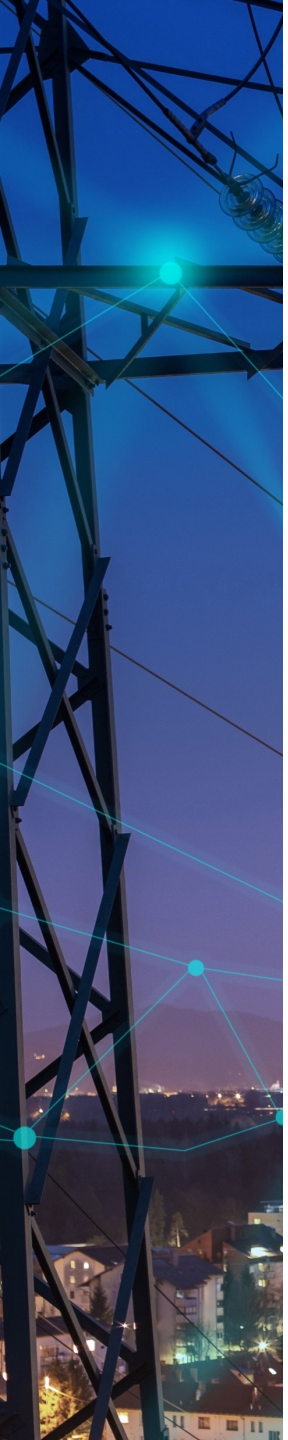
Ampacimon
Unlocking Grid Potential

ESIG GETs – Dynamic Line Rating

How to connect renewables, Quicker & safer

Brian Berry

23 October 2023



Contents

- What is DLR? Why DLR?
- Implementation hurdles
  - Technical
  - Systematic/process
  - Financial
- Case studies

Transmission lines are cooled by local weather conditions

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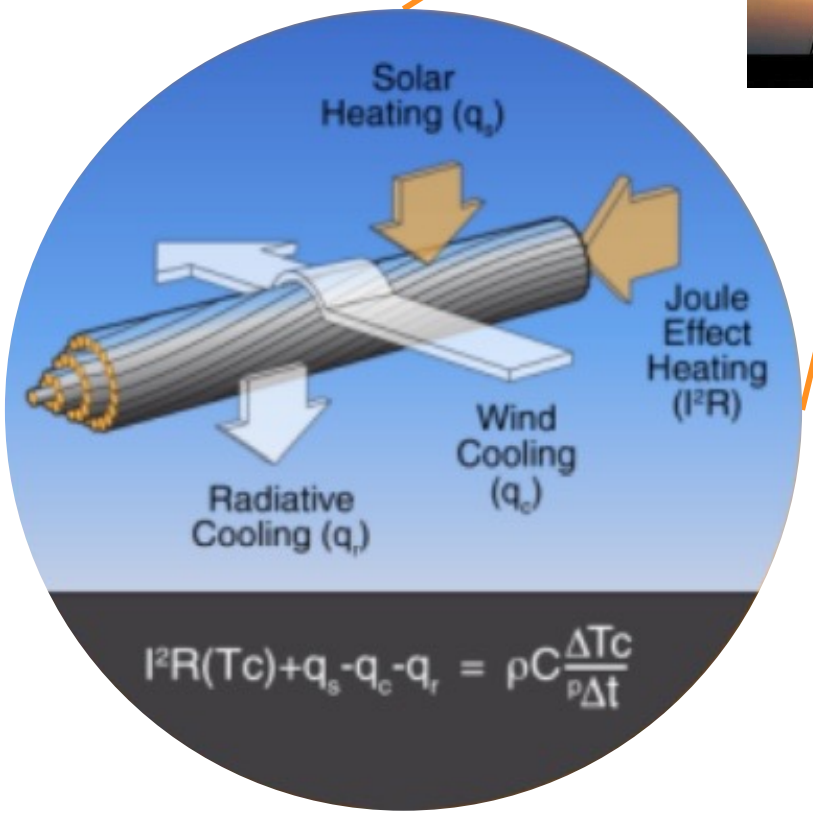
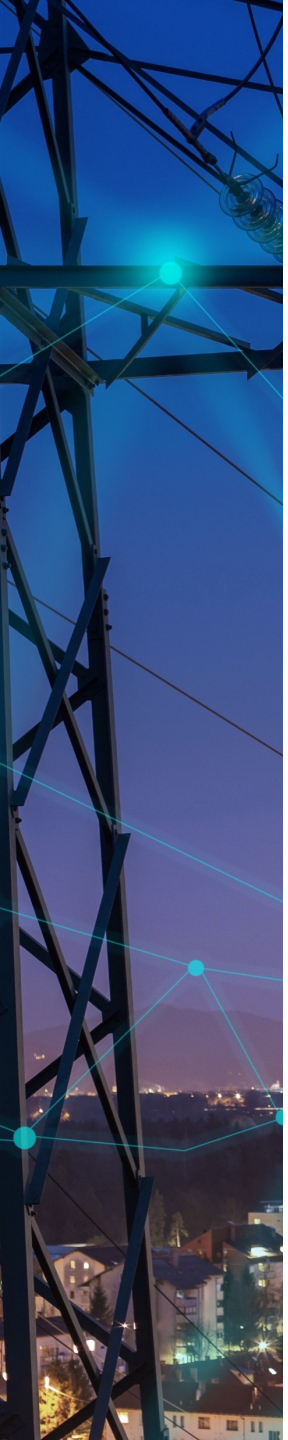


