



INL/EXP-18-51470

Innovation & Entrepreneurship

Innovation Showcase

Weather Based Dynamic Line Rating with Computational Fluid Dynamics using INL's General Line Ampacity State Solver (GLASS) software



Jake P. Gentle, MSMCE

Senior Power Systems Engineer
Critical Infrastructure Security
Idaho National Laboratory

Office: (208) 526-1753

Email: jake.gentle@inl.gov

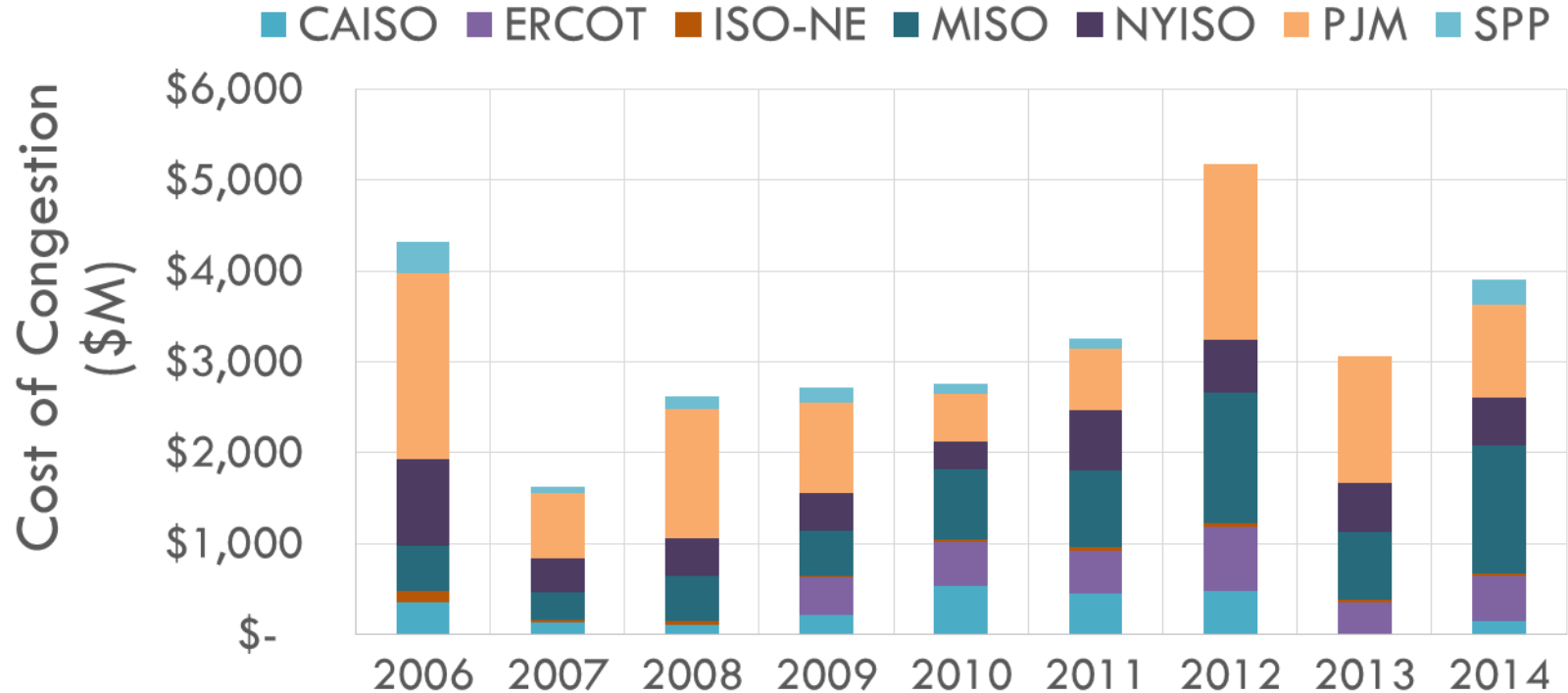
It's always about the MONEY!

