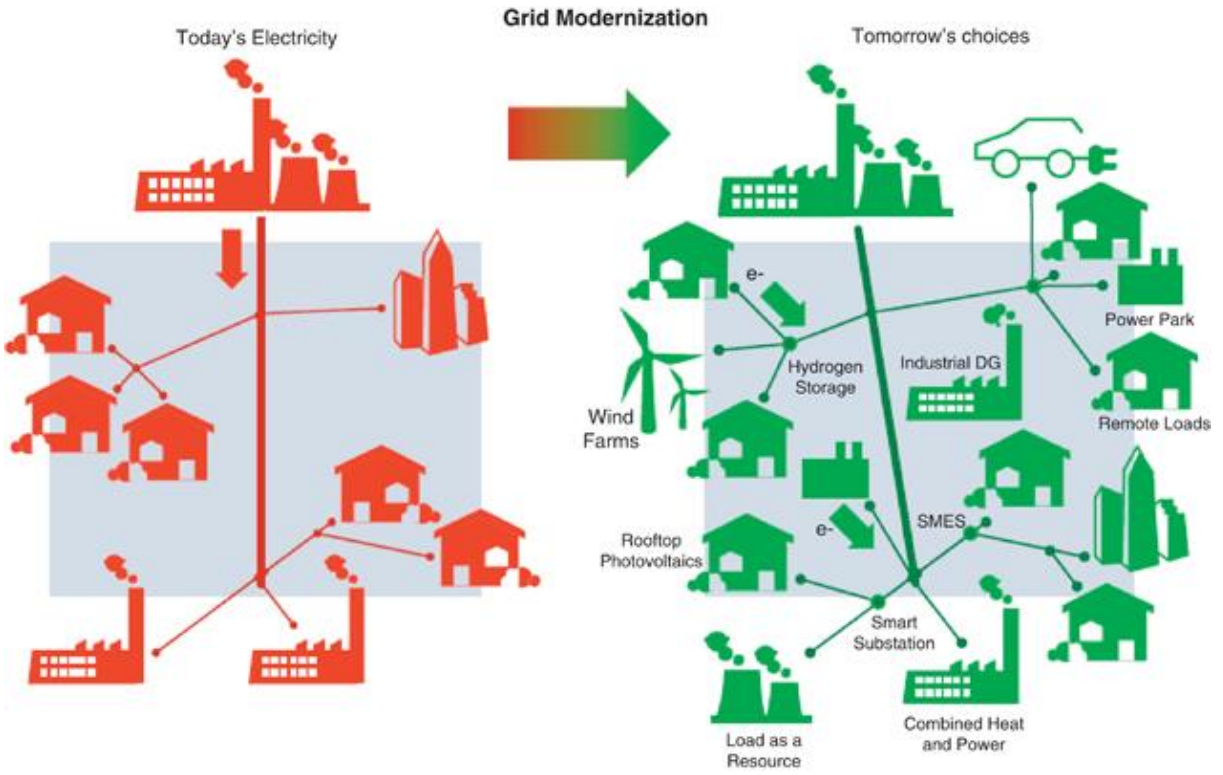
Electric Utility 2.1:

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

www.hadronsolar.com

Distributed Generation – the Future is Here!

