forecasting of exported power to the Grid (Figure7).

Key-Parameter: Financial

The most important key parameter is the financials during various phases of project. Even prior to Covid-19 scenario, the payment delays were there by the state's DISCOMs (Distribution Companies) which are already in financial distress and most of them are loss making. When accelerated depreciation was available in India till 2010, there has been balance-sheet financing of renewables with net profits being pumped in the RE-projects. The captive use of energy, tax holidays on income from renewable generation, banking of energy and use at times of need, enabled borrowed capital with moderate interest rates became the flow of investments. While the awareness and knowledge of "various renewable technologies" of industrial investors being limited, earlier the OEMs (Original Equipment Manufacturers) were mostly the project developers providing turn-key solutions including operation and maintenance (O&M) post commissioning of projects. Then we had investments into renewables pouring in from various venture capitalists and independent power producers, IPPs. These were financiers with specific purpose of making profit through energy sales, and were able to tap any OEMs to supply the engineering equipment and were instrumental in bringing in Asset-management concept

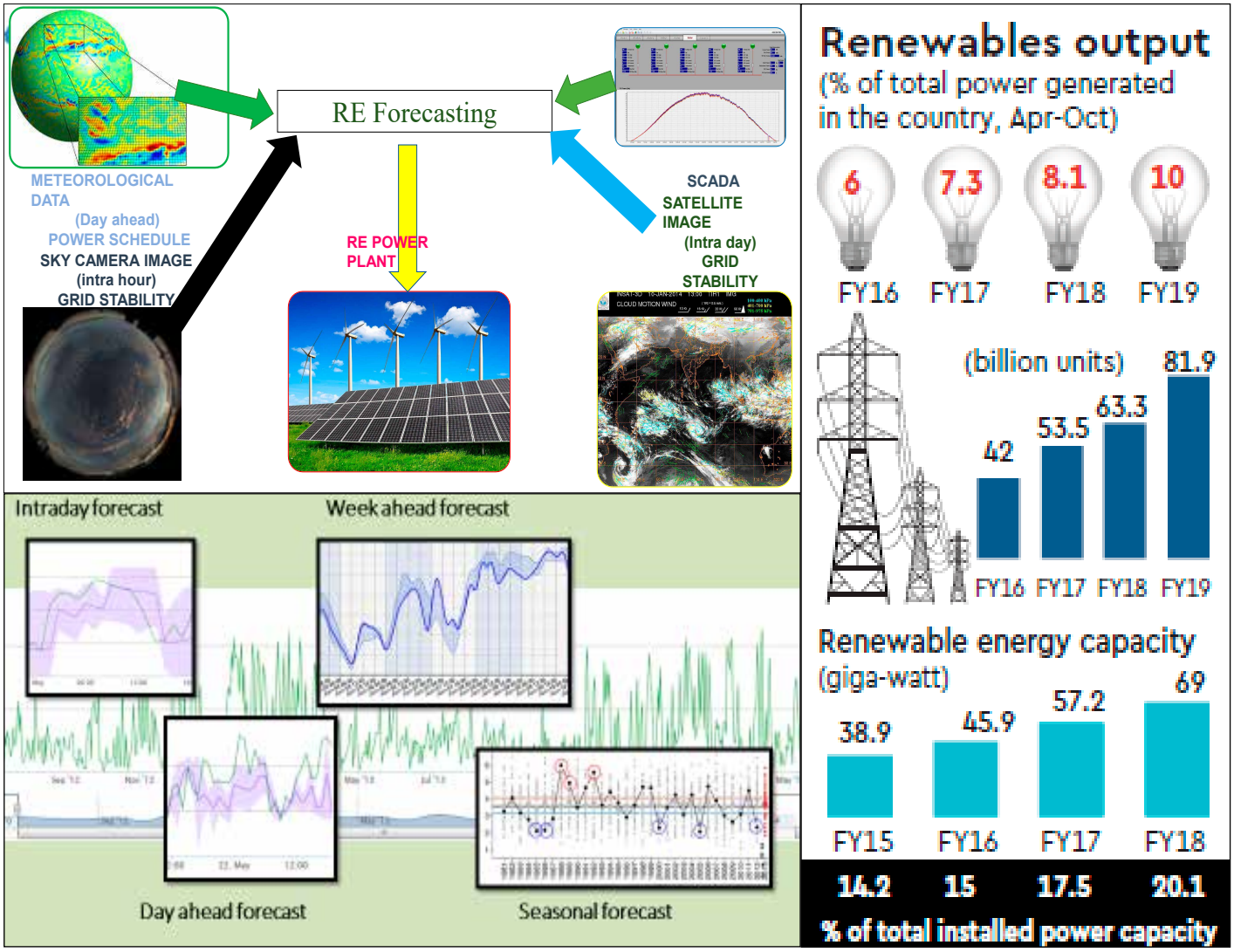
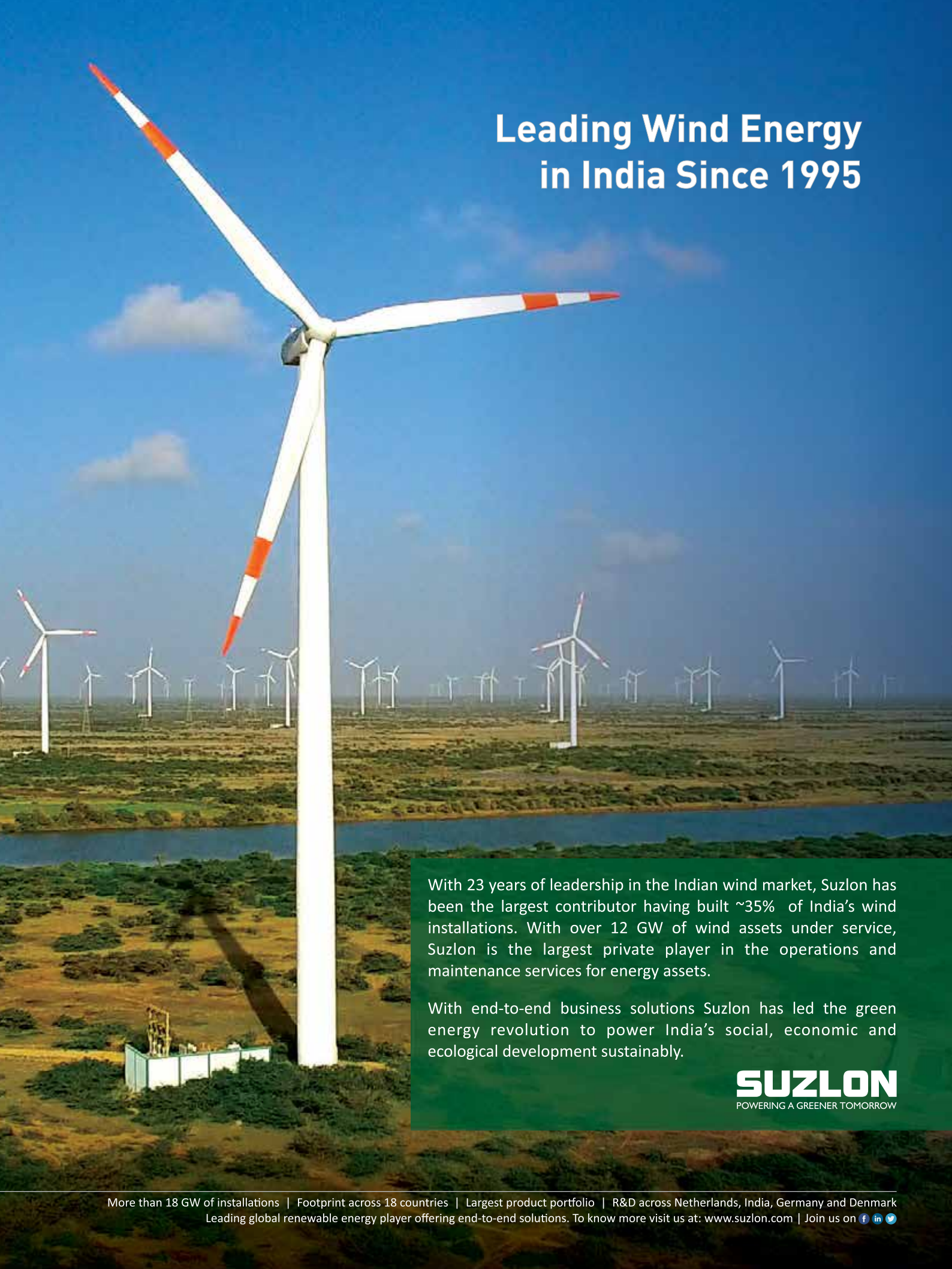


Figure 7: RE Penetration (10%) in India-Well Engineered by Accurate Real Time Forecasting