\$20,000,000,000

Yes, **BILLION**

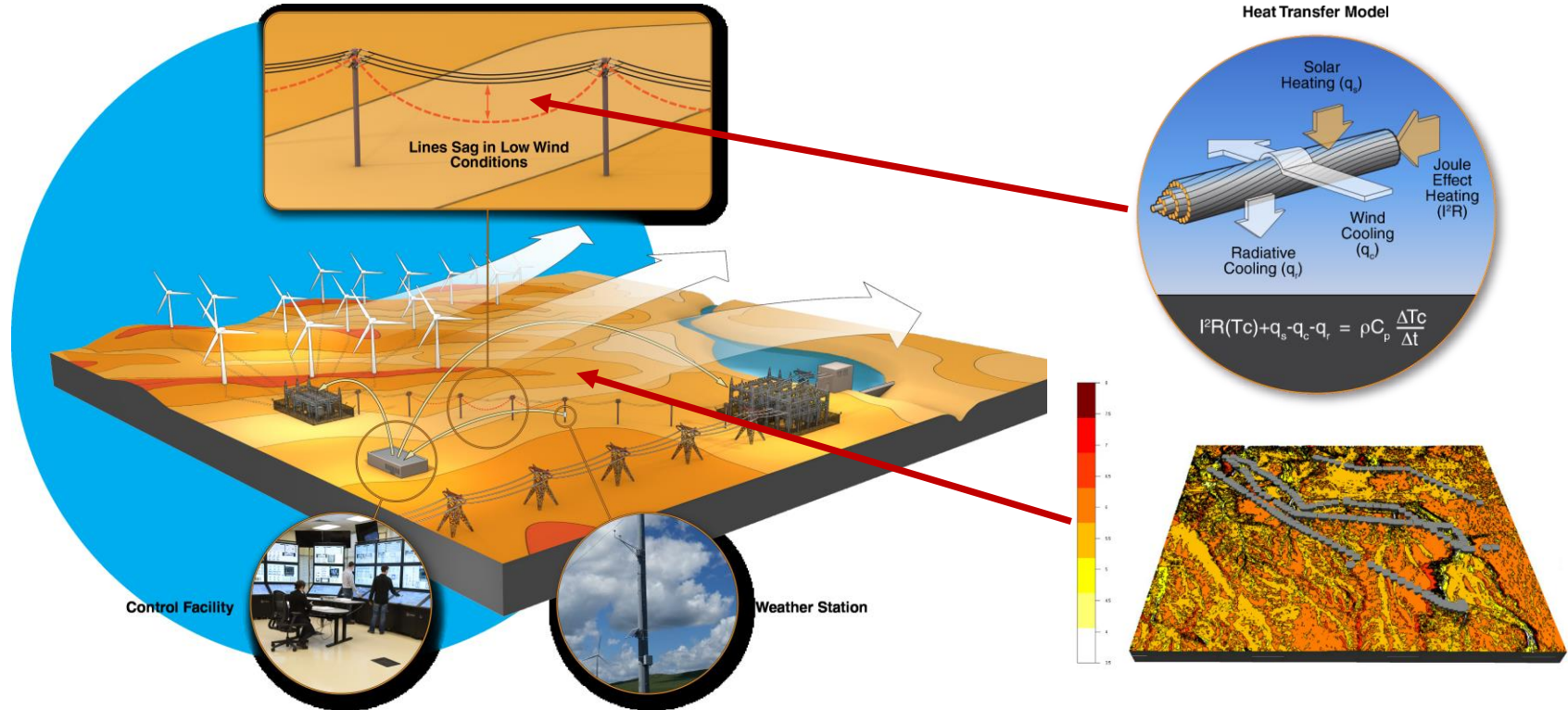
over the next 10 years

DLR Relieves High Congestion Costs

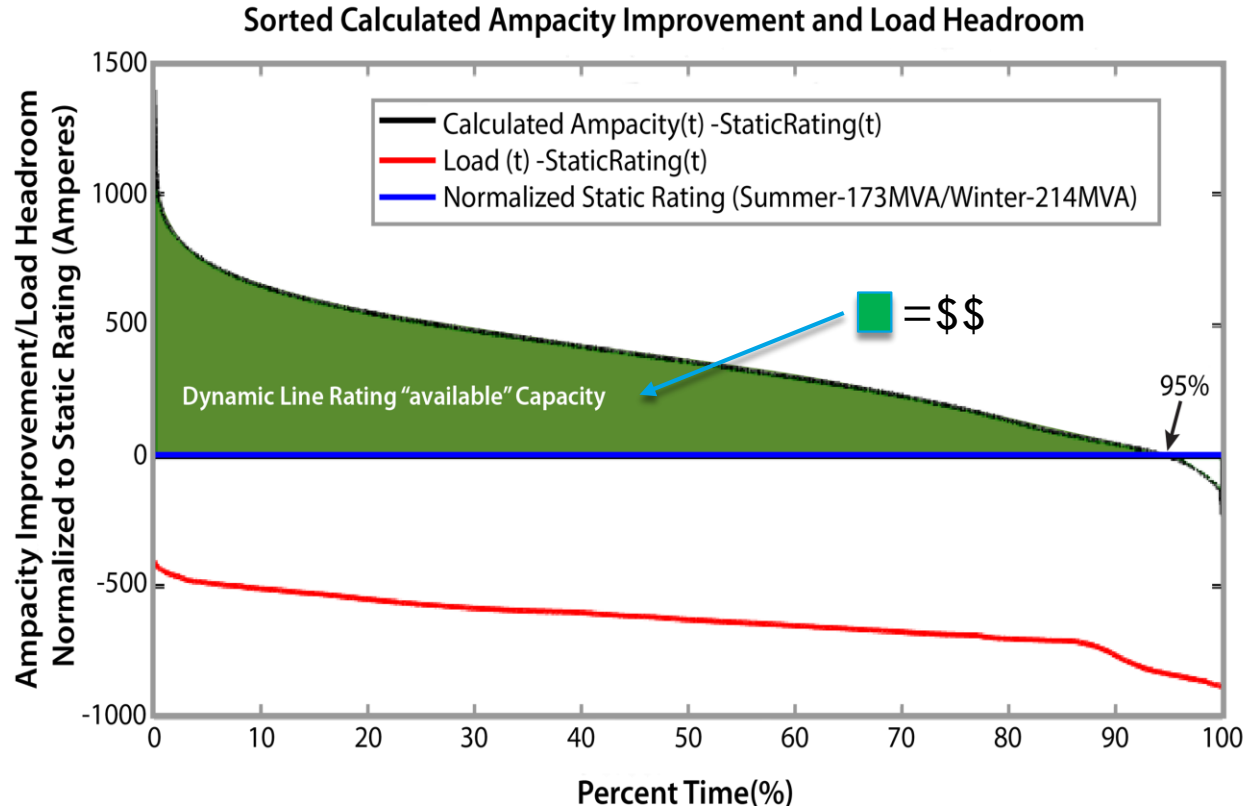


Data Sources: Multiple sources. Go to www.advancedtransmission.org for more information © 2017 WATT Coalition

How Dynamic Line Rating + CFD works



Reliability Enhanced Financial Gain



Utility
Sponsored
Case Study
Results
showing DLR
enhancements
over static
ratings

Competitiveness of DLR based on CFD

INL's solution with Weather, CFD and forecasting has a number of advantages:

The lowest cost of quality

Flexible and portable solution

Smart grid interoperability

Enhancement to existing solutions

Cooperation model with potential partners such as sensor manufacturers, solution providers and system integrators

Monitor	Cost				Accuracy				
	Purchase Cost	Install Cost	Maintain Cost	Line Outage	Measurement Reach	Normal Wind High Load	Normal Wind Low Load	High Load Low Wind	High Load High Wind
Weather	low	low	low	no	variable	good	good	low	good
Weather + CFD	low	low	low	no	wide area	high	good	good	high
Weather + CFD + Forecasting*	medium	low	low	no	wide area	high	high	good	high
Conductor Replica	low	low	low	no	variable	good	good	good	good
Temperature	high	medium	high	no	point	good	low	good	good
Tension	high	high	high	yes	multi span	good	low	high	good
Sag	high	medium	high	no	multi span	good	low	high	good
Combined*	low	medium	medium	yes	multi span	good	good	high	good

Highest Accuracy / Lowest Cost Solution

It's Being Adopted and Integrated

- ISO Support:
 - ▣ ERCOT – Incorporated Dynamic Line Ratings into Security Constrained Economic Dispatch.
 - ▣ PJM – Engaged in DOE-funded pilot project & study
 - ▣ SPP - Held Operational Reliability Working Group session on DLR in May 2017. Actively seeking DLR pilot project.
- Government/Regulator Support:
