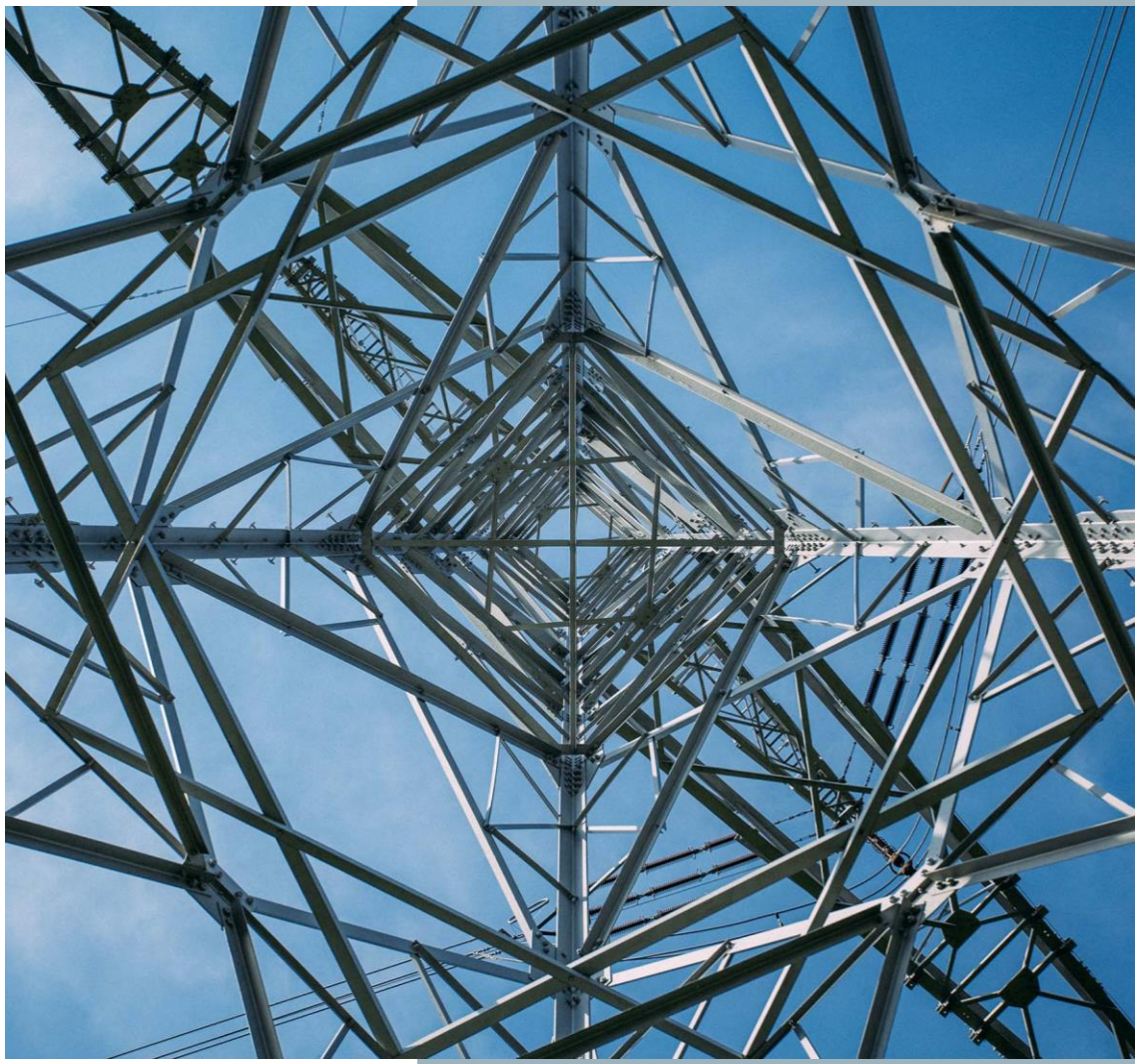
Challenges Connecting the Interconnections

