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12 Nov | 12:30 - 14:00 CET

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YOLANDA GARCIA MEZQUITA
DG ENER

ANDRZEJ CEGLARZ
RGI

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BRIAN BERRY
AMPACIMON

MARK NORTON
SMART WIRES

Agenda

- **Yolanda Garcia Mezquita, Head of Unit at Energy Platform Task Force,** Discussing the role of the European Commission in the assisting the energy transition in Ukraine
- **Andrzej Ceglarz, Director of Energy Systems at Renewables Grid Initiative,** discussing the role of an optimised system planning in supporting energy security.
- **Layla Sawyer, Secretary General of CurrENT,** discussing the role of innovative grid technologies in increasing energy efficiency and security
- **Susanne Nies, Project Lead, Green Deal Ukraïna, HZB** Moderator / Presenting Six options to boost power transfers from Continental Europe to Ukraine, for the next two winters
- **Alex Houghtaling, Senior Vice President at LineVision,** Presenting use case Dynamic Line Rating
- **Brian Berry, Chief Product Officer at Ampacimon,** Presenting use case Dynamic Line Rating
- **Romain Coullette, Sales & Marketing Director at Epsilon Composite,** Presenting use case Advanced Conductors
- **Mark Norton, Vice President of European Business Development at Smart Wires,** Presenting use case Advanced Power Flow Control
- **Q&A Session with the audience**

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YOLANDA GARCIA MEZQUITA

Head of Unit - Energy Platform Task Force
European Commission

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Yolanda Garcia Mezquita
Head of Unit for Relations with the Member States and the Energy Community
Energy Platform Task Force
Directorate-General for Energy
European Commission

12 November 2024

The role of the EU in the energy transition in Ukraine

- **Grids and interconnections** will remain high on the EU's agenda for the next **Commission**
- The **TEN-E Regulation, EU action on grids, regional cooperation:** backbone of an integrated and interconnected European energy system
- A **stable and predictable legislative framework at EU and at national level** is essential for the functioning of the European grid
- The Energy Community Contracting Parties should accelerate efforts to become a part of the **EU's single energy market**
- Important steps already done by **Ukraine**
- The EU is committed to **Ukraine's energy security and its sustainable reconstruction** on the path of accession to a climate-neutral EU

European Commission

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Director Energy Systems
Renewables Grid Initiative

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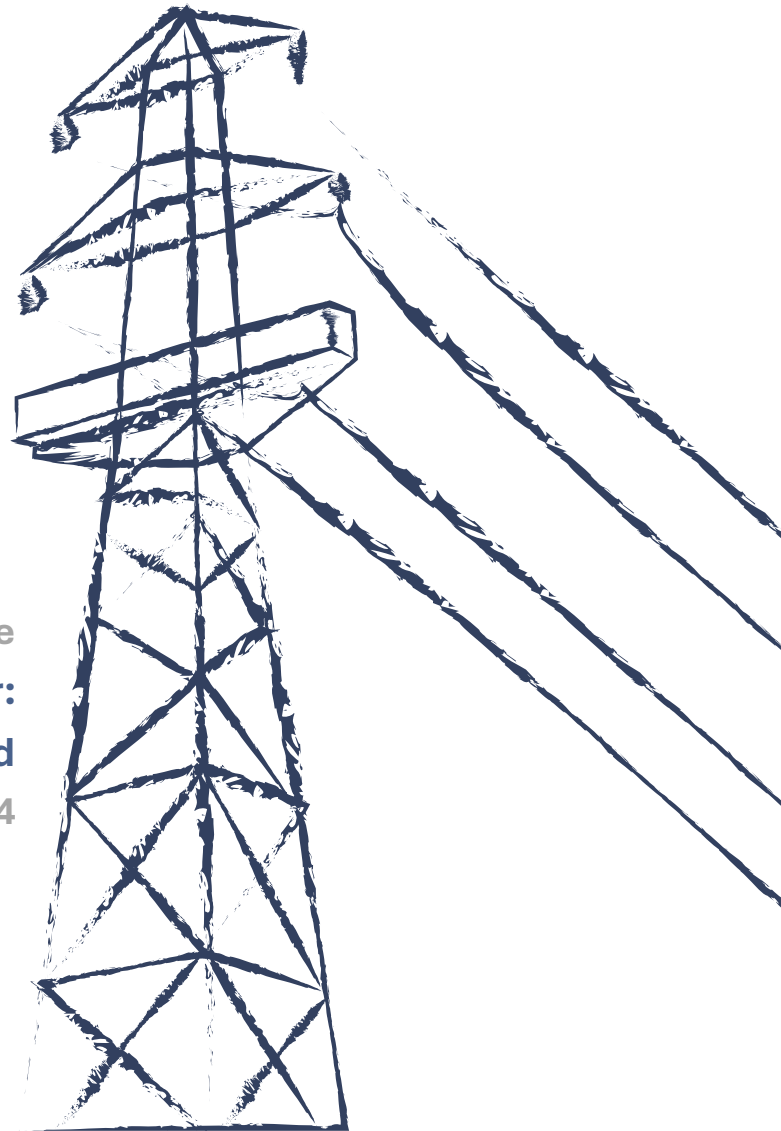
Optimised system planning to support energy security



Andrzej Ceglarz, Renewables Grid Initiative

Webinar:

Innovative Grid Technologies for sustainable energy security in Ukraine and beyond

12 November 2024

Renewables Grid Initiative

About Renewables Grid Initiative

Renewables Grid Initiative

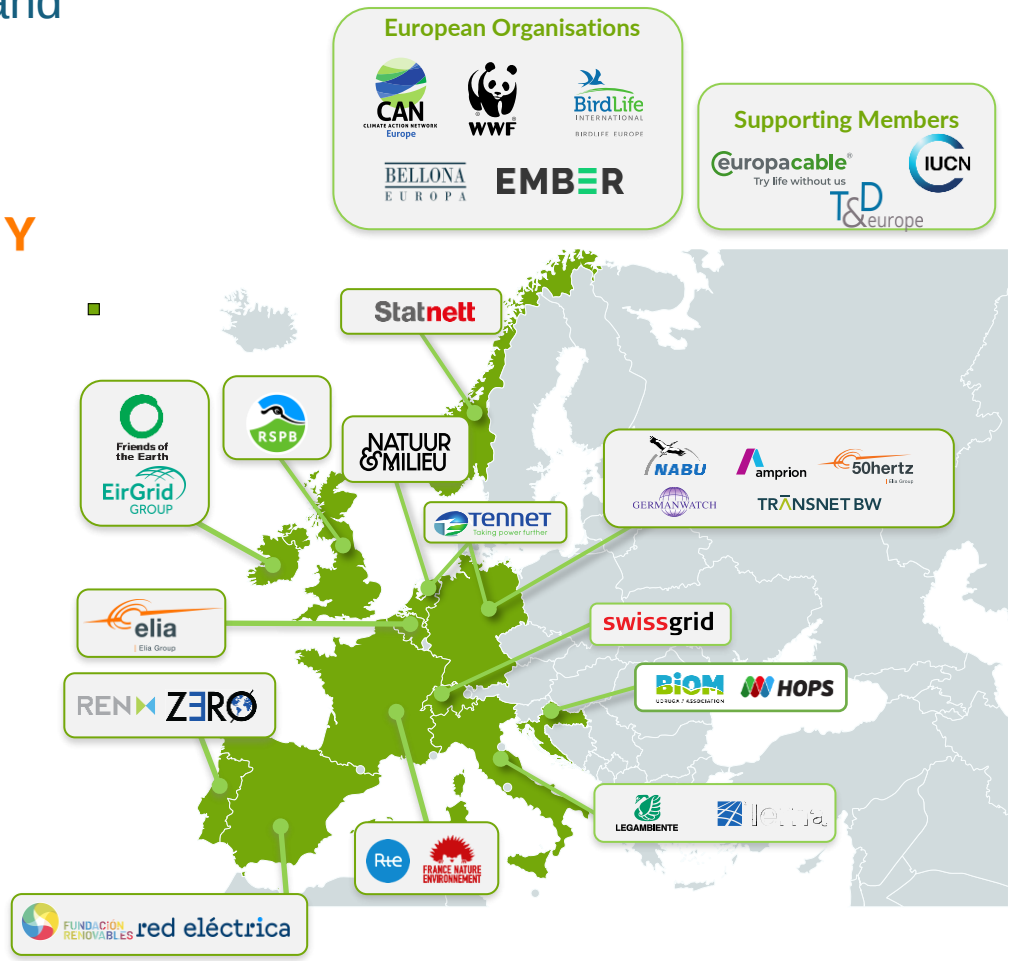
RGI is a unique **collaboration of NGOs and TSOs** from across Europe engaging in an 'energy transition ecosystem-of-actors'. We foster knowledge exchange, discussions on the grid infrastructure needs, and the implementation of best practices within **three dimensions**:

GRIDS & ENERGY SYSTEMS **ENERGY & NATURE** **ENERGY & SOCIETY**

We enable discussions on **how to model, plan and implement** decarbonised and optimised clean energy systems, including different voices in the process.

