Dawn of a new era for utilities

- More intermittent generation resources
- Prices and carbon intensity matters
- Need to better manage the load curve

It use to be that we managed generation to match the load, in the future we'll manage the load to match the generation.



GREAT RIVER ENERGY...

The juggling act



GREAT RIVER ENERGY...

MISO Day-Ahead price variation

| Year | 2 | 201 | 7 🖵 | MI | SO DA | \$/MWh | | | | | | | | | |
|---------|------------|-------|-------|-------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | | | | | | | | | | | | | | | |
| Average | e o'(| Colu | umn 🔻 | | | | | | | | | | | | |
| HE | – J | lan | | Fe | b | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 0 | | \$ 3 | 21.70 | \$ | 16.07 | \$ 16.47 | \$ 15.38 | \$ 17.12 | \$ 16.90 | \$ 17.59 | \$ 16.65 | \$ 13.22 | \$ 12.67 | \$ 18.80 | \$ 20.49 |
| 1 | | \$ 3 | 20.45 | \$ | 15.07 | \$ 15.68 | \$ 14.50 | \$ 16.13 | \$ 15.63 | \$ 16.50 | \$ 15.93 | \$ 12.39 | \$ 12.17 | \$ 18.35 | \$ 19.28 |
| 2 | | \$ | 19.87 | \$ | 14.66 | \$ 15.15 | \$ 14.07 | \$ 15.53 | \$ 14.61 | \$ 15.54 | \$ 15.17 | \$ 11.30 | \$ 11.75 | \$ 17.94 | \$ 18.84 |
| 3 | | \$ | 19.85 | \$ | 14.17 | \$ 15.31 | \$ 14.28 | \$ 15.66 | \$ 14.07 | \$ 15.05 | \$ 14.89 | \$ 11.39 | \$ 12.01 | \$ 17.88 | \$ 18.80 |
| 4 | | \$ | 19.97 | \$ | 14.81 | \$ 15.98 | \$ 15.36 | \$ 16.70 | \$ 14.77 | \$ 15.11 | \$ 15.05 | \$ 11.93 | \$ 12.92 | \$ 18.15 | \$ 19.19 |
| 5 | | \$ 3 | 21.09 | \$ | 15.83 | \$ 19.41 | \$ 20.02 | \$ 19.41 | \$ 15.90 | \$ 15.94 | \$ 16.46 | \$ 14.21 | \$ 16.39 | \$ 19.87 | \$ 20.35 |
| 6 | | \$ 3 | 23.72 | \$ | 19.39 | \$ 26.45 | \$ 25.47 | \$ 23.24 | \$ 16.72 | \$ 15.72 | \$ 16.61 | \$ 16.24 | \$ 20.98 | \$ 23.75 | \$ 23.89 |
| 7 | | \$ 3 | 32.80 | \$ | 24.68 | \$ 28.27 | \$ 26.82 | \$ 26.05 | \$ 20.05 | \$ 18.58 | \$ 18.55 | \$ 18.13 | \$ 22.38 | \$ 29.03 | \$ 30.08 |
| 8 | | \$ 3 | 32.60 | \$ | 23.69 | \$ 27.52 | \$ 28.26 | \$ 27.21 | \$ 22.06 | \$ 21.75 | \$ 20.52 | \$ 20.11 | \$ 22.70 | \$ 27.91 | \$ 29.99 |
| 9 | | \$ 3 | 31.30 | \$ | 23.68 | \$ 27.27 | \$ 29.00 | \$ 28.15 | \$ 23.69 | \$ 24.03 | \$ 21.86 | \$ 21.42 | \$ 23.80 | \$ 28.03 | \$ 29.12 |
| 10 | | \$ 3 | 30.39 | \$ | 23.13 | \$ 26.55 | \$ 29.08 | \$ 28.55 | \$ 25.20 | \$ 26.36 | \$ 23.77 | \$ 22.82 | \$ 24.32 | \$ 27.87 | \$ 28.39 |
| 11 | | \$ 3 | 29.01 | \$ | 22.71 | \$ 24.93 | \$ 28.05 | \$ 28.86 | \$ 26.63 | \$ 28.89 | \$ 25.46 | \$ 23.93 | \$ 24.00 | \$ 26.56 | \$ 27.36 |
| 12 | | \$ | 27.36 | \$ | 21.85 | \$ 23.45 | \$ 27.55 | \$ 29.14 | \$ 28.64 | \$ 32.03 | \$ 27.24 | \$ 25.09 | \$ 24.27 | \$ 25.15 | \$ 25.50 |
| 13 | | \$ 3 | 25.85 | \$ | 20.83 | \$ 22.75 | \$ 27.04 | \$ 29.73 | \$ 31.10 | \$ 35.83 | \$ 29.38 | \$ 26.52 | \$ 24.89 | \$ 24.27 | \$ 24.18 |
| 14 | | \$ 3 | 24.65 | \$ | 20.28 | \$ 21.48 | \$ 25.89 | \$ 28.90 | \$ 31.97 | \$ 38.94 | \$ 31.69 | \$ 27.91 | \$ 24.90 | \$ 23.72 | \$ 23.47 |
| 15 | | \$ 3 | 23.61 | \$ | 19.66 | \$ 20.60 | \$ 25.96 | \$ 28.55 | \$ 33.14 | \$ 42.33 | \$ 33.68 | \$ 29.18 | \$ 25.50 | \$ 23.03 | \$ 22.92 |
| 16 | | \$ 3 | 24.62 | \$ | 19.76 | \$ 20.62 | \$ 26.06 | \$ 28.64 | \$ 33.53 | \$ 43.20 | \$ 33.64 | \$ 28.14 | \$ 25.33 | \$ 23.95 | \$ 24.06 |
| 17 | | \$ 3 | 31.29 | \$ | 20.95 | \$ 21.77 | \$ 25.78 | \$ 27.37 | \$ 31.93 | \$ 39.74 | \$ 30.36 | \$ 26.86 | \$ 26.00 | \$ 29.28 | \$ 31.57 |
| 18 | | \$ 3 | 38.22 | \$ | 25.17 | \$ 24.82 | \$ 25.39 | \$ 26.98 | \$ 29.13 | \$ 34.69 | \$ 27.59 | \$ 25.90 | \$ 30.31 | \$ 33.51 | \$ 35.52 |
| 19 | | \$ 3 | 34.39 | \$ | 26.09 | \$ 31.20 | \$ 31.04 | \$ 29.18 | \$ 26.91 | \$ 30.35 | \$ 25.70 | \$ 25.60 | \$ 27.04 | \$ 28.74 | \$ 30.22 |
| 20 | | \$ 3 | 31.63 | \$ | 23.43 | \$ 26.47 | \$ 29.26 | \$ 30.01 | \$ 26.48 | \$ 27.63 | \$ 23.87 | \$ 22.33 | \$ 22.57 | \$ 26.12 | \$ 27.95 |
| 21 | | \$ 3 | 27.56 | \$ | 21.26 | \$ 21.75 | \$ 22.82 | \$ 25.45 | \$ 23.65 | \$ 23.77 | \$ 21.20 | \$ 19.28 | \$ 18.62 | \$ 23.86 | \$ 25.65 |
| 22 | | \$ 3 | 24.49 | \$ | 19.13 | \$ 19.16 | \$ 19.71 | \$ 22.22 | \$ 21.32 | \$ 21.11 | \$ 19.41 | \$ 16.80 | \$ 15.73 | \$ 21.94 | \$ 23.94 |
| 23 | | \$ 3 | 22.89 | \$ | 17.81 | \$ 17.50 | \$ 17.26 | \$ 19.32 | \$ 19.17 | \$ 19.66 | \$ 18.02 | \$ 14.34 | \$ 14.05 | \$ 20.07 | \$ 21.84 |
| Grand T | \$ 2 | 26.64 | \$ | 20.17 | \$ 22.11 | \$ 23.50 | \$ 24.50 | \$ 23.47 | \$ 25.85 | \$ 22.61 | \$ 20.21 | \$ 20.64 | \$ 24.07 | \$ 25.11 | |