Leading Wind Energy
in India Since 1995
With 23 years of leadership in the Indian wind market, Suzlon has been the largest contributor having built ~35% of India's wind installations. With over 12 GW of wind assets under service, Suzlon is the largest private player in the operations and maintenance services for energy assets.
With end-to-end business solutions Suzlon has led the green energy revolution to power India's social, economic and ecological development sustainably.
SUZLON
POWERING A GREENER TOMORROW
More than 18 GW of installations | Footprint across 18 countries | Largest product portfolio | R&D across Netherlands, India, Germany and Denmark
Leading global renewable energy player offering end-to-end solutions. To know more visit us at: www.suzlon.com | Join us on

in the renewable installations. But, today the very low Bid-in-Tariffs for both wind and solar has certainly hit most RE-investors below their belt, demanding mid-course correction to maintain flow of investments into matured technologies, ensuring timely payment from DISCOMs, providing additional fiscal incentives for the avoided billions of tones of CO_2 in the mother earth's atmosphere, and by pruning the tariffs for hybrid RE-power fully backed with storage infrastructure projects operating 24x7. Think of personal income tax incentivized global crowd funding for both wind and solar power plants, from the like-minded persons interested in Sustainable Global Energy Transition (S'GET), and climate change mitigation.

Key-Parameter: Sustainability and Social Inclusiveness

Missing BETD-2020 (Berlin Energy Transition Dialogue) owing to lockdown imposed by the terrifying virus COVID-19, we derive a chance to revisit Berlin Energy Transition Dialogue, April 9-11, 2019, BETD-2019, which has demonstrated that as per the Figure 8, in the last 20 years globally alternate energy, mostly renewables has increased from a level of 18% to 25%. Use of electricity for vehicles (mobility) has increased in the rest of the world from 17% to 20%. In short, the deployment of wind energy-based electricity generation has increased 10 times and the solar electricity by over 25 times.

However, if one looks at the atmospheric air pollution with higher levels of CO_2, the current status is illustrated in Figure 9. In the atmospheric air 60% CO_2 needs to be reduced, for which almost 86% electricity generation should be using renewable sources and 66% electricity usage in terms of energy should be renewably generated green electricity. This essentially means 50% of energy used in the world should be electricity and that too generation of electricity should be without any atmospheric air pollution. Today's electricity generation stagnates still at 20% (Figure 9 and Figure 10) in which renewable contribution is quite good at 25%. While generation from solar energy seems to be fast tracking there is need to push the matured wind generated power to higher rates of growth. Globally even though 6 million (60 Lakhs) electrically operated vehicles are operational, India is yet to kick start the EV2030 targets. Applications of alternate energy as well as electricity should be increased in heating and cooling needs of the community as well as industry. There should be increased use of hydrogen as fuel and hydrogen generation should be using renewable sources of energy.

India is unique in spite of high population, to remain in the top 5 countries of the world in electricity production and consumption (Figure 10 and Figure 11).

From Figure 10 it is easy to infer that world over in spite of dominance of fossil fuel (coal, oil and gas) in electricity generation their growth rates are reducing significantly with the higher penetration of renewable energy. The highest growth rate of renewables is happening at 11% world's highest level both in India and China (Figure 11). Among the 16 defined Sustainable Development Goals (SDG), the seventh is SDG-7. Affordable and clean energy, will influence more than 12 of the 16 SDG as shown in Figure 12.

IRENA Global Energy Transformation Road Map 2019, report advocates that in electricity generation wind, solar, biofuel/energy and other alternate forms of energy should become mainstream. Eletricity transmission and distribution, smart metering, electricity conservation and storage should have better augmented strong infrastructure. Transport vehicles, industries and buildings should use directly as well as electricity generated from renewables, with a clear focus on energy efficiency too.

Seeing the Figure 13 to 15 one can easily understand the way forward for environment friendly technologies for electricity generation and need for proliferation of electric vehicles. Figure 16 indicates the pollution is close to 25% even while using electricity, since the generation being mostly from conventional thermal power plants and fossil fuels, as of now.

Cost of establishing battery charging/swapping stations will be less than that of a normal petrol bunk. Car travel sharing is common in USA and Europe, even though it is yet to be popular in India. Yet, Ola, Uber like IoT services are getting accepted in tier one cities and probably in some big towns as well. Mobile APP based selectable multi-owned cars (instead of single or self-owned) are yet to be operational in India, if that picks up BEV proliferation on the roads can happen. Just like multi-purpose hydro-electric power houses (flood control, irrigation and power generation), several multi-purpoe engineering research with solar thermal is possible to be done leading with indigenous knowhow and technology for power, drinking water from sea water, electric car battery charging-/or battary swapping station establishment, as well as industrial pre-heating and air conditioning.