We ensure energy systems both onshore and offshore are developed in **coherence with nature and biodiversity**, promoting mitigation, enhancement and restoration measures.

We **include and engage citizens, civil society and policy makers** on strategies towards full decarbonisation, improving capacity and knowledge on the role of grids within for the energy transition.



European system planning

Achievement of **net-zero by 2050** while ensuring **energy security**.

Key role of **innovation** to achieve a **sustainable energy future**.

NEWS

Continental Europe successful synchronisation with Ukraine and Moldova power systems

16 March 2022

System planning and security

Reducing dependencies, while enhancing resilience

Leveraging domestic resources and supporting renewables integration

Improving risk management, while enhancing regional cooperation, knowledge sharing, technical support and European funding

Investing in modernizing infrastructure

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LAYLA SAWYER

Secretary General CurrENT

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The role of Innovative Grid Technologies in increasing energy efficiency and security

Layla Sawyer, CurrENT Europe
12 November 2024

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CurrENT Europe is the voice of Europe's innovative grid technology companies

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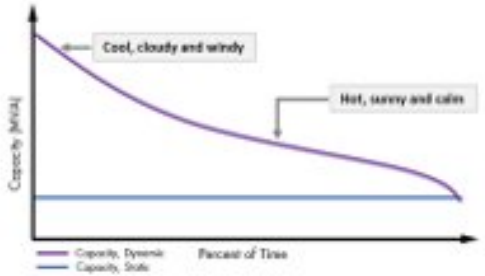
‘Superpowers’ of Innovative Grid Technologies

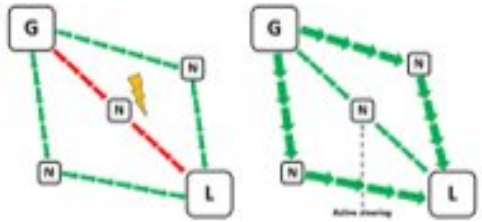
Superpowers:

Capacity increase for a given line

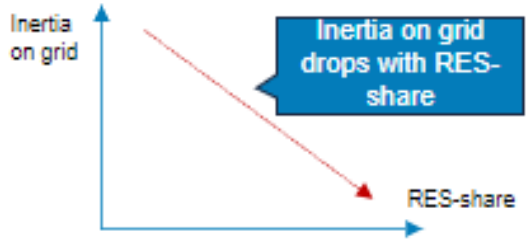
Better understanding of actual line limits



Dynamically controlling power flows on the grid



Better understanding of actual inertia limits/stability limits



Innovative Grid Technologies:

Advanced conductors **High Temperature Superconductor** **Storage as a transmission asset** (SATA)	**Dynamic line rating** (DLR)	**Advanced Power Flow Control** (APFC)	**Grid inertia measurements**

Digital Twin, Flexibility Management Systems

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Projected benefits of Innovative Grid Technologies for increasing efficiency and security

Context of grid expansion needs

20 to 50%
increase in TSO network length required by 2040

20 to 65%
increase in DSO network length required by 2040

3 to 20x
Increase in buildout speed compared to past

IGT Benefit 1:
Reinforcing existing electricity infrastructure

20% to 40%
increase in overall capacity achievable with IGTs based on expert discussions

IGT Benefit 2
Faster deployment of grid capacity at system level

5 to 8 years
Acceleration of TSO grid expansion by 2040

4 to 7 years
acceleration of DSO grid expansion by 2040

IGT Benefit 3
Reduction in required investments

-35%
Reduction in conventional expansion costs by 2040

700 Bn€
gross cost savings of conventional expansion

Compass Lexecon: June 2024

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SUSANNE NIES

Project Lead
Green Deal Ukraïna, HZB

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•SIX SOLUTIONS TO BOOST POWER GRID TRANSFERS TO UKRAINE

1. Capacity Increase on the borders: 1.7 GW to 2.1 GW from 1.12.2024; further increase needed from Winter 2025, to 2.5 GW
2. Use the 220kV Antenna Line Zamosc-Dobrotvir, even if it adds only 100 MW
3. Speed up building transmission projects: Romania, Slovakia
4. Use all available technologies now
5. Use 110kV lines
6. Set up a governance framework for regional electricity integration

CHANGES TO AGREED EXPORTS/IMPORTS BASED ON VARIOUS ENTSO-E ANNOUNCEMENTS, 2022-2024

Date	Export to Ukraine	Import from Ukraine	Comments
16 March 2022	0 MW	0 MW	Emergency Synchronisation Ukraine-ENTSO-E (Continental Europe) decided by the EU Commission and the ENTSO-E. In the first two stages of synchronisation, there were no commercial exchanges.
26 April 2022	0 MW	0 MW	Ukraine becomes an ENTSO-E observer member. The first phase of synchronisation trialling was successfully finished.
30 June 2022	-	100 MW	Start of commercial trading through Moldova-Romania.
16 February 2023	700 MW	400 MW	Massive Russian attacks on energy infrastructure from September 2022 to Spring 2023 ended exports from Ukraine.
27 March 2023	850 MW	400 MW	Emergency assistance was agreed upon between the EU and Ukraine.
15 April 2023	1050 MW	400 MW	Start of commercial power exchanges through the rehabilitated Rzeszów - Khmelnytskyi line.
20 June 2023	1200 MW	400 MW	
1 December 2023	1700 MW/h	400 MW/h	The ENTSO-E announces that as of 1 January 2024, Ukrenergo will become the 40th full member of the ENTSO-E.
27 February 2024	1700 MW/h	550 MW/h	
July 2024	No change	No change	Massive attacks on Ukraine energy system started in 2024 on March 22nd, with a major attack on May 8th. More than 9 GW of thermal capacities lost. Russian energy terrorism continues with now more than 20 attack waves in 2024 alone.
1 December 2024	2100 MW/h	No change	ENTSO-E announces 29 October 2024 increase of exports to 2.1 GW, as well as new methodology for calculations from March 2025, on a monthly basis.

Source: Authors' own compilation, based on information from Ukrenergo and the ENTSO-E.

