

FORM: A Novel Principle for DLR

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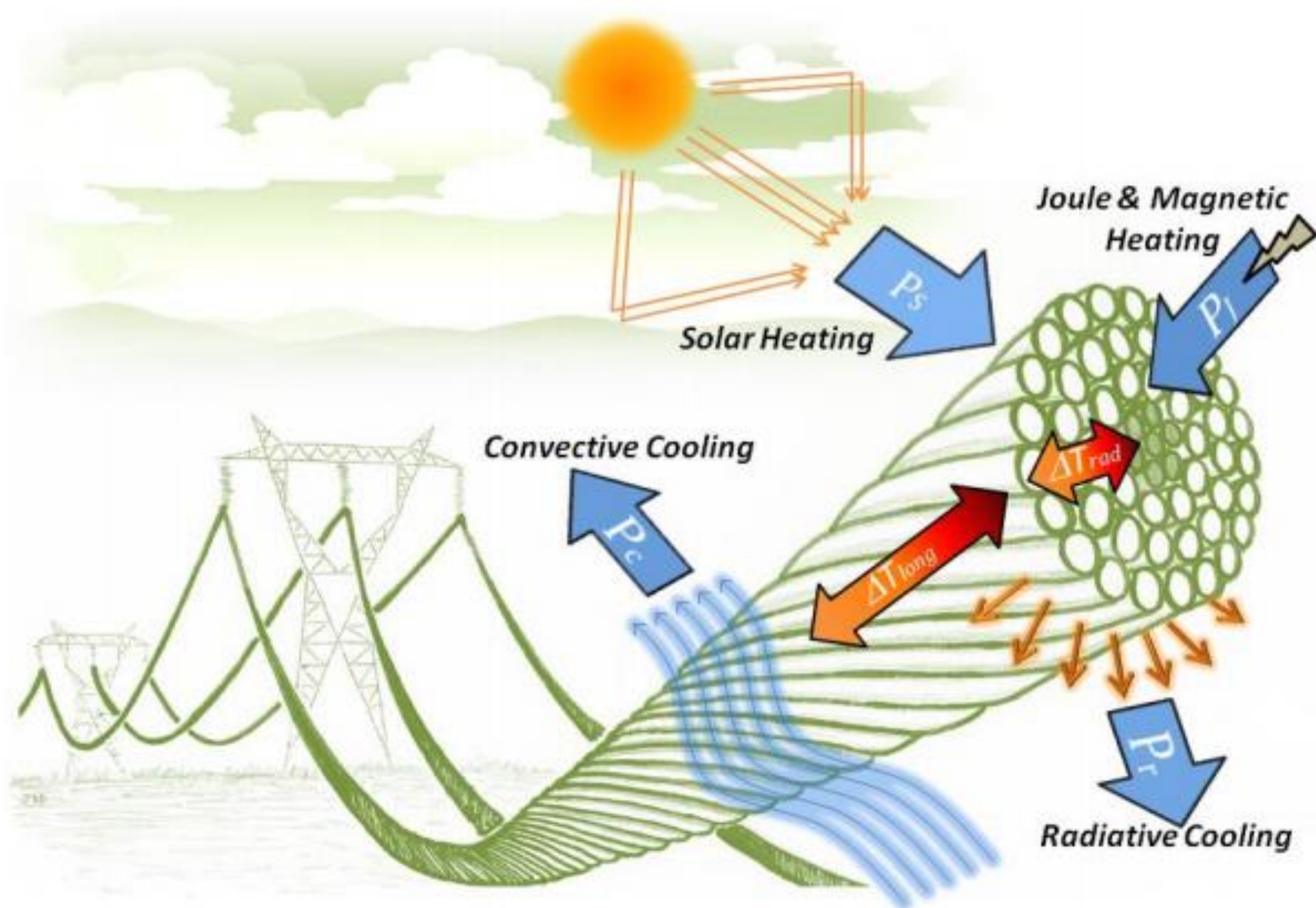
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Introduction

Dynamic Line Rating (DLR): continuously adjusts maximum transmission capacity based on weather



$$m \cdot c(T) \frac{dT}{dt} = i(t)^2 R(T) + P_s(t) - P_c(t, T) - P_r(t, T)$$

Motivation

Temporary solutions are needed to increase transmission capacity before new lines can be built.

