Maintenance—An underrated piece in the solar energy puzzle

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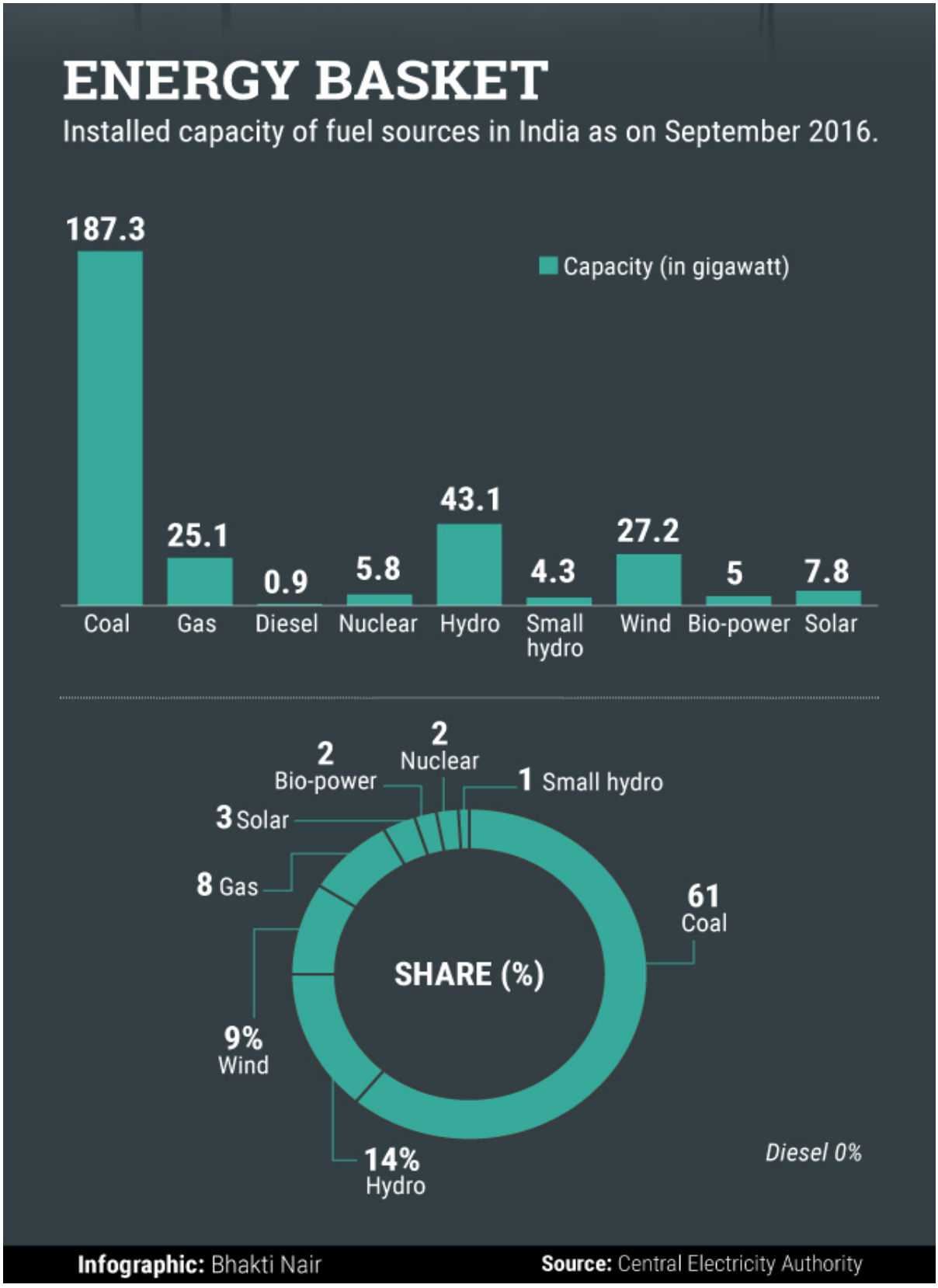
India's march towards a greener energy mix is ambitious, yet achievable. The current total installed power generation capacity is still dominated by thermal power plants at 70%. But, renewable energy (RE) sources have seen a significant growth in the last few years—the energy mix had a 14% RE component in September 2016. The capacity of RE sources has increased by 50% from around 30 gigawatt (GW) in January 2014 to 44.2GW as of September 2016.