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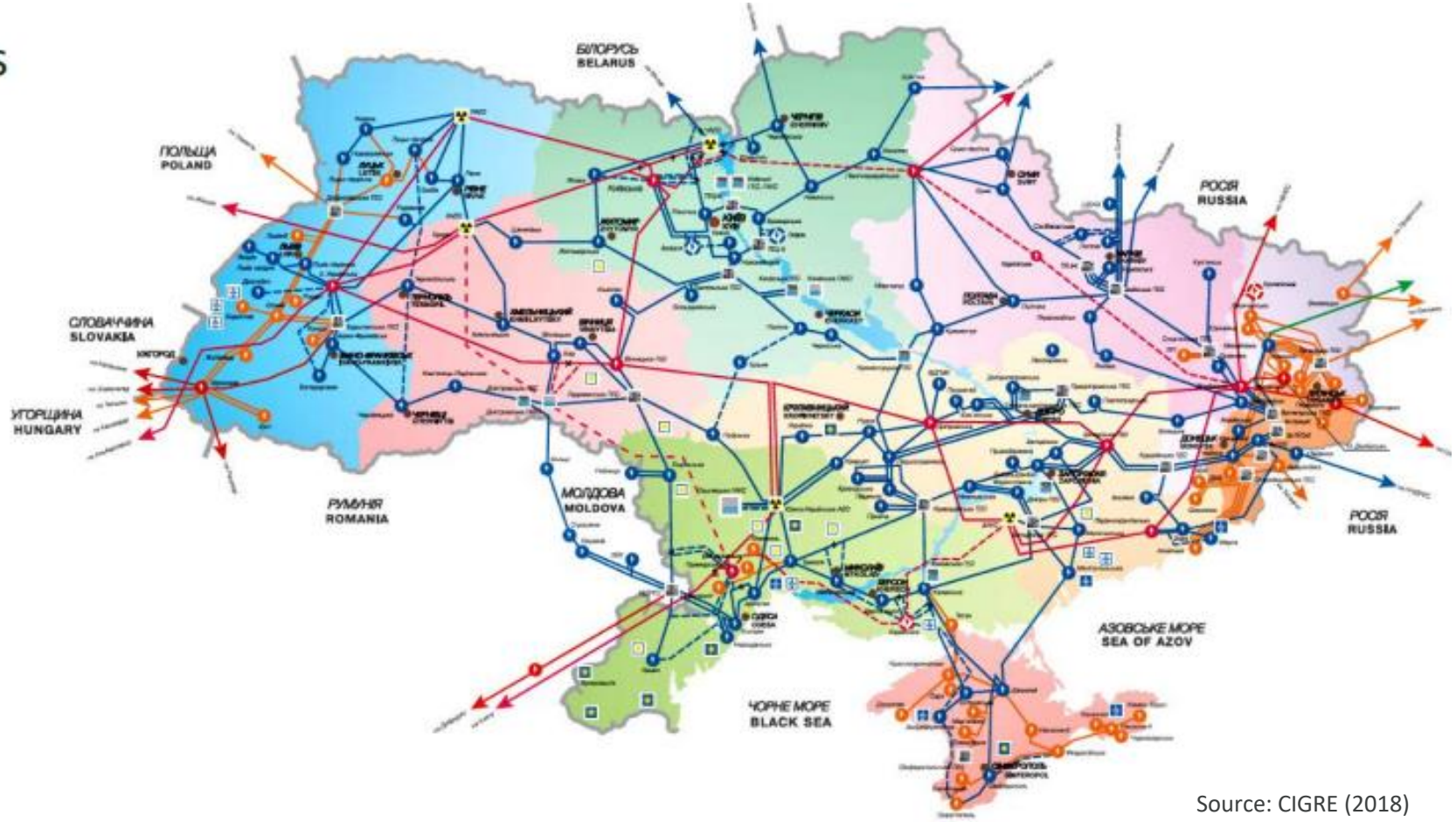
INTERCONNECTORS OF UKRAINE WITH SEVEN NEIGHBORING COUNTRIES

Interconnectors with:

- Russian Federation
- Moldova
- Belarus
- Poland
- Slovakia
- Hungary
- Romania



Source: CIGRE (2018)

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Rzeszów (POL) – Khmelnytskyi (UKR)

- **Purpose**: Rehabilitation of the line and repowering it as a 400 kV line
- **Commissioning:** 2023
- **Capacity (present):** 400 MW: could be 750 MW
- **Challenges:** Impedance
- **Solutions:**
  - Impedance control devices
  - Power electronics, or so-called FACTS
  - Replacing parts of the overhead line with sections of underground cable
  - Buffer batteries

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USE OF ADVANCED TECHNOLOGIES TO OPTIMIZE THE FUNCTIONING OF EXISTING GRIDS

e.g., Dynamic Line Rating (DLR), power electronics

Dynamic Line Rating (DLR)

- Timeframe for the DLR deployment: Less than 6 months
- Planned start of installation: Summer 2025
- Grid transmission capacity increase: 10-30 % (Note: Especially during winter)

Challenges: ENTSO-E permission is needed to ensure additional capacity on interconnectors (Current cap: 1.7 GW)

Solutions: Political pressure to accelerate the deployment

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IMPORT ELECTRICITY OR CONNECT NEW CAPACITIES OUTSIDE UKRAINE VIEW 110 KV LINES

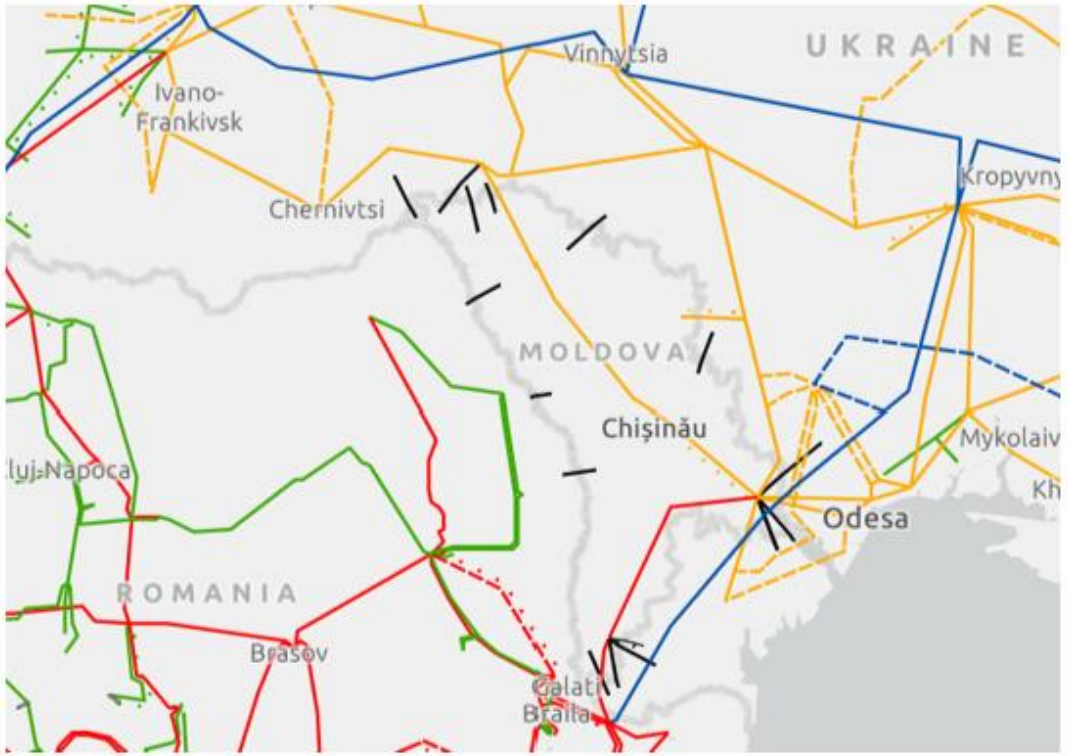
Well-developed network with 11 existing 110 kV lines to Moldova

- Moldova (5 lines), Transnistria (6 lines)
- Slovakia (uprate 35kV line to110kV) formerly was 110kV

- **Challenges:** Intersection of 110 kV and higher voltage grids

- **Solutions**: Special transformers and phase-shifting devices

Moldova Grid Connections. 110 kV lines appear in black



Source: ENTSO-E. (n.d.)

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LAST BUT NOT LEAST… GOVERNANCE IN THE REGION

Boost regional integration through UEMIP: **an Ukraine and Moldova Energy Market Integration Plan,** using the experience from BEMIP (Baltic Energy Market Integration Plan), foster the region, the uptake of low carbon technologies and grids.

Question: is setting up a working group within CESEC a straighforward solution?

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Senior Vice President
LineVision

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What is a line rating?

Given **weather assumptions**,

And given **conductor properties**,

At what ***Loading Current (amps)*** does the conductor reach **Max Operating Temperature?**

