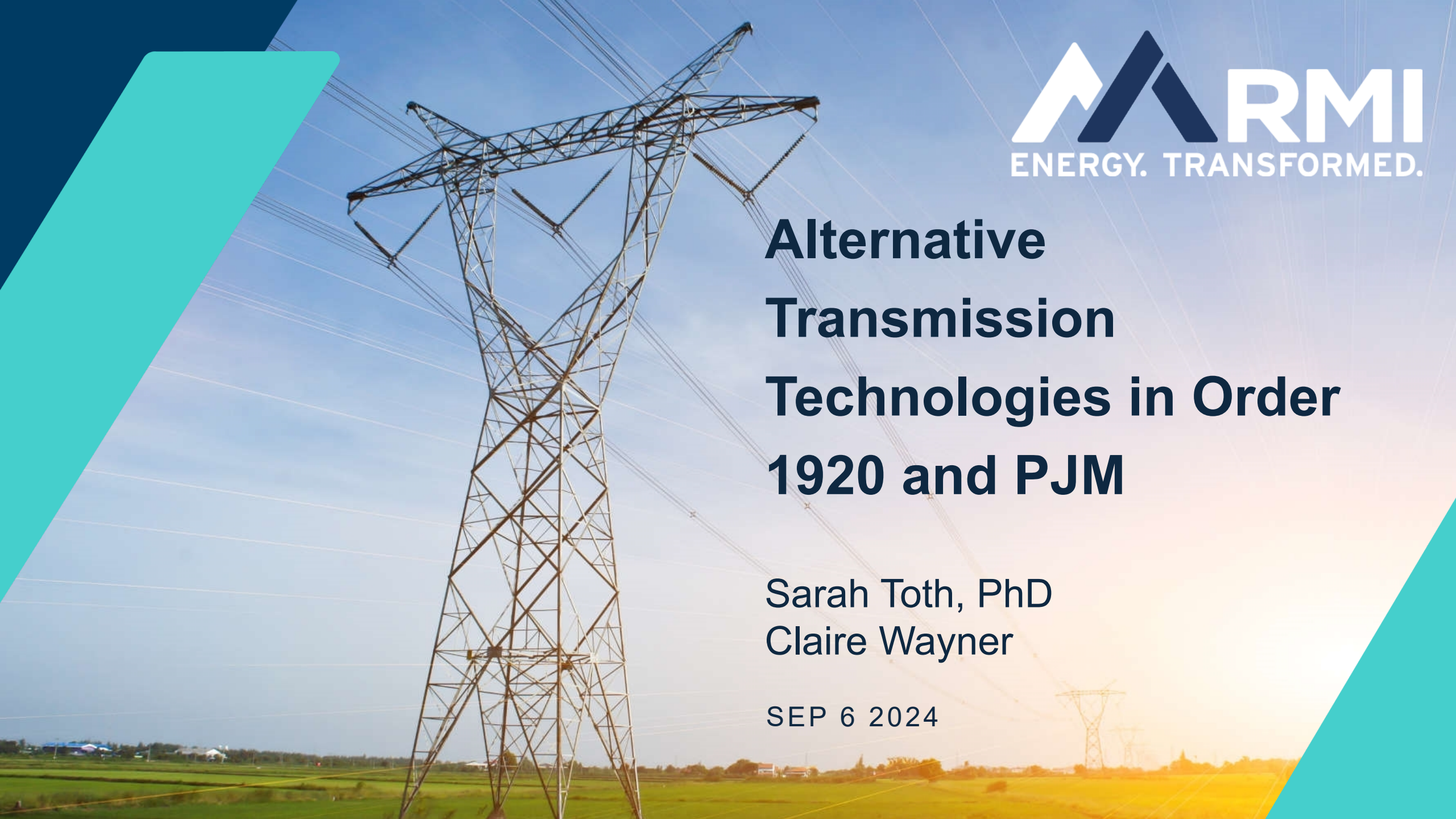

RMI
ENERGY. TRANSFORMED.

