SOLAR AGRICULTURAL FEEDERS IN MAHARASHTRA

Providing Reliable Day-Time Electricity While Reducing Subsidies

In this article, **Ashwin Gambhir** and **Shantanu Dixit** highlight that the availability of the electricity grid in every village coupled with the national feeder separation programme makes Maharashtra's solar feeder programme and KUSUM's decentralized ground-mounted grid solar power plant programme quite feasible across India. The urgent need for providing agriculture with reliable and affordable daytime electricity makes it imperative for the sector to adopt such an approach. This policy framework is a win-win situation for the farmers, government, and discoms, and offers a much needed farmer-centric yet fiscally prudent pathway for the power sector.

Agriculture is the main source of livelihood in rural India, contributing to food security. Two-thirds of the total irrigated area in India uses groundwater pumping, powered by more than 2 crore electric and 75 lakh diesel pumps. Thus, agriculture is a major consumer of electricity, accounting for nearly one-fifth of the total consumption in the country. In many states, this is much higher at one-fourth or one-third of the state's total consumption. Access to groundwater depends on reliable and affordable electricity supply. This is an important issue as it concerns livelihoods of the rural poor and food security of the country.

Since the 1970s, agriculture in many states has been receiving electricity at either low tariffs or for free. Much of this supply is un-metered. Subsidized supply has played a key role in the growth of groundwater irrigation and agriculture production. Due to the lower tariff and poor revenue collection, agricultural sales are often seen as a major reason for the financial losses of distribution companies (discoms). Part of this loss is then recovered through higher tariffs for other consumers such as industry and commercial (called cross-subsidy), and the remaining through direct subsidy from the state governments. Because it is seen as a loss-making sector, agriculture often gets poor quality supply leading to problems such as frequent pump burn-outs and power failures. Restoring supply takes a lot of time and so does getting new connections. Further, the supply is unreliable and often available during late nights. All these factors make farmers distrustful of discoms and both of them are caught in a low level equilibrium.

Electricity demand for agriculture is expected to double in the next 10 years and as the average cost of supply keeps increasing, the problem of agriculture subsidies will become worse. Unless new ideas are tried out, the quality of electricity supply to agriculture will worsen. Any solution must first provide reliable, adequate day-time electricity supply to farmers at reasonable tariff,

leading to a gradual increase in the mutual trust between the discom and the farmer. This should also reduce the subsidy requirement for it to be truly scalable across the country. Further, the long standing and vexed nature of the agriculture–electricity issue means that solutions should also be flexible enough to incorporate the ground realities of the state in question.

Three ongoing developments in the power sector allow for an exciting possibility. One, low-cost electricity from solar photovoltaics, at ₹2.75–₹3 per unit and at a fixed price contract for 25 years due to absence of any fuels is already a reality. Second, states have to exponentially increase their solar procurement to fulfil the national mandate of increasing the use of solar power through the instrument of solar purchase obligations. Both these developments mean a cost-effective increase in the share of renewables, thereby enhancing energy security and contributing to climate mitigation. Finally, the electricity grid has reached every village in India and agriculture feeder separation, where lines carrying electricity to pumps and villages are physically separated, has progressed significantly, with nearly two-thirds of the target completed. Budgetary support for complete feeder separation is already earmarked under the Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) scheme of the Government of India (GoI).

INNOVATIVE SCHEME

An innovative programme taking advantage of these developments has started in Maharashtra under the aegis of the 'Chief Minister's solar agriculture feeder programme'. A solar agriculture feeder is essentially a 1–10 MW community-scale solar PV power plant, which is interconnected to the 33/11 kV sub-station.