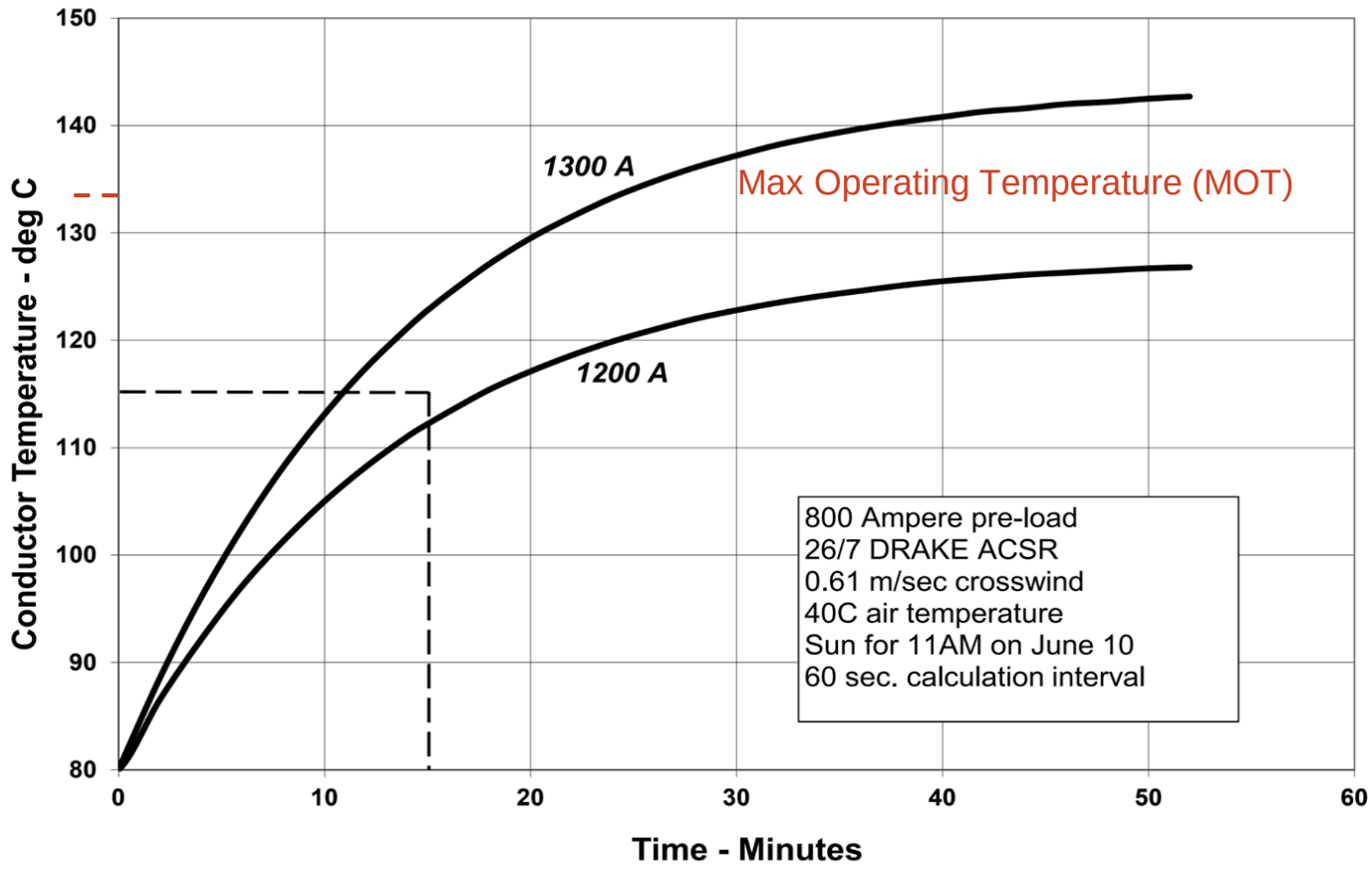
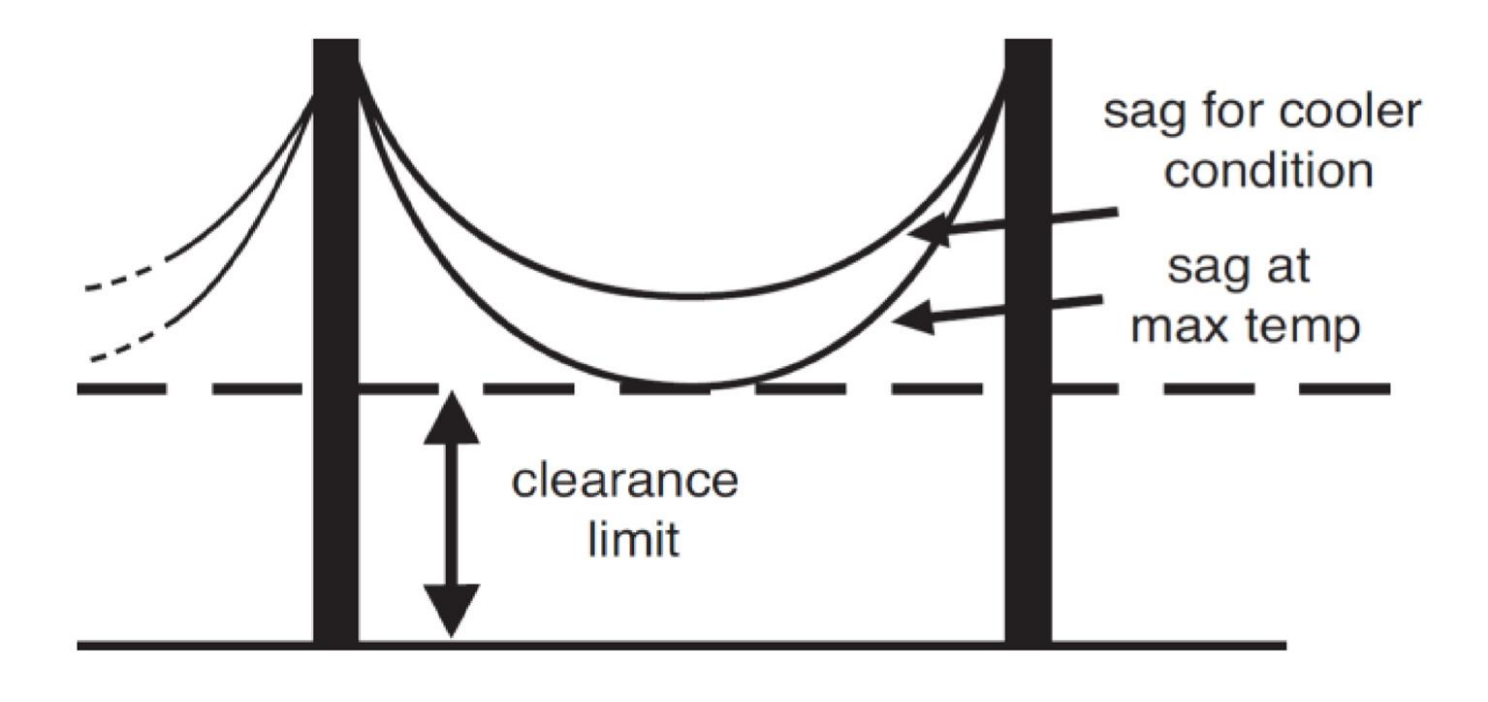


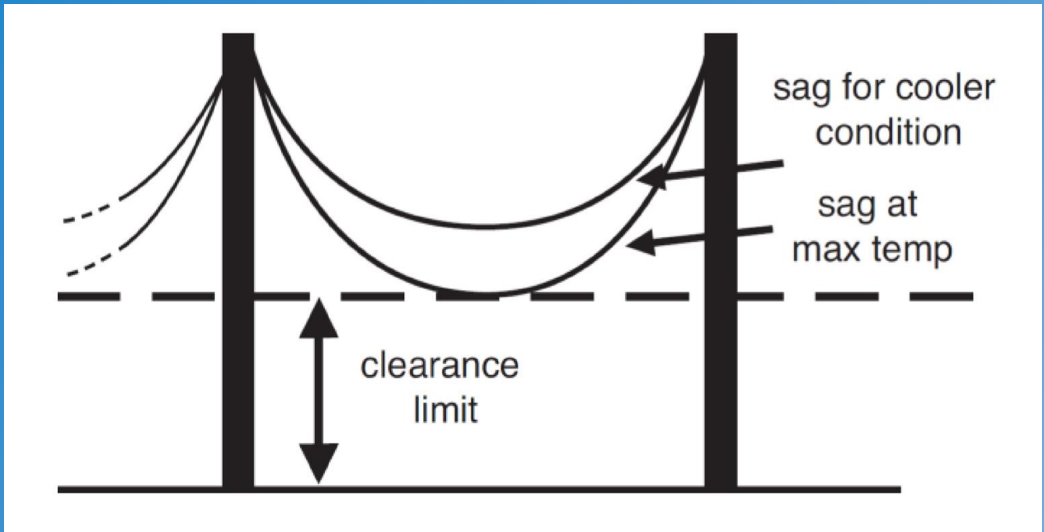
Figure 2—Transient temperature response to a step increase in current

Why do we need line ratings?



- The conductor could **violate the clearance** limit and pose a safety risk beneath the line.
- The aluminum wires in the cable can anneal and **permanently lose tensile strength**.

