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

1. Grow Solar, Save Water, Double Farmer Income : An Innovative Approach to Addressing Water-Energy-Agriculture Nexus in Rajasthan
2. CEEW analysis

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 ₹1.3lakh-₹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

Solarisation of Agriculture

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’

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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

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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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Solarisation of Agriculture

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

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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

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Thank you

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