Conclusion

Monitoring key parameters of renewable energy projects has to be down to earth owing to the unforeseen recession owing to COVID-19 scenario around the world. Now that loss of employment is spread across the entire humanity, renewable energy projects will have an advantage of facilitating an all-round growth of economy with much needed inclusive development. While monitoring key project parameters during all the phases of RE-project, lessons learned in each one of them are unique and should be duly utilized for future project sustainability improvements. A corporate social responsibility programme, (Figure 17) which is highly focussed on sustainable technologies, for aforestation, drinking water management, waste to energy, environmental protection, mitigation and counter efforts for carbon emission from power generation, renewable energy expolitation, green technology adoptation, skill development, human resource development, inclusive economic growth, earth saving environmentally benign development, is a must.

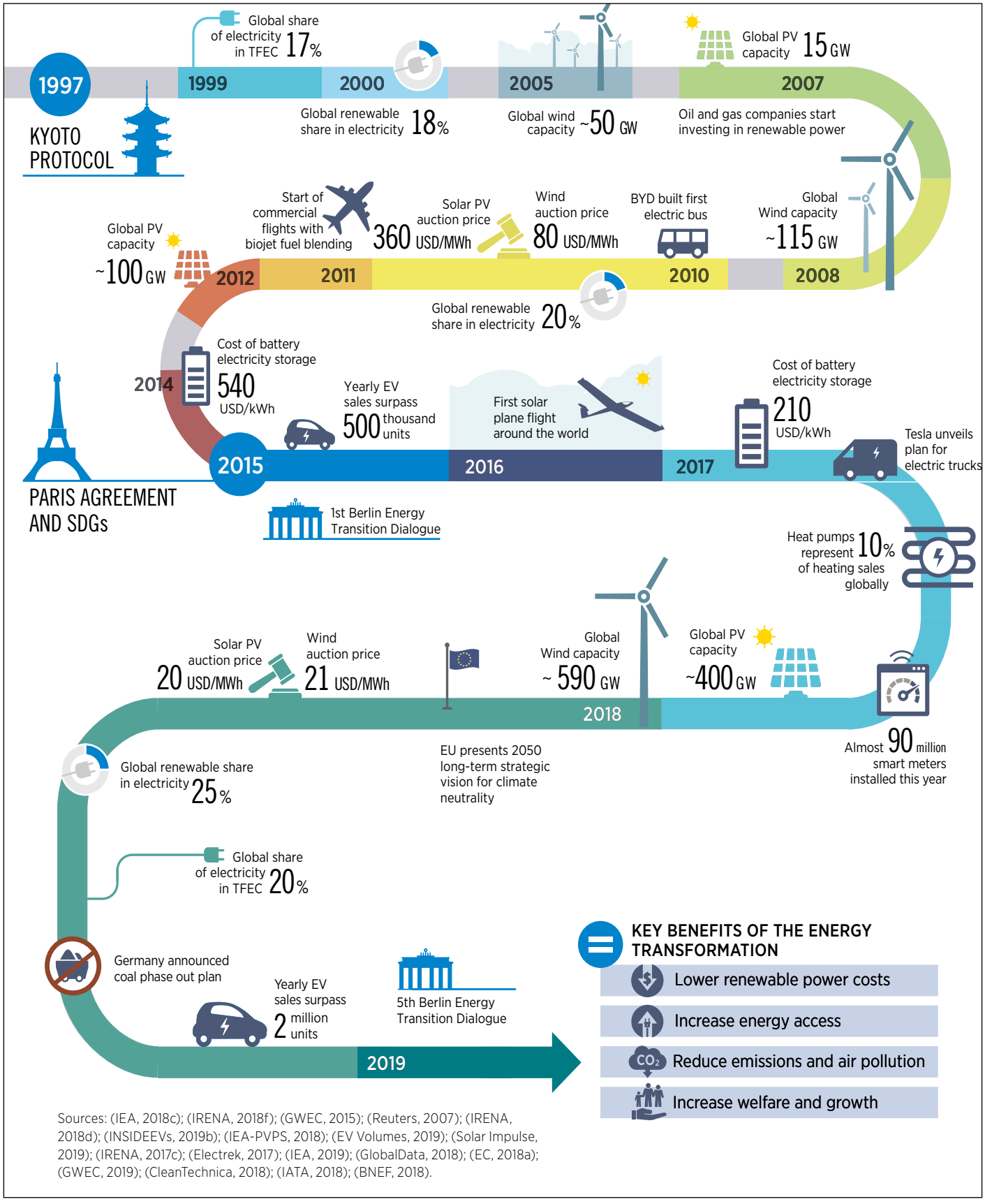


Figure 8: Global Energy Transition Status
(IRENA - Global Report 2019)

