



Working Smarter, Not Harder

Opportunities and Challenges for Industrial Demand Response

The University of Utah and Oak Ridge National Laboratory



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ENERGY DEVELOPMENT

Dr. Kody Powell

University of Utah

- Professor of Chemical Engineering at the University of Utah
- Director of the Intermountain Industrial Assessment Center (IAC)
- Energy systems researcher
 - Hybrid energy systems
 - Energy storage
 - Grid-responsive manufacturing
 - Intelligent systems



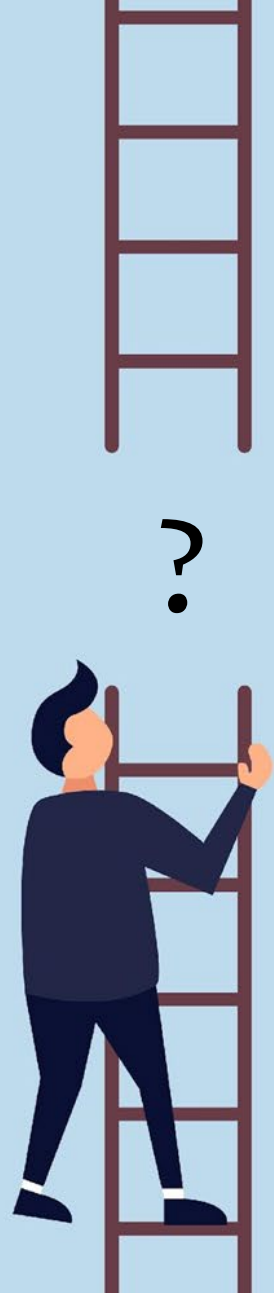
Dr. Blake Billings

Oak Ridge National Laboratory

- R&D Research Associate and Energy Engineer
- Technical Account Manager with DOE's Better Plants program
- Industrial energy efficiency researcher:
 - Industrial load profiles
 - Energy and emission intensive industries
 - Low carbon industrial technologies



Grid Needs

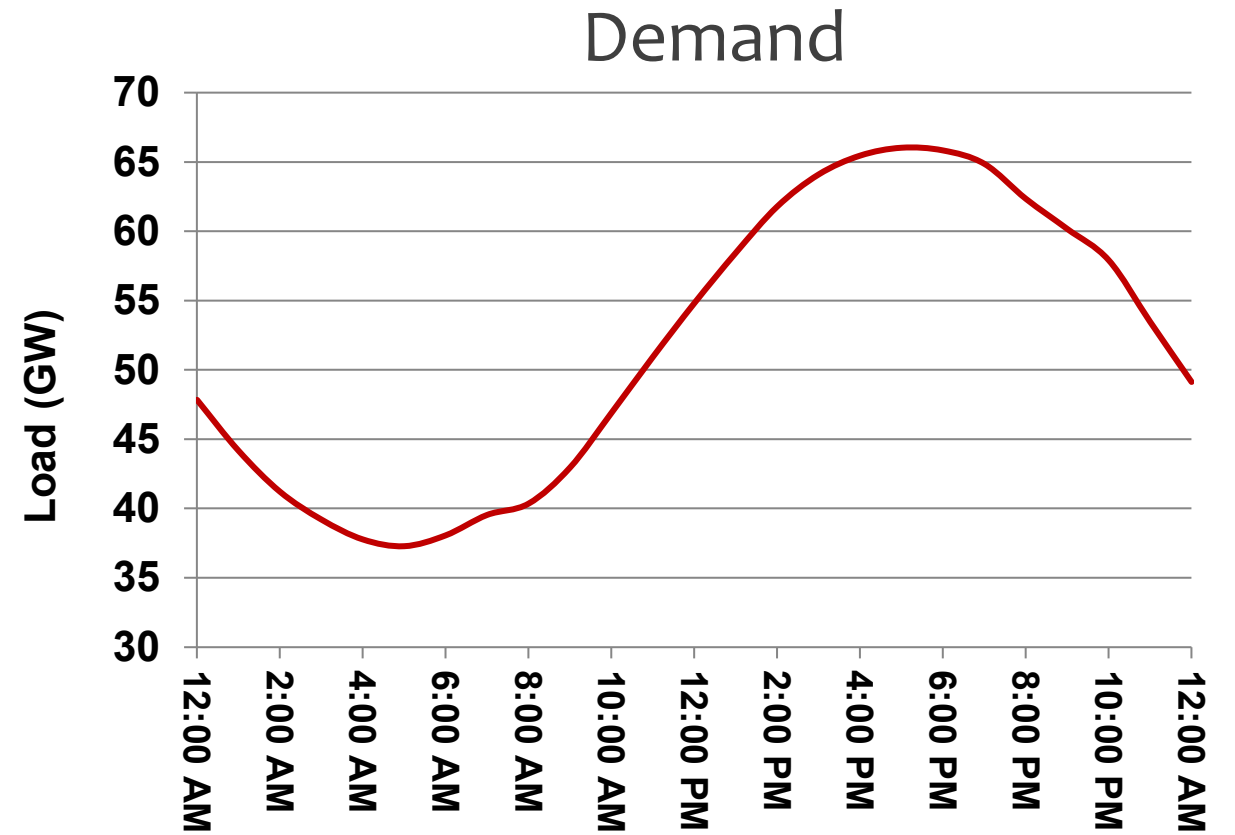
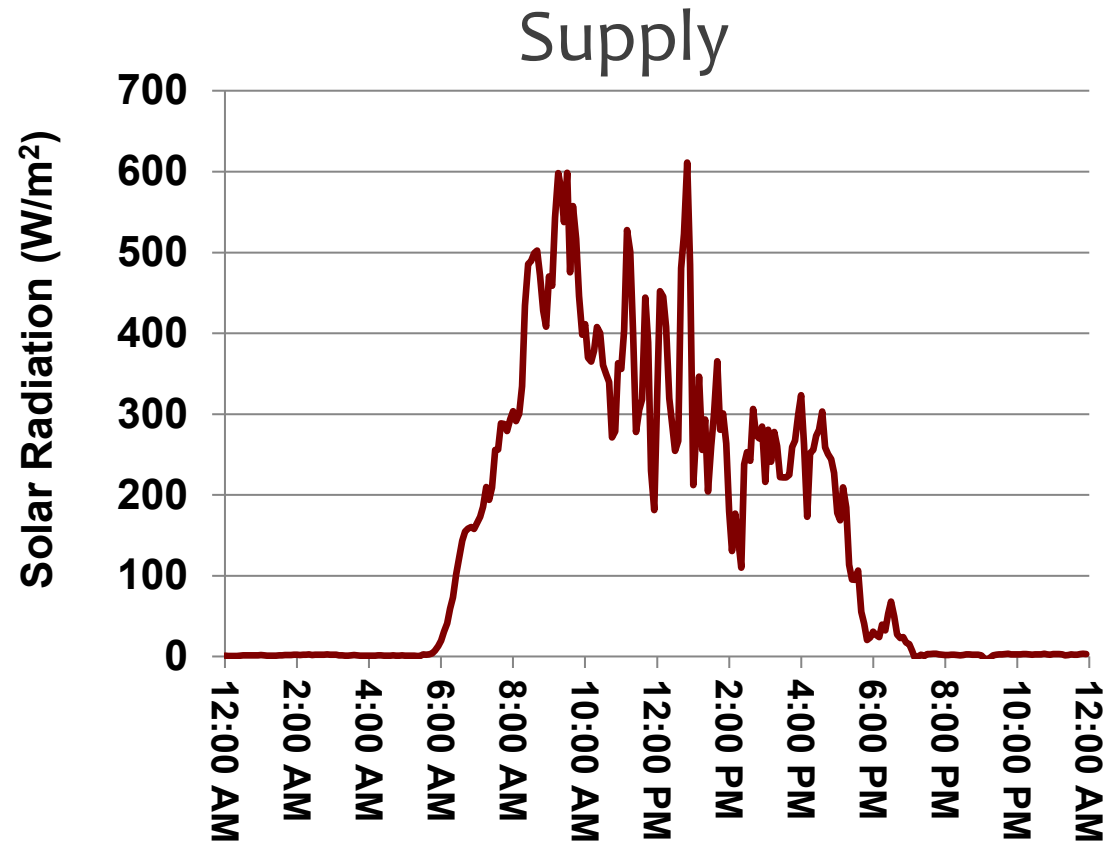


Flexible Loads

**Top Down /
Bottom Up**

How do we close the gap?