ESIG 2023 Fall Technical Workshop

October 25, 2023



Grid United's Strategy

Big-Vision Projects

- Grid United seeks out big-vision, interregional projects.
- Most projects are large grid-to-grid ties rather than gen-ties—the key transmission constraint GU sees.
- When possible:
  - Right-size lines – Large projects are cheaper, but typically too large for a single utility
  - Reuse/repurpose existing infrastructure

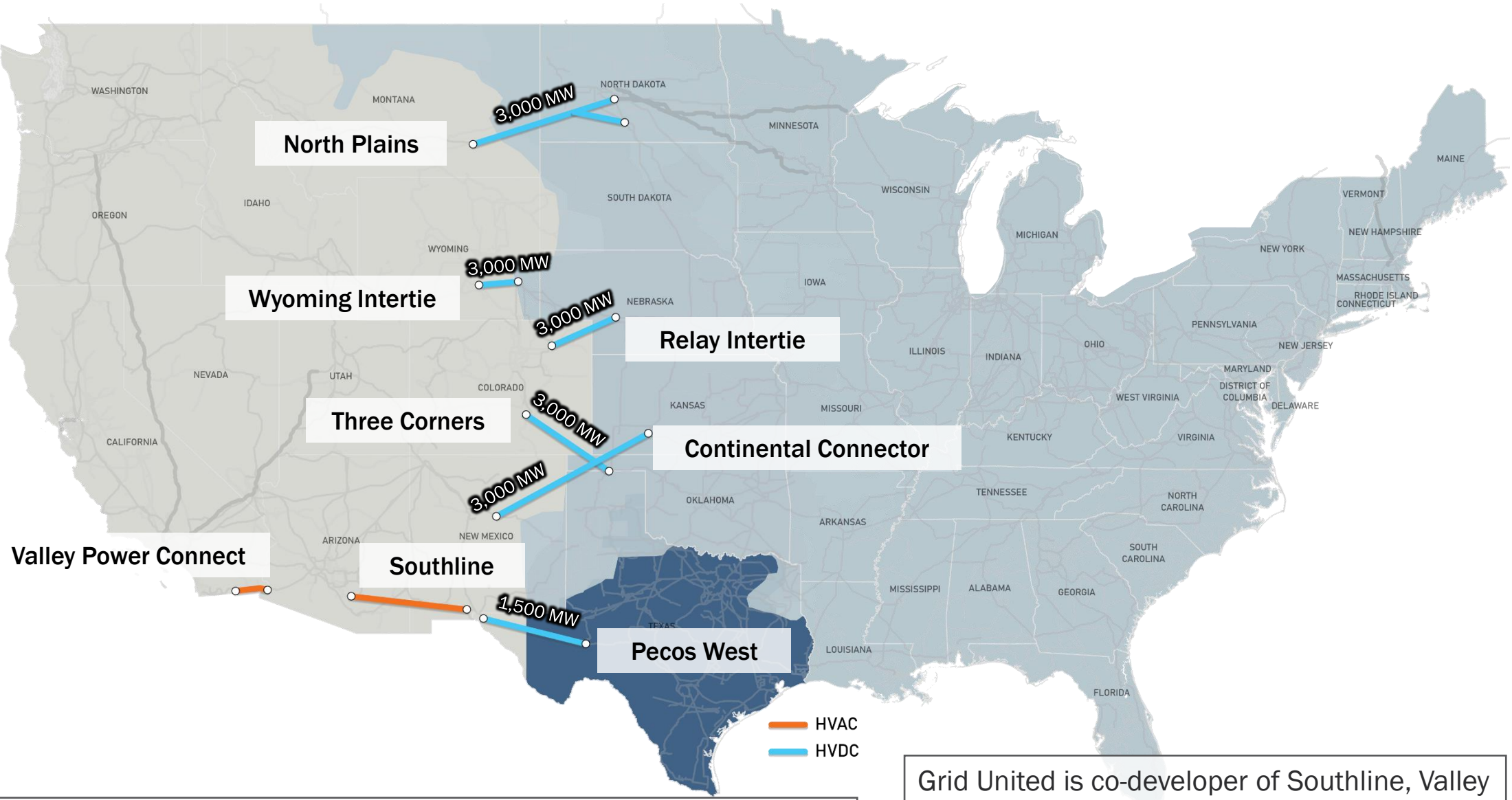
Stakeholder First Approach

- Building strong and lasting relationships with communities & landowners is essential to projects' success.
- Early, direct, and frequent communication with landowners
- Attractive compensation for landowners for easements
  - If right of way is so important, let's properly pay.
- Flexible routing process

