

## Electric Utility 2.1:

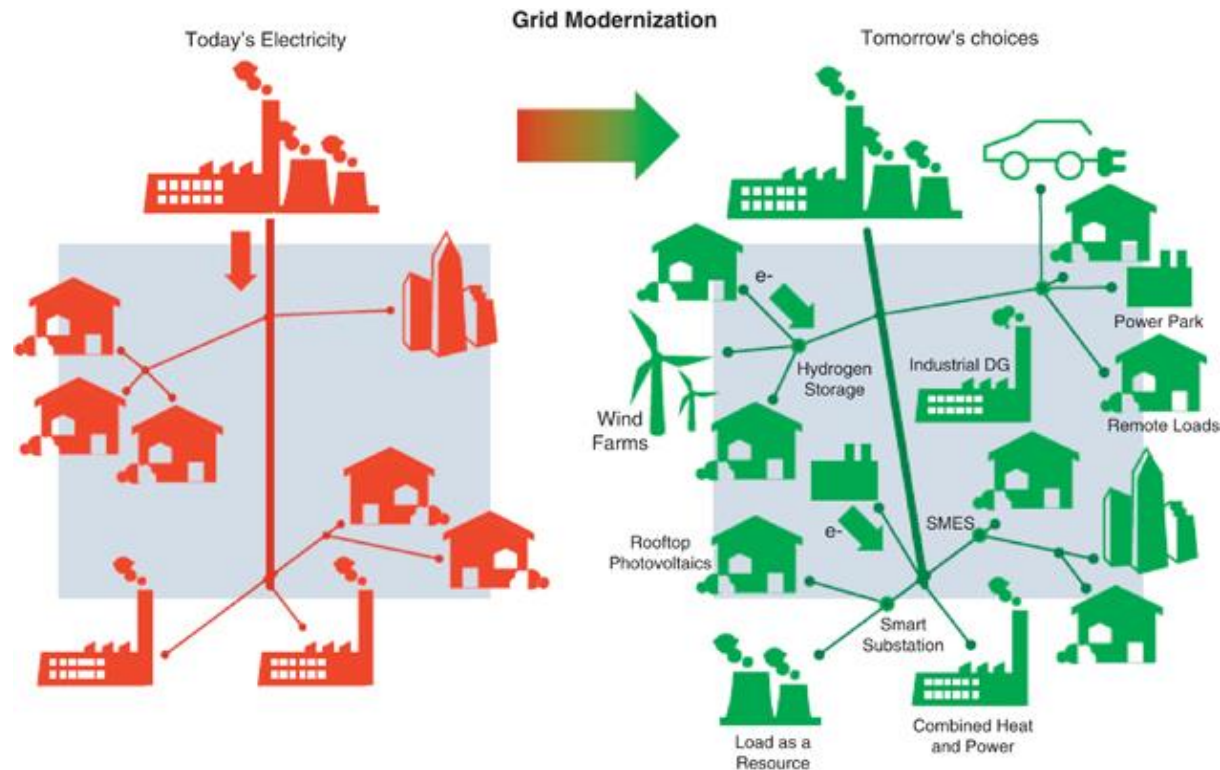
A Study on the Opportunities and Challenges of Distributed Solar and Other Innovations in Pakistan



[www.hadronsolar.com](http://www.hadronsolar.com)

# Distributed Generation – the Future is Here!

- “Distributed” Grid vs. Traditional Grid



- Rapid growth of Distributed Generation - especially Rooftop Solar - has disrupted the traditional Utilities business model around the world
- ‘Net-Metering’ and ‘Decreasing prices of Storage’ will further this trend

# Growth of Distributed Generation in Pakistan

- Steep positive growth of Distributed Generation in Pakistan
- From 1 MW in 2016 to 3 MW in 2017, 10 MW in 2018 and 32+ MW by 2019
- Cumulative installed Distributed Generation capacity in Pakistan reached 47,652 kW by Dec-2019
- 3,000+ licenses issued to Distributed Generators by Dec-2019



Sources:

<http://www.ips.org.pk/distributed-generation-landscape-in-pakistan-an-overview/>

<https://energy-democracy.org/distributed-generation-growth-in-pakistan-key-insights/>

# Distributed Generation is Here to Stay

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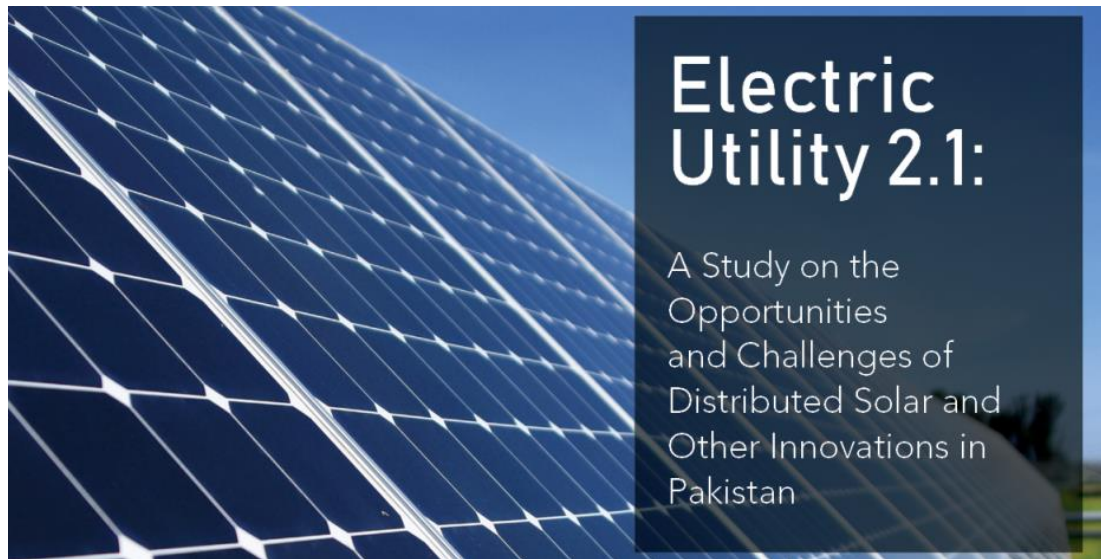
- Clean Energy: mainly solar and wind-based generation
- Supports Grid Supply: delay / avoid expensive capacity expansion projects
- Uses existing Infrastructure: no additional lines or poles needed
- Less Losses: energy is supplied close to Demand
- Better Maintenance: owner is incentivized to produce more energy
- Grid Stability: Ancillary services, particularly in 'solar+storage', improve the quality of electricity supplied

→ the Energy Industry needs to Innovate !





# Electric Utility 2.1



This Energy Institute at LUMS is established to serve as a think tank, center of technical excellence, knowledge network, and capacity building ground for the Pakistan to institutionalize a renewable rich future of Pakistan in the most sustainable and cost-effective way possible.