Assumptions about outside conditions set the Static Rating

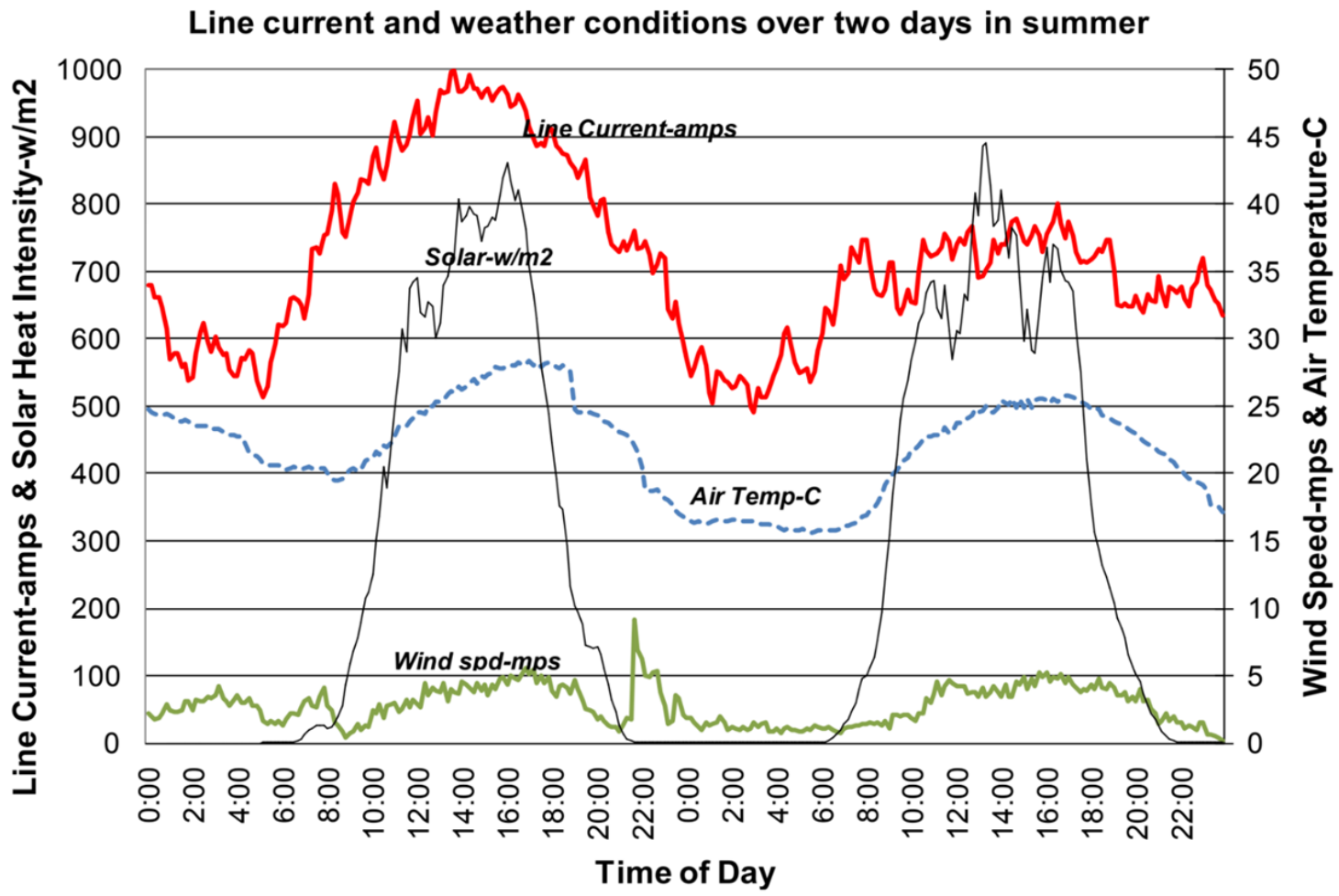


Static line ratings use fixed, conservative assumptions.

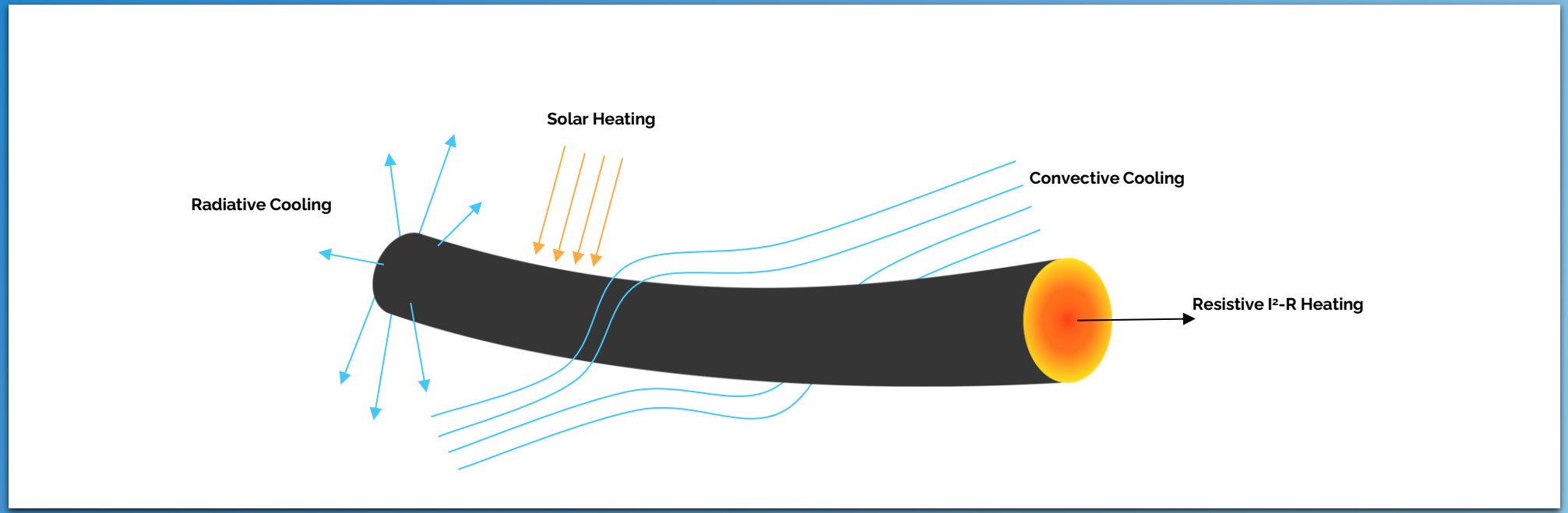
CIGRE TB 299 recommendations:

- Ambient Temperature = max annual value
- Wind speed = 2 feet per second
- Wind direction = perpendicular
- Solar irradiance = 1000 W/m2

…but real conditions are never static; they vary over time



Dynamic Ratings for the maximum, safe capacity



Major Inputs to Ratings Calculation

Wind Speed | Wind Direction | Max Operating Temperature | Air Temperature | Solar Irradiance

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BRIAN BERRY

Chief Product Officer
Ampacimon

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Dynamic Line Rating

The fastest way to unblocking capacity

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Content

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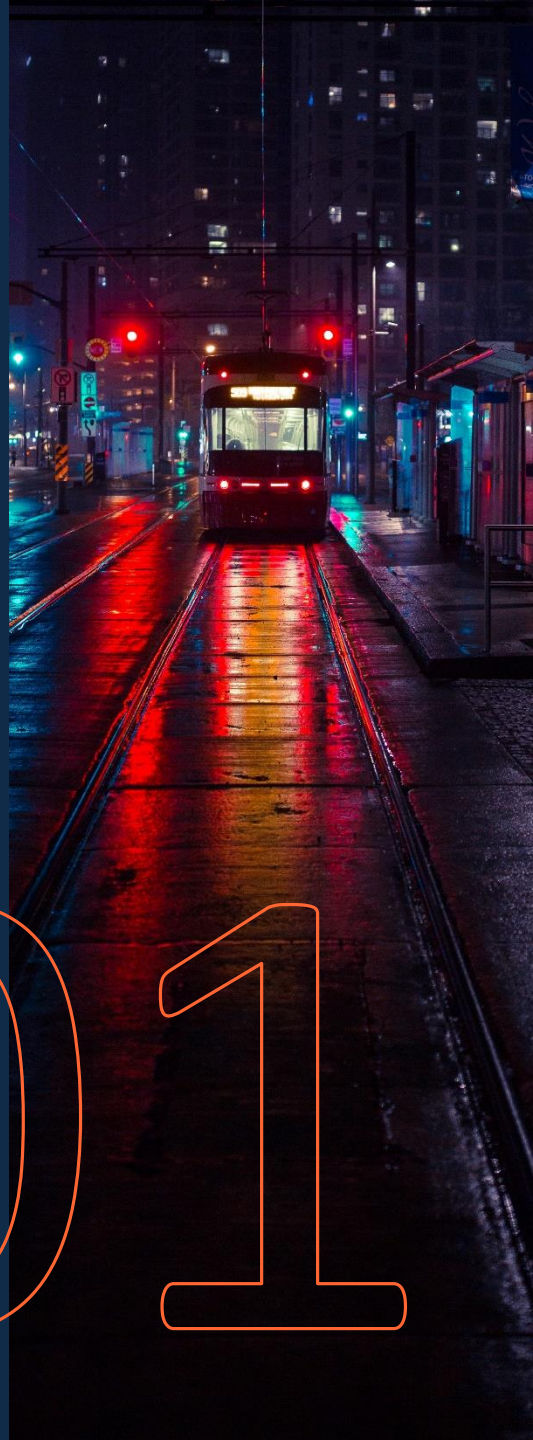

