Indian discoms and the lure of solar-based irrigation

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Context

• Agriculture in power sector
  – 22% of total electricity consumption
  – 3% of consumer revenue
  – Deficit is covered by
    • Cross-subsidising
    • Power subsidy

• ₹1 lakh crores – total power subsidy in last year

• Power supply issues with agriculture
  – Limited & untimely supply
  – Poor quality of supply
  – Huge backlog of connection applications

• Demand-side reforms haven’t materialised
  – Operational and political constraints in metering and billing
  – Political constraints in increasing tariff
The promise of solar: a supply-side solution

• Benefits:
  – Substitute the perpetual power subsidy with a one-time capital subsidy
  – Assured full day-time quality power for the farmer
  – Auxiliary benefits
    • Increase renewables in energy mix (RPO obligations)
    • Emission savings

• Three main models of solarisation
  – On-grid – individual solarized pump
  – Solarized agricultural feeders
  – Off-grid solar pumps
Solarisation of Agriculture

Individual grid-connected solar pumps
Overview

• The model
  – Existing grid-connected pumps are solarised
  – State to provide capital subsidy for solarisation
  – Pumps to run exclusively or predominantly on solar power
  – Sell surplus power back to the grid

• Benefits
  – Avoided subsidy bill for the state
  – Additional income for the farmer
  – Discom gets power at a very low rate
**Discoms’ experiences**

- **Pilots**
  - Karnataka: ‘Surya Raita Scheme’
    - Solarised existing pumps with unidirectional metering
    - A farmer cooperative was formed to facilitate the project
    - Feed-in-Tariff: ₹7.2; ₹6 to payback loans; ₹1 to farmer; ₹0.2 to cooperative
  - Andhra Pradesh: ‘Grid-connected BLDC pumps’
    - Replaced existing pumps with Solar DC pumps
    - A farmer cooperative was formed to facilitate the project
    - Feed-in-Tariff: ₹1.5
  - Gujarat: ‘Suryashakti Kisan Yojana’
    - Bidirectional metering
    - Feed-in-Tariff: ₹3.5

- The experiences of these pilots revealed several operational/commercial/technical challenges to the model
Challenges

• **Commercial**
  – **Financing beneficiary contribution:** The political economy of free power - farmers are reluctant to make any substantial upfront investment.
    • In Karnataka, farmer contribution was fixed at 15% of total cost. But farmers refused to pay. Upfront contribution had to be converted to discom sponsored loans.
    • In Andhra Pradesh pilot, they experimented with no beneficiary contribution, but low Feed-in-Tariff (₹1.5). The annual income from sale of electricity was not more than ₹6000
    • In Gujarat, beneficiary contribution was 5% and FiT ₹3.5. The state government provided an additional subsidy for 7 years to pay off the loans.
  – **Cost of infrastructure upgrade:**
    • Expensive feeder segregation cost for many states
    • Ensuring daytime ‘must-run’ status – upgrades in the tail end
Challenges

• **Operational**
  – **Tackling the free-rider problem:** Perverse incentive for non-participating farmers in the same feeder
    • In Karnataka, there were unauthorized connections which continued after the solarisation.
    • Gujarat introduced ‘Smart Energy Metering’ with IoT devices at farmgate and transformer level. Penalties to the whole feeder if the difference is too high
    • Andhra Pradesh waited till all farmers in the feeder agreed to participate
  – **Metering and billing:** Discom faces man-power shortage. Farmer has trust issues with remote billing
    • Andhra Pradesh – Billing in presence of farmer, discom representative and farmer cooperative representative. Not a scalable model
    • Karnataka – Billing to be done with the help of the cooperative. But the cooperative have become dysfunctional.
Overall assessment