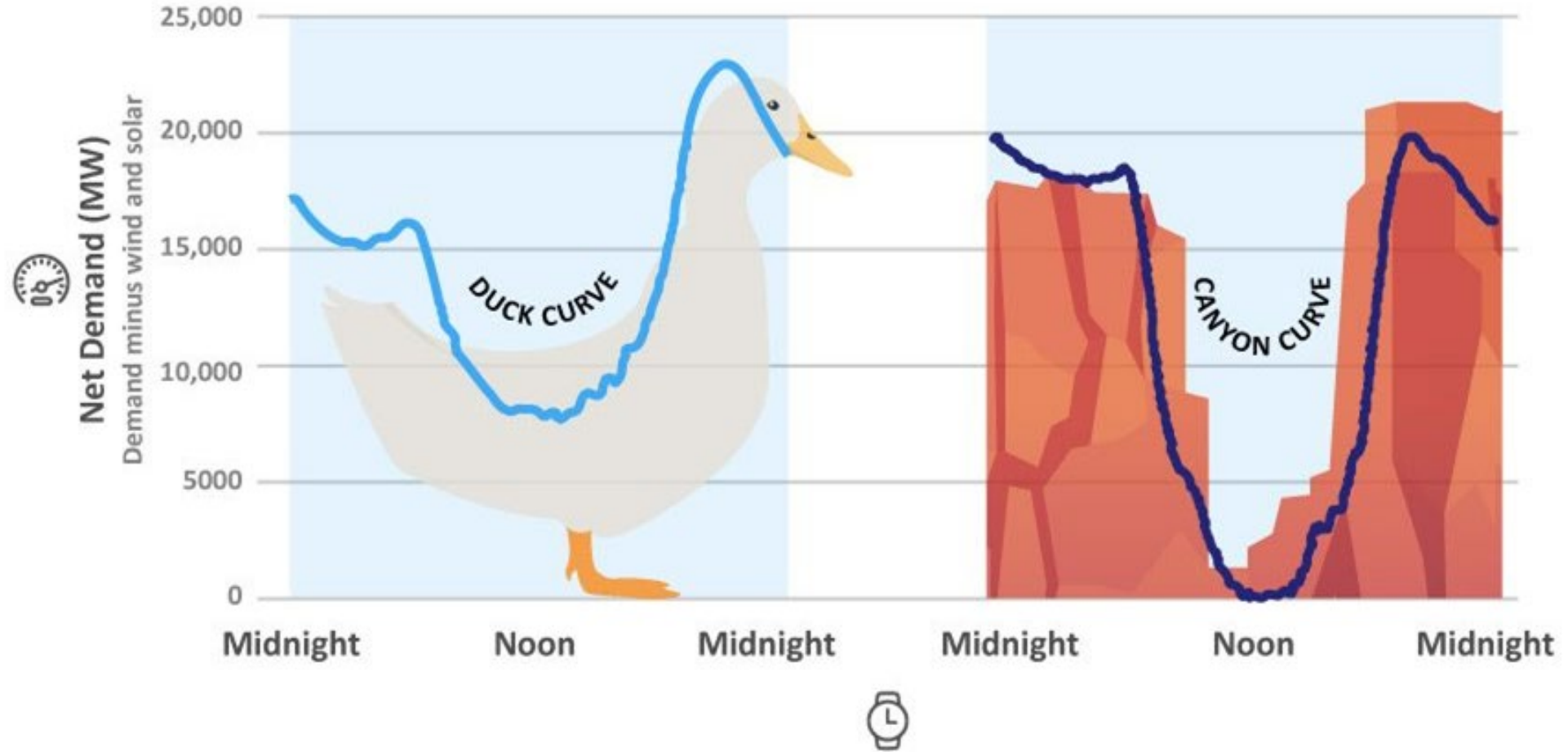
A Major Issue with Decarbonization



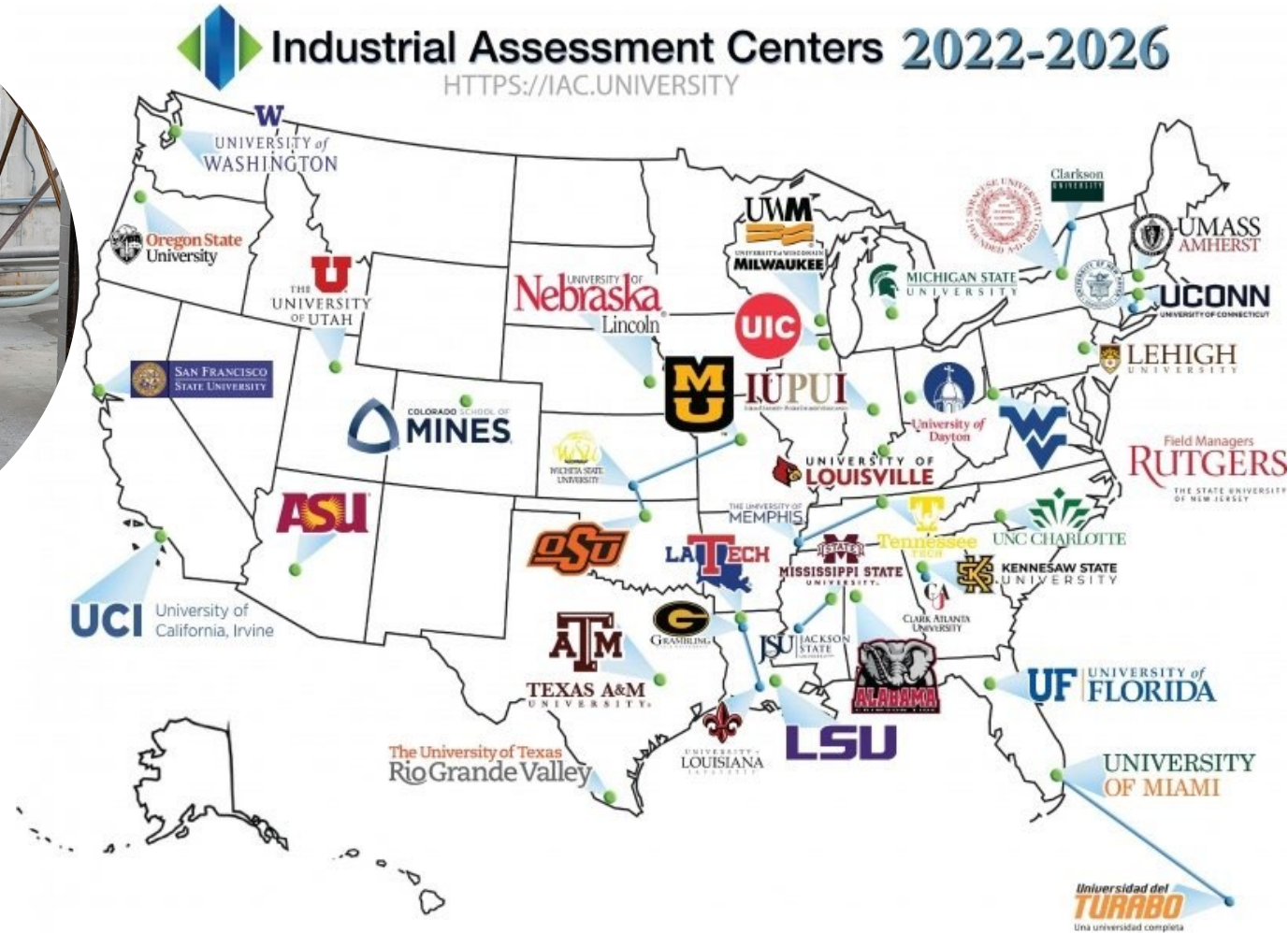
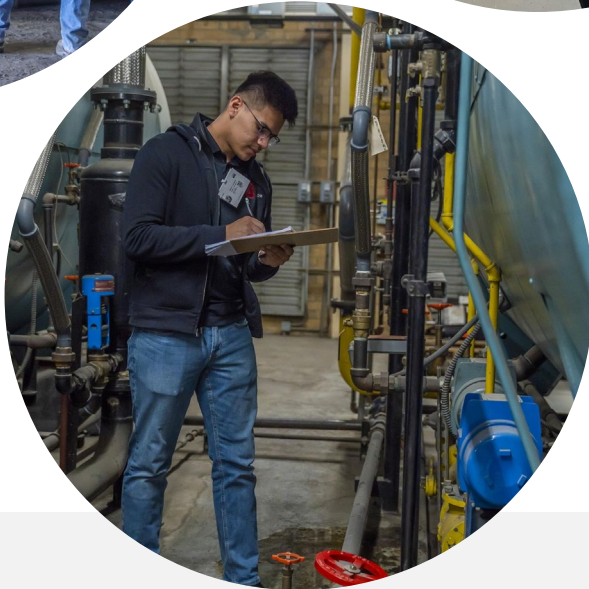
May 27
2018