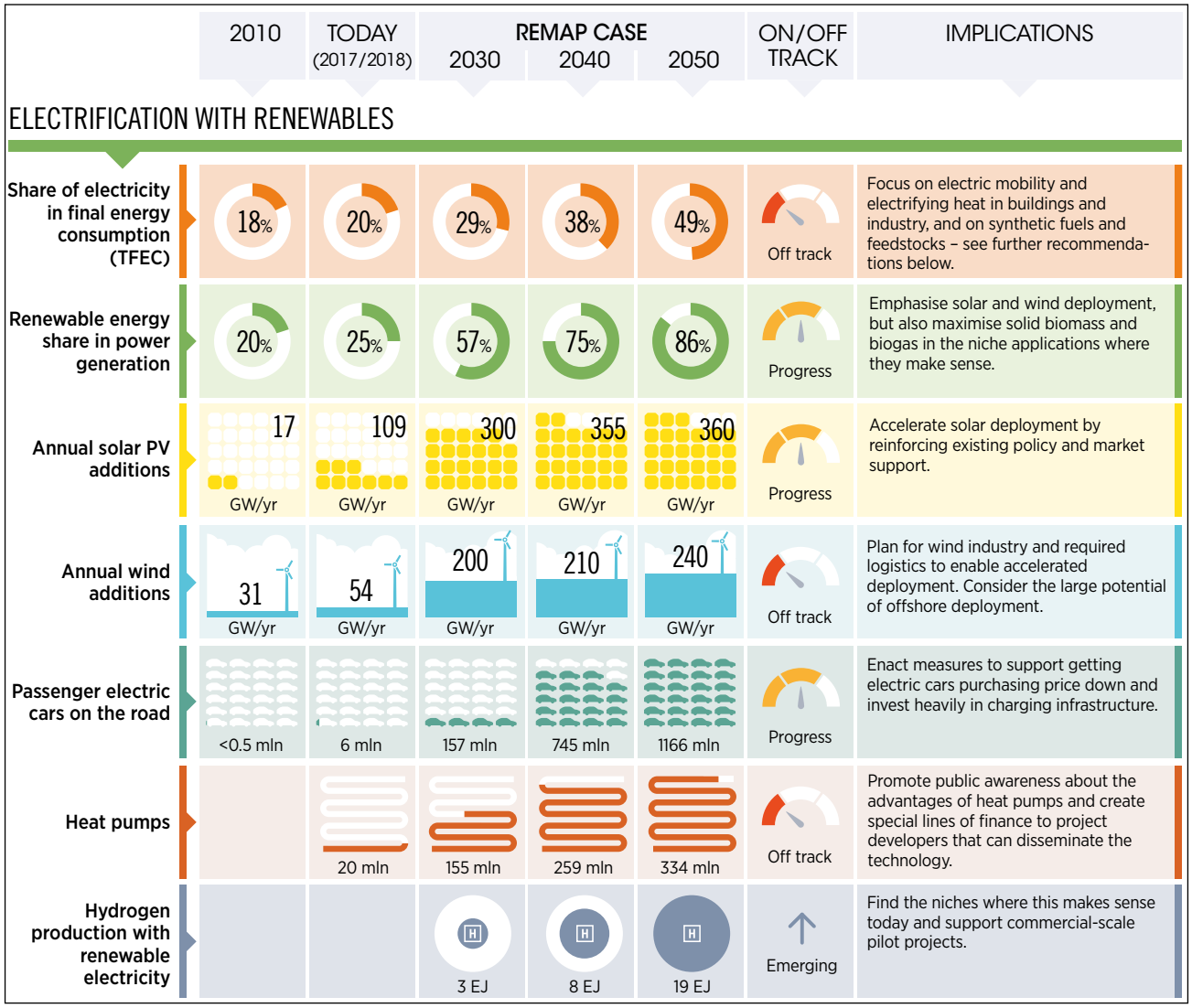


Figure 9: Electricity Generation from Renewables and Their Growth Variations
(IRENA, Global Report on Energy Transformation, 2019)

