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Heimdall Power

GRID OPTIMIZATION GETS REAL: One Year Inside America's Largest DLR Deployment

Great River Energy shares replicable best practices and real-world, realized value— not industry-inflated hypotheticals—to help peer utilities unlock transmission capacity, reduce congestion, and deliver real ROI with DLR.

Authors



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1

The Power Grid Goes Mainstream

Facing historic demand and public scrutiny, the utility industry is under pressure to respond, adapt, and lead.

Not long ago, “supply chain challenges” weren’t exactly dinner table conversation.

That changed when the COVID-19 pandemic made logistics everyone’s business. Toilet paper shortages, empty grocery store shelves, and delayed deliveries brought supply chains into the spotlight—and made them the go-to scapegoat for pandemic-era frustrations.

Today, we’re seeing a similar shift as the global power grid becomes the latest topic to earn a seat at the dinner table. Spurred by headlines warning of looming energy shortages, historic blackouts, a surge in data center construction, and AI-enabled everything, the power grid has become everyone’s business.

And everyone has questions:

- How do we prevent outages?
- Why does my electricity bill keep getting higher, and will it ever go down?
- Will we have enough power to support our increasingly electrified lives?
- Why can’t my utility just produce more electricity?
- Who’s footing the bill for that new power plant project, and why is it taking so long?

The problem?
The answers are only getting more complicated.

Compounding Challenges Threaten the World’s Largest Machine



An aging infrastructure

As of 2023, 70% of lines and transformers deployed on the grid were over 25 years old,¹ and much of the United States’ electric grid infrastructure, which was built in the 1960s and 1970s, is approaching the end of its 50- to 80-year life cycle.²



Extreme weather

2024 unseated 2023 as the hottest year on record globally³ and marked the first year when average temperatures were 1.5 degrees Celsius warmer than the pre-industrial average. With heat comes outages: Heat caused nearly half (47%) of all weather-related outages in the U.S between 2000 and 2023. Weather-related outages in general accounted for 80% of all major outages in the U.S. during that same period.⁴



Load growth

Between 2022 and 2024, the Federal Energy Regulatory Commission (FERC) drastically raised its forecast for how much electricity demand will grow over five years. In 2022, it expected a growth of 23 gigawatts (GW). That jumped to 39 GW in 2023 then soared to 128 GW in 2024, more than five times the original estimate, according to Grid Strategies.⁵



Rising component prices and supply chain challenges

Prices and procurement times for essential components like power transformers and cables have almost doubled over the last four years.⁶ Delays are already affecting energy projects. Belgium’s Princess Elisabeth Island transmission hub, for example, has tripled in cost, from \$2.3 billion to \$7.3 billion, while the completion date for Poland’s Harmony Link has slipped from 2025 to 2028 due to equipment constraints.⁷

The trickle-down effect for ratepayers is electricity costs that are “rising even faster than the cost of groceries,” according to the *Wall Street Journal*: While overall consumer prices rose 2.4% year-over-year in May 2025, power costs increased 4.5% during the same period.⁸

1. As noted by the US Department of Energy [What does it take to modernize the US energy grid?](#)

2. [U.S. Department of Energy](#) (2023)

3. [When Risks Become Reality: Extreme Weather in 2024](#), Climate Central and World Weather Attribution (2024)

4. [“Weather-related Power Outages Rising,”](#) Climate Center (2024)

5. [“Strategic Industries Surging: Driving US Power Demand,”](#) Grid Strategies (2024)

6. [“Building the Future Transmission Grid: Strategies to Navigate Supply Chain Challenges,”](#) IEA (2025)

7. [“Out of Sync: The Infrastructure Misalignment Undermining the U.S. Grid,”](#) *POWER Magazine* (June 11, 2025)

8. [“Your Electric Bill Is Rising Faster Than Inflation. Here’s Why.”](#) *The Wall Street Journal* (June 13, 2025)

Great River Energy's Answer: Dynamic Line Rating

A brand-new solution...30 years in the making.

The promise of dynamic line rating (DLR) has been circulating in engineering and utility transmission circles since the early 1990s. For more than 30 years, research and pilot programs have proven that DLR can help utilities unlock more transmission capacity by using real-time weather and line data.

Like many technologies, DLR has followed a Moore's Law-style trajectory, becoming exponentially smaller, smarter, and more cost-effective over time.

Today, Heimdall Power's package of sensors, called the Neuron™, is the size and weight of a small bowling ball, can be installed on live, high-voltage lines by drone in seconds, and, for the DLR application, and has an average time-to-value of approximately six months. So, why isn't it everywhere?

To be fair, DLR is widely deployed in Europe, where countries like Germany and Norway have scaled the technology across significant portions of their grid.

From Sensors to System-Wide Insights: DLR at Scale

Two Norwegian distribution system operators, *Elvia* and *Fagne*, are using Heimdall Power's solution to achieve system-wide digitization. Scalability is a critical consideration for utilities selecting a DLR solution: The realized, sustained value potential of DLR is directly associated with how rapidly and inexpensively sensors can be added or moved across a system.