01

Types of DLR

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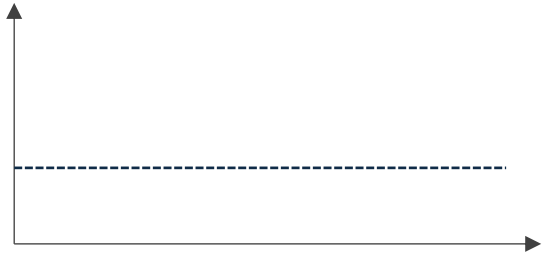
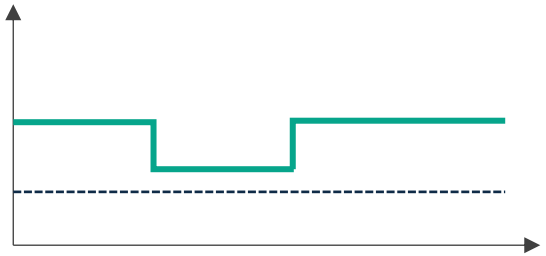
Types of line capacity rating

Considers worst case: least cooling



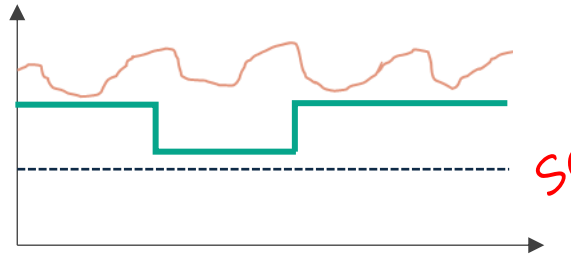
Static Line Rating (SLR)

Considers seasonal worst case



Seasonally Adjusted Rating (SAR)

Considers air temperature cooling

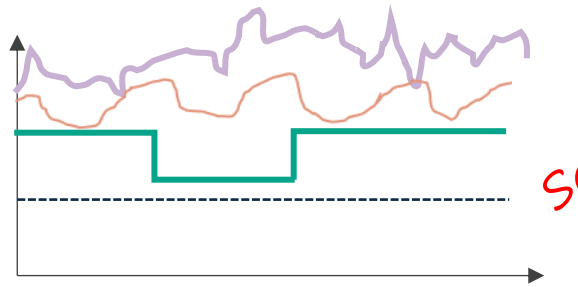


Sensorless

Ambient Adjusted Rating (AAR)

5-10% gains

+ Considers wind cooling



Sensor-based

Dynamic Line Rating (DLR)

10-50% gains

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02

Installing DLR

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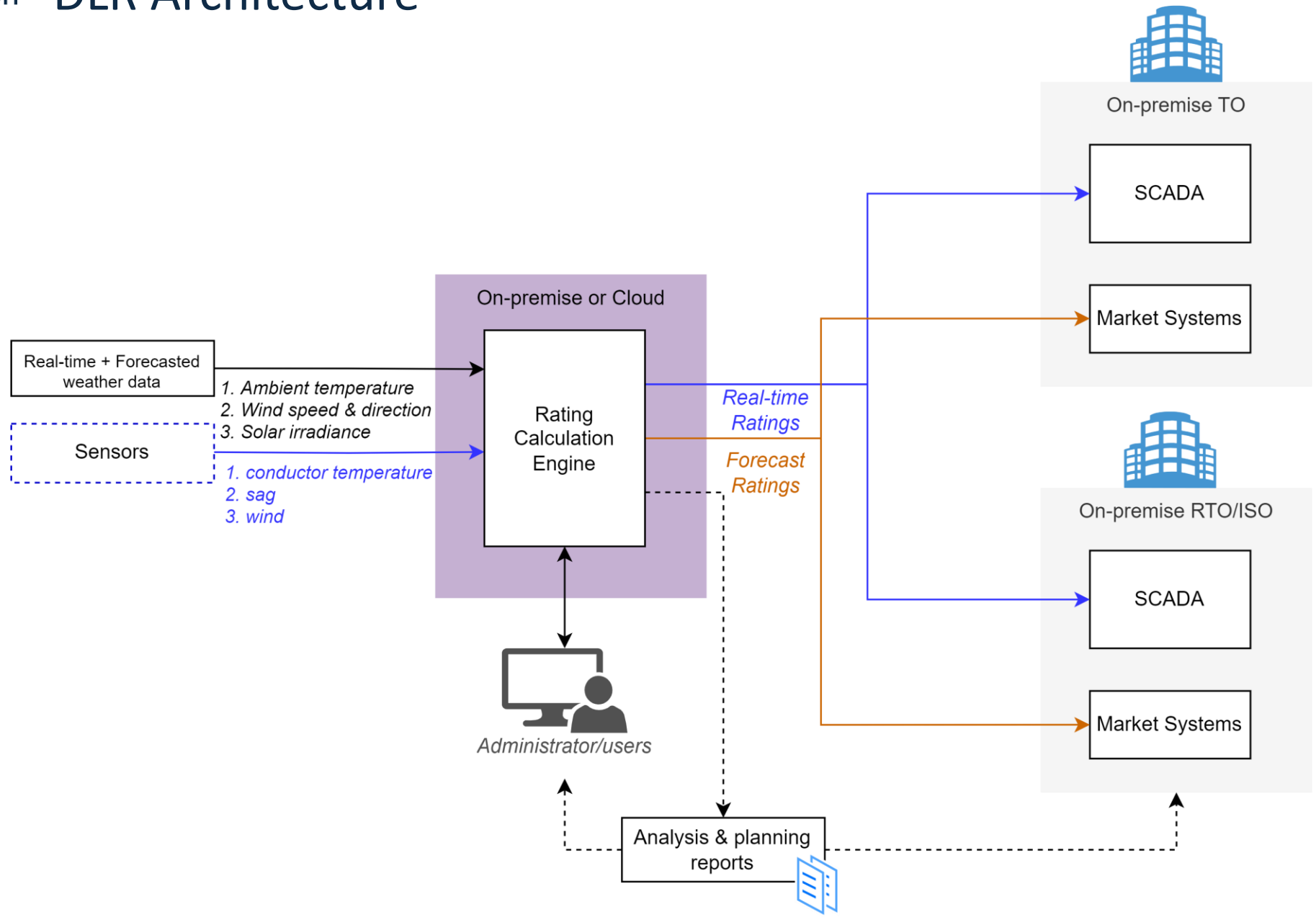
DLR Architecture



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Installation Steps

Days
1. Install Rating Calculation Engine
   - Fastest with Sensorless & Cloud

Months
2. Connect to SCADA/EMS
   - Typically, real-time data
   - APIs, flat files of SCADA protocols

Months
3. Connect to Market & Planning Systems
   - Typically forecast data – 72 hours in advance
   - APIs or flat files

Weeks/ Months
4. Add sensors
   - Increases capacity gain through higher accuracy

Months
5. Improve business processes to use this
   - Training, processes, documentation, tools

Months/ Years
6. Improve reliability & security
   - Redundancy, On-premises installation, etc

Ampacimon

CONCLUSIONS

DLR is Proven & Adds Benefit to Utilities & Society

1. Wind is key to unlocking larger gains and sensor-based wind is the only accurate way available today
2. DLR and AAR is commercially available and proven around the world – it is not an innovation
3. Installation can be quick if well-planned
4. Capacity gains can improve over time with addition of sensors, data connections and improved business processes

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Thank you

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USE OF ADVANCED CONDUCTORS TO QUICKLY BOOST TRANSFERS FROM CONTINENTAL EU TO UKRAINE

November 12th, 2024

WHAT IS AN ADVANCED OVERHEAD LINE CONDUCTORS ?