A 1-MW solar plant can support around 350, 5 hp pumps and requires around 5 acres of land to set up. The plant can be set up in few months and there is no change at the farmer's end. Pumps need not be changed and farmers do not have to take responsibility of installation and operation. All the pumps connected to the separated agriculture feeder will be given reliable day-time electricity for 8–10 hours between 8 a.m. and 6 p.m. When solar generation is low, maybe due to cloud cover, balance electricity can be drawn from the electricity grid. Alternatively, when pumping demand is low, maybe during rains, excess solar electricity will flow back to the grid. This allows for optimal sizing of the power plants. Project developers are selected through a competitive-bidding process and the entire electricity would be bought by the discom through a 25-year contract. The discom would continue to distribute the electricity to farmers on concerned feeders. The policy has notified that Maharashtra Electricity Distribution Company Ltd (MSEDCL) and Maharashtra State Power Generating Company (MahaGenco), both would be the implementing agencies. To ease project development, state government land near substations can be made available on lease at nominal rate. Lease of private land is also possible under the policy. Finally, groups of farmers can also develop projects through bidding process and sign PPA with MSEDCL. A simple schematic of the solar feeder is shown in Figure 1.

The major advantages of this approach are that apart from ensuring day-time reliable power for the farmers, it requires no capital subsidy from the government. Rather, it is cost-effective in comparison to the existing supply from the centralized grid, thereby enabling reduction in subsidy.

Additionally, no new large transmission lines are needed, which has become a bottleneck for various large-scale wind and solar power tenders. Further, since load being served will primarily be only during generation hours (day-time) coupled with the value of geographic diversity unlike large centralized solar parks, this minimizes the grid integration costs of such a form of distributed solar development. Deployment is possible under the existing regulatory framework, and the generation also qualifies for Solar RPO of the participating discom.

Finally, this approach will also provide jobs to local youth in construction, operation, and maintenance of the plant. More significantly, these jobs will be geographically distributed across the state. After demonstrating the benefits of this approach, future programmes could link deployment of such solar feeders to reduce unauthorized use/connections, improve metering and tariff recovery, energy efficient pumps, water saving approaches, etc.

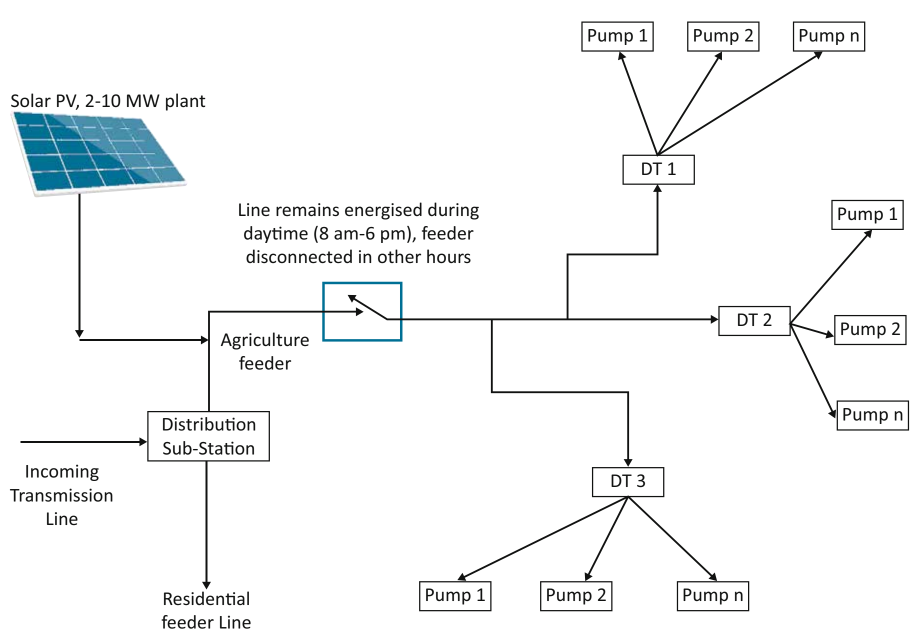
Currently, solar plants with overall capacity of around 2,500–3,000 MW are under various stages of tendering and implementation under this scheme in Maharashtra. This is equivalent to supplying solar power to 8–10 lakh pumps, or 20%–25% of the pumps in Maharashtra. As of December 2018, nearly 10,000 farmers are already getting reliable daytime power under this scheme and the discom is planning to scale this significantly beyond initial target of 7.5 lakh in next three to five years.