"In kilometers, *Fagne*'s power grid is longer than all the national roads in Norway combined," said Kristoffer Vannes, a director at *Fagne*. "We know we have to expand the power grid, but this technology [which combines the Heimdall Cloud and several hundred physical and virtual Neurons] could make it easier to transport enough electricity to our customers in the short term."

In the U.S., however, adoption has been slow. A mix of unfavorable regulatory environments, limited external incentives, and entrenched internal practices—especially within investor-owned utilities (IOUs)⁹—has created headwinds. These factors reinforce a long-standing industry reality: U.S. utility leaders are highly risk-averse (and often with good reason) and prefer to wait until new technologies are validated by peer deployments before moving forward.

Which is exactly what makes Great River Energy something of an anomaly.

As one of the largest generation and transmission cooperatives in the U.S., Great River Energy serves 26 member-owner distribution cooperatives and 1.7 million people stretching from Minnesota's scenic North Shore to its beautiful southwestern farmlands.

Great River Energy by the Numbers

26

member-owner
distribution cooperatives

5,100

miles of
transmission line

100+

substations for
transmission

1.7M

customers
served

While Great River Energy is notably large by cooperative standards, its commitment to delivering safe, reliable, and affordable electricity remains deeply rooted in its values.

So, when faced with the same compounding pressures confronting utilities nationwide—soaring demand, extreme weather, aging infrastructure, and rising costs and procurement delays—Great River Energy took the opportunity to evaluate a broad range of options.

When Great River Energy launched its DLR program in September 2023, it wasn't seeking headlines: It was charting a sustainable, cost-effective path forward amidst a rapidly changing energy landscape.

Now, nearly two years after the pilot began, and one year into full deployment, that path is paved with best practices, proven methodologies, and actionable insights for accelerating DLR adoption across the country.

What follows is a practical, hard-earned playbook shaped at the frontlines of America's largest DLR deployment.

9. "[Out of Sync: The Infrastructure Misalignment Undermining the U.S. Grid](#)," *POWER Magazine* (June 11, 2025)

3

How DLR Fits in the Grid-Enhancing Technologies Framework: A Systems-Level Assessment

An actionable guide to where DLR fits, when to deploy, and why it matters.

Dynamic line rating, the solution featured in this piece, is one tool in a growing toolbox of grid-enhancing technologies (GETs), and it's important to acknowledge the broader GETs ecosystem to fully understand DLR's unique position in it.

Why? Because over-tasked transmission operators, siloed solutions, and tech bloat threaten to stunt the adoption of DLR and GETs in general; tools that are overwhelming proven to increase the capacity, efficiency, reliability, and safety of the existing power grid.¹⁰

By starting from a GETs purview, we believe that threat can be disarmed.

A 2021 study published by the Brattle Group and WATT Coalition found that the implementation of GETs could lead to \$5 billion in yearly energy production cost savings, double the amount of renewable energy sources added to the grid without large-scale transmission expansions, and reduce carbon emissions by 90 million tons.¹¹

The WATT Coalition contextualized the top three GETs solutions—DLR, Advanced Power Flow Control, and Topology Optimization—with a traffic control analogy.¹²



DLR The speedometer

The most limiting factor to a transmission line's capacity on many circuits is its temperature due to loading and ambient conditions. When a line gets too hot, it can soften and sag, reducing its safe operating capacity. Since transmission line owners have had little to no awareness of the actual conditions on the line, the industry has responsibly assumed the worst-case conditions and limited the flows accordingly.

In the context of a traffic analogy, reducing the number of vehicles that can safely travel at a given speed because the conditions are unknown is like limiting the flow on a line.

Drivers everywhere can relate: A broken-down vehicle closes a lane ahead, the road is wet or icy, or there is a thunderstorm, and traffic slows...or stalls entirely. High temperatures, still winds, and sunlight act just like a broken-down vehicle or bad road conditions slowing the overall speed—and throughput—of traffic.

So, in an absence of real-time data, utilities have assumed the worst: High temperatures, still winds, and full sun require utilities to limit the “number of cars” on every span. The alternative—pushing too much traffic too quickly in treacherous conditions—could be disastrous.

Enter DLR, which arms utilities with real-time “traffic and road conditions,” and enables them to increase the throughput of energy when line conditions safely allow it.

10. “[Unlocking the Grid with Advanced Transmission Technologies](#),” WATT Coalition (2024)

11. “[Report: Unlocking the Queue](#),” The Brattle Group and WATT Coalition (2021)

12. “[What are Grid-Enhancing Technologies?](#)” WATT Coalition (2025)



Advanced Power Control

The traffic director

Power naturally flows through the grid along the path of least resistance, with generation and demand creating a constant push-and-pull dynamic. Advanced Power Flow Control helps manage this by actively redirecting electricity away from congested lines and toward those with available capacity—much like rerouting traffic to open roads.



Topology Optimization

The navigation app

Like Waze, this GETs solutions uses the mesh of grid networks to find a route that maximizes transfer capacity from the generation sources to the demand centers in cities and industrial areas.