U.S. Department of Energy | April 2014

Operating Conditions	Change in Conditions	Impact on Capacity
Ambient temperature	2 °C decrease	+ 2%
	10 °C decrease	+ 11%
Solar radiation	Cloud shadowing	+/- a few percent
	Total eclipse	+ 18%
Wind	3 ft./s increase, 45° angle	+ 35%
	3 ft./s increase, 90° angle	+ 44%

Source: Navigant Consulting, Inc. (Navigant) analysis; data from (7)

Table 1. Impacts of Changing Operating Conditions on Transmission Line Capacity



Types of line capacity rating

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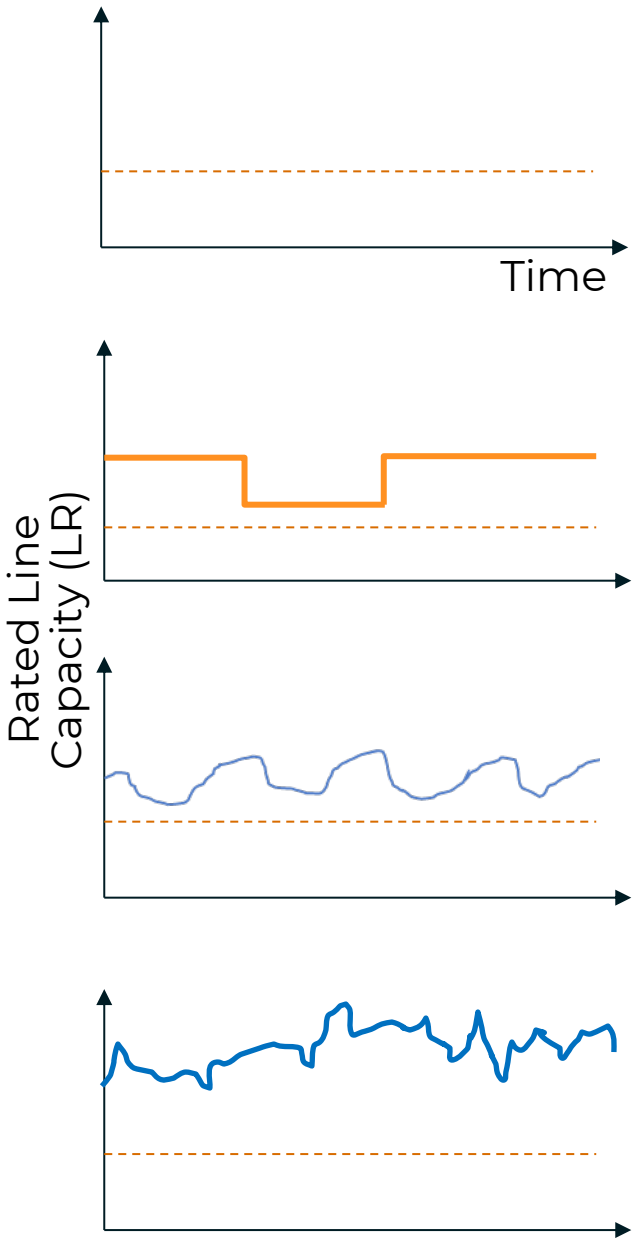
Considers worst case: least cooling