- “Distributed” Grid vs. Traditional Grid

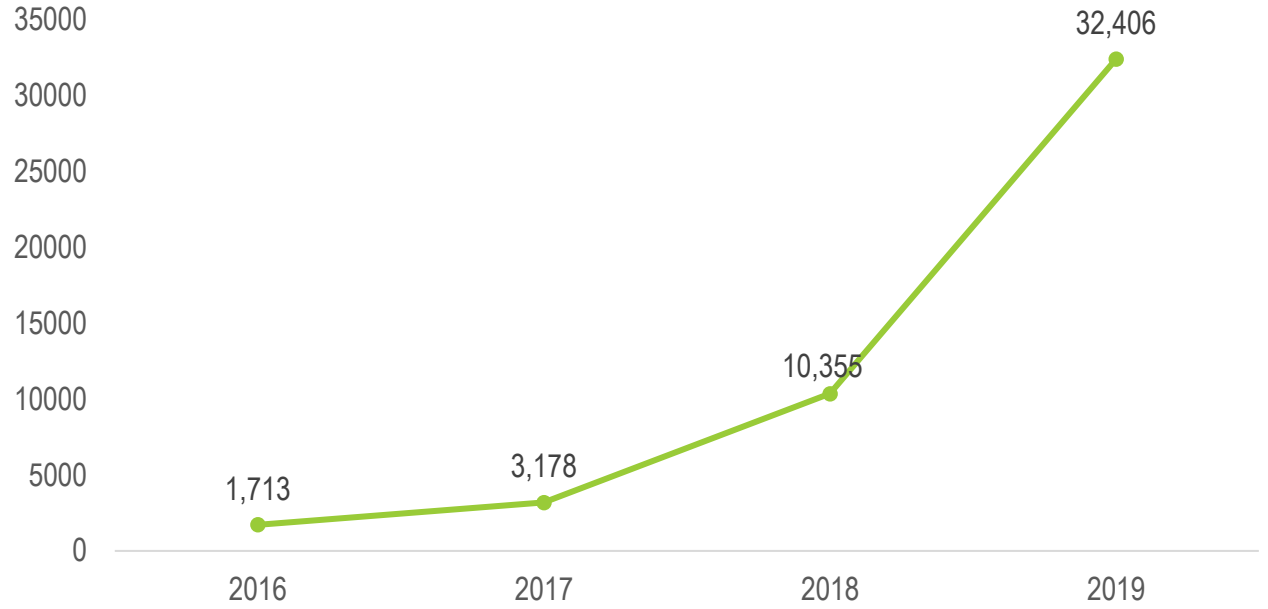


- Rapid growth of Distributed Generation - especially Rooftop Solar - has disrupted the traditional Utilities business model around the world
- ‘Net-Metering’ and ‘Decreasing prices of Storage’ will further this trend

hadronsolar

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/

hadronsolar

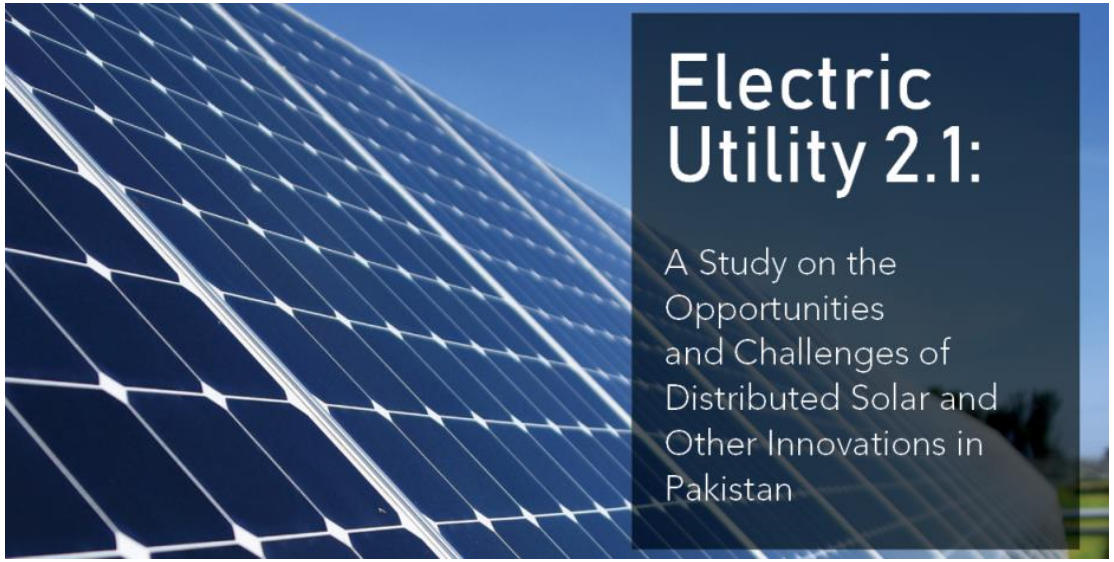
Distributed Generation is Here to Stay

- 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 !

hadronsolar

Electric Utility 2.1



LUMS Energy Institute

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.

