Solar powered agriculture feeders: a conceptual framework

*Prayas (Energy Group)*

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Existing agriculture supply

Line is energised mainly during off-peak hours, poor quality and irregular supply.
Solar PV, 1-2 MW plant

Line remains energised during daytime (8 am-5 pm), feeder disconnected in other hours

Incoming Transmission Line

Residential (Gaothan) Feeder Line

Agriculture Feeder

Distribution Sub-Station
Concept

• Action
  – Tail end grid-connected solar PV plants (1-2 MW) dedicated to agricultural loads in areas with feeder separation
  – Inter-connection at sub-station.
  – Feeder needs to be kept live/load shedding free from 8 am – 5 pm.
  – Power purchased by local DISCOM

• Operation
  – In case of low load, power will flow back to DISCOM grid.
  – If load is higher than solar supply; differential provided by grid.

• Output
  – Reliable, quality supply during day time (8 am-5 pm).
Crucial benefit to farmers

• Assured and reliable hours of supply to agriculture and improved quality.
  – Potentially less pump burn outs due to better voltage

Source: Prayas’s Electricity Supply Monitoring Initiative (ESMI), available at watchyourpower.org
Other benefits

• Significantly more cost-effective and manageable as compared to individual solar pumps.
  – About 50% cheaper

• Supply from tail end solar plants competitive with conventional grid supply in 4 -6 years.
  – Considering rising grid tariffs, falling solar prices (and costs being fixed over project life)

• Effective use of Solar RPO (set to be 8% by 2019 as per NTP) to meet agricultural demand.
Case even better if integrated with energy efficient pumps

• Replacement of all pumps on feeder with BEE 5–star rated pumps.
  – Reliable and better quality day time power ensured due to solar tail end generators
  – Trained human resources at solar plant would be available in the farm vicinity, to ensure EE pump guarantee.

• Both these factors, could greatly contribute to a successful agriculture-Demand Side Management program of pump replacement

• Significantly higher possibility of a scalable and sustainable initiative unlike earlier isolated programs.
Comparing annual payments in different options

Solar Power Cost of Rs 6/kWh

- Cost from conventional grid supply
- Cost of solar feeder supply
- Total cost of solar feeder and EE pump option

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Comparing annual payments in different options

Solar Power Cost of Rs 5.5/kWh

- Cost from conventional grid supply
- Cost of solar feeder supply
- Total cost of solar feeder and EE pump option
Next Steps

• Adopt ‘integrated solar powered agriculture feeder + efficient pump’ approach for pilot implementation on 5 agricultural feeders (may be with different business models)

• Scale up to a new solar-agriculture initiative depending on the results from pilots.

• State energy policies should explicitly promote such a program.
Effective use of new proposal from MNRE

• MNRE recently announced a new solar proposal for unemployed youth and farmers.
  – ~10 GW grid connected tail end solar PV plants (0.5-5 MW), connected to the distribution substation.
  – Power to be bought by DISCOM at the rate decided by the SERC.
  – MNRE willing to contribute Rs. 0.5 crore/MW (~ 8% of the capital cost), provided the state institutes a committee and policy for transparent selection and allocation of projects.
  – Several details of MNRE proposal yet to be worked out.

• **Crucial modification in scheme to link it to agriculture as suggested could be one of the crucial steps in addressing the Achilles heel of Indian power sector – i.e. agricultural power supply.**
THANK YOU

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Economics, preliminary estimates

• Assumptions
  – 11 kV feeder with 25 dedicated Agriculture Distribution Transformers
  – Each DT has 20 pumps (average 5 hp rating) with average 1200 hours use/year
  – Solar pump price: Rs. 150 /W_p; Solar power price: Rs. 6/kWh
  – Solar power plant utilization factor: 19%;
  – Discount rate for NPV: 10%
  – Pump replacement with 5 star pump cost: Rs. 35,000/pump; costs spread over 15 years;
  – Energy savings of 40% from efficient pump usage.
  – Power Cost for supply Rs. 3.5/kWh, escalating at 4% per year,
  – 10% Transmission losses
Results

• **Individual solar pump option**
  – Replacing 5 hp with 3 hp solar pump, upfront cost of **Rs. 21 crore**.

• **Solar Powered agriculture feeders**
  – 1.5 MW solar PV system needed to offset yearly energy use. Yearly payment of Rs.1.5 Cr (i.e. NPV of **Rs. 10.8 cr**)  

• **Solar Powered agriculture feeders**
  – 0.86 MW solar PV system needed to offset yearly energy use. Yearly payment of Rs. 0.85 Cr for solar power and 0.23 cr/year as cost of pump replacement. A total yearly payment of 1.08 cr (i.e. NPV of **Rs. 8.2 cr**)  

• **Conventional Grid Supply**
  – Cost of supply to this agriculture feeder will increase from ~ 0.92 crore/yr to Rs. 1.09 crore/yr in about 5 years, i.e. will be comparable with solar + EE pumps agricultural feeder model (since cost of solar is constant over 25 years)
Individual off-grid solar pumps

• Approach suitable for areas not served by the grid and with high water tables

• Limitations of this approach.
  – Very high upfront capital subsidies to the tune of 90%.
  – Lack of innovations and slow cost reduction due to the capital subsidy structure
  – Limitation on use by small and marginal farmers due to high upfront costs and contributions
  – Significant under-utilization of the solar system
  – Possibility of continued use of diesel/electric pumps
  – Additional maintenance burden for farmers
  – Fear of theft of panels