Alternative Transmission Technologies in Order 1920 and PJM

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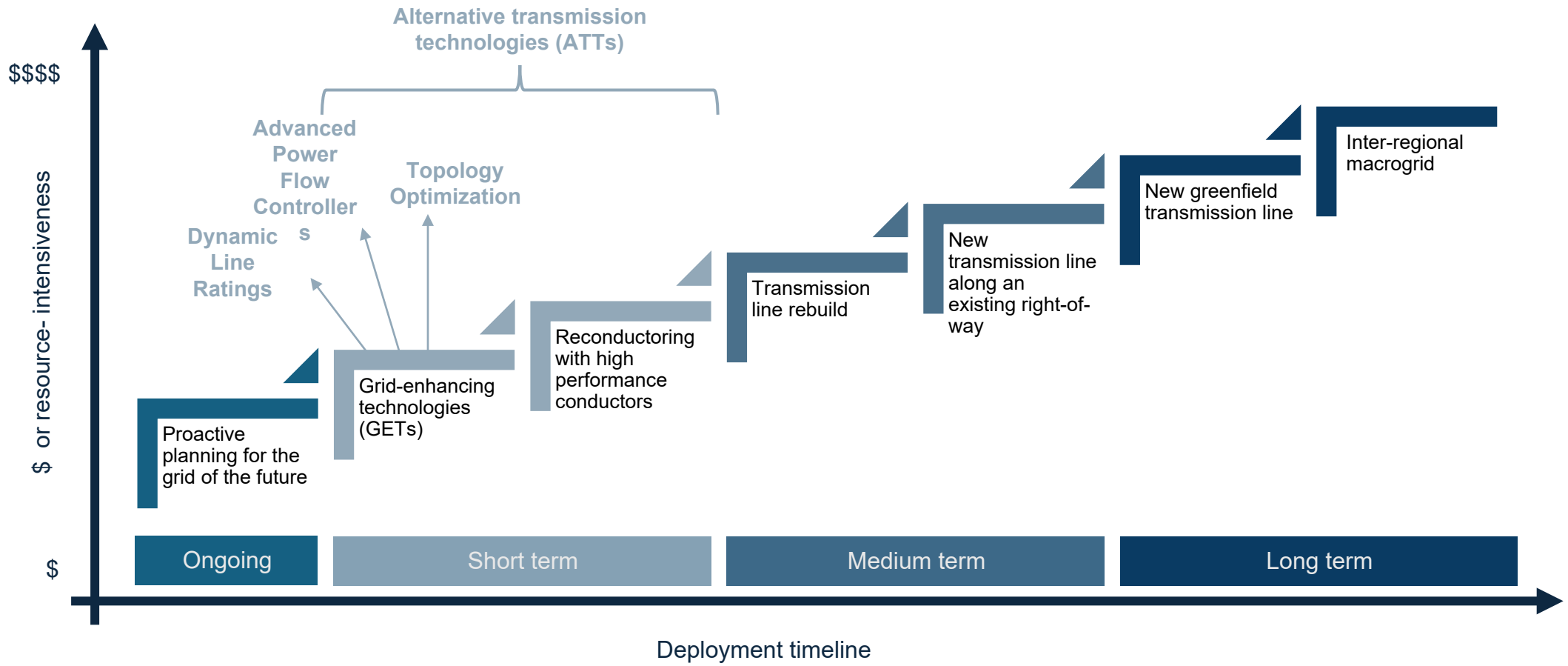
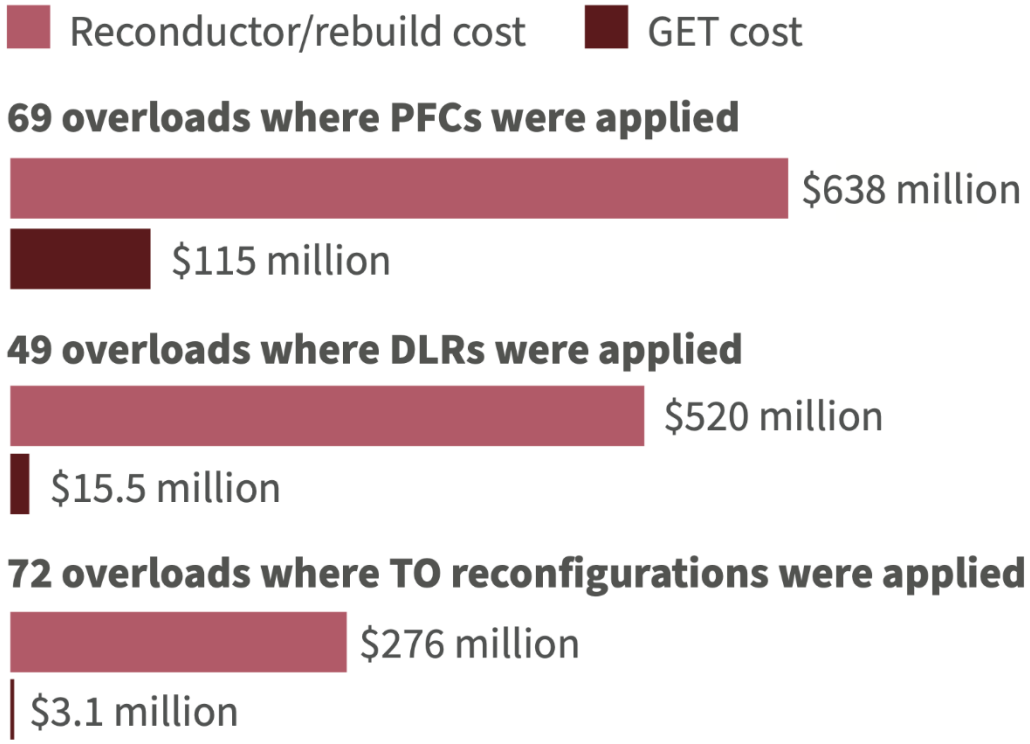
Claire Wayner

