Solar powered agriculture feeders: a conceptual framework

Prayas (Energy Group)

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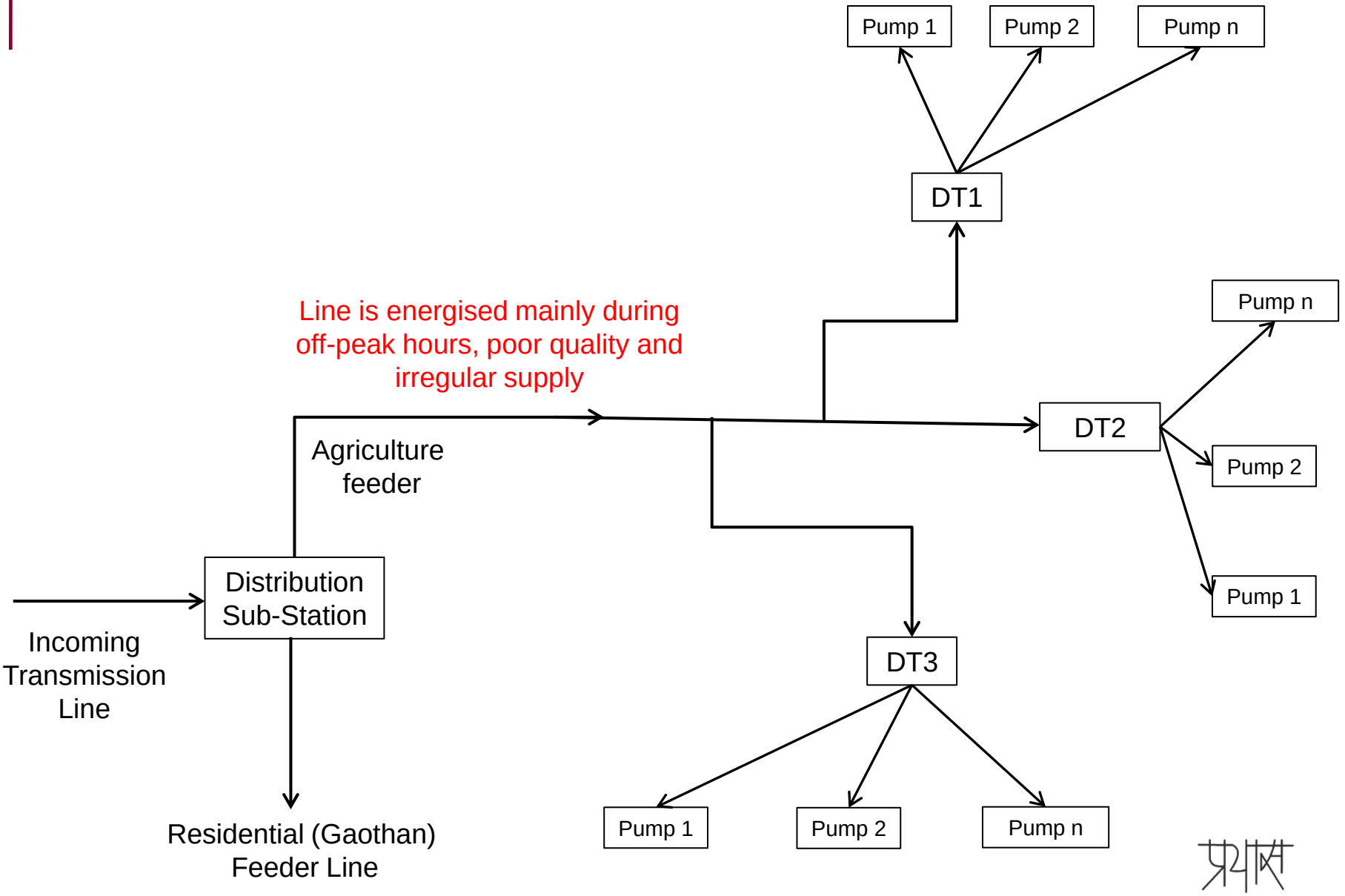
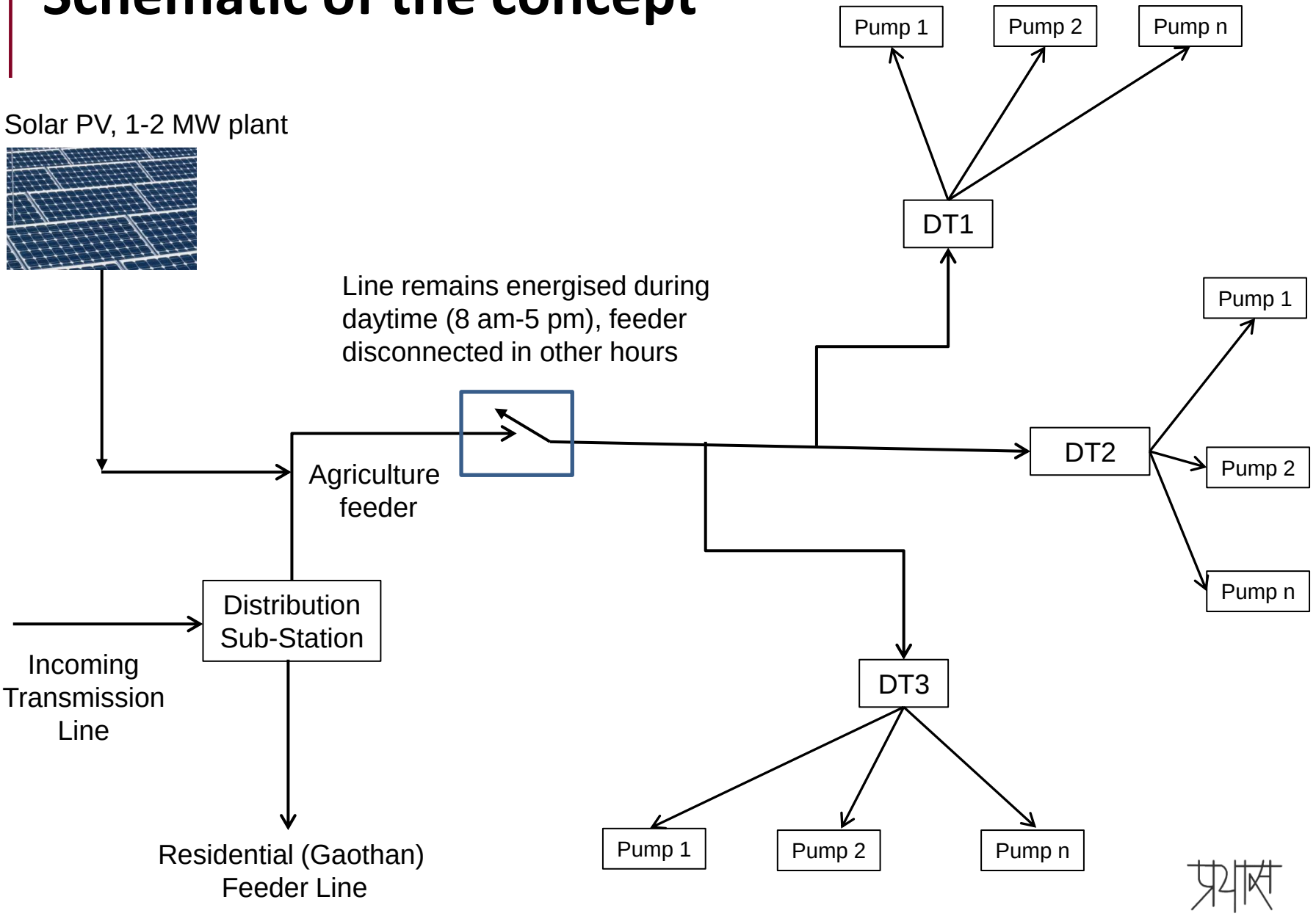
Existing agriculture supply