April 16
2023

The Duck and the Canyon



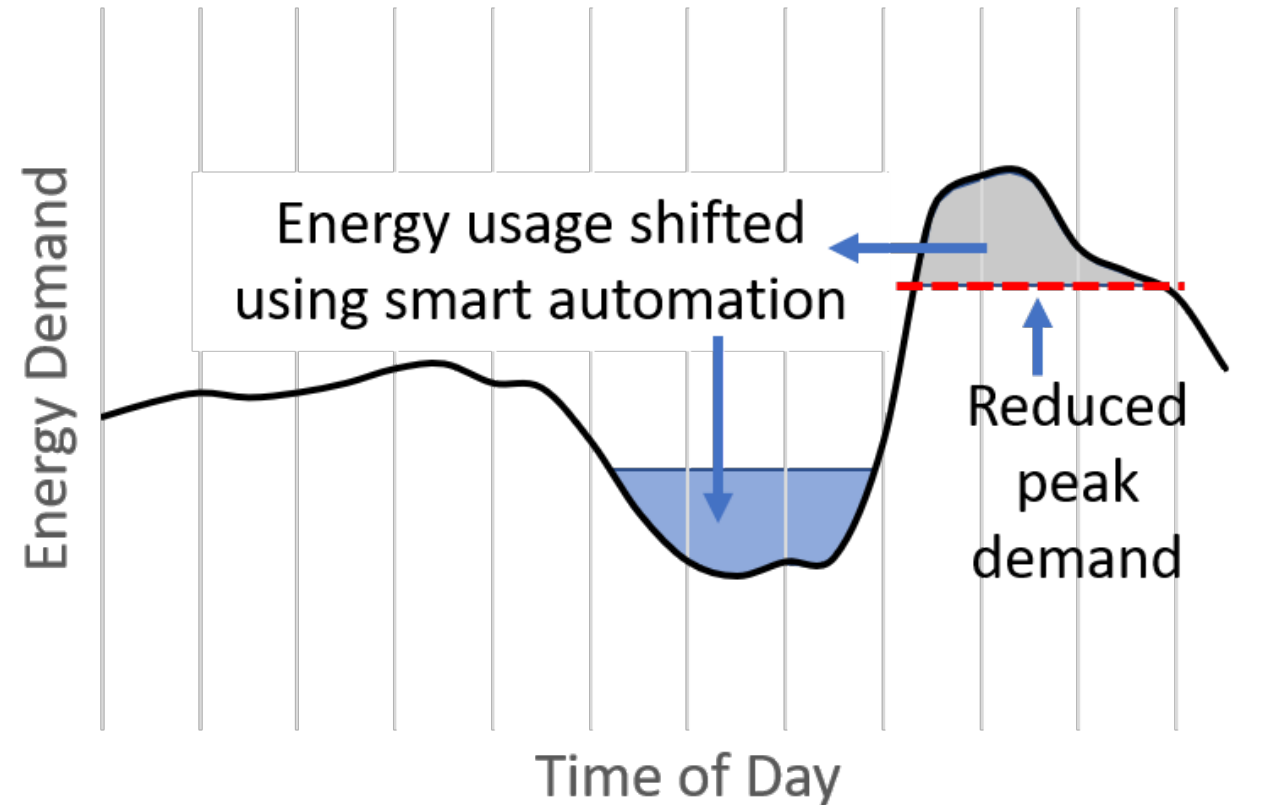
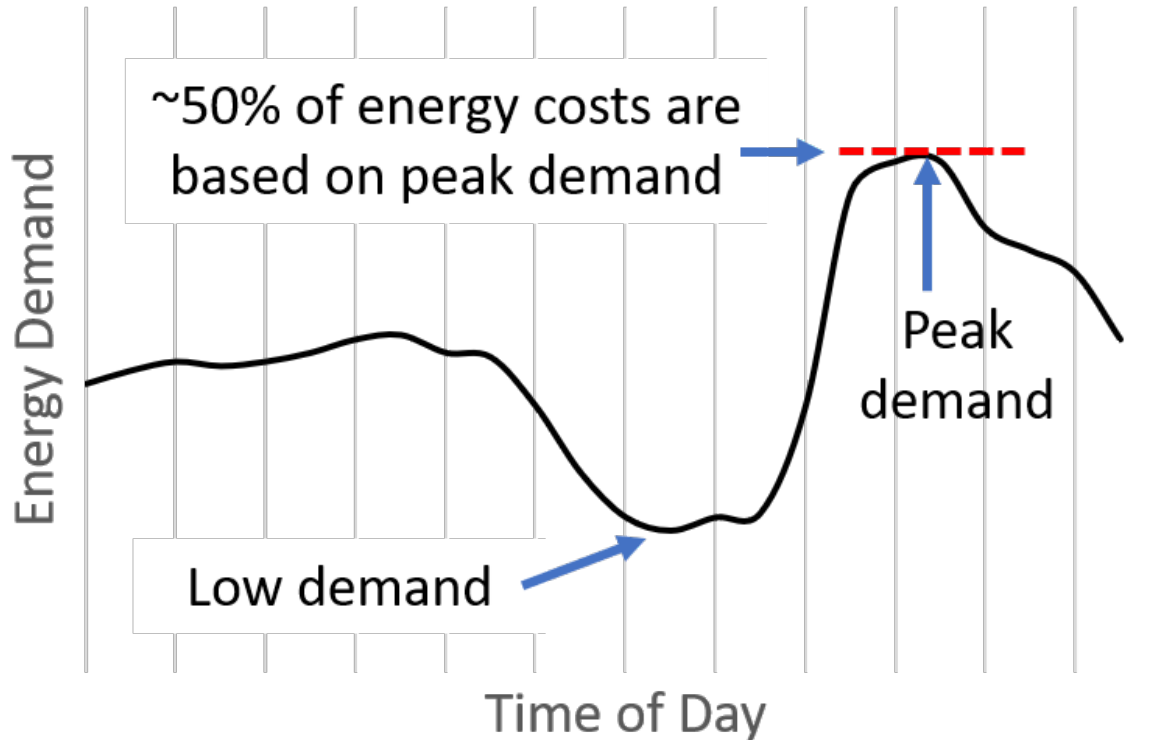
The Industrial Assessment Centers Program



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The Impact of Industrial Flexibility



