***Towards reliable solar powered agriculture***

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Renewable Energy  is now seen as the key electricity supply option, given its rapidly falling costs and its contribution to enhancing energy security at a time of ever-rising fossil fuel imports. Climate mitigation is a key added co-benefit. Recognizing this, the Government of India has recently announced an ambitious target of 175 GW of renewable energy capacity addition by 2022. Solar power (100 GW) forms the mainstay of this target. This is further divided into large scale centralized power plants (50 GW) and distributed smaller scale projects (40 GW of rooftop mainly used by industrial, commercial and residential consumers and 10 GW grid-connected tail-end plants).

This leaves out the crucial agriculture sector. The only option proposed in this sector, is individual off-grid solar pumps, with very high upfront capital subsidies to the tune of 90%. The solar pump approach is suitable for areas not served by the grid and with high water tables. But, several studies have already pointed out the limitations of this approach. Limitation on use by small and marginal farmers due to high upfront costs and contributions, lack of innovations and slow cost reduction due to the capital subsidy structure, possibility of continued use of diesel/electric pumps, additional maintenance burden for farmer, fear of theft of panels and most importantly significant under-utilization of the high cost solar system when not in use.

Our analysis shows that a significantly more cost effective, socially equitable and easier to manage alternative is possible, for certain areas, especially where agricultural feeder separation has taken place. MNRE has recently announced a new proposal for unemployed youth and farmers wherein ~10 GW of grid connected tail end solar PV plants (0.5-5 MW) will be connected to the distribution substation. Power from these projects would be bought by the DISCOM at the rate decided by the SERC. MNRE is willing to contribute Rs. 0.5 crore/MW (~ 8% of the capital cost), provided the state sets up a committee and institutes a policy for transparent selection and allocation of projects. While several details of MNRE proposed approach have yet to be worked out, such tail-end, MW scale PV projects could be used effectively to meet agricultural power demand. Under our suggested approach, in areas with feeder separation, 1-2 MW tail end solar PV plants (representative of a typical feeder load) would be inter-connected to the 33 kV sub-station and such feeders would be kept live/load shedding free during the day time from 8 am – 5 pm to primarily meet agriculture load. Any excess generation from solar would flow back to the local grid. If the agriculture load is high the differential would be provided by the grid.

A preliminary economic analysis suggests that it is roughly 50-60% more cost effective than solar pumps (see table below). Apart from the cost effectiveness, this approach is investment driven and does not involve upfront subsidy.

**Cost effectiveness of different solar agricultural pumping options**

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| **Option A; Individual Solar Pumps:** Upfront cost of **INR 21 crores** (at Rs. 150/Wp and replacement of 5 hp grid pump with 3 hp solar pump) |
| **Option B; solar powered feeder:** 1.4 MW solar plant to offset yearly energy use. @ Rs. 6/kWh, yearly payment of Rs. 1.4 crores, or an NPV of **INR 10.8 crores** over 15 years. |

**Option C; solar powered feeder with energy efficient pumps:** 0.86 MW solar plant (40% reduction due to efficient pump). Existing pump replaced with 5 star pump @ Rs. 35,000/pump. Yearly payment of Rs. 1.08 crores (incl. pump replacement cost spread over 15 years), or an NPV of Rs. **8.2 crores** over 15 years.

**Assumptions:** 11 kV feeder, with 500 pumps (avg 5 hP), usage of 1200 hours/year; discount rate: 10%

The solar powered feeder approach could also be compared with the existing conventional grid supply situation. Cost of power up to agriculture feeder is about Rs. 4/kWh considering cost of generation and losses while solar power costs ~ Rs. 6/kWh. Efficient pumps, if integrated into this solar feeder scheme can bring down the effective cost of solar power for agriculture by about 25% (after accounting for cost of new pumps, which can reduce power requirement by 30-50%). Thus, considering the fixed cost of solar generation (over 20-25 yrs) and the increasing cost of grid supply, an integrated solar powered feeder with efficient pumps would be cheaper than grid supply in just 5-6 years. This will have added benefits of reliable and better quality (rated voltage) power, leading to lower pump burn-outs. Additionally trained human resources at solar plant would be available in the farm vicinity. Both these factors, could greatly contribute to a successful agriculture-DSM program of pump replacement, unlike earlier isolated programs.

States would be well advised to take up the proposed MNRE scheme, but should modify it to make the crucial link with agriculture and thus reap its multiple benefits including rural industry jobs. This could be one of the crucial steps in addressing the Achilles heel of Indian power sector – i.e. agricultural power supply. It also allows for the DISCOM to account for its mandated solar purchase obligation (set to be 8% by 2019). Through reliable and better quality power, it would truly support agriculture in these times of agrarian distress.

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