When is DLR the Right Tool?

If two or more of the following indicators apply to your transmission organization, DLR may be the right addition to your GETs toolbox.

- ☐ Your transmission network is already experiencing some congestion, even if it's just a couple of hours per year, and load forecasts show rising demand that will likely outpace the timeline for new infrastructure.
- ☐ Your seasonal line rating assumptions are safely conservative and you suspect—or have evidence—that real-time weather conditions are more favorable when line capacity is needed.
- ☐ Your planned and approved lines for construction are more than one-year from completion and there is an immediate need for the additional line capacity prior to completion.
- ☐ You need a way to alleviate, or better-manage, dispatch limitations or congestion caused by semi-temporary outages, e.g. transmission line construction, repair, or reconductoring.
- ☐ Your periods of peak demand and peak renewable generation are roughly aligned.
- ☐ You are concerned about the sag clearances, safety, and reliability of critical lines during emergencies or peak loads.
You're already exploring or implementing Ambient Adjusted Ratings (AAR).
- ☐ You're testing or using asset health monitoring tools that currently serve single or limited use cases.
- ☐ Your operations are (or aim to be) data-driven, and your leadership embraces an operational philosophy of *network optimization and grid strengthening before grid expansion*.¹³

13. [TransnetBW GmbH](#) (2025)

4

Building a Strategic Case for DLR in the Land of 10,000 Lakes

The key drivers behind America's largest DLR deployment.

If the “Is DLR the Right Tool for You?” assessment had existed in 2023, Great River Energy likely could have checked every box. While the cooperative's ambitions were singular—to increase transmission capacity with its existing infrastructure—a dynamic blend of factors made DLR the right tool for the job.

1

Forecasted load growth put Minnesota's power grid on high alert.

Transmission congestion in Minnesota was already a growing concern, and forecasts pointed to steeper demand ahead. The North American Electric Reliability Corporation (NERC) identified the Midcontinent Independent System Operator (MISO) region—which includes Minnesota—as one of six regions (11 total are assessed) at “elevated” risk of energy shortages during the 2025 summer season.¹⁴

Meanwhile, exponential demand looms: Great River Energy is preparing for 1,000 MW of new load—equal to the current consumption of one million Minnesota households¹⁵—as 10 large-scale data centers evaluate coming online in the state over the next several years. over the next several years.

Why does it matter? Because DLR is empirically proven to increase transmission capacity by 40% on average (more on this industry standard later). And thanks to cellular- and satellite-communications and proprietary drone-installation capabilities that enable wide-scale deployment in days, Heimdall Power's DLR solution helps utilities outpace demand.

2

Minnesota's extreme temperatures underscore the limitations of seasonal line ratings.

Minnesota ranked second on a 2024 list of U.S. states with the most extreme weather, just behind California.¹⁶ One standout factor: Its dramatic temperature swings.

Minnesota's average temperature in May 2025 was 58.9 degrees Fahrenheit. However, single-day temperatures that same month plunged to as low as 41 degrees *and* broke 125-year-old high-temperature records in cities like Grand Forks (99 degrees Fahrenheit), Baudette (97 degrees Fahrenheit), and Fargo (95 degrees Fahrenheit).¹⁷

Why does it matter? Because temperature extremes within a single season force utilities to use more conservative seasonal line ratings to account for worst-case highs or lows. The more conservative your seasonal line ratings, the greater your potential gains from DLR.

3

The state's periods of peak demand and peak renewable generation are aligned.

Electricity demand in Minnesota peaks from May to September.¹⁸ During roughly the same period—April through August—the state also sees its highest wind and solar generation, which respectively account for 25% and 4% of Minnesota's net energy mix.¹⁹

Why does it matter? While renewables represent a significant portion of the total generation mix, they are not part of the base generation that can be dispatched on the day-ahead market. Why? Because wind and solar generation is typically available less than 40% of the time, and no one—including independent system operators (ISOs)—can guarantee they'll be there when transmission operators need them.

So, when renewable generation is available in real-time markets, transmission operators need additional flexible capacity to optimize the dispatch of all generation assets, meet load demand, and reduce locational marginal pricing (LMP) disparities.

14. “2025 Summer Reliability Assessment,” NERC (2025)

15. “Mega data centers are coming to Minnesota. Their power needs are staggering,” *The Minnesota Star Tribune* (2025)

16. *National Centers for Environmental Information* (2025)

17. “Twin Cities breaks 125-year-old temperature record,” *Bring Me The News* (2025)

18. *Minnesota Load Profile*, minnesota.gov (2025)

19. *Choose Energy* (2024)



3

Great River Energy understood the opportunity to leverage AAR requirements as a springboard for greater value.

Great River Energy recognized that while AAR is a good step, DLR goes further in unlocking transmission capacity for key areas that see congestion during peak production and peak demand. While working to meet FERC Order 881 requirements for AAR, Great River Energy used the opportunity to take the next step and identified opportunities where DLR could deliver even greater value using a single tool—the Neuron—to address multiple needs and maximize operational impact.*

Why does it matter? Simply put, AAR is good, but DLR is better. Given the required AAR investments—of costs, time, and change management—some industry experts have recommended moving directly to DLR.²⁰ This approach offers more accurate line ratings and unlocks additional use cases, such as enhanced renewable integration and improved asset health management.