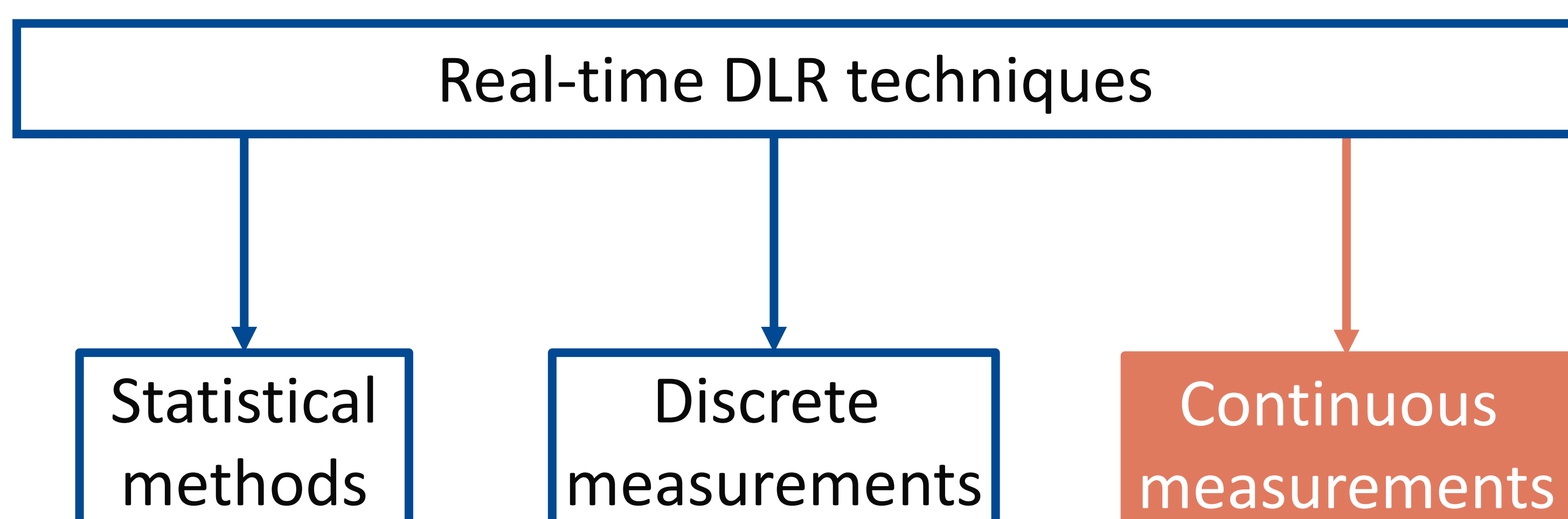
UTILITY DIVE
US grid congestion costs soared to \$13.3B in 2021, will likely grow until transmission capacity is built: report
Published April 14, 2023

ENR
Engineering News-Record
New DOE Study Calls for Tripling US Transmission Capacity
By Debra K. Rubin