SEP 6 2024

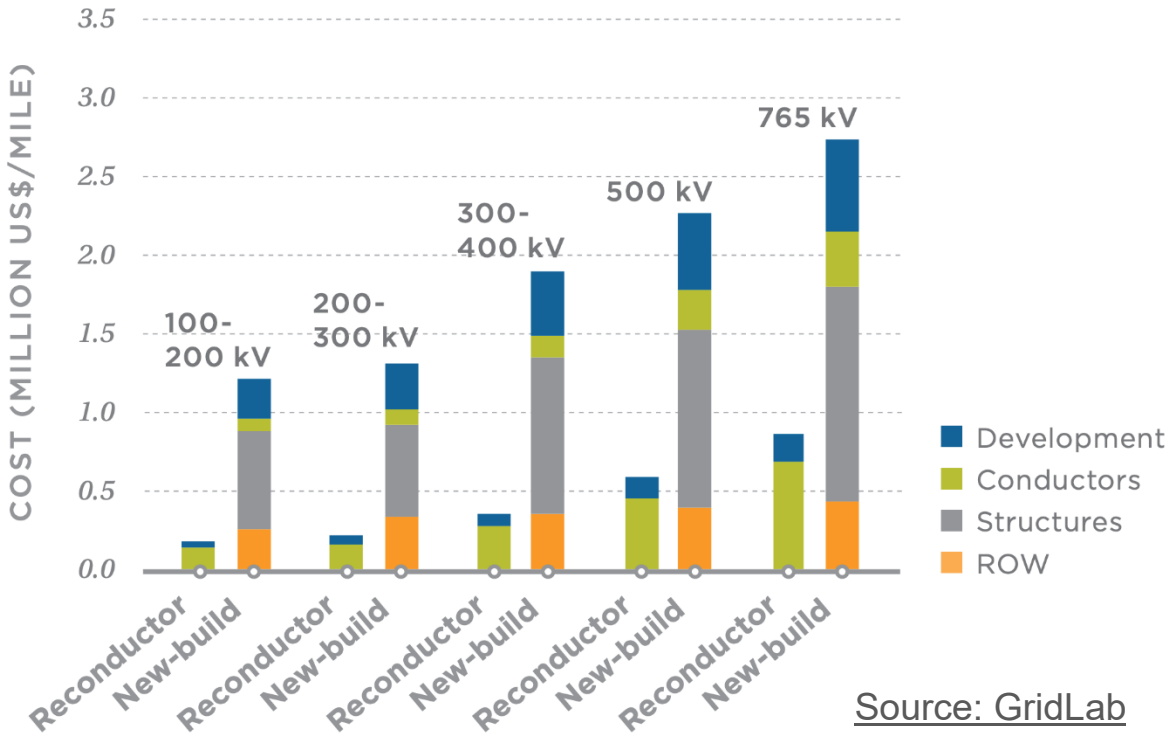
We need *all* kinds of transmission solutions to realize a 21st century grid