Dr. Fiaz Chaudhry,
Director – LUMS
Energy Institute

Dr. Naveed Arshad,
Director – LUMS
Energy Institute

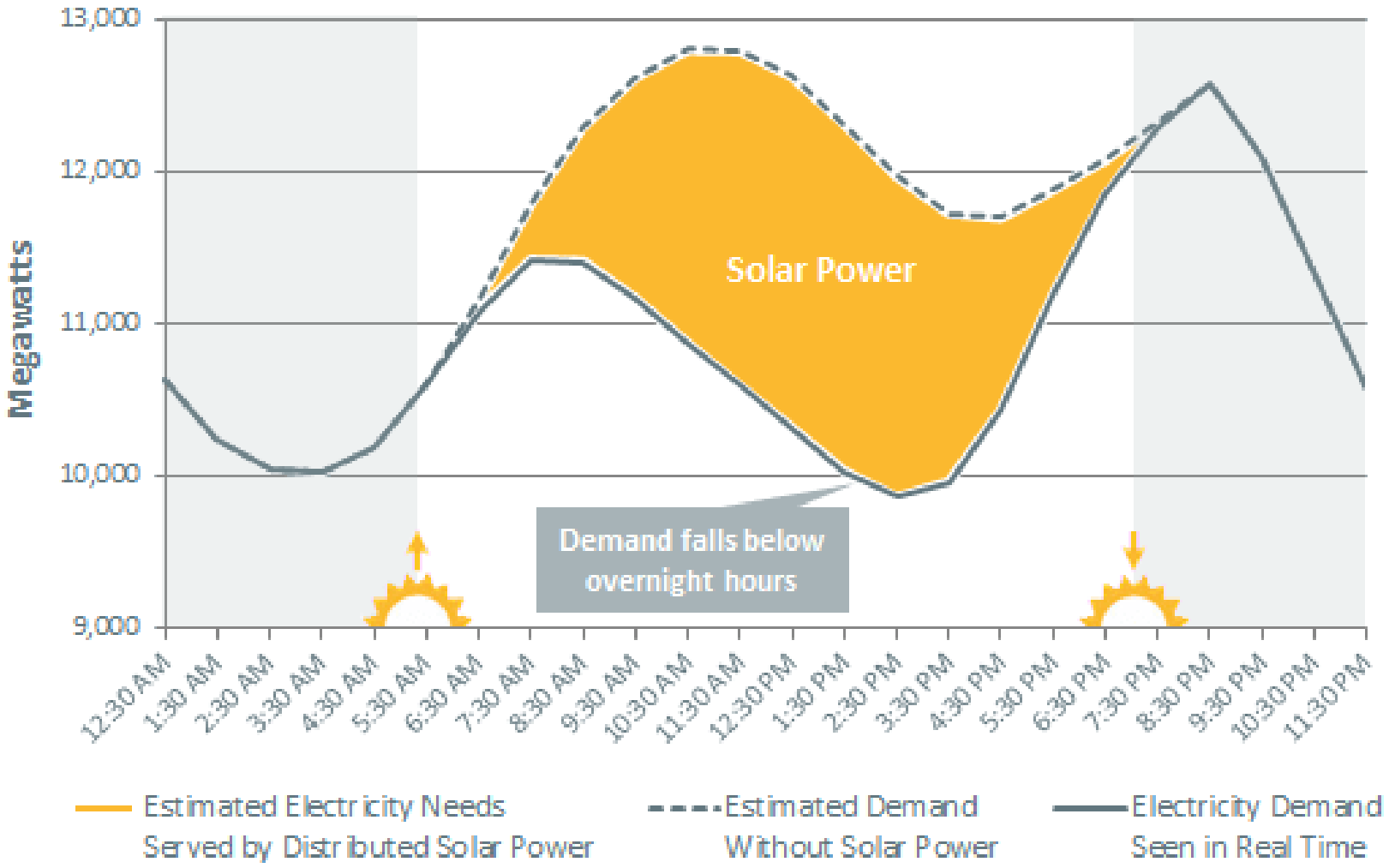