Considers seasonal worst case

Considers air temperature cooling

+ Considers wind cooling



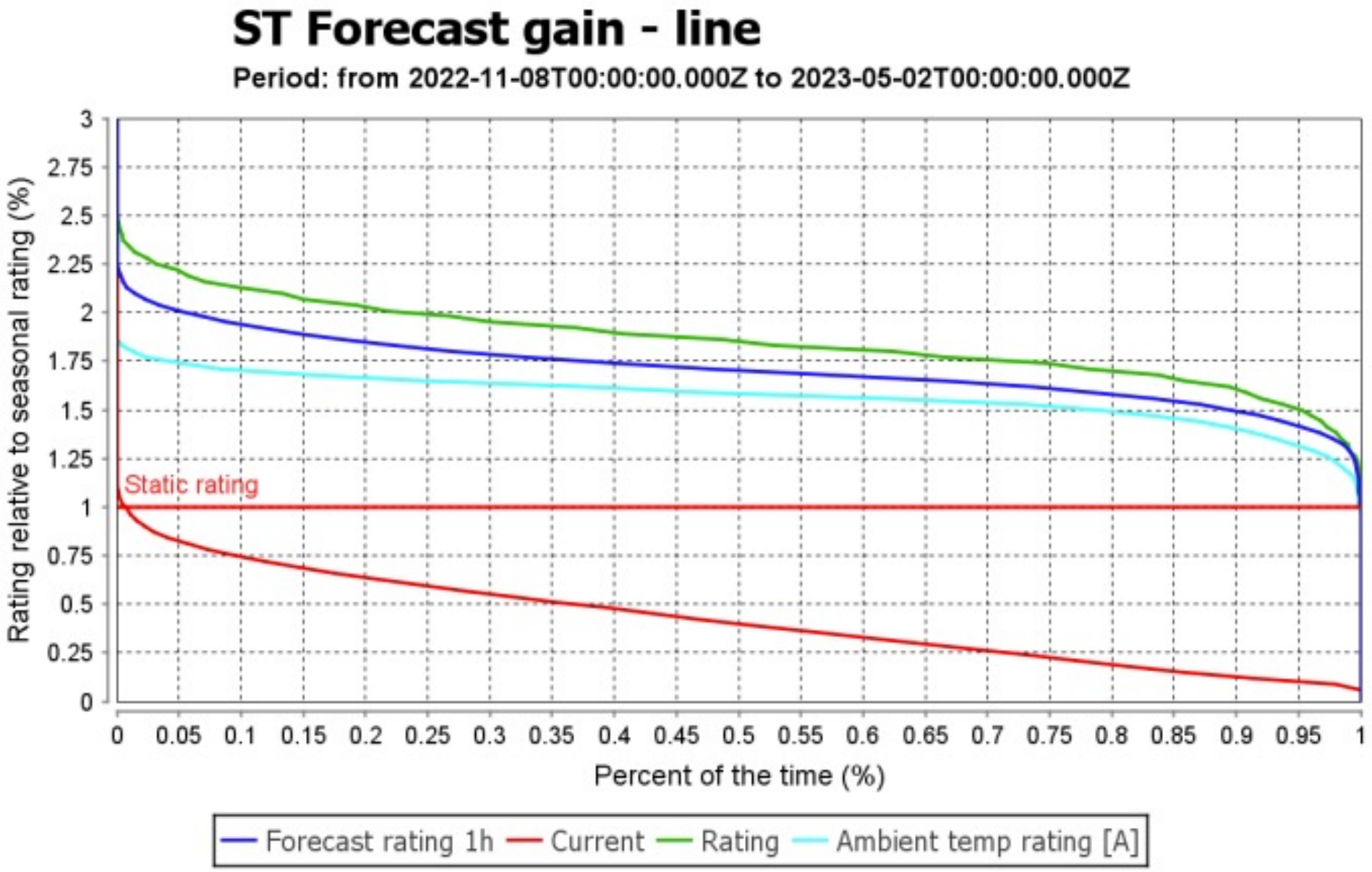
Static Line Rating (SLR)