 - ▣ FERC hosted session on “Forecasting of Dynamic Line Ratings for Market Systems” on June 26, 2017.
 - ▣ DOE report and pilot project funding 2014.
 - ▣ On-going Office of Electricity and Idaho National Laboratory project.
 - ▣ California Energy Commission RD&D.

Current Development

- DOE Technology Commercialization Fund project
 - ▣ (FY18-19), \$300k DOE, \$300k WindSim Americas
- Finalizing R&D industry pilot with utility partner in Idaho
- R&D 100 Finalist (GLASS Software only), 2017
- R&D 100 Finalist (GLASS + CFD + Utility), 2018
 - ▣ Awards announced November 2018
- Peer Reviewed Publications and Awards
 - ▣ IEEE, AWEA, AMS, CIGRE, EWEA, NWA, others
- Idaho National Laboratory and WindSim are in completion of [DOE Energy I-Corps Program Cohort 3 -2016](#) – Technology to Market program.

Commercialized State

- **Fully Integrated Solution** that has minimal impact on utilities existing infrastructure, while enabling new dynamically calculated line rating limits to be used in transmission line operations.
- Modern **EMS/SCADA** systems make this integration possible.
- **Human Factors/Performance** developed control center displays.
- Software as a Service (**SaaS**)-based Solution provides access to the line-based alerting technology using either existing or new weather observations AND weather forecasts.
- **Utility-hosted Solution** with Engineering Consultation and Support

Next Steps

- Needs
 - Capital Investment/Partnership
 - Field validation and Forecast solution demonstration
 - Exposure and Customer Engagement
 - Equipment/Service Supplier Partners
 - Incubation Support

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INL

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WIND INTEGRATION R&D
Concurrent Cooling, Dynamic Line Rating

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