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# Contents of Study

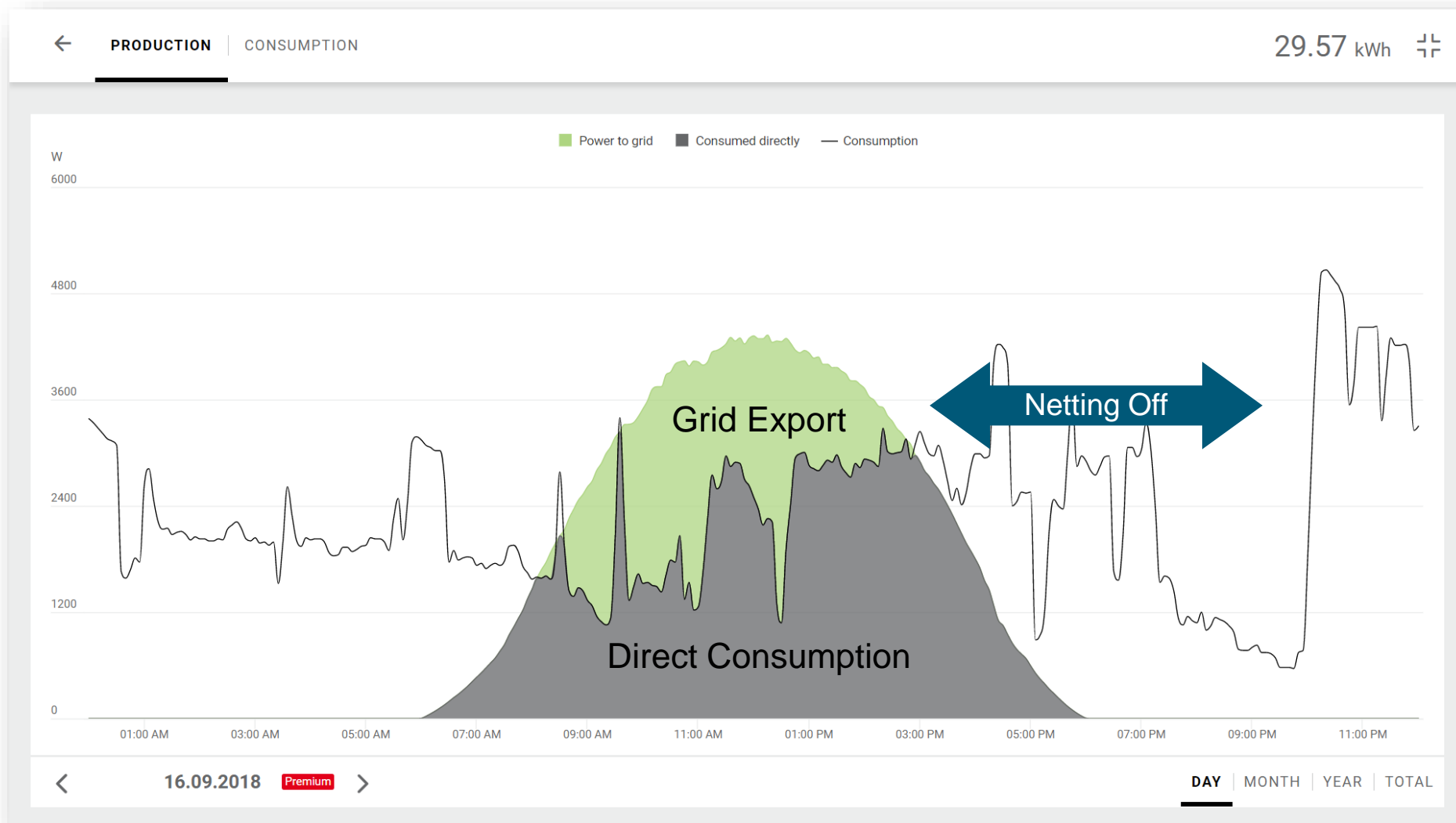
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- Introduction & Global Overview
- The Decade of Innovative Disruptions
- Distributed Generation Benefits
- Distributed Generation Challenges
- Current Utility Model & Electricity Situation in Pakistan
- Global Practices and the Future Utility Model
- Conclusion & Way Forward