GETs and advanced conductors have been shown to provide dramatic cost savings compared to default transmission options



RMI Graphic. Source: Quanta analysis



Source: GridLab

Within its sponsorship model, PJM should require demonstration of ATT consideration in bids to fully comply with Order 1920

- ✓ All bidders should include demonstration that they considered the four required ATTs (at minimum) in their project proposals
- ✓ All bidders should include an explanation as to why each of the four required ATTs (at minimum) were included or excluded
- ✓ Bidders are not required to utilize ATTs
- ✓ If no bidders utilize ATTs in their bids, PJM could conduct a comparative analysis of whether ATTs could be utilized to meet the identified need; if the results show insufficient consideration, PJM could reopen the window for resubmittals

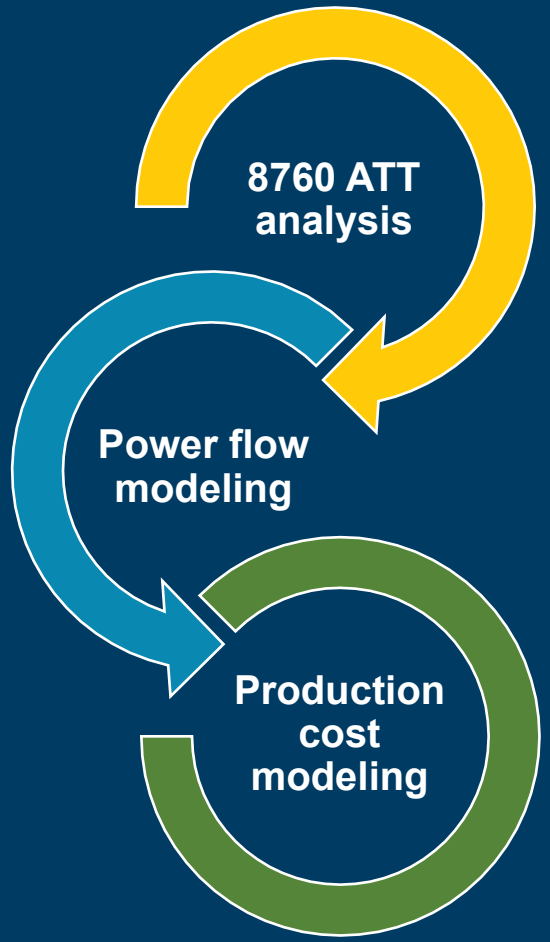
If no bids utilize ATTs, PJM can conduct a comparative analysis of whether ATTs could be utilized