A CLOSER LOOK AT THE ECONOMICS OF SOLAR FEEDER

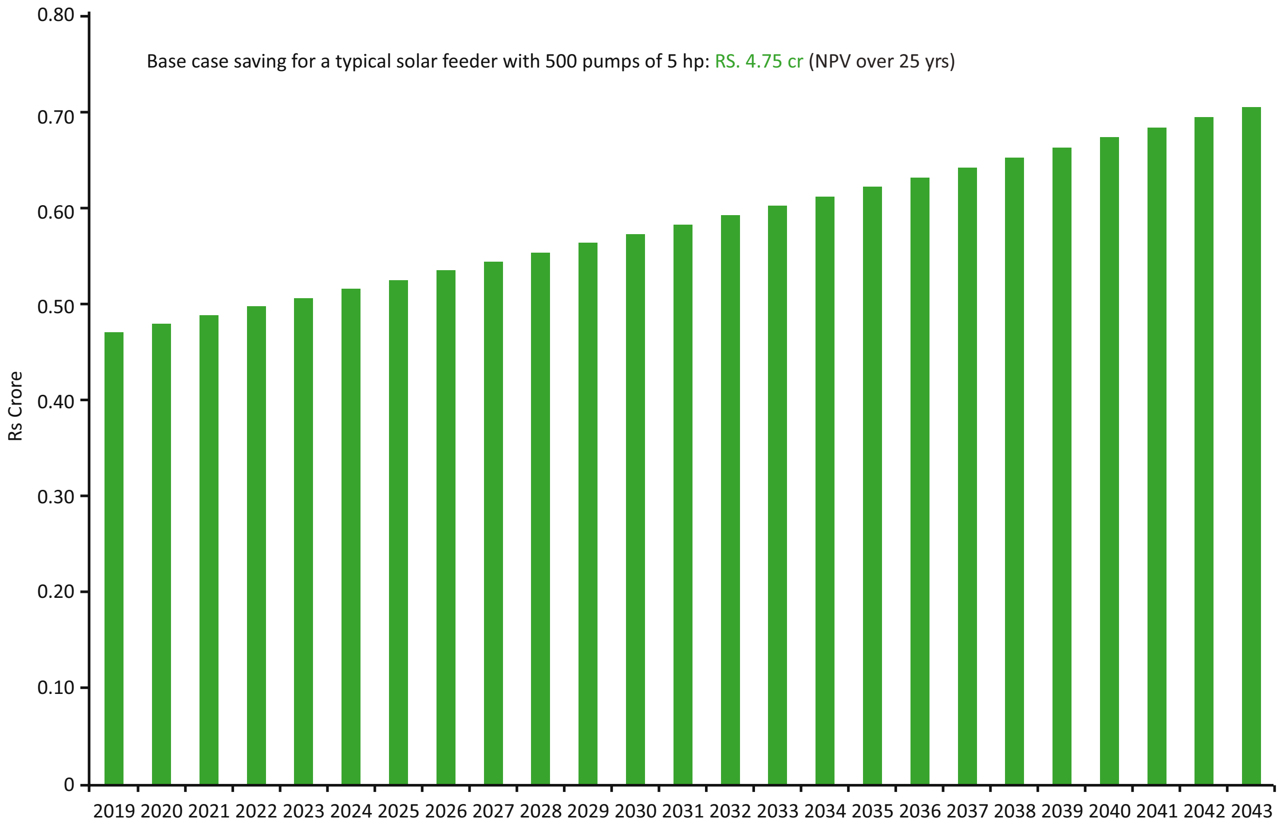
Assume a separated 11-kV agriculture feeder with 500 pumps of 5 hp each. Further assume that they operate for 1,250 hours each year with losses of 6% in the 11-kV line. This translates to an annual energy requirement of 2.47 million kWh (MUs) for the feeder.