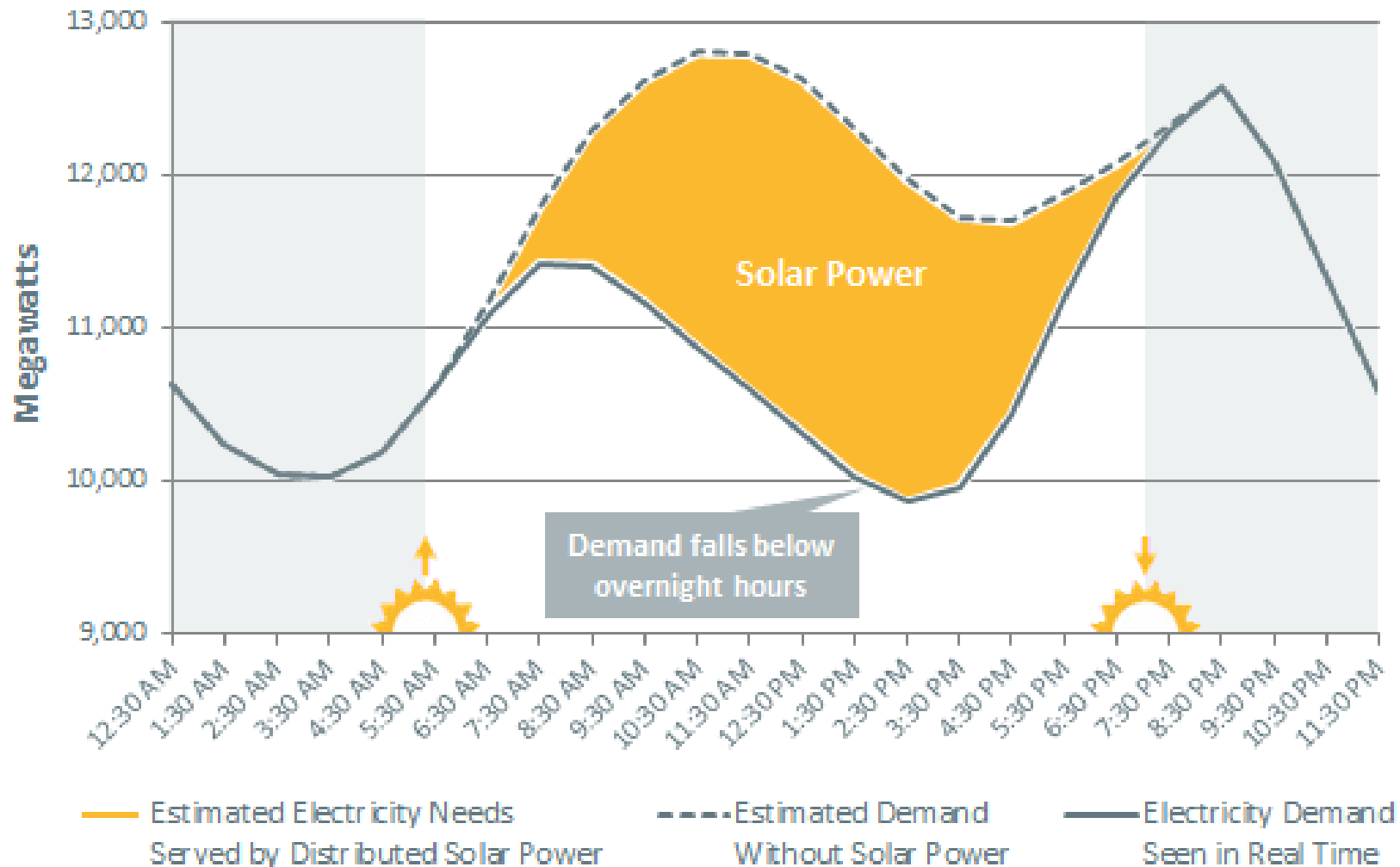
Link to Study: <https://www.hadronsolar.pk/wp-content/uploads/2019/05/Electric-Utility-HadronSolar-LUMS.pdf>