4

Great River Energy’s mission put the ratepayer first.

Great River Energy’s North Star was simple: To safely provide its member-owners with affordable, reliable energy by optimizing the infrastructure it already had.

Why does it matter? Optimizing your existing infrastructure is just good business sense. While many IOUs are effectively incentivized to build instead of optimize, the reality is that demand is growing fast, the public has less appetite for new lines, and supply chains are strained. Barring an external forcing mechanism or incentivization—the proverbial carrot or stick—utilities may need to proactively reassess their own operational principals, especially those that prioritize investor returns over ratepayer accountability.

**At the onset of Great River Energy’s DLR initiative in September 2023, FERC Order 881 was on track for a July 2025 enforcement date. At the time of this publication, MISO was granted a three-year extension by FERC, pushing the enforcement date to December 2028.*

20. [“It’s Time to Use Accurate Line Ratings,”](#) WATT Coalition (2020)

DLR Delivers: Great River Energy's One-Year Results by the Numbers

Not All Capacity is Created Equal

DLR helped Great River Energy unlock 63% more conductor capacity between 4–10 p.m. on hot summer evenings when energy demand peaked. That's gold-standard capacity—and real, actionable headroom—when and where it's needed most.

Average conductor capacity gains: 1-year pilot

Sept. 2023 – Sept. 2024

🕒 24 hours-per-day across the full summer season:

+48.92% w/ DLR

☁️ In the summer between the hours of 4 PM and 10 PM:

+63.15% w/ DLR

The Line Doesn't Lie

The dramatic variance between Great River Energy's AAR and DLR gains in the winter season illustrates the powerful impact of wind on ratings.

AAR only accounts for ambient line temperature. In the winter of 2024, Minnesota's ambient temperatures were generally higher than Great River Energy's seasonal ratings estimated, so AAR called for an 8.8% decrease in conductor capacity.

However, real-time conditions on the line told a different story: Winter winds significantly cooled the lines, and by directly measuring line temperature and the winds' cooling effect across all critical spans and sections, Great River Energy unlocked average conductor capacity gains of +22.5% with DLR.

Average conductor capacity gains: 1-year full deployment

☀️ In the summer:

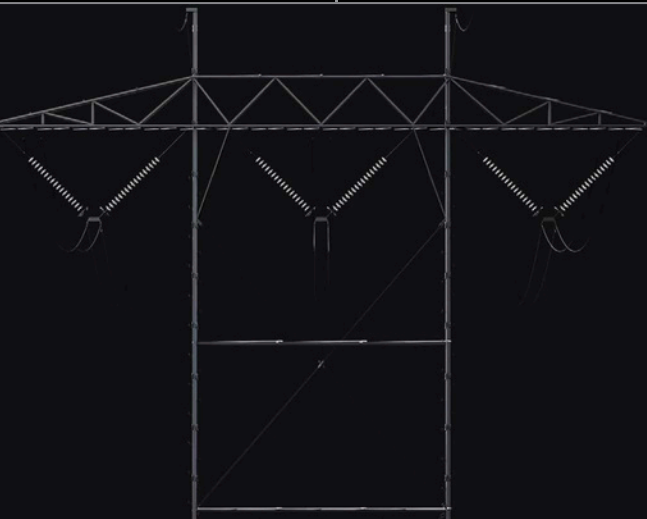
+20.1% w/ AAR

+50.5% w/ DLR

❄️ In the winter:

-8.8% w/ AAR

+22.5% w/ DLR

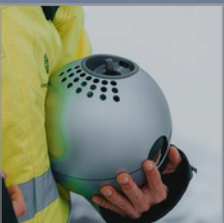


10

Total number of transmission lines monitored

50

Physical Neurons deployed across eight lines



37

Virtual Neurons deployed in adjacent areas on the eight monitored lines and two additional associated lines

175

Approximate miles of transmission line monitored by Heimdall Power technology

115 & 230

Kilovolts (kVs) of monitored transmission lines

80%

Percentage of Neurons installed by drone by Heimdall Power

10

Number of working days required to install and deploy 50 Neurons

0

Outages required for installation

\$30,000

Estimated cost savings from a single, 48-hour congestion event avoided with DLR in July 2024