Electric Thermal Storage





Interacting with the Grid





Community storage





Sustainable and Efficient Electrification







Corporate Sustainability goals and customer engagement aligns



Reducing our air emissions impact





Current customer energy solutions





Appendix







Electric truck refrigeration units make sense

Cleaner, healthier work environment Electric TRUs have zero site emissions. Reducing idling diesel engines results in a cleaner work environment and less exposure to harmful exhaust.

Less noise, safer work environment Electric TRUs are much quieter than diesel engines, "Madamparahr soorser condet regale divertifications" (aschrift are gesting and and dimmi-

Lower costs for fuel, maintenance and lower lifecycle costs

Electric TRUs can plug in at night when lower, offpeak rates are in effect. The volatility of of and gasprices can be avoided and hier costs can be reduced up to 75% or 80% depending when trailers are stationary. They also have 90% fewer parts than a

Concordio cualdrakegaraceler concentration activity of the second sec

We can help you identify the solution that fits your business needs. Contact your key account manager at 1-866-255-4268, press 2 twice

busin as een tor(pallantonorgy.com alliantonorgy.com/truck

Alliar Energ

▶ Q & A

How much electrical infrastructure is needed?

In warehouses or other facilities, typically power is either available or may require a short extension or transformer upgrade. Even with costs to install the infrastructure, the return on investment is typically under two years. We offer rebates to help reduce the costs of bay wiring and plug infrastructure. This investment can also allow for greater expansion of plug-in capabilities down the road.