A Minerals Processing Facility with Big ESG Goals

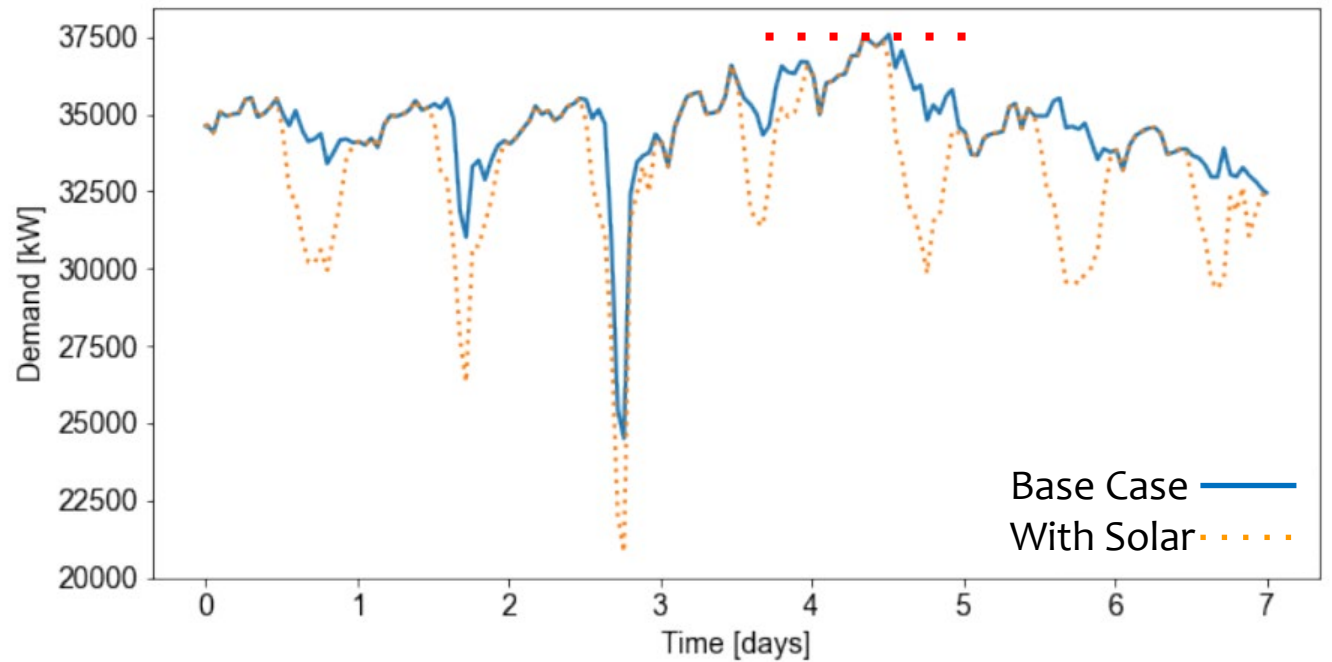
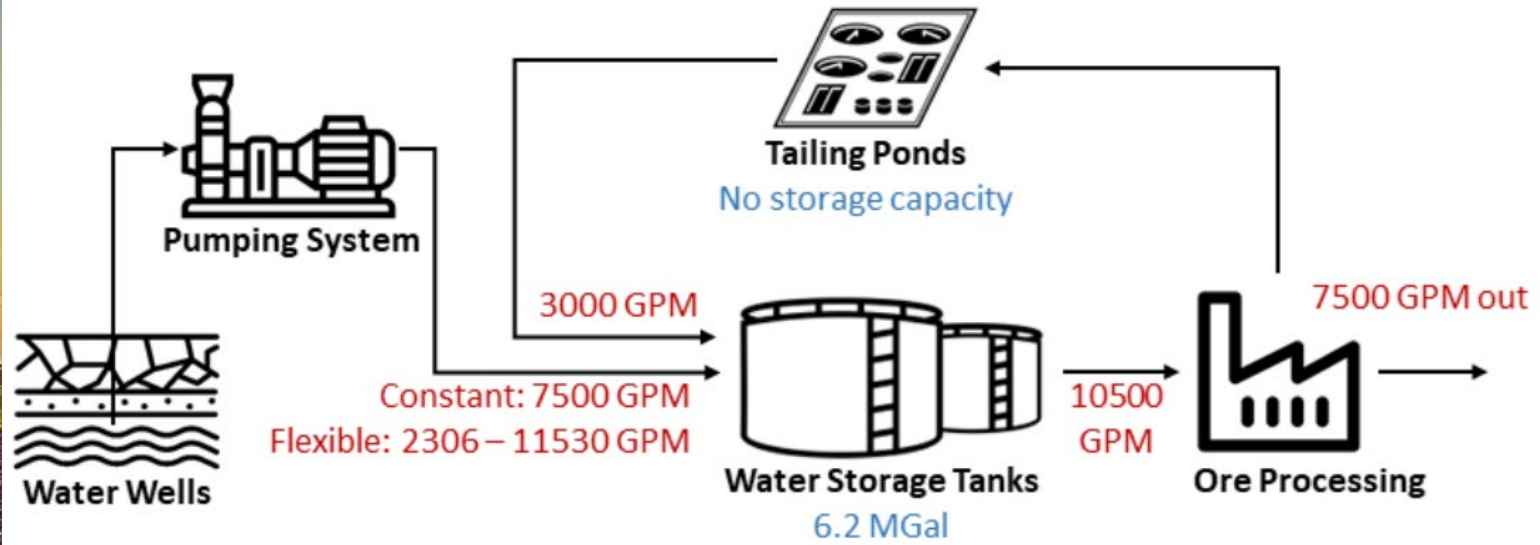


Photo courtesy of Wikipedia

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A Smarter Solution Using Existing Infrastructure

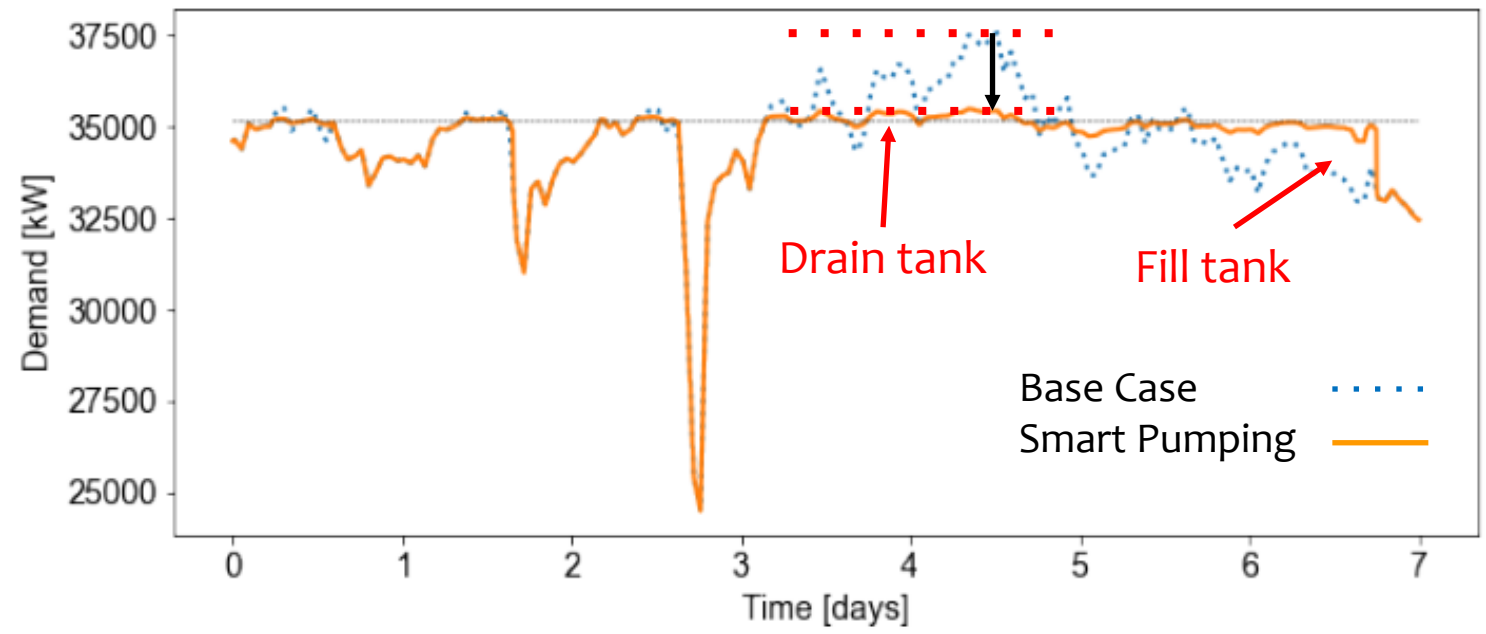
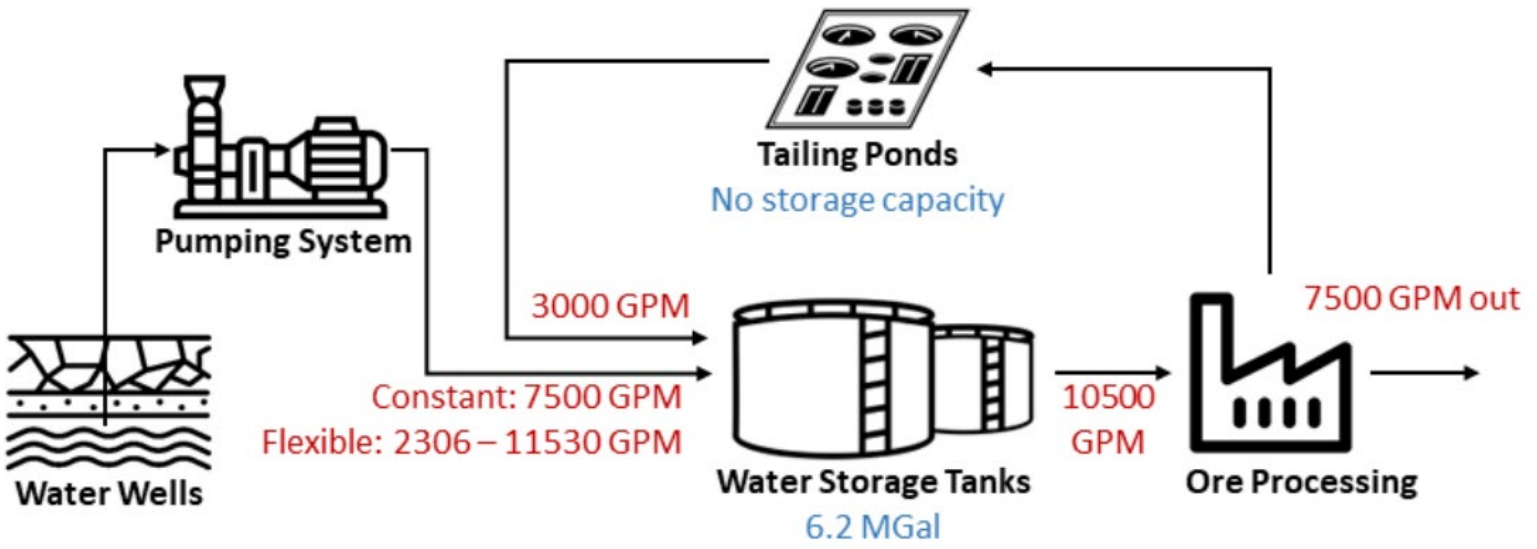