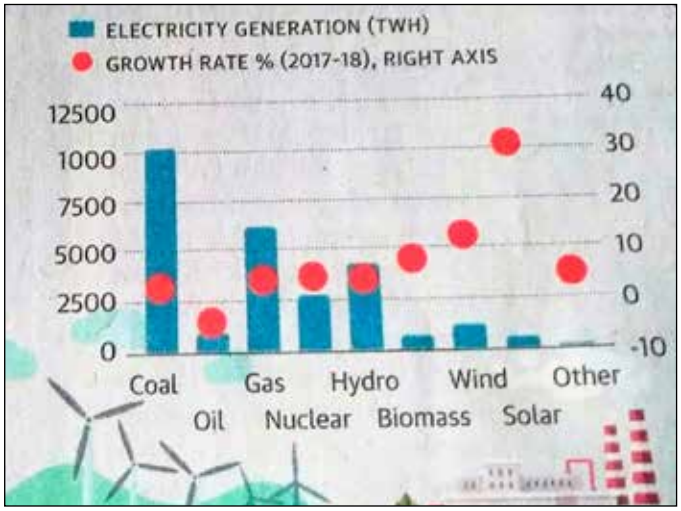


Figure 10: Fossil Fuel Usage Need Curtailment of Growth Rate

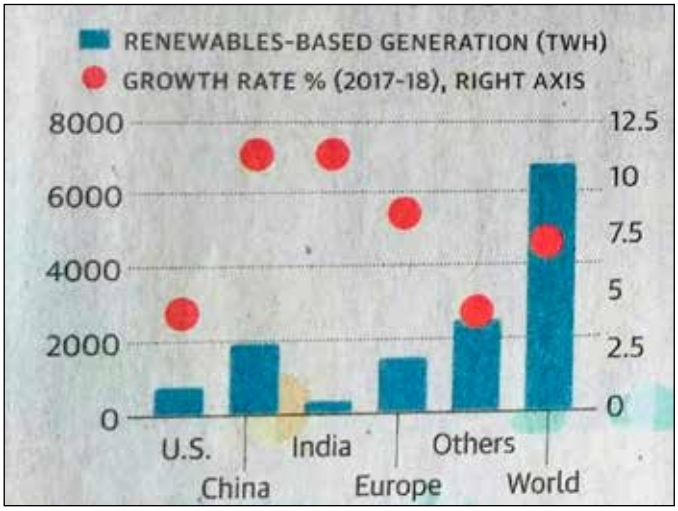


Figure11: Significant Higher Rate of Growth of Renewable Energy in India

(Reference: The Hindu, International Energy Agency, IEA, 2018)

SDG INDIA INDEX

Goal 7 is closely Interrelated with many other Goals as below

This chapter presente India's status at the national and state level on Goal 7. Since Goal 7 is linked to other Goals, chapters linked to other Goals should be referred to for a more holistic understanding.

Goal 1: No Poverty
aims to reduce poverty in all its dimensions, and by ensuring universal access to affordable energy services, SDG 7 aims at raising living standards

Goal 2: Zero Hunger
that aims to end all forms of malnutrition, and provision of safe, nutritious and sufficient food to everyone as the agriculture sector and food supply chain is dependent on energy

Goal 3: Good Health and Well-being
which seeks to preventable deaths and provide access to quality essential health care services, medicines and vaccines which relies on energy

Goal 4: Quality Education
which aims to ensure that all learners acquire the knowledge and skills needed to promote sustainable development is influenced by provision of sources of energy

Goal 5: Gender Equality
which aims to eliminate all forms of violence and other types of exploitation of all women and girls as women's safety as well as the care economy for which women are responsible are dependent on access to energy

Goal 6: Clean Water and Sanitation
which seeks to universal access to safe and affordable drinking water for all and ensure access to adequate and equitable sanitation and hygiene for all rely on energy

Goal 8: Decent Work and Economic Growth
which seeks to sustain per capita economic growth. All sectors that contribute to economic growth are intrinsically dependent on access to energy

Goal 9: Industry, Innovation and Infrastructure
which aims to upgrade infrastructure to make industries sustainable, increase resource-use efficiency and adopt clean and environmentally sound technologies and industrial processes

Goal 10: Reduced Inequalities
by aiming to ensure universal access to affordable modern energy services