\$3.175M

Estimated DLR generated cost savings*

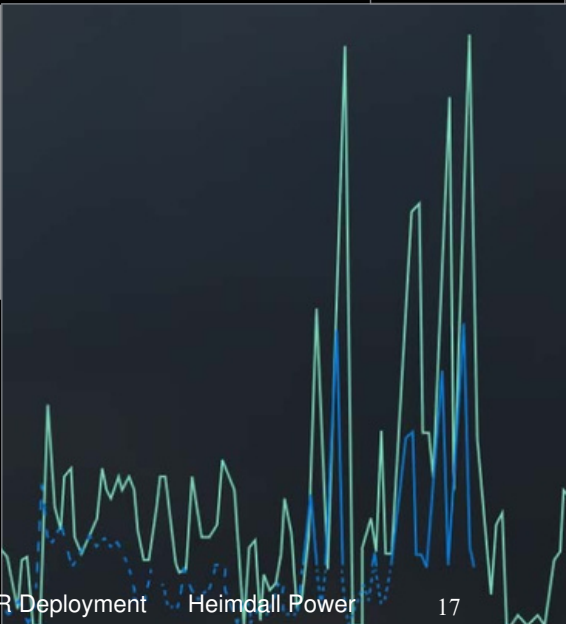
2-3%

Instances when Great River Energy's summer seasonal ratings are higher than DLR (across 12-months)

7

New Neurons slated for deployment on Great River Energy's grid in late summer 2025

**Cost savings directly related to Great River Energy over the life of the project (five-years). Additional direct and indirect savings for other impacted utilities were not included this analysis.*



5

A Deep Dive into Best Practices in DLR Deployment

Five ways to avoid death-by-pilot and to generate real value with DLR.

“It’s no longer enough to simply throw some sensors on a line and hope for the best. The industry has to move from simply “doing pilots” to designing pilots with long-term value and scalability as the core.”

– Drew McGuire, Director, EPRI

Change is difficult in any organization, but large utilities are especially change resistant. In fact, most report that they only innovate when forced to do so.

72% of utility leaders say innovation at their organization is primarily driven by regulation or compliance.²¹

Stakeholder resistance, siloed workflows, low-quality line studies, and misaligned incentives can all prevent utilities from scaling a DLR pilot into a high-value deployment. By assessing the steps Great River Energy took to successfully scale its initial, single-line pilot to nine additional lines and potentially millions in savings, peer utilities can begin to build their own foundation for DLR value.

Just 24% of utility innovation pilots ever make it to full implementation.²²

21, 22. “Utility Innovation Survey,” National Grid Partners (2024)

Essential Considerations for High-Value DLR: A Five-Point Checklist

1 Define your objective(s) or use case(s).

The objective of Great River Energy’s pilot was straightforward: Increase transmission capacity and reduce congestion. In less than six months, the results were clear: DLR delivered measurable capacity improvements on lines historically prone to congestion, especially during the summer, compared to seasonal line ratings.

But validating that hypothesis took more than simply placing a few Neurons on the line.

Great River Energy had to build and deploy robust data governance protocols, then closely monitor and validate early results. The team integrated real-time DLR data into its Energy Management System (EMS) and developed processes to reliably transfer that data to MISO. Transmission operators were trained to interpret and act on the data, and organizational buy-in was fostered by clearly demonstrating the value of a real-time, data-driven approach to line rating.

How did Great River Energy define the right DLR objectives?

(Grid Challenges + Proven Use Cases) + Critical Enablers = High-Impact DLR Objectives

Great River Energy connected its most urgent grid challenges with proven DLR technology use cases. Each opportunity was then evaluated through the lens of four critical enablers for high-impact deployment: Robust benchmarking data, a defined timeline, streamlined deployment, and a clear path to integration at scale.

DLR Cases That Generate Value	What it Takes to Deliver Them
● Increase transmission capacity ● Reduce transmission congestion ● Mitigate the impact of outages ● Avoid or defer construction costs ● Achieve compliance ● Protect assets from future degradation ● Improve situational awareness ● Improve ratepayer and stakeholder sentiment ● Improve integration of renewables and other alternative energy sources ● Facilitate cross-regional interconnection ● Digitize and optimize new transmission infrastructure	1. A proven control set of benchmark data 2. A validation period with defined milestones therein 3. Easy, low-cost, fast, and safe deployment option(s) 4. Scalability

2 Start by targeting known congestion points.

Like most utilities, Great River Energy had a clear understanding of where congestion routinely occurred on its grid: Those “squeaky wheel” lines—10 in total—that consistently demanded heightened operational attention. This understanding was validated with internal and regional studies that helped Great River Energy understand congestion occurring in Minnesota and explore options for mitigation.

From the ten initially identified congestion-prone lines, Great River Energy selected one—the 12-mile, 115 kV JJ-Morris line that runs between the Minnesota cities of Alberta and Johnson—for its

pilot. The chosen line featured relatively flat terrain, a straight-line path with minimal curvature, and no unique environmental variables that wouldn’t also affect other parts of Great River Energy’s grid. This made the line ideal for isolating and evaluating the performance of the DLR technology and the resulting real-time data.

Heimdall Power conducted an in-depth line study on all 10 lines to determine optimal Neuron placement.

Accurate positioning is essential for capturing representative data, as real-time line capacity is influenced by numerous variables—everything from elevation changes and vegetation density to microclimate conditions—all of which can vary significantly along a single span.



A span with numerous orientation changes (left) will require more Neurons than one with fewer (right).



Some structure insulators are not compatible with Neuron installation.