Photo courtesy of Contain Water Systems
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The Results of Working Smarter

Scenario	Avg. Monthly Peak Demand (kW)	Project Cost (\$)	Savings (\$/yr)	Time Required to Recoup Investment (yrs)
Business as usual	35,919	-	-	-
Solar	35,850	\$7.6M	\$269K	28.4
Battery	34,638	\$3.6M	\$318K	11.5
Solar + Battery	34,258	\$11.3M	\$664K	17.0
Smart Pumping	34,428	\$250K	\$372K	0.7
Solar + Smart Pumping	33,906	\$7.9M	\$755K	10.5

Results from “Grid-Responsive Smart Manufacturing: Can the Manufacturing Sector Help Incorporate Renewables?”
Chen et al., *IFAC PapersOnLine*, Volume 55, Issue 10, 2022



Bottom Up: Flexible Loads and Intelligent Operation

Improving the economics of battery storage for industrial customers: Are incentives enough to increase adoption?

Anne Dougherty, Blake Billings, Nestor Camacho, Kody Powell  

Integrating a Microturbine into a Discrete Manufacturing Process with Combined Heat and Power Using Smart Scheduling and Automation

Moriah Henning ¹, Derek Machalek ², Kody M. Powell Ph.D. ²  

Dynamic optimization with flexible heat integration of a solar parabolic trough collector plant with thermal energy storage used for industrial process heat

Jake Immonen, Kody M. Powell  

Techno-economic analysis of the impact of dynamic electricity prices on solar penetration in a smart grid environment with distributed energy storage

Moataz Sheha ^a, Kasra Mohammadi ^a, Kody Powell ^{a, b}  

Industrial battery operation and utilization in the presence of electrical load uncertainty using Bayesian decision theory

Blake W. Billings ^a, Philip J. Smith ^a, Sean T. Smith ^a, Kody M. Powell ^{a, b}  

Grid-Responsive Smart Manufacturing: Can the Manufacturing Sector Help Incorporate Renewables?

Yunzhi Chen ¹, Blake Billings ¹, Sammy Partridge ¹, Brittany Pruneau ¹, Kody M. Powell ^{1, 2}  

Automated electrical demand peak leveling in a manufacturing facility with short term energy storage for smart grid participation

Derek Machalek, Kody Powell  

Mine operations as a smart grid resource: Leveraging excess process storage capacity to better enable renewable energy sources

Derek Machalek, Aaron Young, Landen Blackburn, Pratt Rogers, Kody M. Powell  



Can we work smarter and not just harder?

“We can’t solve problems by using the same kind of thinking we used when we created them.”

-Albert Einstein

Photo courtesy of NBC News

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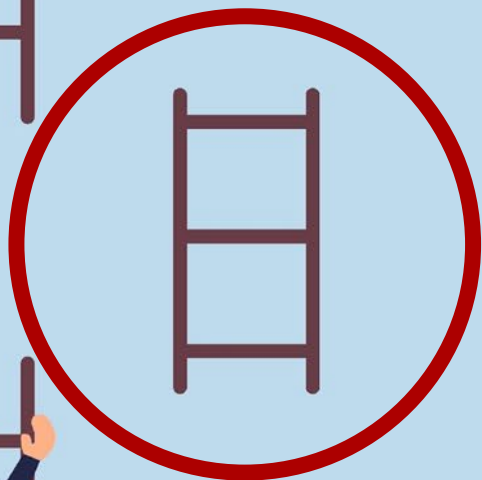
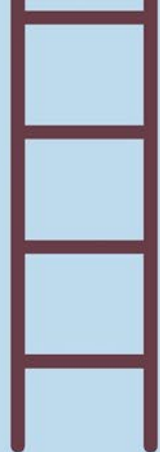
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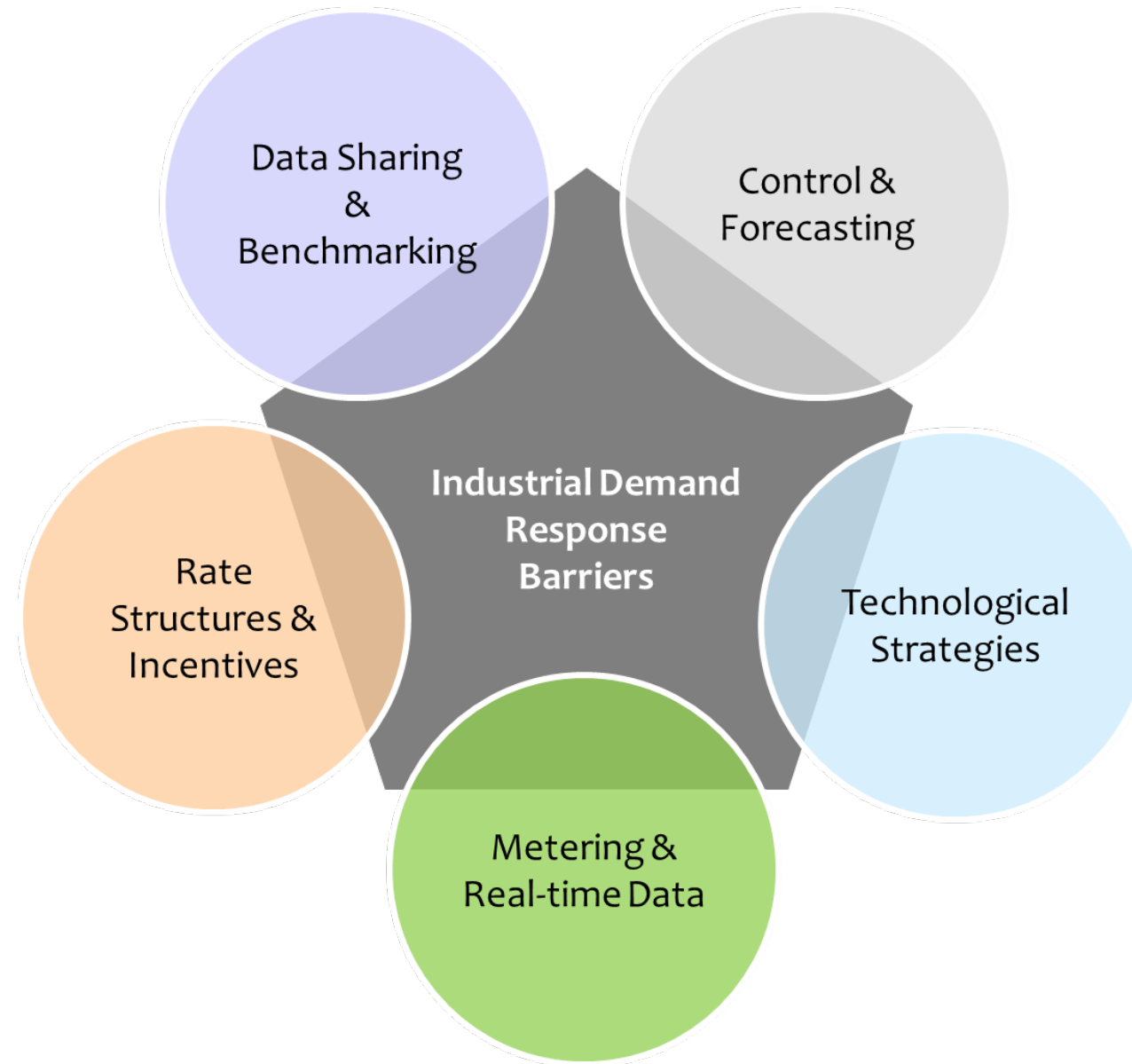