Seasonally Adjusted Rating (SAR)

Ambient Adjusted Rating (AAR)
5-10% gains

Dynamic Line Rating (DLR)
10-40% gains

Typical Gain Statistics



Implementation Hurdles

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Technical

- ✓ Lab tests
- ✓ Field Tests
- ✓ Technical documentation & peer review
- ✓ Competitive solutions

Systematic/ Process

- ✓ Cybersecurity
- ✓ Data connections
  - ✓ Real time use
  - ✓ Forecast use with market connections
- ✓ Operational systems

Financial

- ✗ Who benefits vs who pays
- ✓ Regulatory incentives/mandates

PPL Electric Utilities - Use Case

First Fully Operational DLR System in North America

BUSINESS CASE

	Reconductor	Rebuild	Dynamic Line Rating
			
Time to Implement	2 – 3 Years	3 – 5 Years	~1 Year
Downtime	Extended Outages	Extended Outages	No Outages
Cost	$0.5 M per mile	$2 - 3 M per mile	< $1 M
Est Capacity Benefit	+ 34%	+ 106%	+ 10 – 30%

PPL Electric Utilities - Use Case

First Fully Operational DLR System in North America

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ppl

EMS INTEGRATION

One line with DLR saved around $23 Million in one year in congestion costs!

Elia - Belgium / Reduce congestion management costs

Challenge / Pain Point

- High North to South flows with outage on backbone 380kV line
- High wind infeed expected
- Overload threatening grid security

Solution

- Dynamic Line Rating on critical 380kV Lines
- +30% extra capacity released

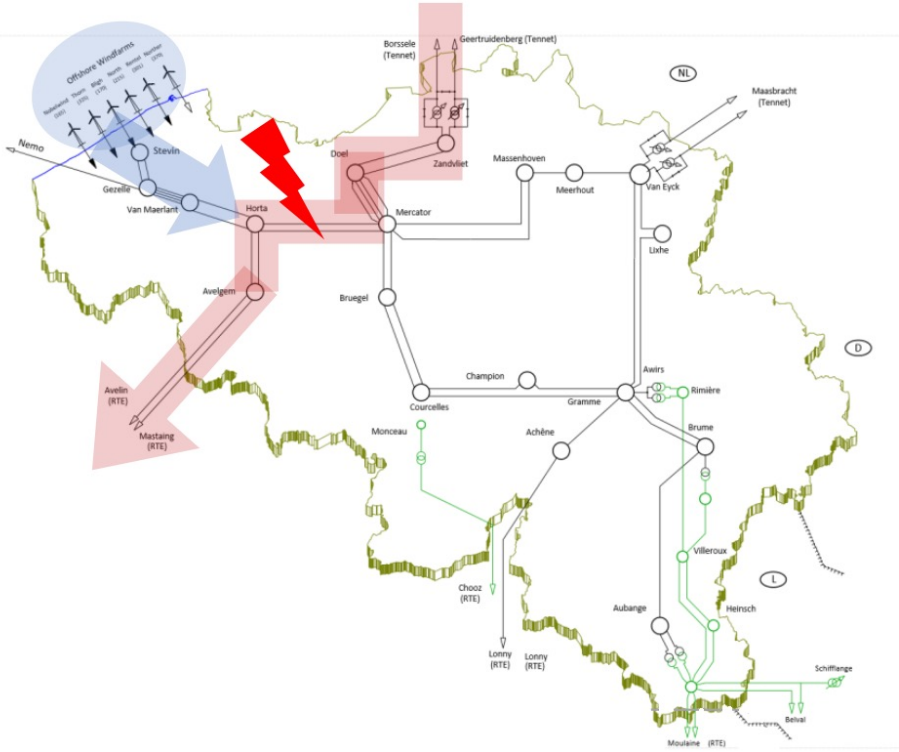
Outcome

- Further PST tapping avoided
- 500 000 EUR of International Redispatch saved in one day

