Working Smarter, Not Harder
Opportunities and Challenges for Industrial Demand Response

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- Director of the Intermountain Industrial Assessment Center (IAC)
- Energy systems researcher
  - Hybrid energy systems
  - Energy storage
  - Grid-responsive manufacturing
  - Intelligent systems
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• Industrial energy efficiency researcher:
  • Industrial load profiles
  • Energy and emission intensive industries
  • Low carbon industrial technologies

Working Smarter, Not Harder: Opportunities and Challenges for Industrial Demand Response
Top Down / Bottom Up

How do we close the gap?

Flexible Loads

Grid Needs
A Major Issue with Decarbonization

Supply

Demand

Solar Radiation (W/m²)

Load (GW)
The Duck and the Canyon

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Net Demand (MW)

Demand minus wind and solar

Midnight
Noon
Midnight
Midnight
Noon
Midnight

DUCK CURVE

CANYON CURVE
The Industrial Assessment Centers Program
The Impact of Industrial Flexibility

~50% of energy costs are based on peak demand

Energy usage shifted using smart automation

Reduced peak demand
A Minerals Processing Facility with Big ESG Goals

Photo courtesy of Wikipedia

Working Smarter, Not Harder: Opportunities and Challenges for Industrial Demand Response
A Smarter Solution Using Existing Infrastructure

Working Smarter, Not Harder: Opportunities and Challenges for Industrial Demand Response

Photo courtesy of Contain Water Systems
The Results of Working Smarter

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

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, Derek Machalek, Kody M. Powell Ph.D.

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 *, Kasra Mohammadi *, Kody Powell

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


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

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

Yunzhi Chen, Blake Billings, Sammy Partridge, Brittany Pruneau, 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
Top Down / Bottom Up

How do we close the gap?
Major Barriers to Industrial Demand Response

- Data Sharing & Benchmarking
- Control & Forecasting
- Rate Structures & Incentives
- Technological Strategies
- Metering & Real-time Data

Rate Structures & Incentives

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

Metering & Real-time Data

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

Technological Strategies

- Understand the response capabilities of specific facilities and industries

Control & Forecasting

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

Data Sharing and Benchmarking

- Creating benchmarks to understand and compare facilities and capabilities

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

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

- Working with utilities and regulators on dynamic pricing options
- Incentives that augment demand response technology
- Showcasing or highlighting projects utilizing real-time data
- Promoting visibility of price changes and grid strains
- Hosting workshops or conferences to highlight strategies and facilities
- Trainings or programs to help facilities utilize metering data
- Programs to deploy or incentivize metering upgrades