CARBON FIBERS

No thermal expansion
Very high tensile strength
Stiff
Lightweight
Corrosion free

GLASS FIBERS

Galvanic corrosion protection
High tensile strength
Flexible
Corrosion free

EPOXY MATRIX

High temperature resistance
Lightweight
Corrosion free

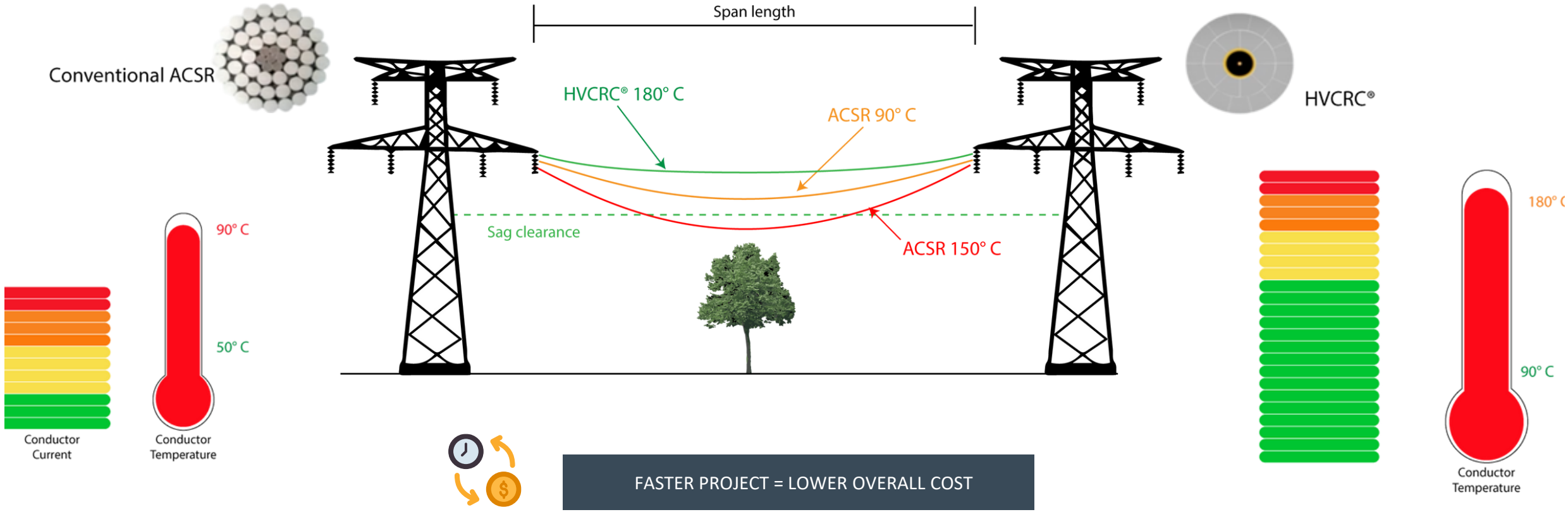
COMPOSITE CORES

Higher ampacity
Low sag
Easy installation
No corrosion

HVCRC®

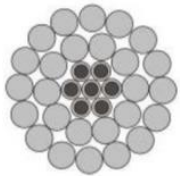
EPSILON CABLE

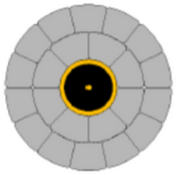
BENEFIT #1 : HIGHER AMPACITY USING EXISTING STRUCTURES

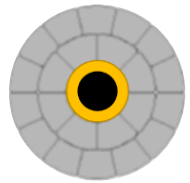


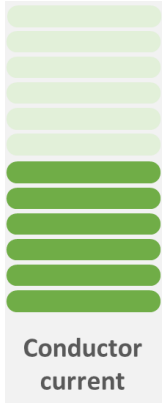
FASTER PROJECT = LOWER OVERALL COST

BENEFIT #2 : REDUCED LOSSES ENABLING FAST ROI



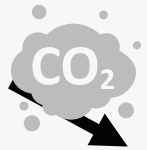






	ACSR 240/40	HVCRC® 320/40	HVCRC® Lite 320/40
Current	50 % load => 350 Amps		
T° @ 350 Amp	49°C	46°C	46°C
AC resistance @ T°	0.1336 Ω/km	0.1012 Ω/km	0.1029 Ω/km
Losses by year	143 366 kWh/km	108 598 kWh/km	110 422 kWh/km
Savings by year		**34 800 kWh/km**	**33 000 kWh/km**

	HVCRC®	HVCRC® Lite
Savings by year (generation cost 0,07 $/kWh	2 430 $/km/year	2 300 $/km/year
Price difference with ACSR	13 500 $/km	6 000 $/km
ROI (Return of Investment)	**6 years**	**2.5 years**

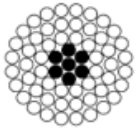
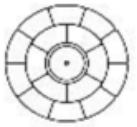


	HVCRC®	HVCRC® Lite
Savings by year (emission 475 gCO2/kWh)	16 500 kgCO2/km/year	15 675 kgCO2/km/year
Savings after 40 years	**660 000 kgCO2/km**	**627 000 kgCO2/km**

EPSILON CABLE

CASE STUDY : SINGLE CIRCUIT 110 KV LINE - ACSR 240/32

Referred Standard
GOST 839-80

			Same weight/Ø		Same alu content	
		ACSR 240/32	HVCRC® LISBON HVCRC® 320-40	Diff (%)	HVCRC® GDANSK HVCRC® 250-28	Diff (%)
Dimensional/mechanical specs	Schematics	 Al: 24/Ø3.60 St: 7/Ø2.40	 Ø7.11 core 6+10 TW		 Ø5.97 core 6+10 TW	
	Ø conductor (mm)	21,6	21,79	1%	19,21	-11%
	Linear mass (kg/km)	921	949,5	3%	735,8	-20%
	Aluminium section (mm²)	244	317	+30%	247,5	1%
	Rated Strength (kN)	75,1	108,0	+44%	74,7	-1%
Electrical specs - capacity	Max Operating Temp (°C)	90	180	+100%	180	+100%
	Comparative Ampacity at 90°C*	619	715	+16%	612	-1%
	Max ampacity at max temp*		1181	+91%	1004	+62%
Electrical specs - losses reduction	DC resistance at 20°C (ohm/km)	0,1182	0,0884	-25%	0,1131	-4%
	AC resistance @ 90°C (ohm/km)	0,1521	0,1143	-25%	0,1459	-4%
	Mean ampacity (*~75% ACSR load)*	453A (hypothesis for calculation)				
	T° conductor @ 453A	69,5	63,9		69,8	
	AC resistance @ T°	0,1424	0,105		0,1366	
	Losses per year (kWh/km)*	464166	342258		445261	
	Yearly savings (kWh/km)	/	121909		18906	
Large CO2 emission reduction	Yearly savings (tonsCO2/km)*	/	61		9	
	10km circuit yearly savings (tonsCO2)	/	1829		284	
	40 years total savings (tonsCO2)	/	70000		10000	
	Co2 offset equivalent: Annual emissions of "X" cars	/	18300		2800	
	Co2 offset equivalent: "X" round-trip tickets NY-London	/	36600		5700	
	Co2 offset equivalent: "X" wind turbines offset (full lifetime)	/	15		2	
Financials - rapid ROI*	Yearly savings (€/km)*	/	12191		1891	
	Price difference gap (€/km)	/	6000		4000	
	ROI (Return of Investment, years)	/	0,5		2,1	

*Calculations based on IEEE Standard 738-2023 with following parameters: 40°C ambient temperature, 0.5 m/sec wind transverse to conductor, Clear atmosphere, 0.5 coefficients of emissivity and absorption, solar radiation 1000W/m2, 50Hz

*calculation based on CIGRE Technical Brochure TB265

*based on emission at 500 gCO2/kWh

*based on generation cost at 0.1€/kWh

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SMART WIRES

REIMAGINE THE GRID

Advanced Power Flow Control - Powering Ukraine

12th of November 2024







What technology do you have? - SmartValve v1.04

A common platform for current and future orders – driving efficiency, quality and scale