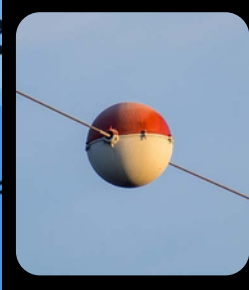
Line topology will affect the number of sensors.

- Changes in orientation of the line (e.g. changes in direction of 10 degrees or more)
- Length of the line
- Structure insulator type



Ground topology will affect the location of each sensor.

- Changes in elevation
- Roadways
- Waterways
- Wind sheltering from trees, mountains, and buildings



Spans that make poor sensor locations:

- Short spans
- Spans under high tension
- Spans with other devices installed on the conductor

Everything from marker balls to line spacers can impact the real-time conditions of a span, and therefore sensor placement.

3 Preemptively identify barriers to change.

Why? Because utilities that do so are more likely to proactively address them in ways that streamline transitions, reduce wasted resources, and improve employee adoption. Common barriers to change include:

- An inability to measure return on investment (ROI) or poorly defined key performance indicators (KPIs).
- Unclear or mis-assigned ownership of the project/technology at the utility.
- A lack of understanding or a misunderstanding of what the technology does, how it works, its expected outcomes, and most critically, how it will impact the day-to-day operations of impacted employees.
- Conflicting priorities.
- Poor visibility into DLR's upstream and/or downstream impacts.

Great River Energy's Story

NERC Critical Infrastructure Protection (CIP) standards for cloud-based tools are still being developed, and for now can pose a significant data integration challenge for utilities. Anticipating this barrier early in its DLR planning, Great River Energy took a proactive approach by performing a security evaluation and developing anticipated security protocols. As a result, these protocols were ready for implementation before Great River Energy began importing Neuron-generated, real-time data into its interface server and EMS.

4 Conduct a stakeholder analysis.

What happens when you don't effectively manage stakeholders in a DLR deployment?

- Hidden resistance from employees, decision-makers, and external influencers may quietly block progress and slow speed-to-value.
- In a communication vacuum, misinformation can run rampant, fueling uncertainty and doubt.
- Technology rollouts don't typically fail because the tech is bad; they fail because the enabling strategies, systems, or ways of working are ignored or outright rejected by end users or tech enablers.

Effective stakeholder management starts with the accurate and comprehensive identification of stakeholders inside and outside of your organization.

Business stakeholders: Identify the potentially impacted functions and domains inside your organization, which could include:

- Procurement
- Information technology (IT) and cybersecurity
- Rates and regulatory affairs
- Compliance, legal regulatory
- Engineering
- Construction
- Operations
- Maintenance, asset management
- Long- and short-term planning
- Finance
- Marketing, communications, and media relations
- Renewables
- Human resources and/or training functions

External stakeholders: Then identify the external entities that could be directly or indirectly impacted, including:

- Residential and commercial customers
- ISOs and regulators
- Investors and shareholders
- Labor unions and other contracted employees
- Suppliers and vendors
- Customer membership organizations and advocacy groups

Next, identify and assign three key roles essential to the success of your DLR implementation:



The internal change manager



The executive sponsor



The external champion

Once stakeholders are identified and leadership roles are assigned, assess each group's potential concerns, needs, shared objectives, and expected contributions. Based on this analysis, categorize stakeholders by their level of impact and influence.

Then, tailor communication and engagement plans for each group, focusing on three key goals:

1. **Involve stakeholders early**
2. **Give them a meaningful voice**
3. **Acknowledge their role in realizing DLR's full value**

Great River Energy's Story

Michael Craig, Great River Energy's internal change manager for the DLR deployment, was fortunate: Using congestion studies and projected benefit outcomes, he successfully secured robust executive sponsorship early into the project. That leadership support—grounded in a deep understanding of transmission congestion and system-wide needs—helped ensure DLR's potential was recognized early and championed throughout the organization.

5 Don't take installation for granted.

One of the most persistent sticking points in a DLR deployment is the sensor installation process. This is where theory meets reality; where cutting-edge technology becomes a utility-owned asset that can actively influence the broader transmission system.

Not all installations are created equal. Utilities must prepare early and often to prevent cumbersome installation processes from derailing their DLR ambitions before sensors even go live.

Great River Energy's Story

Initially, Great River Energy planned to self-install its Neurons using hotstick methods. In September 2023, Heimdall Power's proprietary drone installation technology had not yet been deployed in the U.S., and hotstick installation worked well for Great River Energy's first four pilot Neurons.

Fast forward nine months: After a soggy Minnesota spring, installing by hotstick would have required extra matting, labor, and machine hours just to access the selected spans. Additionally, Great River Energy crews were extremely busy with other planned and unplanned work.

The cooperative had a few options:

- Spend additional time and money to install by hotstick on-schedule, an option that would likely include overtime work,
- Delay deployment until conditions improved,
- Or leverage Heimdall Power's drone installation technology.

By that time, pilot data showed summertime capacity gains averaging over 48%. Given the stakes, choosing drone installation to avoid extra costs and delays was the best decision.

What should utilities consider when evaluating installation options?