Contents of Study

- 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

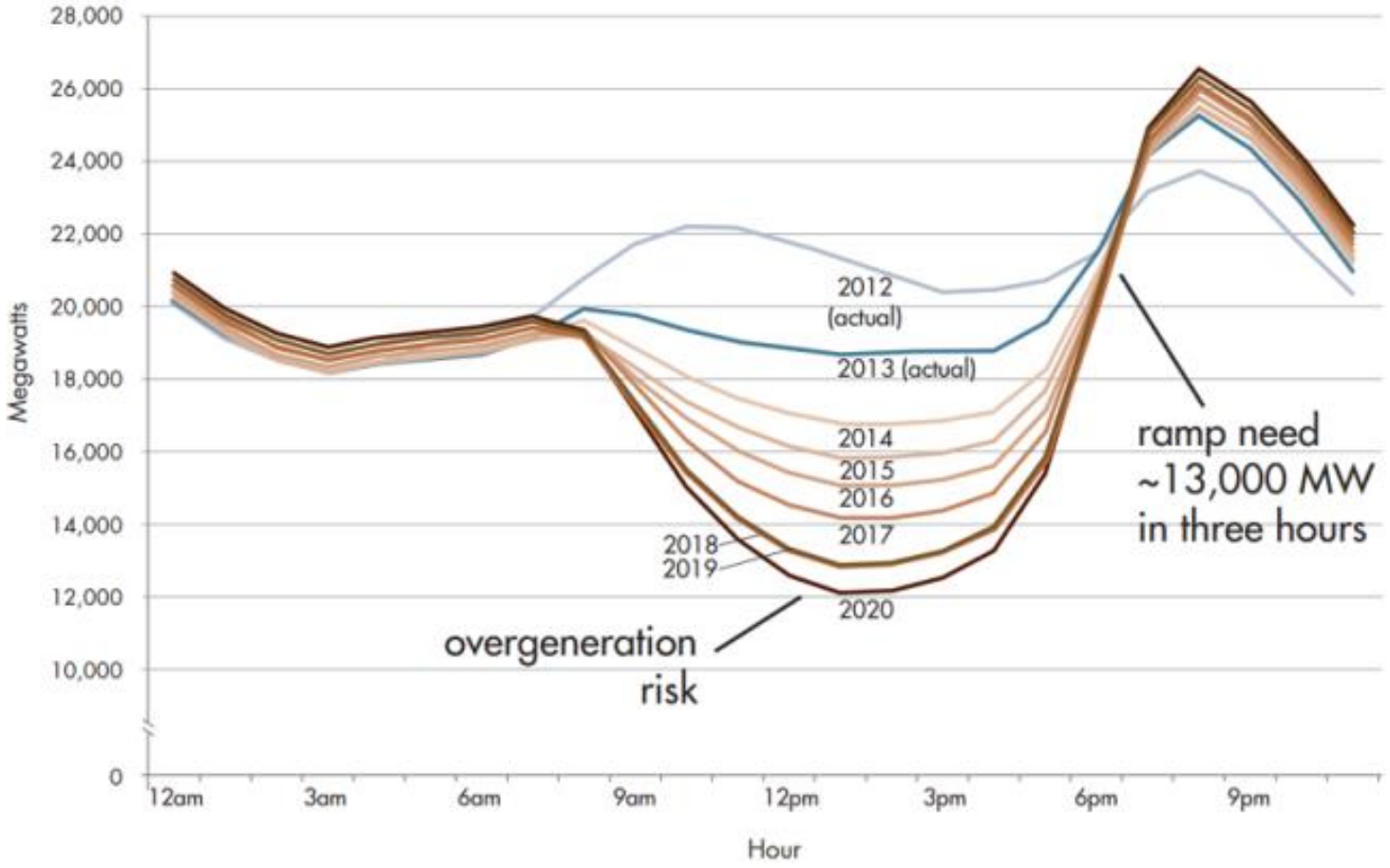
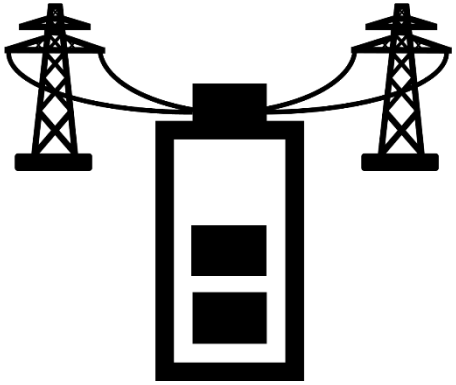