Top Down / Bottom Up

How do we close the gap?



Major Barriers to Industrial Demand Response



Works Cited: Billings BW, Powell KM. Grid-responsive smart manufacturing: A perspective for an interconnected energy future in the industrial sector. *AIChE J.* 2022; 68(12):e17920. doi:[10.1002/aic.17920](https://doi.org/10.1002/aic.17920)



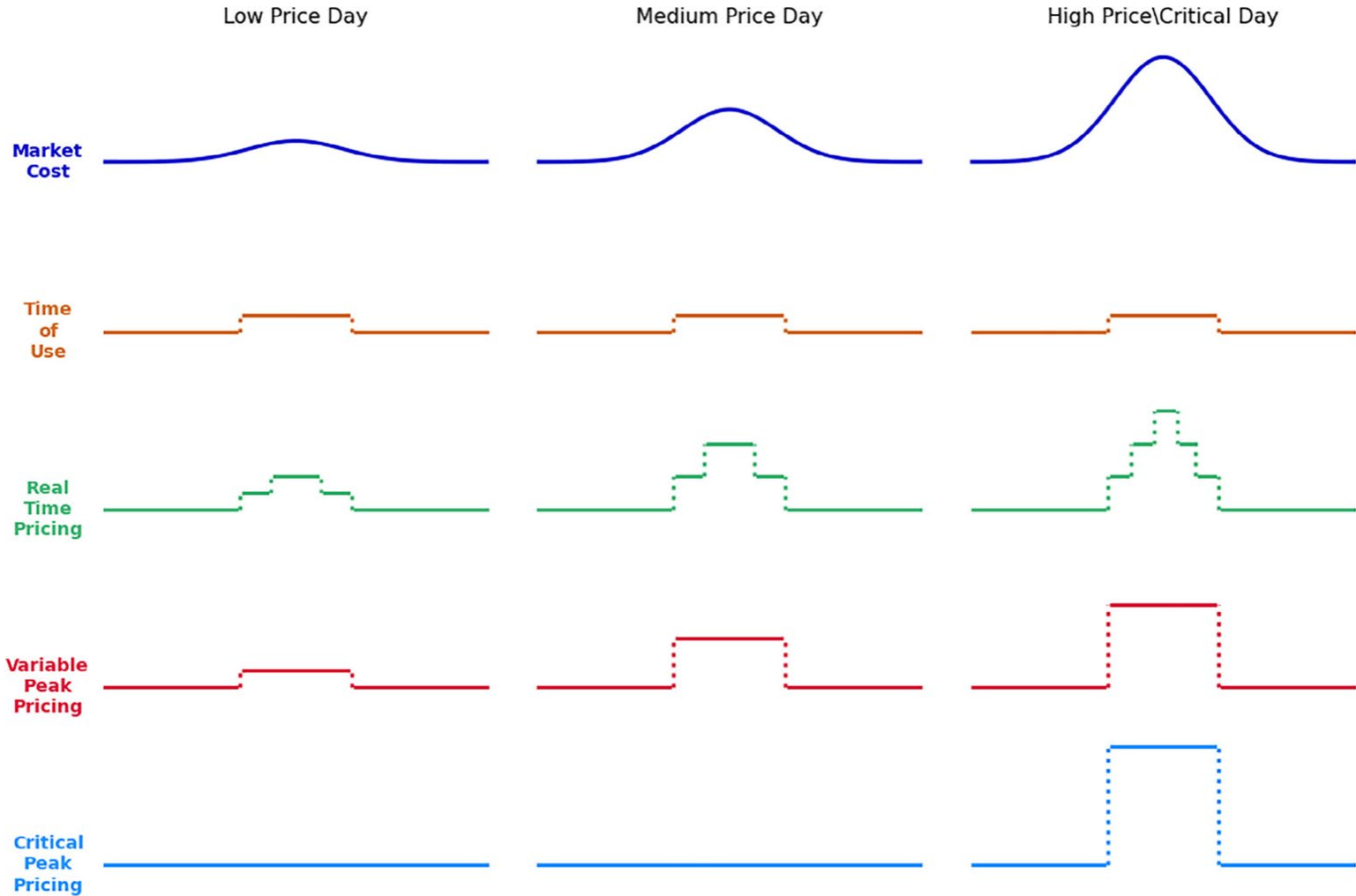
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Rate Structures & Incentives



- Giving facilities a reason to respond to signals from the utility or grid

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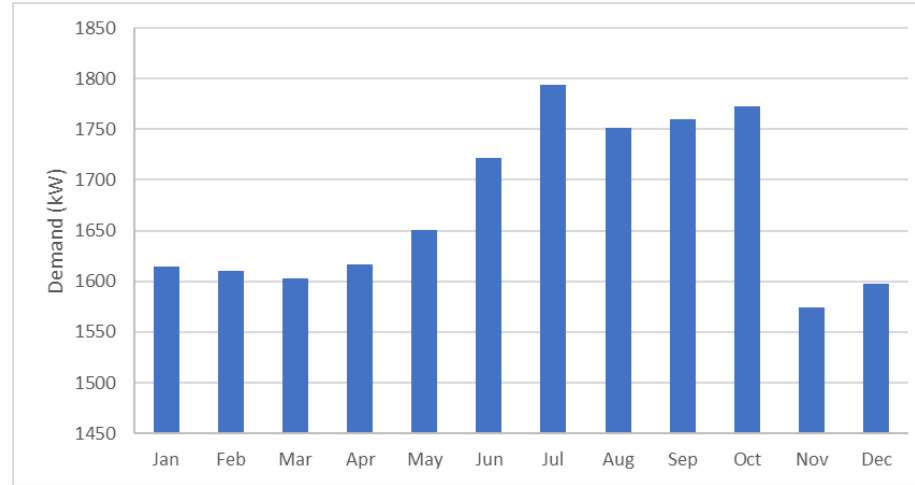