The solar energy sector, in particular, has seen a sharp growth of 85% as of early 2016 and has grown by 60% further since then. But there is still a lot of ground to cover to reach our ambitious targets. By 2022, India aims to achieve 175GW (of which 100GW is solar) of installed RE capacity. This translates to increasing the share of RE by a factor of 3, and the share of solar—mostly photovoltaic (PV)—needs to grow by a factor of 12. Even if only the utility-scale installation target of 60GW is considered, it still points to an increase in the solar share by a factor of 7. With such strong dependence on solar, there is merit in understanding its sensitive nature. A clear understanding of this would help in designing a sustainable way forward with solar-based technologies.

There is a perception that solar PV technology-based plants resemble a 'plug and play' type of model. Even the most elegant technology requires some form of upkeep and maintenance. Solar technologies are no exception. In fact, the long-term performance of a solar PV plant is strongly dependent on the maintenance practice employed. Bad maintenance practices could lead to decline in annual energy output leading to plants not being able to honour their financial commitments. To understand the true effect of declining plant outputs due to bad maintenance practices, a view of multiple solar plants connected to a larger network (Indian Power Grid) has to be considered. The idea is to look into the aggregated energy contributed by all solar plants and associate it with the forecasted energy demand of the power sector.

A conservative estimate of the average annual energy generated by a 1 megawatt-peak (MWp) plant is approximately 1.5 gigawatt-hour (GWh). The low yield compared with conventional fossil fuel-based plants is because of the fact that the efficiencies of conversion of light to electricity are still less than 20% in present day PV technologies, and electricity generation occurs only during the day. Considering only the utility-scale installation solar target, India's installed solar capacity would have to be scaled up to 60,000MWp. The annual power generated for this capacity would be 90,000GWh. This would account for approximately 5% of the overall electric energy requirement for 2021-22 for all India as per the estimates of the 18th Electric Power Survey. Even a 1% drop in energy generation due to poor maintenance practices results in a 900GWh loss annually. This is approximately 4% of the energy requirements for the entire north-east region. If the drop increases to 1.5% of energy generation, the energy deficit rises to approximately 6% of the requirement for the entire north-east region.



For solar PV plants, proper cleaning of the layers of dust and soil that accumulate on the modules is one of the most important maintenance activities. Losses in the plant output due to poor cleaning and maintenance are referred to as derating losses. It should be noted that despite proper maintenance, solar modules do degrade over time. Typical manufacturer-specified degradation rates indicate that a module degrades to 90% of its rated capacity in the first 10 years, and it further degrades to 80% of the rated capacity at the end of 25 years. However, poor handling of modules during installation and operation could accelerate module degradation.

The financial viability of the plant is strongly tied to the estimated energy output of the plant throughout its prescribed lifetime. It's a simple equation: higher the power generation output of a plant, lower is the tariff needed to sustain the equity, debt and expense commitments. One of the metrics which indicates the financial

viability of a plant is the levelised cost of energy (LCOE). The effect of losses due to derating and degradation increases the LCOE of a plant due to reduced energy output annually.

It is unfortunate, but little attention is paid towards ensuring that maintenance activities are carried out by trained personnel. Cleaning activities are typically carried out by unskilled labourers hired by generation plants—finding a lady standing on top of a module dusting off dirt is not an uncommon sight. But this is not a good idea because the weight of the operator could stress the delicate solar cells in the modules resulting in the development of micro-cracks in cells. These cracks would act as a source of power loss and heat up individual cells, thereby creating hotspots, ultimately causing accelerated module degradation.

The National Institute of Solar Energy, an autonomous institution of the ministry of new and renewable energy, announced the ‘Surya Mitra’ programme to aid skill development for the solar energy sector. The programme is certainly an encouraging step, but knowledge of appropriate maintenance of solar modules needs to be actively and more openly disseminated. This could particularly aid in making the case of solar rooftop installations—where every unit generated or lost can impact the business case—successful both from standpoints of energy and financial savings.

The maintenance aspect of solar installation is currently a shy topic and not adequately discussed. To make solar energy a success story, we must embrace its nature completely and support it the right way to make it a sustainable solution. Even a simple step such as cleaning the modules the right way could support a bigger idea of an effective clean energy solution.