14/09/2017

National Grid Control Center

Belgium



RTE - France / Defer grid investment

Challenge / Pain Point

- French Alps resort with growing ski-season consumption
- Peak only seen in some months of the year
- Mountain area makes upgrade works dangerous and costly

Solution

- Preliminary evaluation : 40% gain in the winter seasons
- DLR System installed Nov 2012 (just before season start): 4xSensors + Real-time Monitoring + Forecast

Outcome

- Smooth operation during winter load peaks
- After 4 years of monitoring, no reinforcement needed
- Avoided new line investment

2012 DLR deployment in French Alps

Elia - Belgium / Maximize acceptable generation infeed – Wind case

Challenge / Pain Point

- High wind generation infeed in Western Europe
- Congestion expected as static rating will be exceeded
- Clearance and conductor temperature beyond safety values

Solution

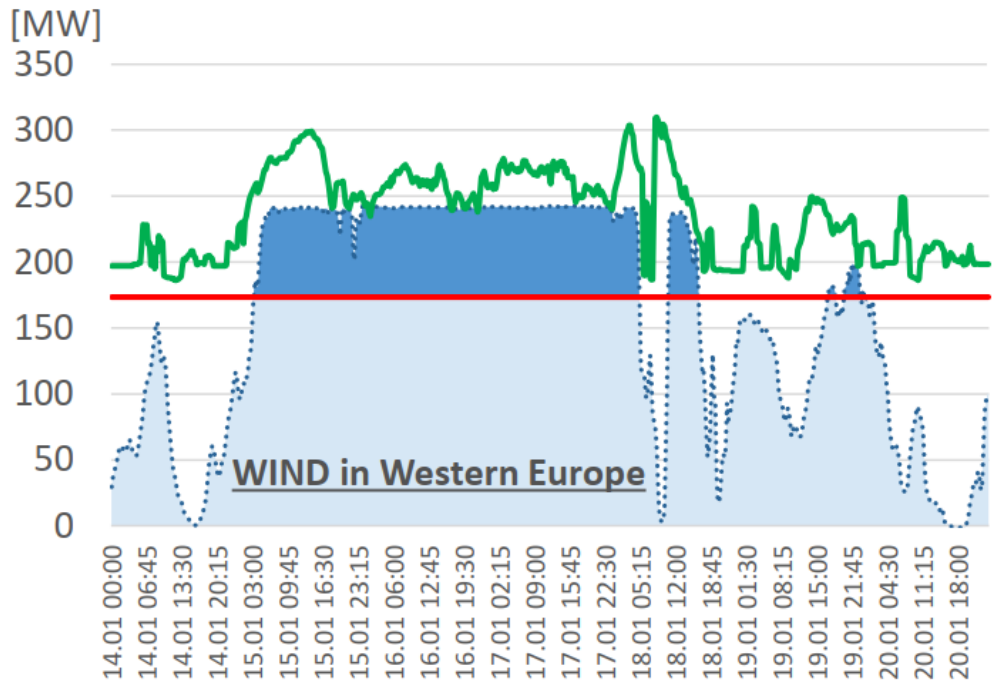
- Dynamic Line Rating to measure real-time line capacity
- Implementation in SCADA to allow capacity beyond static rating

Outcome

- 20% extra capacity 90% of time with low wind speeds (<5m/s)
- Double capacity available under favorable cooling conditions
- Constant monitoring of clearance & conductor temperature

January 2012

Belgium



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Thank You

Disclaimer

Ampacimon – World Leaders in DLR

Ampacimon

Founded in 2010 | 24 different countries globally | over 200 transmission lines | Sensor-based solutions

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Capacity Optimization

GridBoost®

Rating increase with sensor & sensorless based techniques

Asset Health

GridLife®

Assessment of conductor fatigue

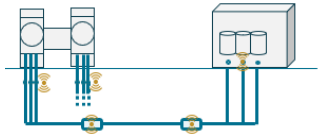
Grid Reliability

GridVisor®

Communicating Fault Circuit Indication (CFCI) with mechanical sensing

Overhead Lines

Underground Cables



CableBoost®

Rating increase with sensor-based techniques

CableLife®

Detection & assessment of insulation failure in cables (Partial discharge)

CableVisor®

Faults detection and localization Operational assessment of cable condition using metrics like temperature, tan-delta or harmonics degradation