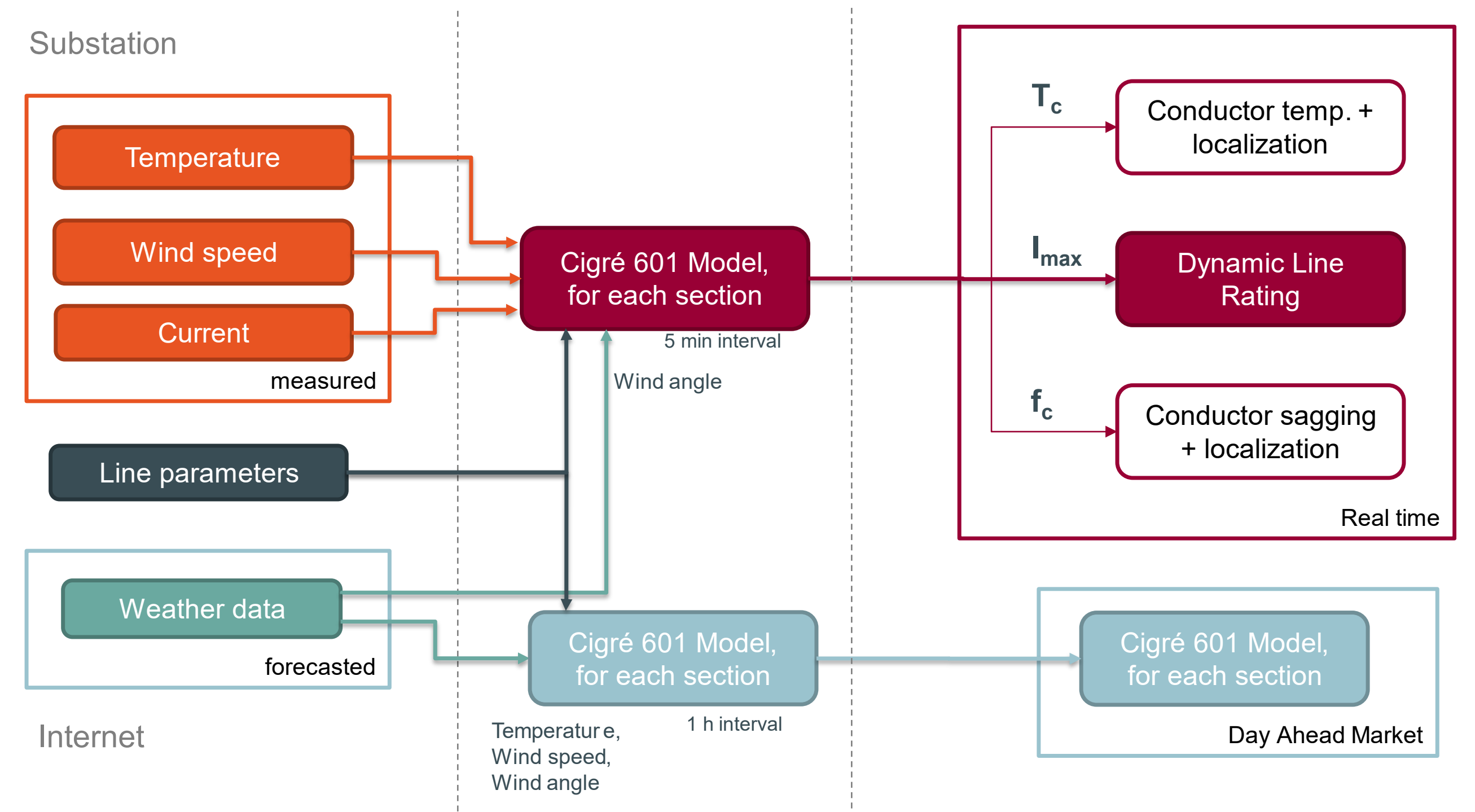
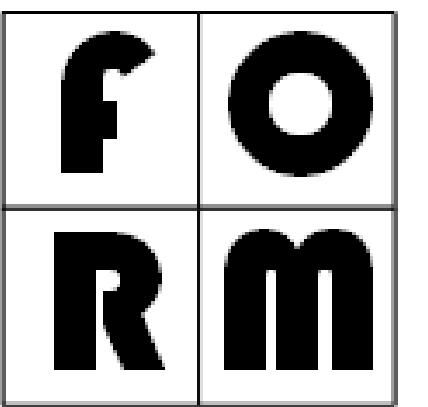
Challenges with existing technology

DLR solutions typically utilize weather stations, sensors installed on conductors, or Lidar. However, these methods are plagued by several issues:

- Need for external power supply (e.g., battery)
- Inconvenient and difficult installation of equipment
- Discrete measurements → limited accuracy of weather/line conditions along transmission route

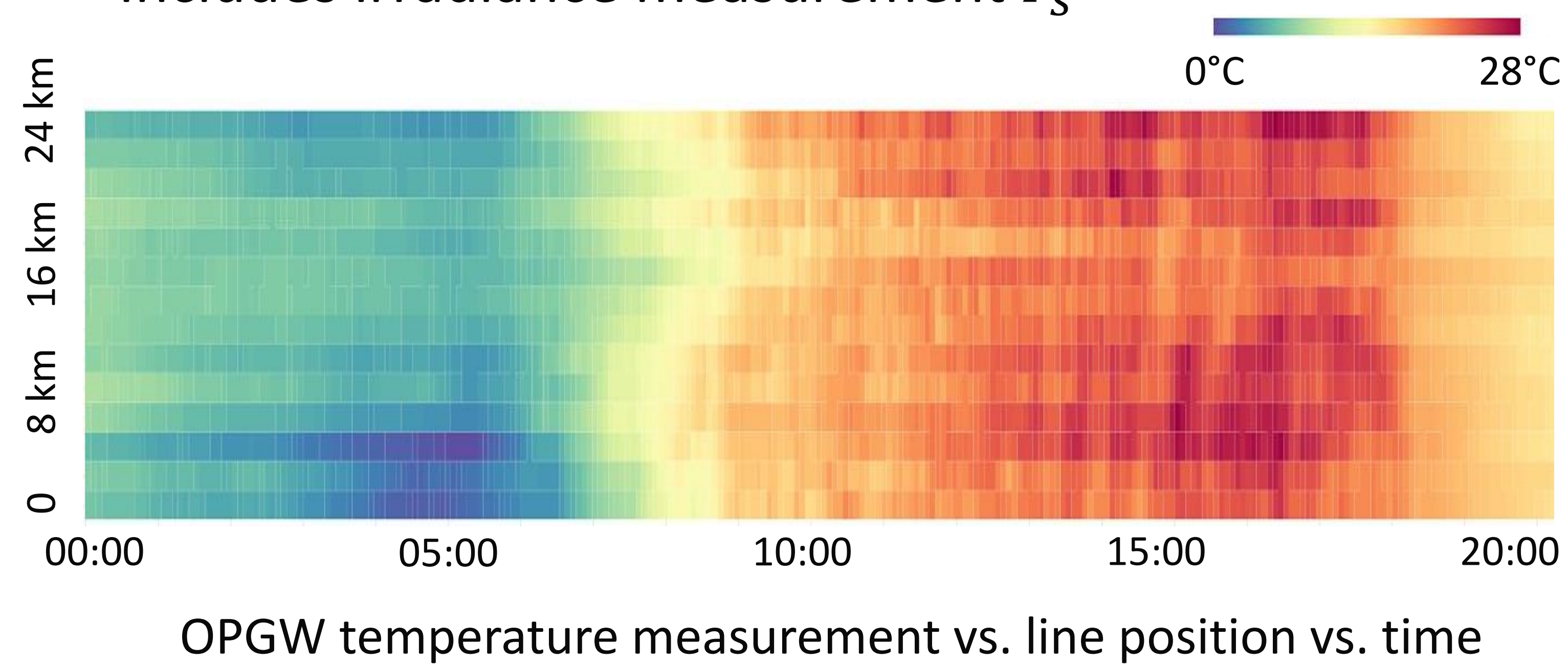


FORM: FiberOptics for Rating and Measurement



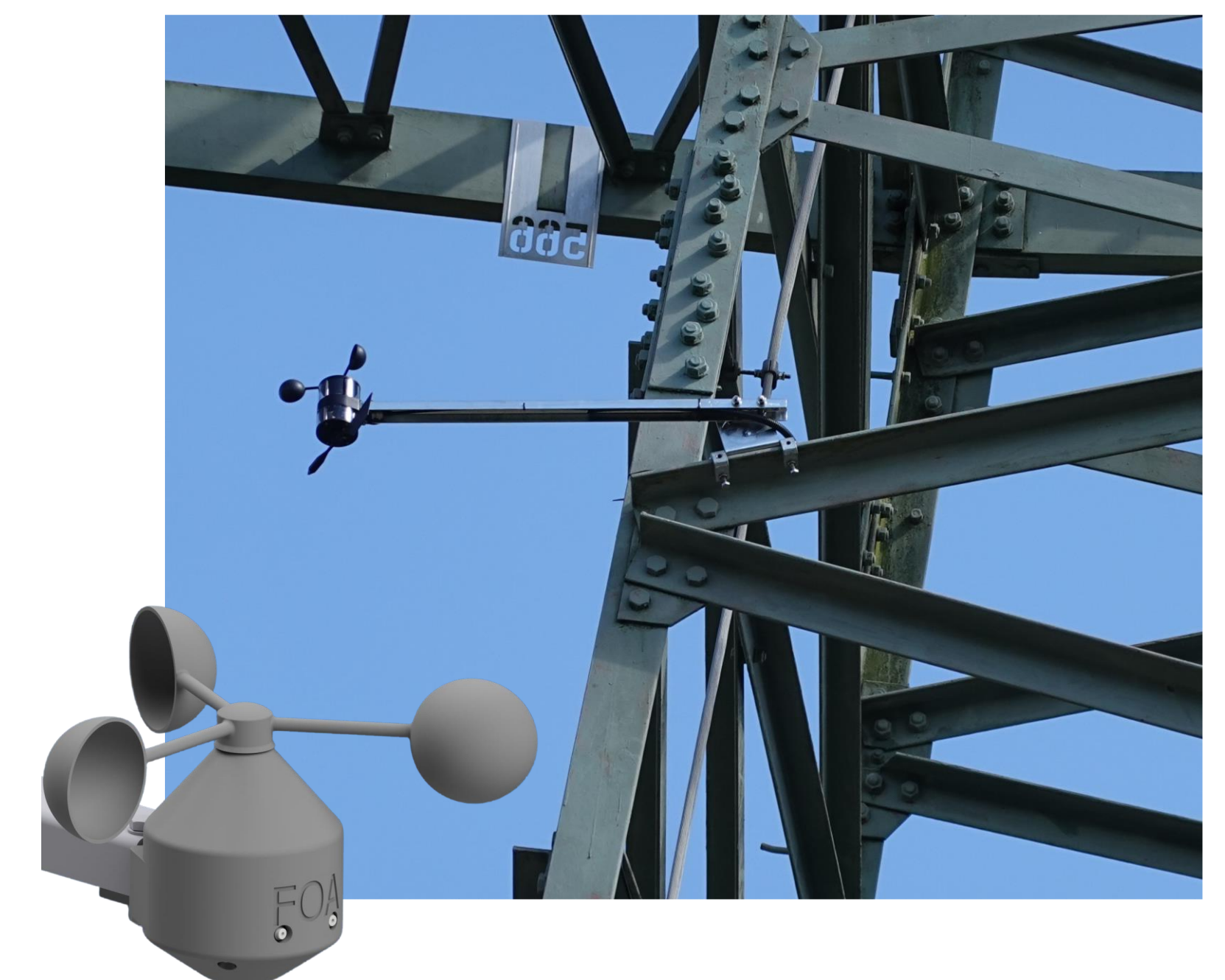
Distributed temperature sensing (DTS)

- Integrates with optical ground wire (OPGW)
- Temperature profile along entire route
- Includes irradiance measurement P_s



Fiber-optic anemometer (FOA)

- No external power supply needed
- Easy to install
- Uses OPGW for data transmission



Conclusions

- **Simple:** do not need to deenergize lines to install equipment
- **Secure:** no public telecommunications for data transmission
- **Convenient:** no external power supplies necessary