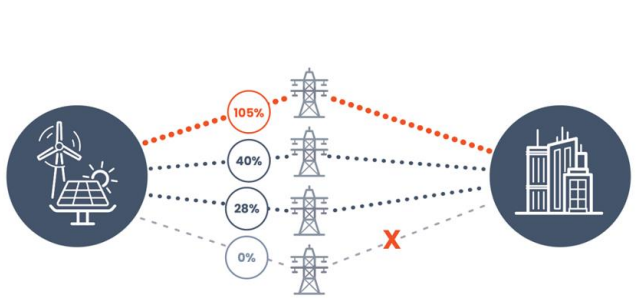
SmartValve 10-1800 v1.04

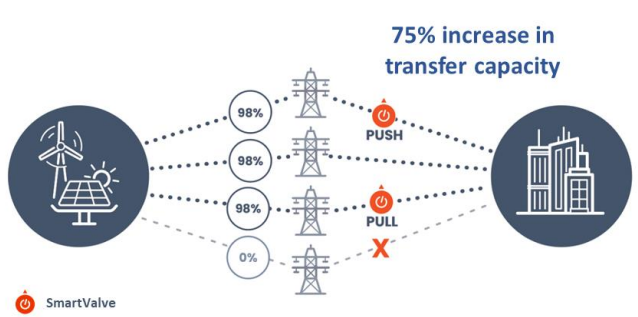
Model details

Model	Start of Manufacturing	Nominal Rating (A RMS)	2hr overload rating (A RMS [% nominal])
10-1800 v1.04	Nov 2022	1800	1260 [120%]
10-3600 v1.04	Jan 2024	3600	4320 [120%]
27-4800 v1.04	TBC	4800	5760 [120%]

Applications

- Increase transmission/interconnection capacity when thermally constrained
- Reduce congestion costs/ integrate renewable energy
- Increase transmission capacity when stability constrained (voltage or transient)
- Damp power oscillations
- Optimize flow through assets that are dynamically rated
- Outage/emergency network management





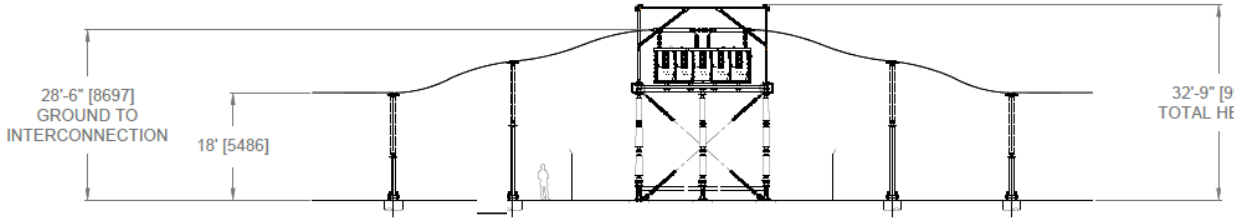
Differentiation

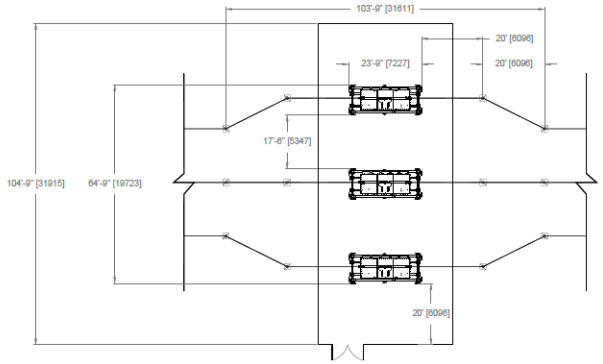
- **Scalable and redeployable** – GWs annually
- **Reduced solution cost and footprint** - no transformer
- **Lower cost** relative to power-electronic non-modular solutions assembled in the field
- **No single point-of-failure** at the solution level
- **Fast deployment:** built for rapid delivery and deployment typically with 12-18mths
- **Phased Development** improving value in Cost Benefit Analysis

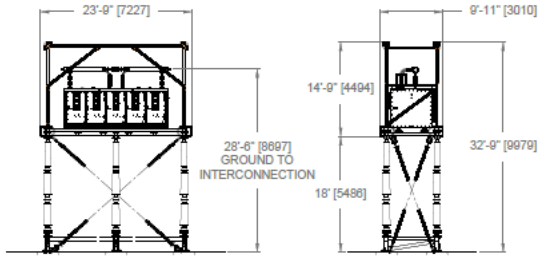
How fast can it be deployed?

Concept → installation → commissioning possible in less than 1 Year

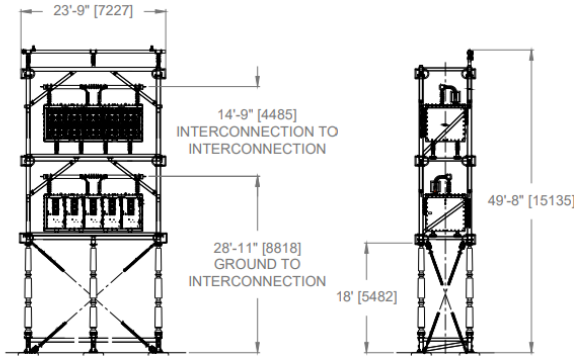
- Modular construction
- Installation requires simple concrete base
- Single/double stack possible for compact installation
- Power harvested from line
- Single fibre optic connection
- Almost completely recoverable for reuse
- Ukraine projects already considered deliverable in a year
- Faster mobile unit option installed in ½ day outage



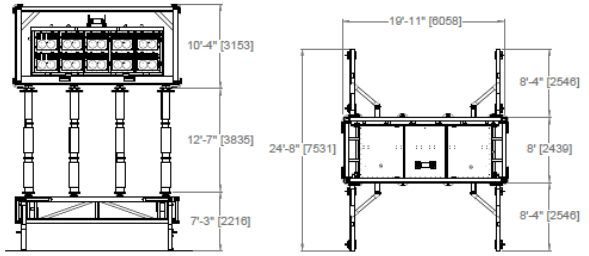




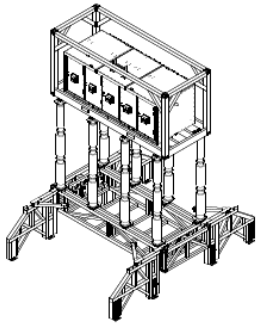
SmartValve 10-1800 v1.04
Single Stacked



SmartValve 10-1800 v1.04
Double Stacked



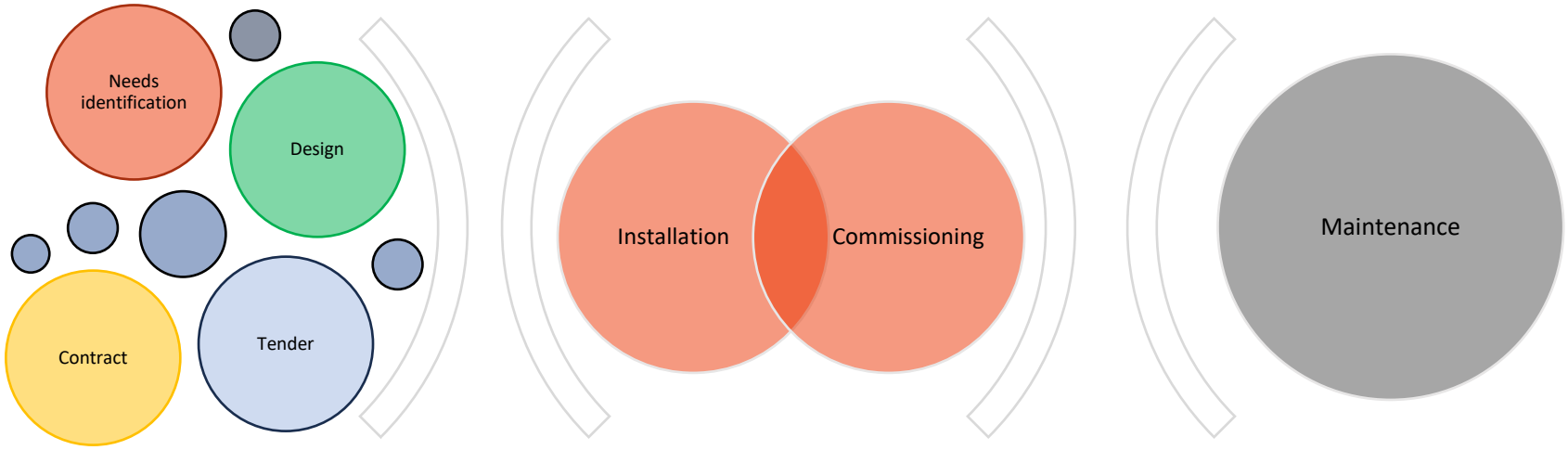
FRONT VIEW TOP VIEW



ISOMETRIC

What do you need to facilitate deployment?

Not Much!



Customer
- Needs identification and tender awareness
- Design resources
- Suitable financial structure
  - Positive cash balance
- Functional specification
- Any Building Permissions

Customer/EPC
- Detailed design resources and Installation partner customer/EPC
  - Know local regulations, standards and equipment
  - Access to right equipment and materials to install
  - Existing capabilities for legal and banking

Customer/EPC
- Maintenance partner customer/EPC

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Thank you for your attention

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