Scope

ATT assessment:
Thermal only for DLR
Thermal, voltage, and stability for PFCs, TO, and advanced conductors

Across select future years:
Eg 2026, 2028, and 2030

Under relevant grid conditions:
Eg summer peak, winter, and light-load



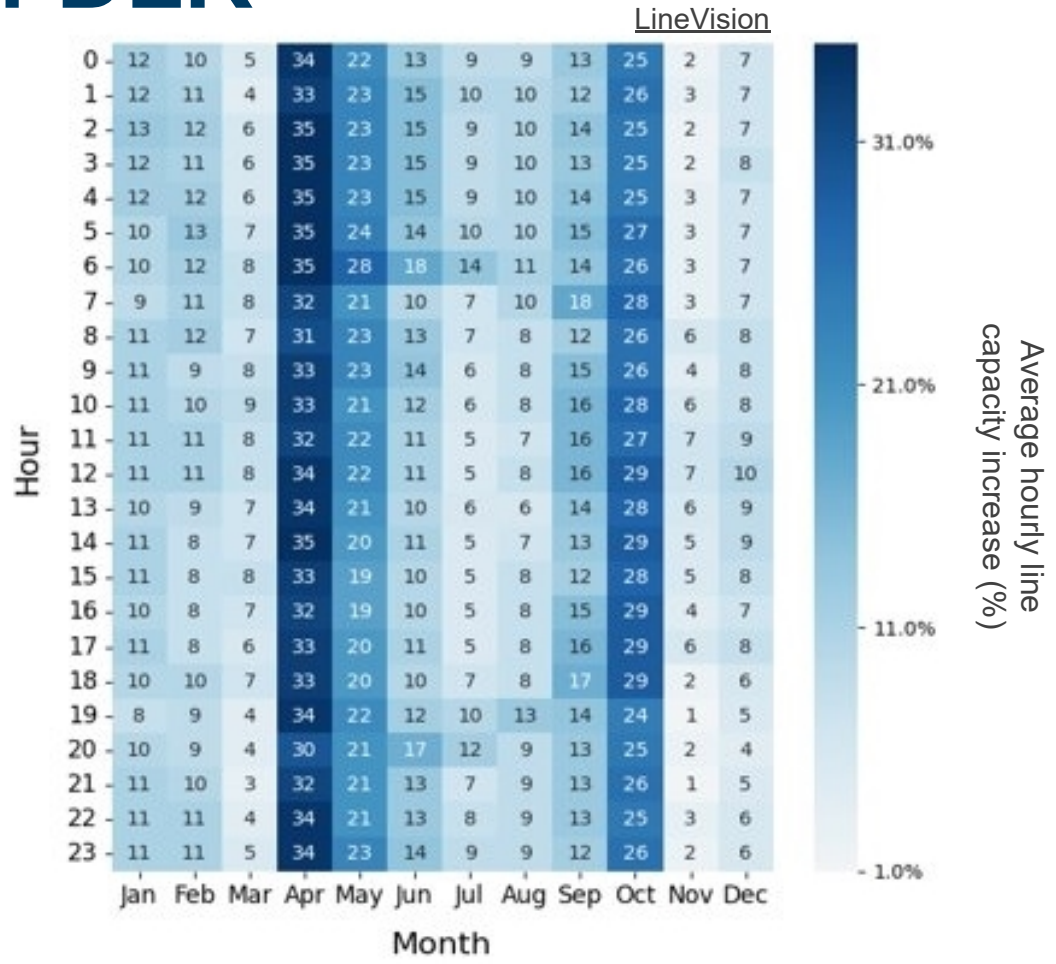
Conduct 8760 analyses unique to each ATT, quantifying sensitivities and statistical representations

Incorporate generation and ATTs into a power flow model + contingency analysis to assess reliability violations

Quantify cost savings via 8760 economic dispatch analysis (one of the seven Order 1920 benefits)