1. The ability to install on live lines, ensuring zero downtime
2. Access to spans beyond sightlines or in difficult terrain
3. Total labor and machine hour costs
4. Ease of sensor removal or relocation

Live from Minnesota

Heimdall Power's proprietary drone installation process enables utilities like Great River Energy to operationalize their DLR investment in hours, not months.

Autonomous flight-mode

Autonomous operations massively reduce the risk of power line interference and guarantee the world's fastest, safest, and most reliable sensor installation process.

No outage necessary

Live lines with both current and voltage? No problem, and no outage required.

Plug-and-play

Heimdall Power delivers the drone and the piloting expertise so utilities can focus on what they do best: Powering the future with insights from the line.



[Watch CBS News' coverage](#) of Heimdall Power drones installing Neurons at Great River Energy.

When Real-Time Ratings Don't Equal Realized Capacity Gains

Great River Energy's DLR pilot revealed +50% capacity potential on paper, but limiting elements capped realized gains, and established a powerful case for setting realistic expectations around DLR ROI.

A dynamic line rating—which reflects the real-time current-carrying capacity of a conductor—is ultimately constrained by the lowest-rated element within that transmission facility. While DLR helped Great River Energy identify an average capacity increase of 50.5% on its monitored conductors (compared to summer seasonal ratings), the cooperative can't fully capitalize on that potential. This is a challenge many utilities likely share. Here's why:

Before deploying DLR, Great River Energy managed its transmission operations using fixed winter and summer seasonal line ratings. Each line in Great River Energy's system has its own seasonal rating.

Over the 2024 summer season, DLR helped Great River Energy prove that its pilot line conductor had an additional **+48.92% in capacity potential**.

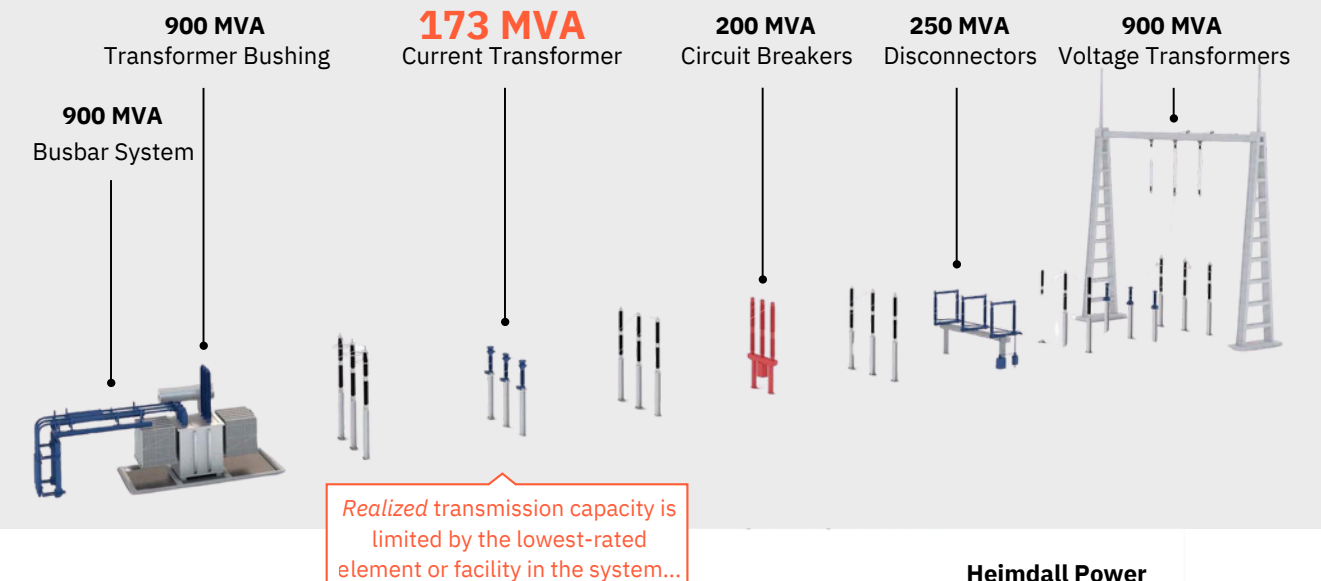
If fully realized, these gains would boost the line's overall transmission capacity to an average of **211 megavolt-ampere (MVA)** over the summer season, adding an additional 69 MVA compared to the 142 MVA seasonal rating.

However, that potential is based on the transmission line/conductor only and does not factor in the next most limiting element in the system.

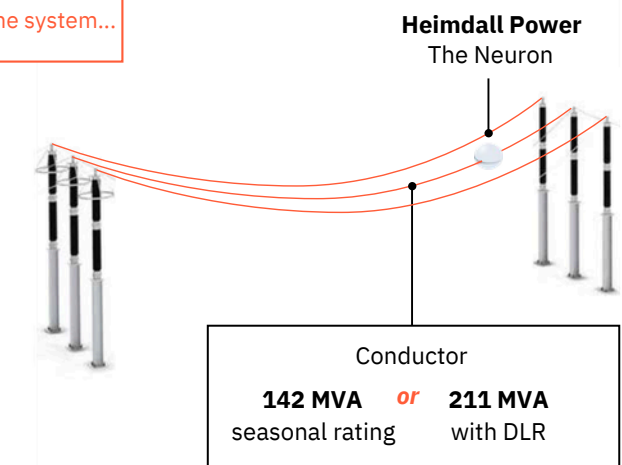
In the case of Great River Energy's pilot line, the next most limiting element—interconnected utility equipment—was rated at 173 MVA. Therefore, the realized gains were capped at 173 MVA, or an increased transmission flow of 31 MVA, across the summer season.