Goal 11: Sustainable Cities and Communities
which aims at providing access to safe, affordable, accessible and sustainable infrastructure and amenities which are dependent on clean and affordable sources of energy

Goal 12: Sustainable Consumption and Production
by aiming to increase the share of renewable energies and increase energy efficiency

Goal 13: Climate Action
by increasing the share of renewable energies and increase energy efficiency, it aims to promote mechanisms for raising capacity for effective climate change-related planning and management

Figure 12: Sustainable Development Goals- SDG (Reference: SDX India Index 2018 NITI Aayog)

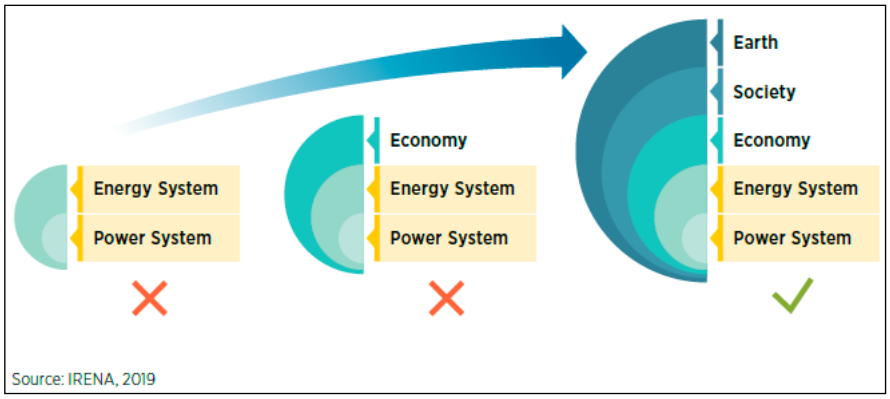


Figure 13: Energy Transition is now Inclusive of Economy, Earth and the Society

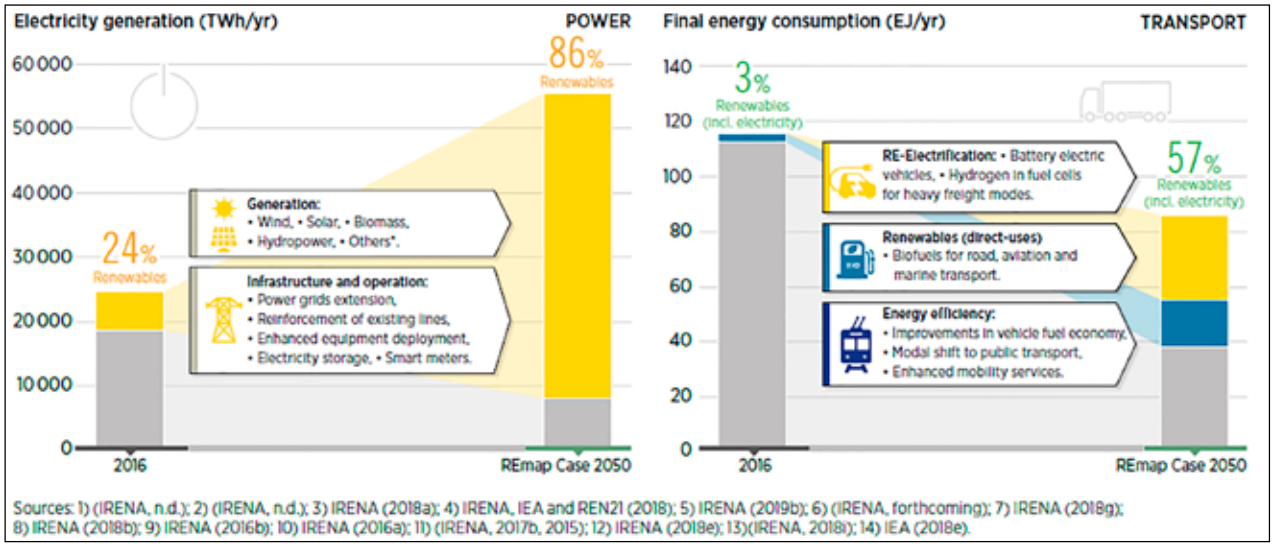


Figure 14: Electricity Generation and Usage of Energy for Transport Mobility

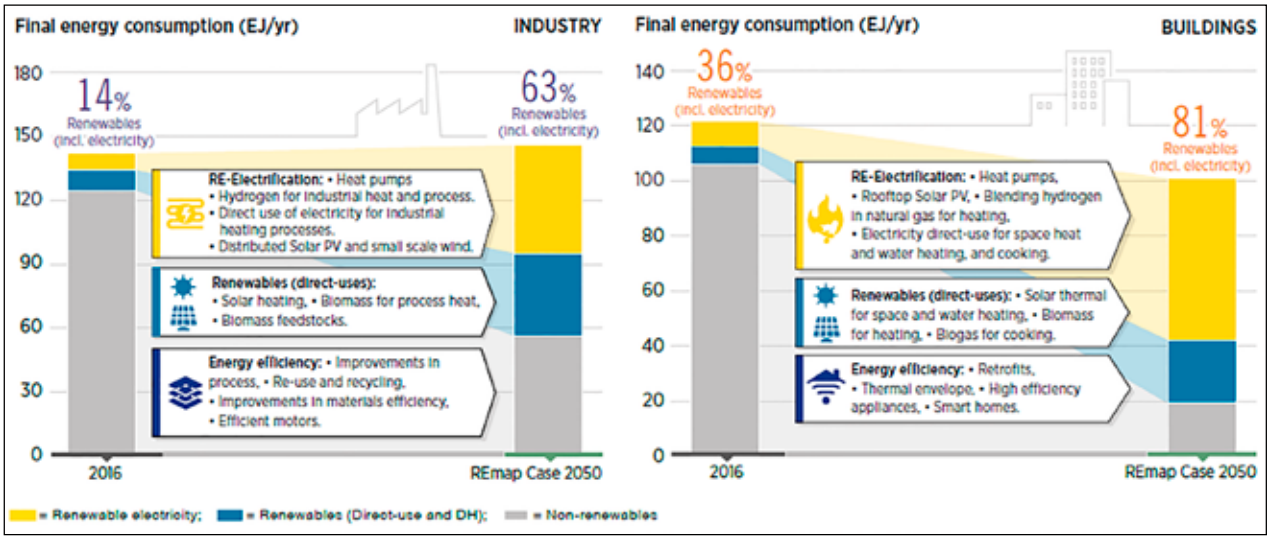


Figure15: Energy Usage: Industries and Buildings

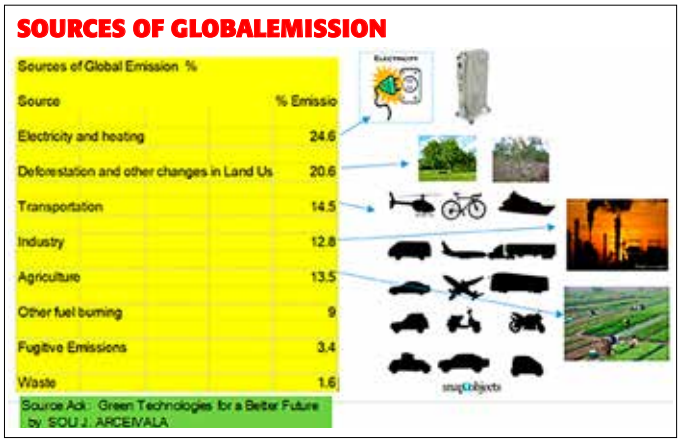