Example deep-dive analysis of DLR

- Evaluation of potential for a single line:
  - Begin with the known static rating (or calculate, given reasonable assumptions with sensitivity analysis)
  - Calculate the dynamic rating given forecasted or historic measurements of local wind speed, temperature, and irradiance data
  - Compare on as granular a basis as possible, eg as shown in this heatmap
- To cover a broader footprint, multiple lines in an area can be assessed in concert. Or, new computational methods can be leveraged (see Splight, GridAstra, Enline, etc)



Based on these results, a transmission planner can model the deployment of DLR across similar nearby lines by applying an uprate during the relevant grid condition based on statistical probability

Requiring demonstration of consideration of these fast-to-deploy, flexible ATTs as part of Order 1920 compliance can deliver substantial savings and reliability benefits

ATTs are applicable in a planning paradigm

- Some ATTs are viewed today as only operational tools; this fails to recognize their full potential.

ATTs can be modeled and deployed reliably

- Statistical approximations and sensitivity analyses are especially helpful when translating hourly trends into reasonable snapshot expectations. ATTs can also work well in combination (particularly DLR, which can be effectively paired with the other ATTs).

PJM should require consideration of all ATTs in all bids

- ATTs are complementary solutions that can obviate the need for a transmission project, be part of a broader transmission project, or serve as bridge solutions to longer-term transmission upgrades and be moved from one line to another due to their modularity.

We hope to work with transmission owners and planners to leverage our research as a capacity-building tool, as well as support new requirements that promote consideration of all ATTs

Thank you

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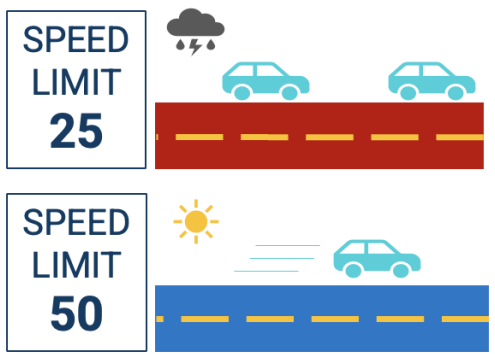
Order 1920 alternative transmission technologies (ATTs) at-a-glance

Dynamic line ratings (DLR)

Adjust the carrying capacity of transmission lines based on real-time weather measurement

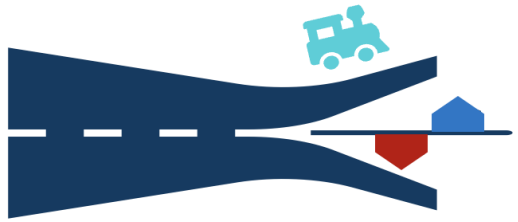
Transit analogy: real-time adjusted speed limits



Power flow controllers (PFC)

Push power away from overloaded lines with capacity constraints onto lines with spare capacity

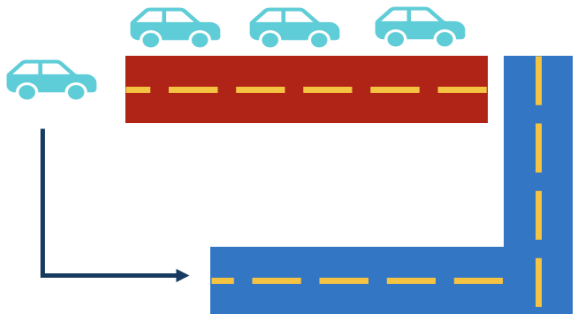
Transit analogy: railroad switching stations that direct trains to free tracks



Topology optimization (TO)

More broad than "transmission switching", this is a software solution that optimally routes power flows around congested areas

Transit analogy: re-routing drivers around traffic



Advanced conductors

Reconductoring with the latest in advanced conductor technologies can dramatically increase capacity in-place

Transit analogy: widening a highway