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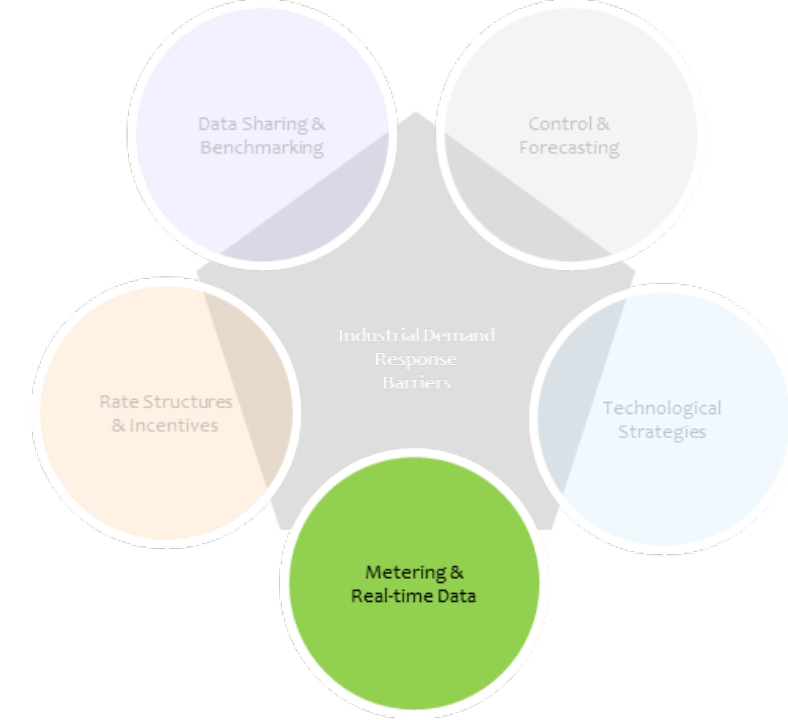
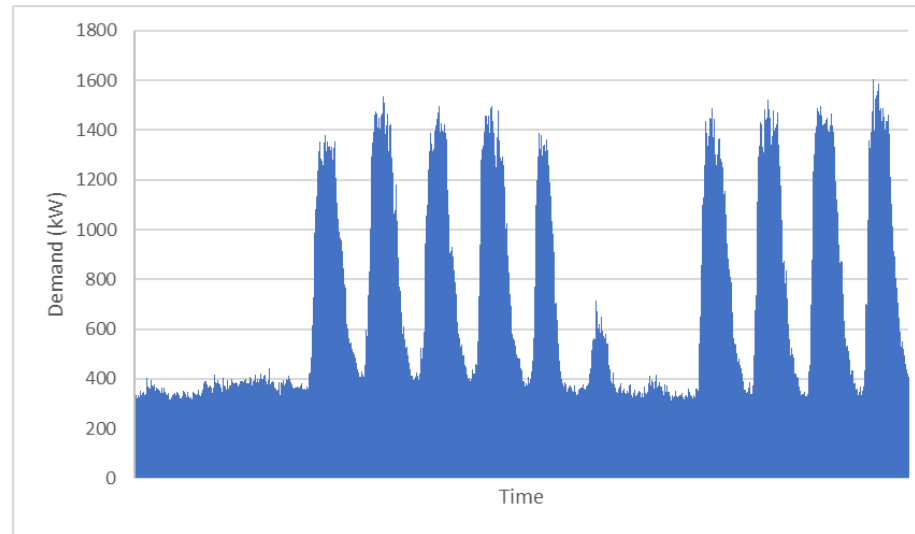
Metering & Real-time Data



Taken from: https://en.wikipedia.org/wiki/Electricity_meter



Taken from: https://en.wikipedia.org/wiki/Smart_meter



- Having the right level of data available for decision-making

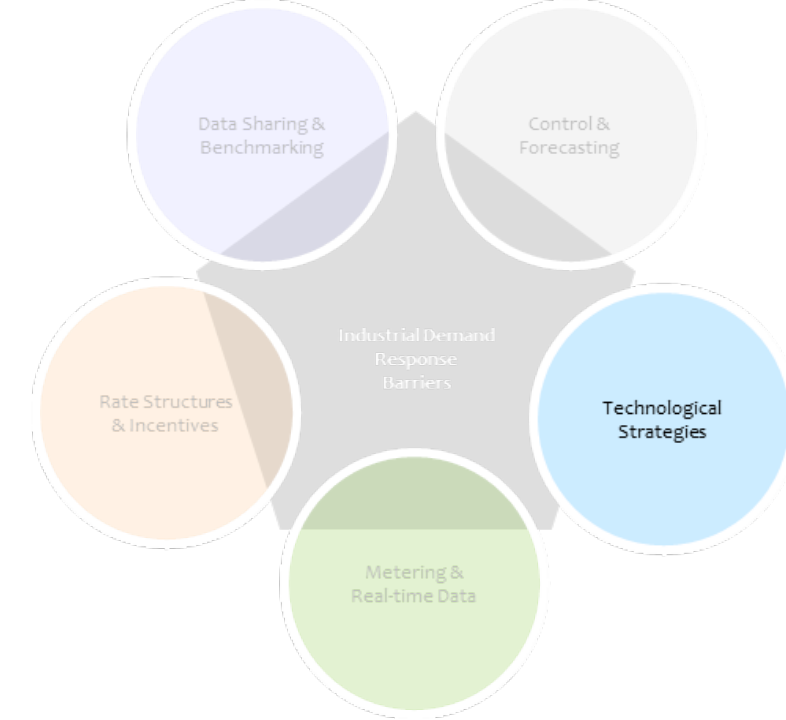
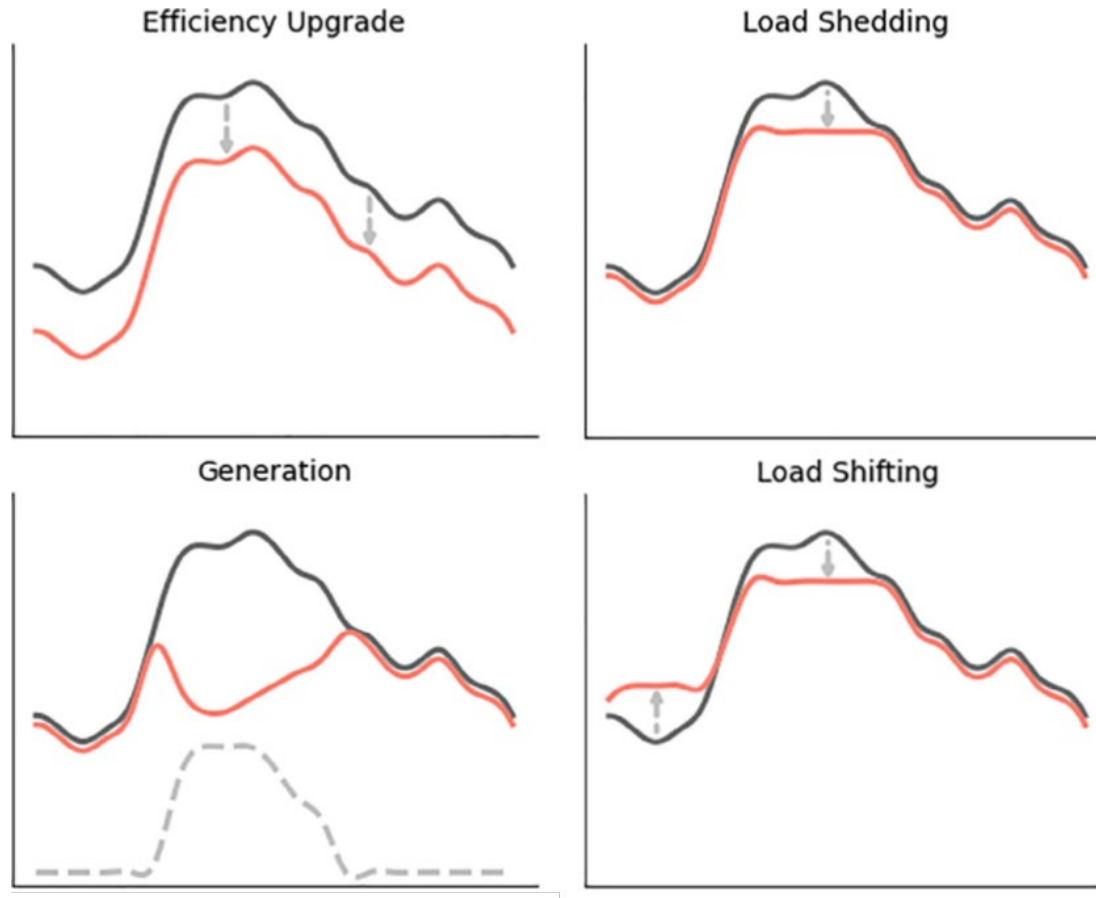
Works Cited: Billings BW, Powell KM. Grid-responsive smart manufacturing: A perspective for an interconnected energy future in the industrial sector. *AIChE J.* 2022; 68(12):e17920. doi:10.1002/aic.17920