- Does the model lead to overall savings for the state?
  - Only theoretical assessments
    - Andhra Pradesh has estimated a net savings of ₹1.3 lakh-₹2.1 lakh for a 5HP system
    - In Rajasthan, a study by World Bank has estimated that a one-time capital investment of ₹10,700 crores can substitute an annual subsidy outgo of ₹6,200 crores
- Does the model lead to savings for farmer?
  - Impact assessment
    - Andhra Pradesh has estimated an annual income of ₹6000 to farmers
  - Theoretical assessment
    - CEEW estimates that a 5 HP system with 1.5 times panel oversizing and ₹3 FiT can give up to ₹24000 income annually (before paying EMI for loan)
    - In Rajasthan, the World Bank study estimated an annual return of ₹19,000 during loan period and ₹54,000 during remaining period for a 7.5HP system
Overall assessment

• **Does the model incentivise irrigation efficiency?**
  – Beneficiaries have two options with the surplus power
    • In Karnataka, farmers resorted to selling water to neighbours as the income during loan repayment period were meagre.
    • In Andhra Pradesh, the income wasn’t attractive enough for energy conservation
  – States will have to discover the right financing approach to make it work

• **How do states view the opportunity?**
  – Generally states are reluctant to adopt this model
    • Andhra Pradesh and Karnataka are not interested in scaling up the model.
    • From discom’s point of view, the feeder solarisation model give same benefits, but without all the operational difficulties.
  – Gujarat and Rajasthan are investing in the model. Gujarat solved many challenges using technology. They have announced a scale up of SKY. But it has been delayed significantly
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Feeder solarisation
Overview

• **The model**
  – Whole feeder is to be powered by a decentralised solar power plant
  – In case of shortfall in power generated, it is compensated from the grid.

• **Benefits**
  – Reduced cost of supply for the discom
  – Reduction in transmission losses
  – Improved quality of power supply for the farmer

• **Pilots**
  – Maharashtra: ‘Mukhyamantri Saur Krishi Vahini Yojana’
  – Karnataka: ‘Solar Farmer Scheme’
Challenges

• Operational
  – Land issue:
    • In Maharashtra, land prices were too high for decentralised solar plants to be competitive. Out of 7000MW put for tender, only 1800MW received bid and about 500MW commissioned
    • Land diversion: In Karnataka, diversion of agriculture land for solar plant were causing administrative delays in project approval

• Commercial
  – Competitive tariff:
    • Due to many logistical overheads, the tariff for decentralized solar plants are higher than the large scale plants. In Maharashtra, a tariff of ₹3.3 did not elicit good response, while the tariff of large scale solar plant is less than ₹3
Overall assessment

- Potential savings from the difference between current cost of supply and solar power tariff (typically between ₹1.5-2.5 per unit)
- There are less operational and commercial challenges in the implementation
Hence, many discoms are interested in this model

- However,
  - The model in itself does not incentivise electricity and water conservation by the farmers
    - Need for convergence with water saving scheme. E.g.: ‘Pani Bachao Paisa Kamao’ Punjab
  - For sustainable deployment of model, it should be integrated to discom’s long term planning
    - E.g.: Chhattisgarh
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**Solar off-grid pumps**
Overview

• **Target**
  – Avoid new subsidised connections
    – Applicants in the queue
    – Farmers using diesel pumps
    – Locations where grid won’t reach currently
  – Replace existing electric connections – E.g. Rajasthan

• **Benefits**
  – Improving access to irrigation
  – Avoided grid extension cost
  – Avoided

• **Experience so far**
  – 2 lakh off-grid pumps under different state schemes
  – 20 lakh off-grid pumps targeted under PM-KUSUM
Challenges

- **Commercial**
  - Financing beneficiary contribution: Unaffordable for most farmers
    - Even a 10% upfront contribution is 6-8 times the average monthly income of small and marginal farmers
    - Loan-based models haven’t taken off
      - Access to credit
      - Lack of financial instruments
      - Technical capacity of banks to assess the investment
  - High subsidy cost for the state
    - So far, only subsidy heavy models. More than 75% in most states

- **Operational**
  - Targeting
    - Rajasthan – Over 80% beneficiaries have existing electric connections

- **Regulatory**
  - Groundwater withdrawal
    - Zero marginal cost of water extraction - excess withdrawal
Thank you

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