Because Great River Energy's winter seasonal line ratings are typically higher than the most limiting element in its transmission system—again, using the pilot line as an example, 173 MVA—Great River Energy's DLR-powered capacity gains in the winter are significantly lower: **Across 12-months of full DLR deployment, Great River Energy's monitored lines averaged +50.5% capacity gains in the summer, but just +22.5% in the winter.**

*Realized gains on the pilot line were capped at **31 MVA***



...despite DLR-identified potential of +69 MVA on the conductor.



Without context, these outcomes might seem like failures: Afterall, 31 MVA in additional transmission output seems paltry when compared to potential gains of 69 MVA, right?

Not for Great River Energy. Those +31 MVA, when extrapolated across Great River Energy’s 10 monitored lines, are expected to generate savings of **\$3.175 million** in the form of avoided congestion events over five years of DLR deployment.*

Moreover, approximately 2-3% of the time, Great River Energy’s summer seasonal ratings are

must be contextualized before utilities deploy DLR as not only expected, but valuable in terms of gaining visibility and improved controls over your true transmission operations.

Which is why right-sizing expectations—which must shift from “40% average gains” to emphasizing the value of visibility and improved controls over your true transmission operations—is so critical to a successful DLR deployment.

Heimdall Power helps utilities account for the unique parameters in their transmission systems and environments, and includes realistic, contextualized ROI expectations as part of its initial line study process.

**This estimate, which is based on MISO shadow settlements and forecasted congestion events, assumes that all 10 lines monitored by Heimdall Power’s DLR solution would have experienced at least one congestion event each between 7/3/24 and 7/3/29.*

How to Reverse-Engineer Your Congestion Savings

Great River Energy saved an estimated \$30,000 by avoiding a single, 48-hour congestion event in July 2024. Curious how much your system could save? Multiply the shadow price by the rating increase in MVA to generate your estimated ISO savings. From there, look at your individual load and generation in the area to see how much of the congestion savings you’ll directly benefit from.

Rating Comparisons Across One 48-Hour Congestion Event for Great River Energy: July 2024



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Strategic Wrap-Up:

A message from Heimdall Power CEO Jørgen Festervoll



For those who need to know:

If you’re like most utility executives, you’ve been pitched DLR more than once. Maybe the potential sounded good, but the risk felt too high, the path too vague, the returns too theoretical.

Without hard data or practical guidance, it’s been easy to push DLR to the back burner, where it can be overlooked in favor of projects perceived to be lower risk, even if they guaranteed lower returns.

Today, the industry is charging toward a critical inflection point, where guaranteed returns—in transmission capacity, grid visibility, and operational resilience—are more important than ever.

And those returns aren’t just about utility performance: They’re about powering the next chapter of human progress.

After nearly 30 years in the energy industry, I have a deep appreciation for the challenge DLR presents. In boardrooms and transmission fields across the country, where self-verified reliability trumps all, it requires leaders to challenge the status quo.

And yet, human progress depends on it.

If you’re considering DLR, or being nudged toward it through regulation, let Heimdall Power be your shortcut to clarity. With real-time data, you can fix less and power more. You can transform aging energy systems into superhighways. You can weave adherence into data-driven operations that convert compliance from a cost center into a competitive advantage.

In all we say and do, we are committed to arming and protecting the changemakers, the leaders willing to take a calculated risk for the greater good.

Because we know that tomorrow depends on those working to power it today.

**Let’s talk about how you can power the future
with insights from the line.**

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FOR THOSE WHO NEED TO KNOW

About Great River Energy

Great River Energy, Maple Grove, Minnesota, is a not-for-profit wholesale electric power cooperative that provides electricity to member-owner distribution cooperatives, serving more than 1.7 million member-consumers. Great River Energy owns and operates more than 4,800 miles of high-voltage transmission lines. The organization is on track to meet Minnesota's goal to reduce carbon dioxide emissions 80% from 2005 levels more than 25 years before the 2050 target. Learn more at greatriverenergy.com.

About Heimdall Power

Heimdall Power is the world's most-deployed grid intelligence solution, trusted by 50+ utilities in 20 countries to help them manage capacity, mitigate outages, protect their infrastructure, and streamline compliance. Our solution combines a plug-and-play software platform with the Neuron, a "magic ball" featuring bleeding-edge communication and sensor tech, award-winning hardware design, and proprietary installation-by-drone capabilities. From DLR and AAR to asset health, our solution is proven to help utilities optimize the power grid and fuel better lives. Learn more at heimdallpower.com.



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