# Net-Metering – Consumer Side Scenario



# Net-Metering – Grid Side Scenario





# The Duck Curve

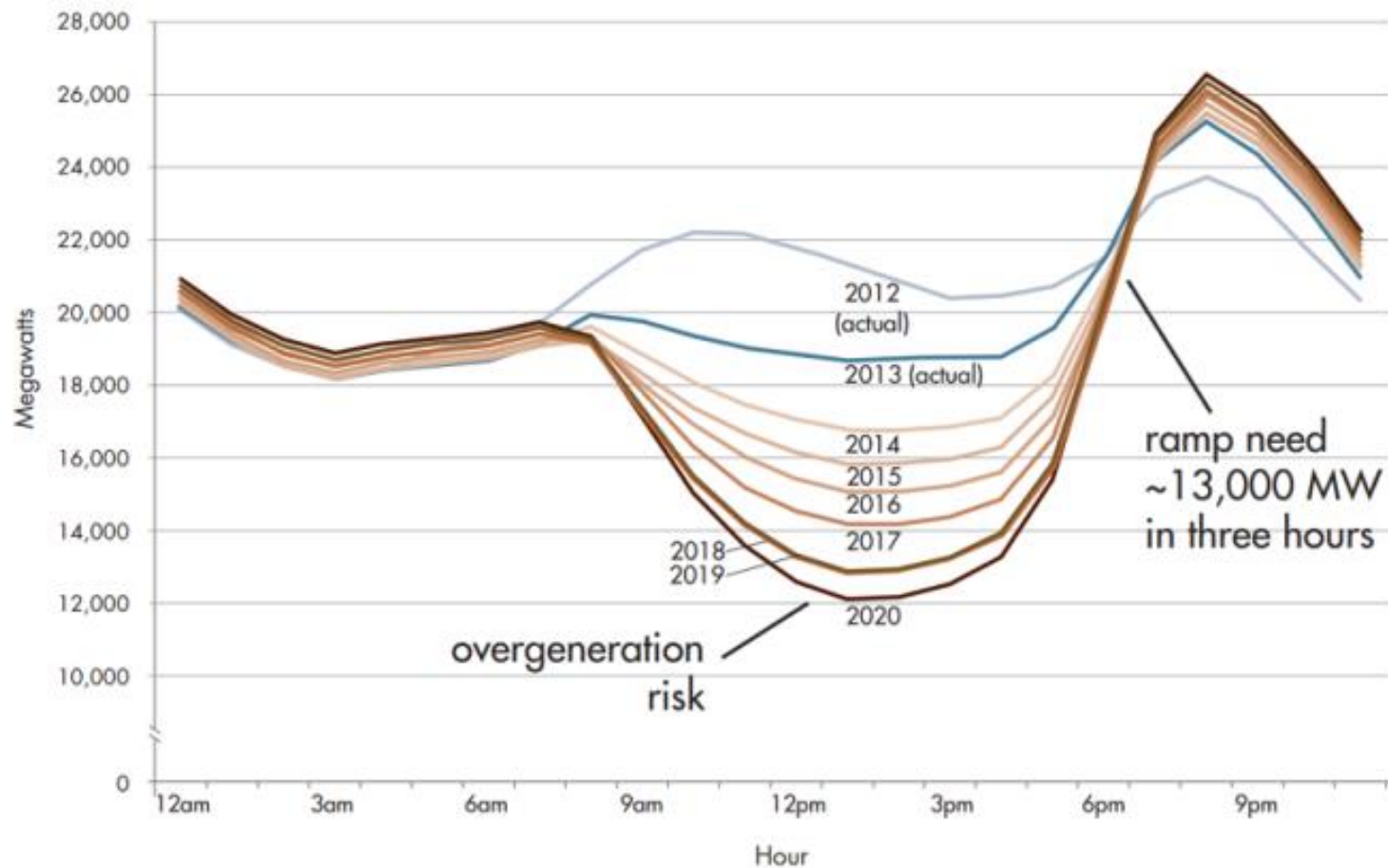


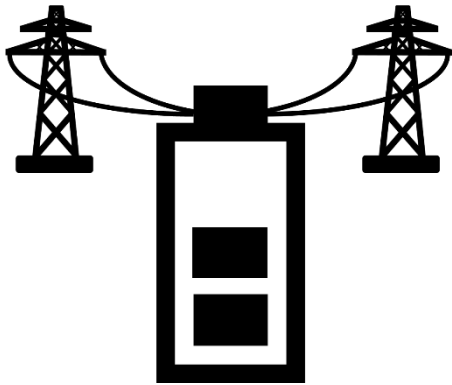
Figure 6: The CAISO Duck Curve [52]

Source:

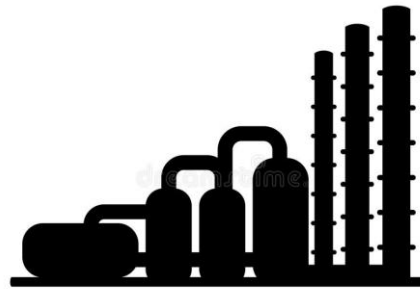
[52] P. Denholm, M. O'Connell, G. Brinkman, and J. Jorgenson, Overgeneration from solar energy in California: a field guide to the duck chart. National Renewable Energy Laboratory Golden, CO, 2015

# Mitigating the 'Duck Curve' Problem

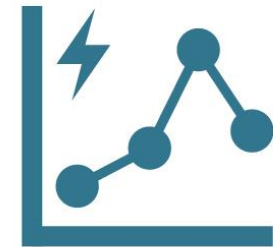
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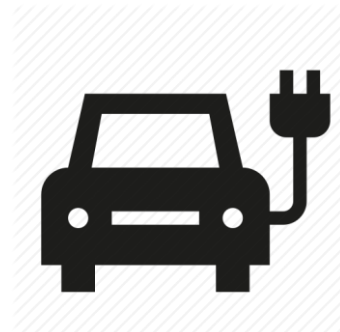
Investing in storage



Investing in natural gas plants



Demand Side Management



Using Electric Vehicles



Exporting Electricity to other regions

# Fear of the 'Utility Death Spiral'

- Grid Defection & the 'Utility Death Spiral'
- Introduction of Smart Grids

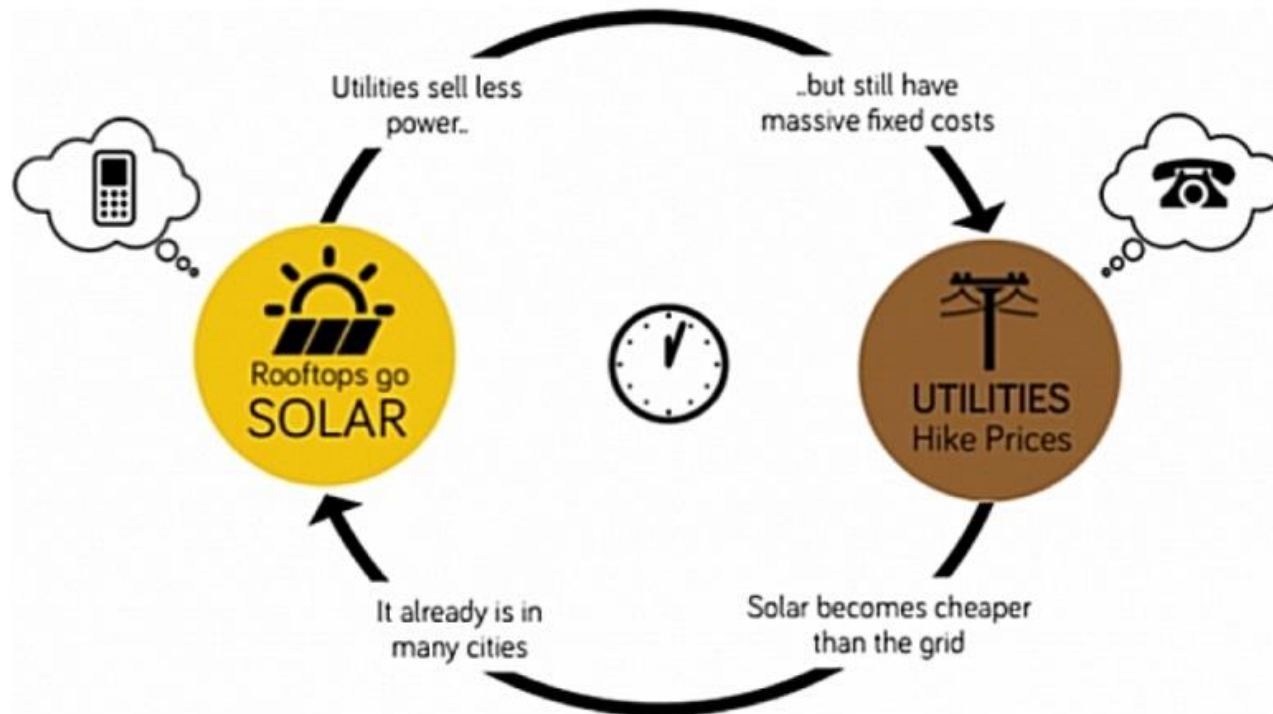


Figure 3: 'Utility death spiral' illustrated [34]