Schematic of the concept



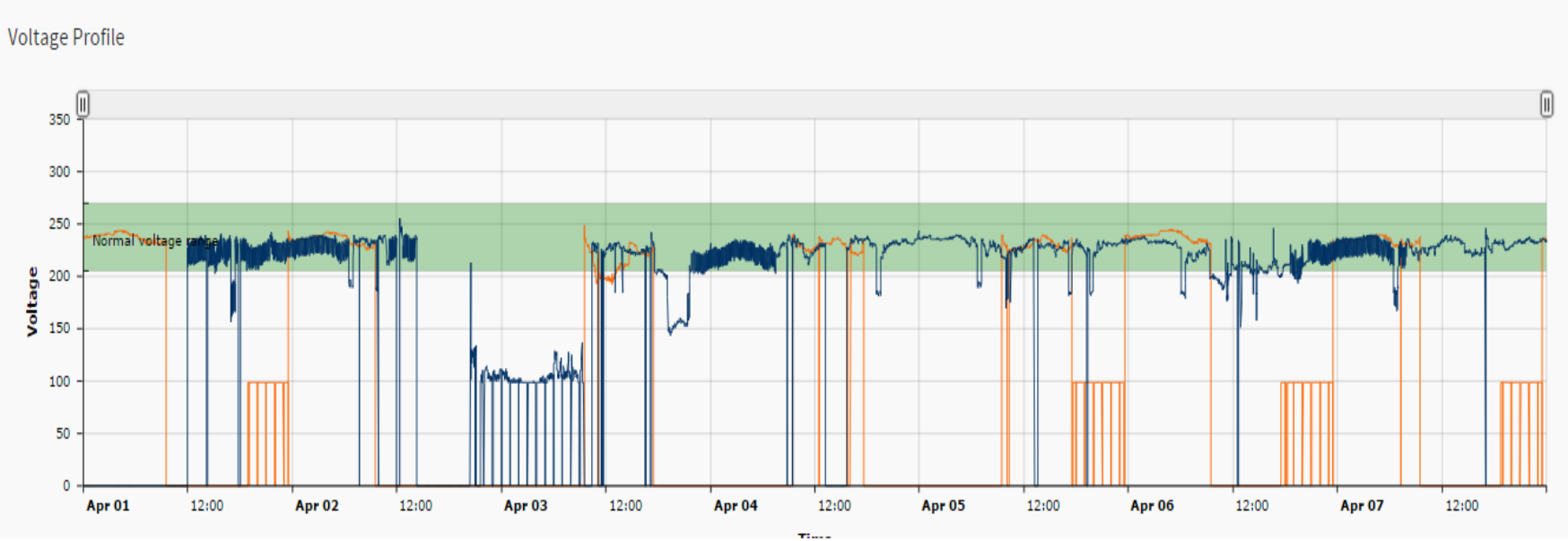
Concept

- 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

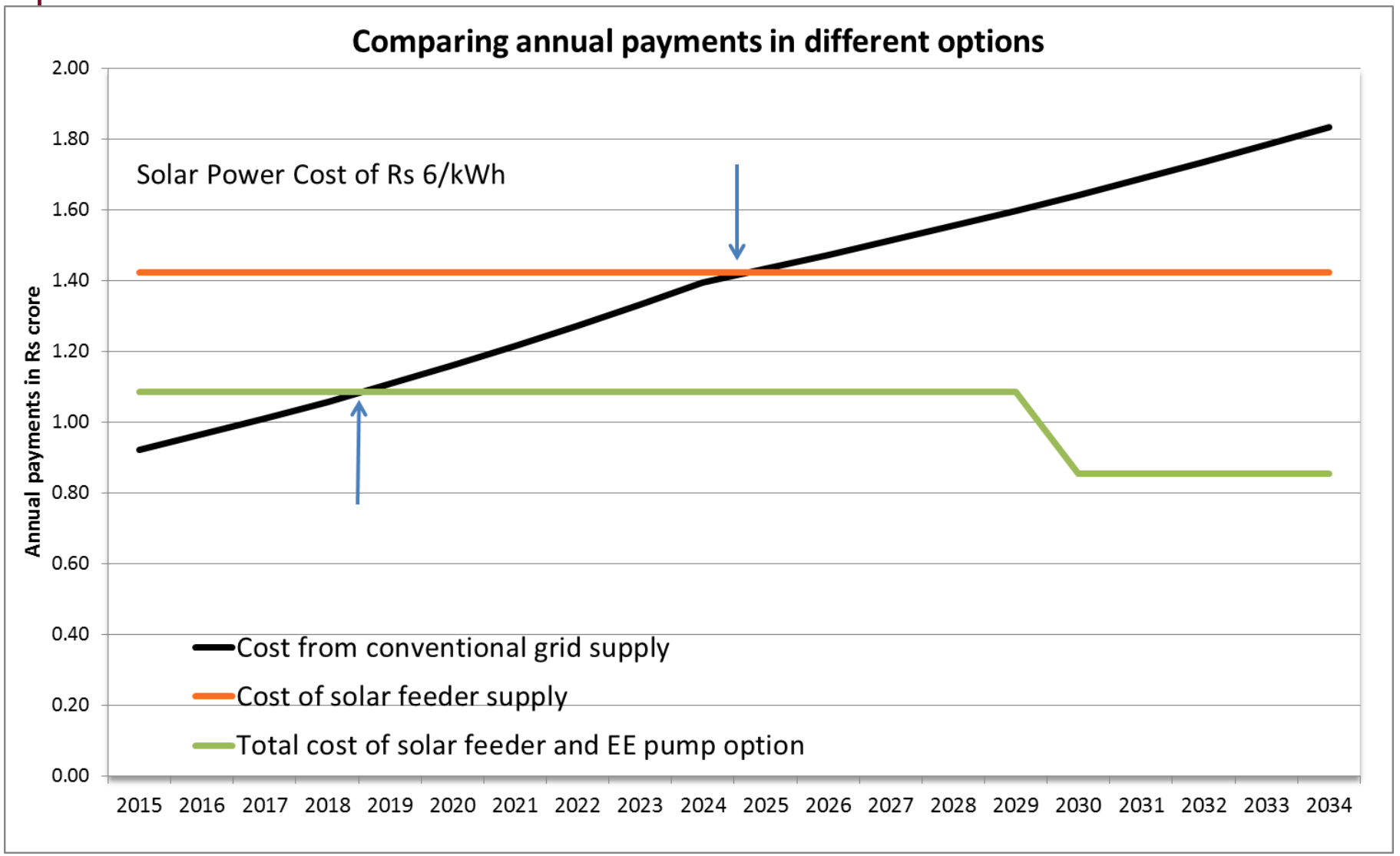
- Supply from tail end solar plants competitive with conventional grid supply in 4 -6 years.
  - Considering rising grid tariffs, falling solar prices (and costs being fixed over project life)