Figure 16: Electricity is Major Pollutor since Fossil Fuel still is the Main Stream for Generation

RE-Assure Your and Yours'
(Future Generations, by S'GET)
(Sustainable Global Energy Transition)

- You have enjoyed, BUT Co_2 emitted stays over 120-150 years- S'GET
- Renewable plays a vital role for S'GET.
- Shine/heat cool with solar for S'GET
- Wind with Wind (Onshore/offshore) sea-land breeze too for S'GET
- Think Small, Do and get done by the mass for S'GET
- Infirm Renewable Energy, Not anymore with Smart Grids... S'GET
- God has created No Waste, Only Wealth, ...S'GET
- Future of Sustainable Mobility is IoT, ICT, IIoT..... for S'GET
- WE ARE THE ONLY GENERATION WHICH CAN SAVE THE FUTURE OF MANKIND AND MOTHERR EARTH BY S'GET

Figure 17: Sustainable Global Energy Transition: S'GET - A Way of New Life

"Think Global, Act Local" will be the mantra for the future of RE-projects in India, as well as to the rest of the world.

Acknowledgements: MNRE and resources compiled from latest 2017-2020 Web Published Reports from IEA, GWEC, IRENA, NITI Aayog, MNRE-GoI, NIWE, NISE, and NIBE