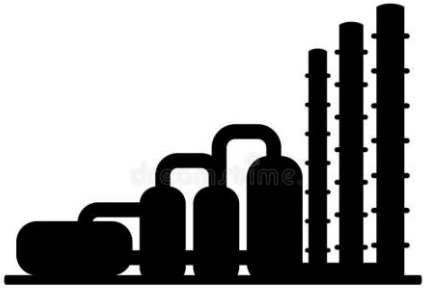
Figure 6: The CAISO Duck Curve [52]

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

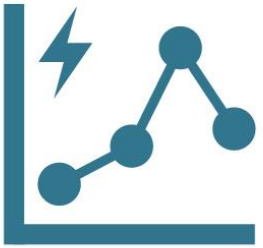
Mitigating the ‘Duck Curve’ Problem



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

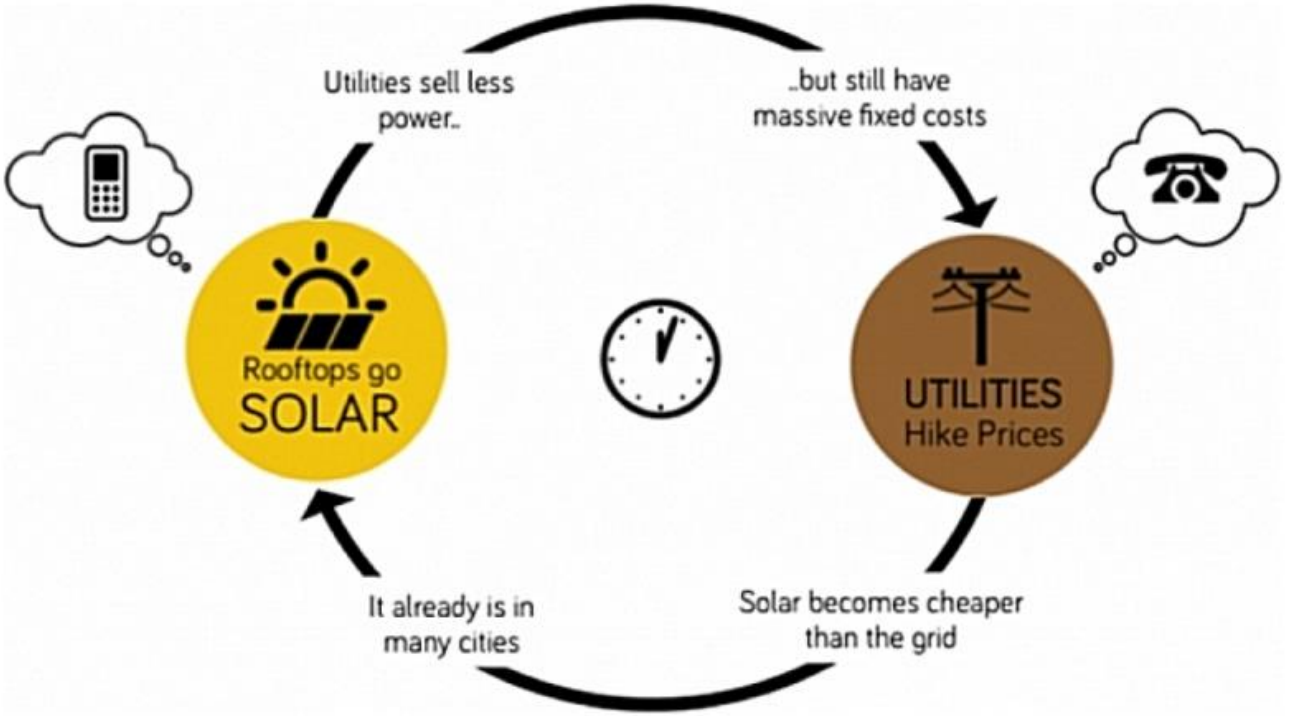
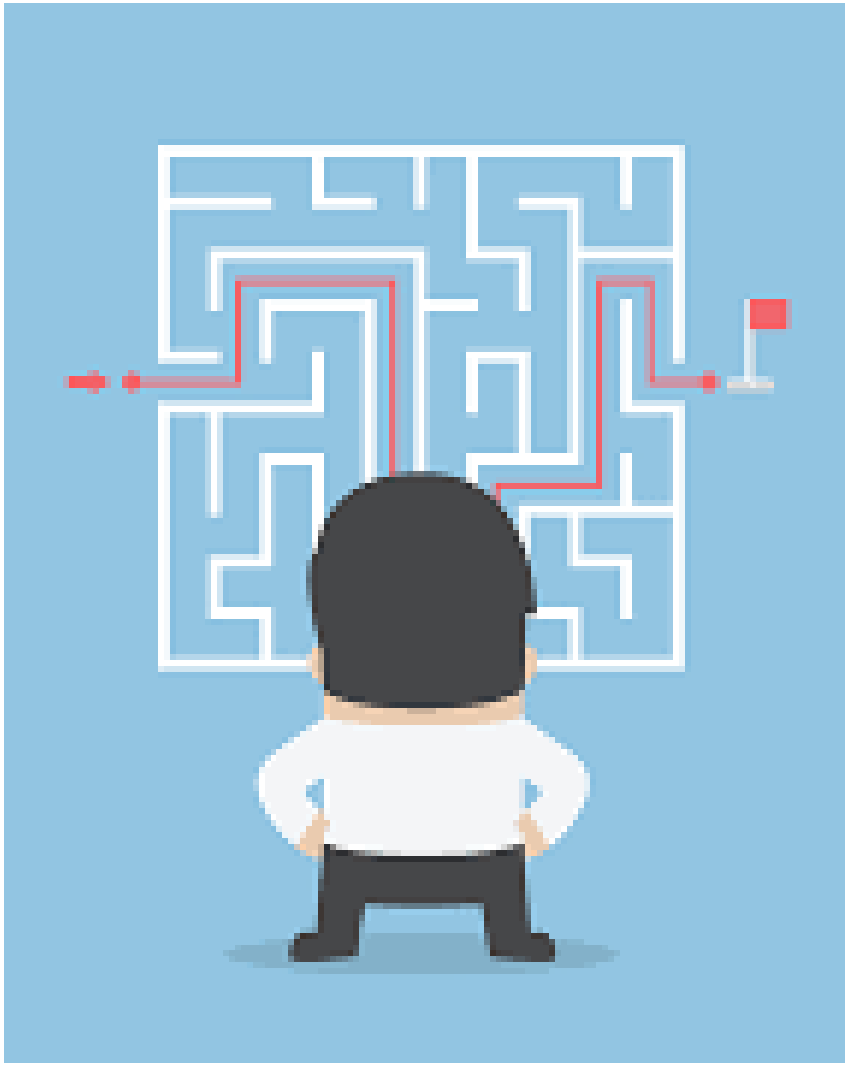


Figure 3: ‘Utility death spiral’ illustrated [34]

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

What's Next?

- 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

For further details, please contact:

Waqas Moosa, CEO, Hadron Solar
info@hadronsolar.com

Dr. Naveed Arshad
Founding Member, LUMS Energy Institute
naveedarshad@lums.edu.pk