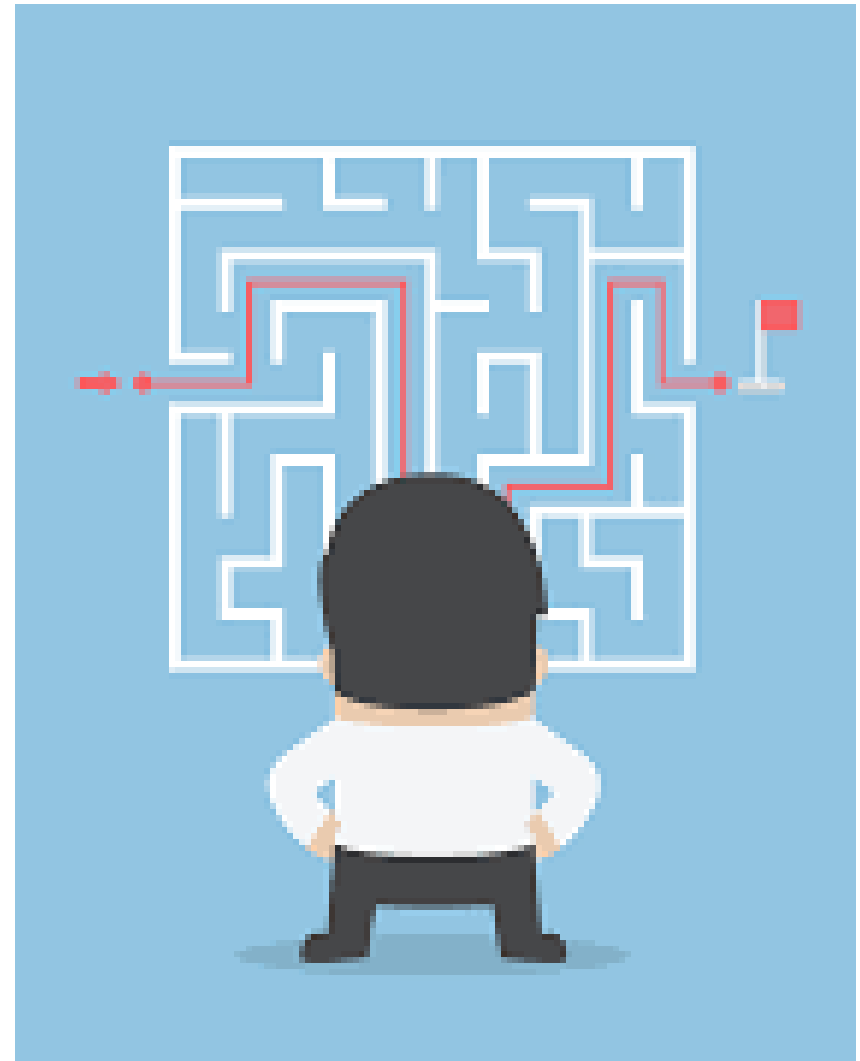
Source:

[34] <https://seekingalpha.com/article/2778945-the-death-spiral-residential-solar-versus-the-utilities>

# What's Next?

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- A follow-up Critical Study with greater focus on solutions / recommendations suitable for Pakistan.
- Pilot Testing of solutions to determine feasibility and develop implementation plans.





# Q&A

Link to Study:

<https://www.hadronsolar.pk/wp-content/uploads/2019/05/Electric-Utility-HadronSolar-LUMS.pdf>

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