In the existing situation, this energy is supplied from the central grid. Assuming an average power purchase cost of ₹4/kWh, transmission charges of ₹0.4/kWh and 9% losses (state transmission losses + 33 kV wheeling losses), the landed cost works out to ₹4.85/kWh in the first year. Thus, the total input cost for this feeder is ₹1.2 crore/year. A modest 0.75% yearly increase in the landed cost would mean that the cost would be ₹1.35 crore/year by the 25th year. In stark contrast, the cost of solar power is fixed for 25 years and assuming it to be ₹3/kWh, the annual input cost for the solar feeder is only ₹0.74 crore/year. These yearly savings for such a typical feeder are shown in Figure 2. The net present value of the total savings over 25 years is roughly ₹4.75 crore per feeder. In nominal terms, this is equivalent to a saving of just over ₹10,000 per pump per year. This saving could be used for various purposes including increasing farmer incomes, water saving measures, loan waivers, etc.

At the national level, the GoI has also proposed a scheme for the use of solar power in agriculture, namely, 'Kisan Urja Suraksha evam Utthaan Mahabhiyan (KUSUM)'. The



» Solar feeder schematic



» Yearly savings (Rs cr) per feeder to MSEDCL from solar feeder over grid supply over 25 years

recently published draft guidelines under this scheme detail out three sub-components. Component-A involves setting up of 10,000 MW of decentralized ground/stilt-mounted grid connected solar or other renewable energy-based power plants. This approach is very similar to the solar feeder programme underway in Maharashtra and hence has all the advantages enlisted above.

Components B and C involve setting up of 17.50 lakh stand-alone solar agriculture pumps and solarization of 10 lakh grid-connected agriculture pumps, respectively. While stand-alone off-grid solar pumps may be a good option in places where the grid has not reached or where the water table is relatively low, solarization of existing grid connected pumps (component C) warrants a comparison with Component A which is an alternate way of achieving the same end result.

Grid-connected solar pumps will be given a total 60% capital subsidy, equally from the central and state governments while the farmer will have to make a contribution of 10%, which is nearly ₹42,500 considering the cost of the pump. Thus, 10 lakh pumps will need a capital subsidy of ₹25,500 crore and ₹4250 as a contribution from farmers. Unlike the capital subsidy which is linked to capacity deployment and not to performance, deployment under Component A (decentralized ground-mounted solar plants) will be given a performance-based incentive of ₹ 0.4/kWh for a period of 5 years. This works out to be a total of ₹3,300 crore for a capacity of 10,000 MW which in turn would support nearly 33.5 lakh pumps of 5 hp each. Even after accounting for the surplus power which would be exported to the grid from these over-sized solar pumps, one sees that ground-mounted solar power plants are much more economically viable. Finally, Component A is high scalability with low gestation period while Component C has much lower scalability due to higher project and transaction costs. Hence, considering the favourable economics and ease/scale of implementation, focusing effort on Component A would be appropriate. This should be significantly scaled up over time and should be rolled out quickly.

CONCLUSION

In summary, the availability of the electricity grid in every village coupled with the national feeder separation programme makes Maharashtra's solar feeder programme and KUSUM's decentralized ground-mounted grid solar power plant programme (10,000 MW) imminently feasible across the nation. The urgent need for providing agriculture with reliable and affordable daytime electricity makes it imperative for the sector to adopt such an approach. This policy framework, a win-win situation for the farmers, government, and discoms, offers a much needed farmer-centric yet fiscally prudent pathway for the power sector.

Mr Ashwin Gambhir and Mr Shantanu Dixit, Prayas (Energy Group).