What about the cost of electric truck refrigeration?

Electric-standby TRUs cost more upfront because you're purchasing an additional will of # 200% or strained. I whereau with Cost Parameter beweithout best pointed on additional parameter with a strain new Biblion minimum or work. If Parameter Winds The Parameter https://www.cost.if.parameter.word.theory The Parameter Parameter Parameter beck and the Parameter Parameter Parameter Parameter Parameter and Biblion minimum or work. If Parameter Parameter Parameter and Biblion minimum or work of the Parameter Parameter Parameter and Biblion minimum or work of the Parameter Parameter Parameter and Biblion minimum of the Parameter Parameter Parameter Parameter and Parameter Parameter Parameter Parameter Parameter Parameter Parameter and Parameter Parameter Parameter Parameter Parameter Parameter Parameter and Parameter and Parameter Parameter

What happens if a driver forget

unplug from Appendix Breakaway plug Appendix safety features can be installed to prevent electric infrastructure from being damaged.

TRUs have emissions?

Maken that and objection. This Pathoa zare site emissions, which seespecially benaticial coldor climates when the historians.





FIRSTFUEL

BUILDING ELECTRIFICATION

WHEN IT MAKES SENSE AND HOW TO DO IT

ERE Staff Subcommittee Meeting 2018 NARUC Winter Policy Summit

DATA-DRIVEN INTELLIGENCE CAN ALSO FOCUS ELECTRIFICATION EFFORTS





HEAT PUMP CASE STUDY: 3,000 COMMERCIAL BUILDINGS



FIRSTFUEL

SOME ELECTRIFICATION WOULD HAVE HIGH GRID COSTS



FIRSTFUEL

SOME ELECTRIFICATION WOULD HAVE HIGH CARBON BENEFITS







Austin Whitman Vice President, Energy Markets

FirstFuel Software

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February 11, 2018

Beneficial Electrification: Implementation Considerations for Regulators

Presentation to the NARUC Staff Subcommittee

on Energy Resources and the Environment

David Farnsworth

Senior Associate

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Power Sector is Changing

- Consumer Choice
- Tech Advances
 - Renewable Energy/Distributed Resources
 - Storage
 - Information Technology
- Grids
 - Designed for 1-way power flows
 - Now home to thousands of DERs
- Innovations are changing utilities' formerly-predictable supply/demand relationship

Beneficial Electrification (BE)

Isn't this really just about *more* load?

Isn't *all* electrification *beneficial*?

No – Not all Electrification is Created Equal



Before That Horse Gets Out of the Barn...



And She Bolts on You...



Let's Consider a few implementation points

BE Defined

- Electrification is beneficial if it meets one or more of three conditions, without adversely affecting the other two:
 - Saves consumers money over the long run;
 - Reduces environmental impacts; and
 - Enables better grid management.

A Lot of Electrification Load is Different

- It's from more efficient end-uses:
 - End-uses that can be <u>less expensive</u> to operate, and
 - With the right rate design--less expensive to "fuel"
- Because it's flexible, it's valuable

Unlike this Inflexible Load



BE Load Can Fill Valleys and Shave Peaks





Valuable for Reducing Curtailments

| v 1 | 8% | | | | | |
|-------|--|------|--------------------------------|------|-----------------------|--|
| 1.100 | A CONTRACT OF A CONTRACT. A CONTRACT OF A CONTRACT. A CONTRACT OF A CONTRACT OF A CONTRACT OF A CONTRACT OF A CONTRACT. A CONTRACT OF A CONTRACT OF A CONTRACT OF A CONTRACT. A CONTRACT OF A CONTRACT OF A CONTRACT OF A CONTRACT. A CONTRACT OF A CONTRACT. A CONTRACT OF A CONTRACT. A CONTRACTACT OF A CONTRACT. A CONTRACTACTACTACTACTACTACTACTACTACTACTACTACTA | 5.60 | Burner Bruch & Turner & Broken | | Window County washing | |

7 2016 Wind Technologies Market Report, Ryan Wiser and Mark Bolinger, Lawrence Berkeley National Laboratory

Rates Can Influence When We Charge



Source: MJ Bradley, 2017

What About Efficiency? Augmented by Emissions Efficiency

- Efficiency Measures kWhs
- Emissions Efficiency Measures Joules

Conclusions

- Electrification can be *beneficial* if it reflects:
 - Tech. innovations,
 - Consumer interest, and
 - New value in the grid; and
 - Coordinates consumers to help companies manage the grid by <u>sharing that value with</u> <u>all consumers</u>.



This is Avoidable



Electrification Can be Rolled Out for the Benefit of Everyone



* No Animals Were Injured in the Preparation of this Presentation



About RAP

The Regulatory Assistance Project (RAP)[®] is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org



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