- 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
Annual payments in Rs crore
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
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
2015
2016
2017
2018
2019
2020
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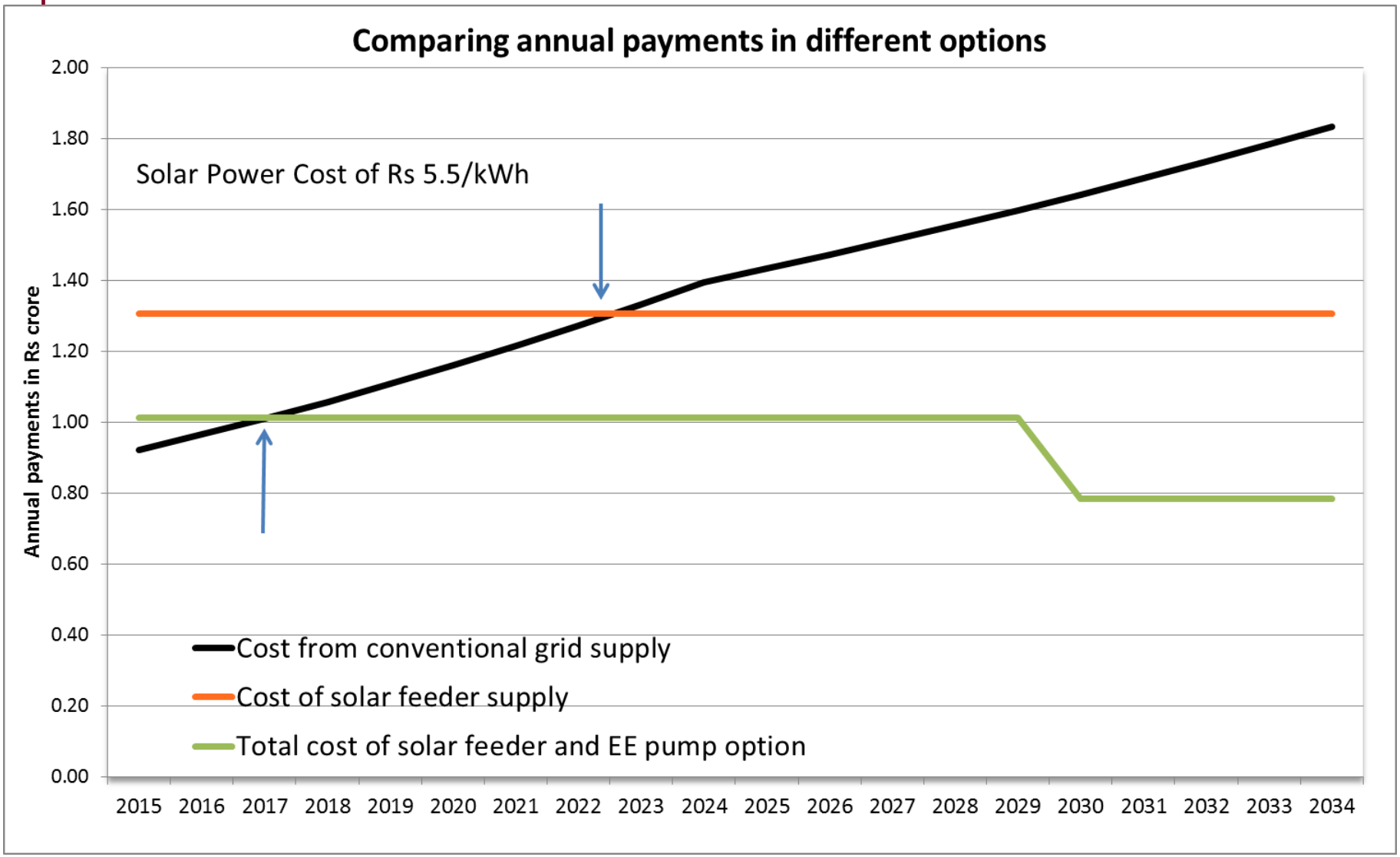
Comparing annual payments in different options
Annual payments in Rs crore
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Solar Power Cost of Rs 5.5/kWh
Cost from conventional grid supply
Cost of solar feeder supply
Total cost of solar feeder and EE pump option
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Next 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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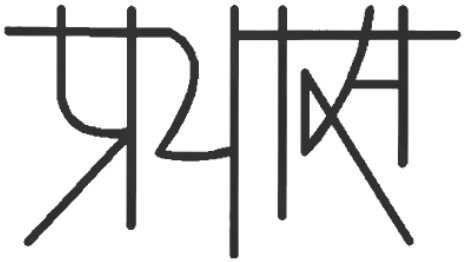

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Economics, preliminary estimates

- **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