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Technological Strategies



- Understand the response capabilities of specific facilities and industries

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Control & Forecasting



- Integrate existing control systems with demand response capabilities
- Be able to forecast electric loads within a facility

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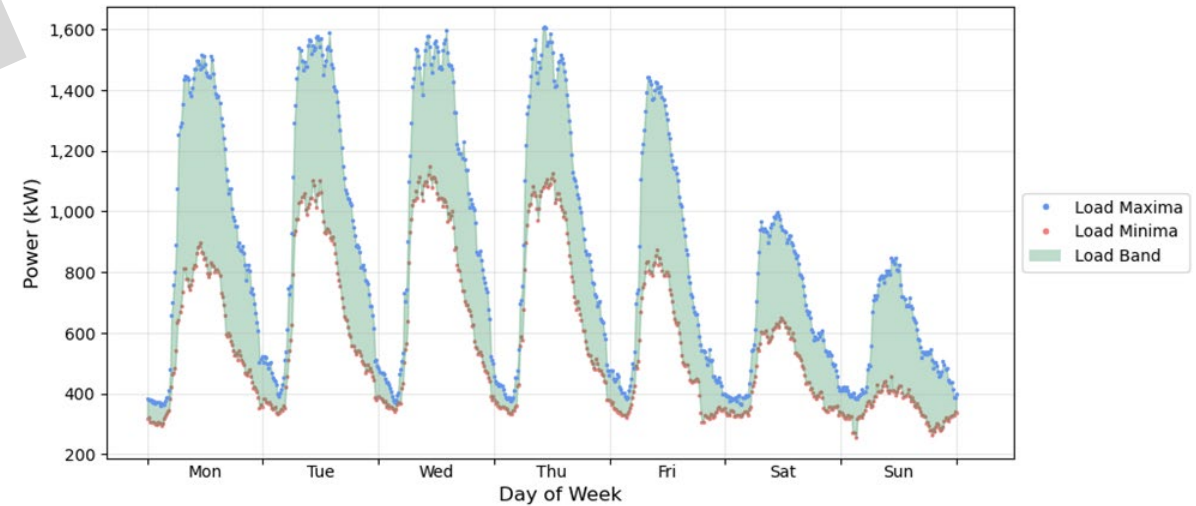


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Data Sharing and Benchmarking



- Creating benchmarks to understand and compare facilities and capabilities



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Photo courtesy of Jerome 20/20 Inc

Agropur Dairy Cooperative

Western US, cheese production facility

- Electric DR through local utility program
- Have 15-minute interval data meters
- Change chiller setpoints and shut down processes
- Utility calls anytime in summer and they anticipate

In 14 years, average \$12,030 per year

Production always takes priority over DR

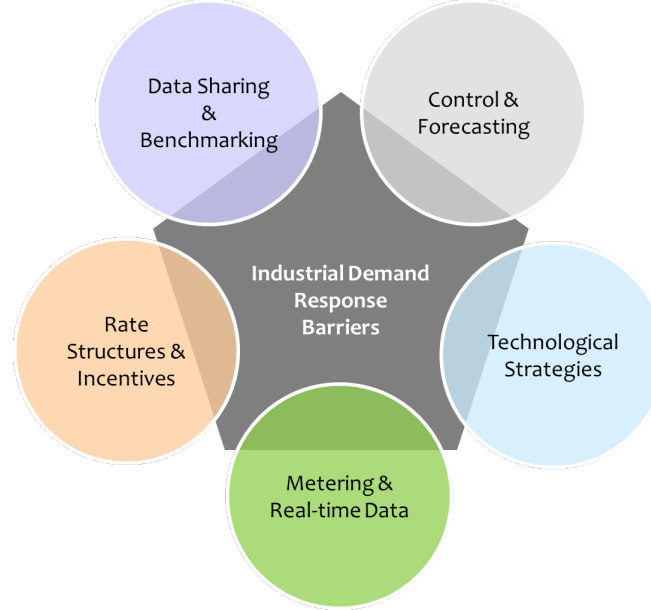


Photo courtesy of Cleveland-Cliffs

Cleveland Cliffs

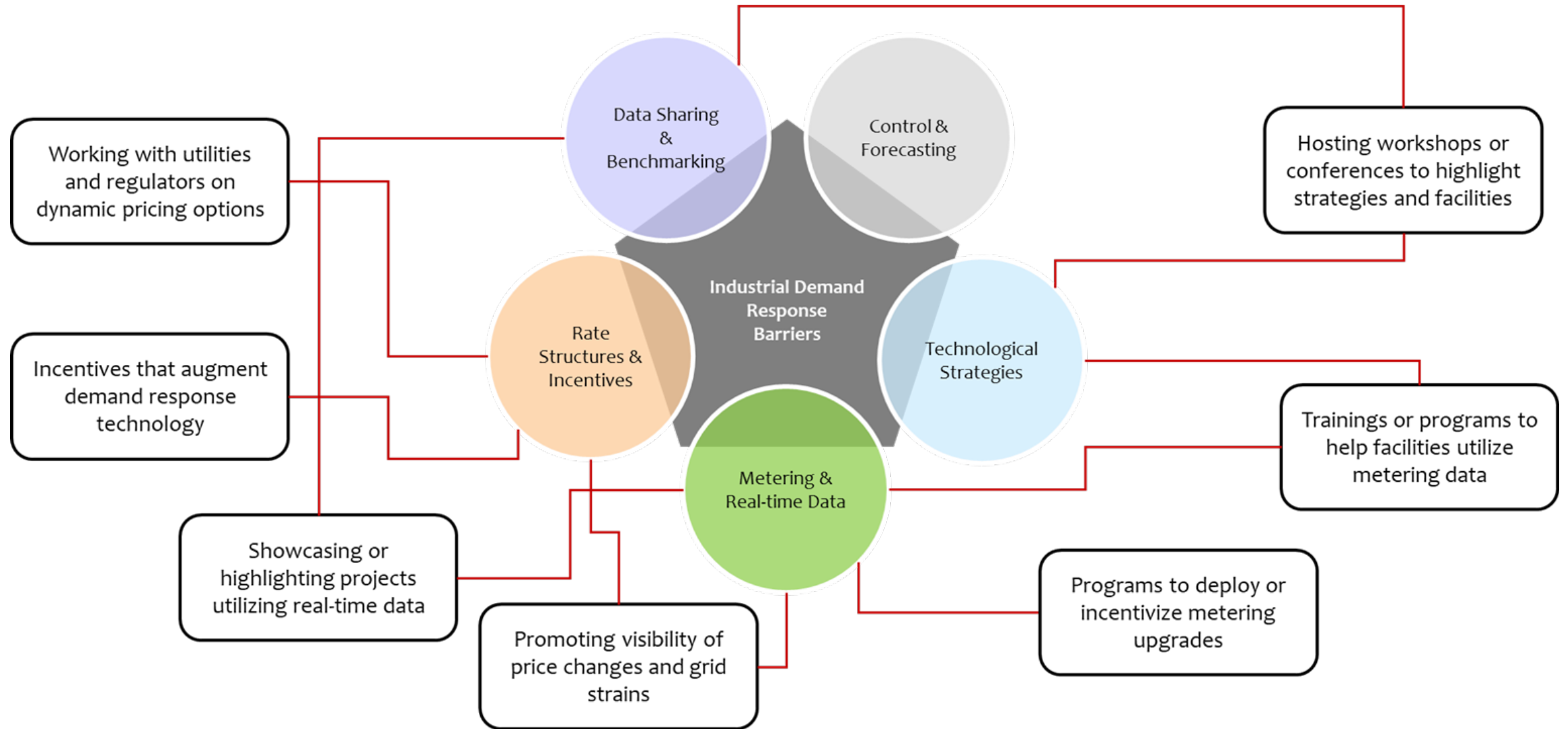
Eastern US, steel mill

- Electric DR through local utility incentive program
- Have 15-minute interval data meters and process sub-meters
- Have an outside 3rd party that coordinates strategies and shares profits
- Correlate outside temperature with DR events

Annual revenue is \$500,000 to \$1,000,000



Examples of Roles State Offices Could Play





How can we work smarter?

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Kody: kody.powell@utah.edu