Utility Partnerships

- GU's projects are often best owned by utilities, but outside their typical planning cycle
- GU provides risk capital, single-minded focus, innovative technical approaches, & talent during development – creating opportunities to buy de-risked projects
- When possible, sharing ROW or structures reduces costs, impacts, & timeline.

Project Portfolio



Projects' routes are under active development. Map shows proposed interconnections.

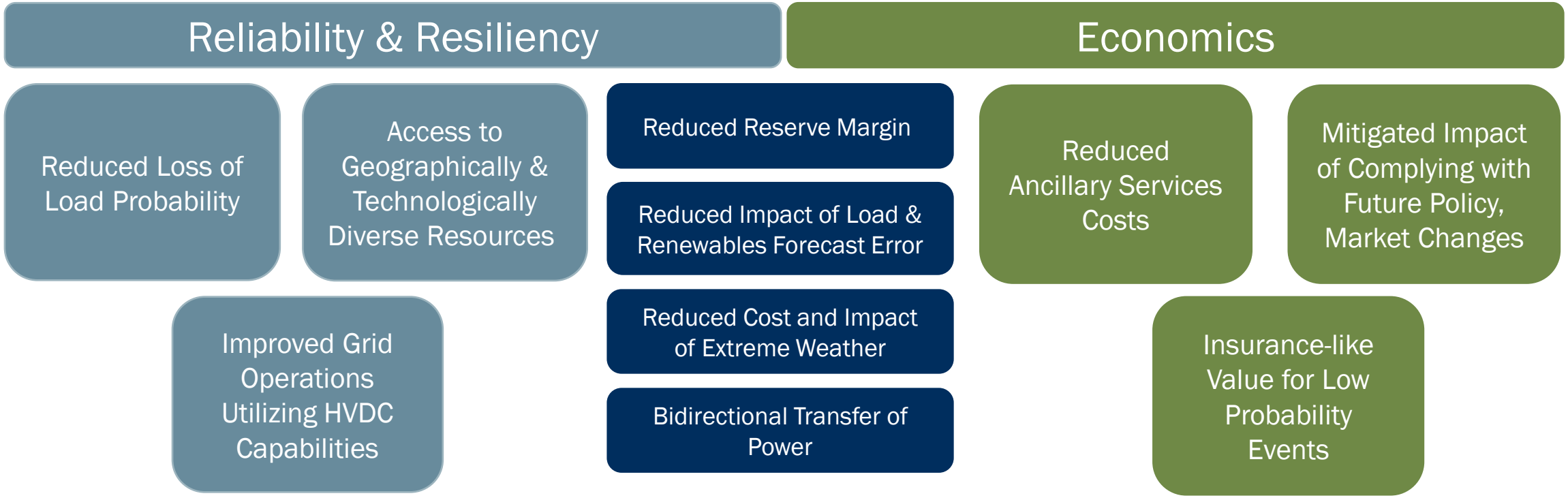
Grid United is co-developer of Southline, Valley Power Connect, & North Plains.

“All of the Above” Grid Expansion Approach For a High CAPEX, Low OPEX Generation Future – déjà vu?

- Every imaginable generation source of the future will most likely require high capital expenditure, lower operations and fuel cost:
  - Nuclear, Geothermal, Coal & Gas plants with Carbon capture, Onshore & Offshore Wind, PV Solar
- This means we will need a transmission grid that can maximize utilization of this investment in generation
- This is not a new challenge – We have been here before.
- We are at a new inflection point in our energy infrastructure development
- An “all of the above” approach will allow utilization of cheapest & most reliable resources

Interregional transmission provides broad, meaningful benefits

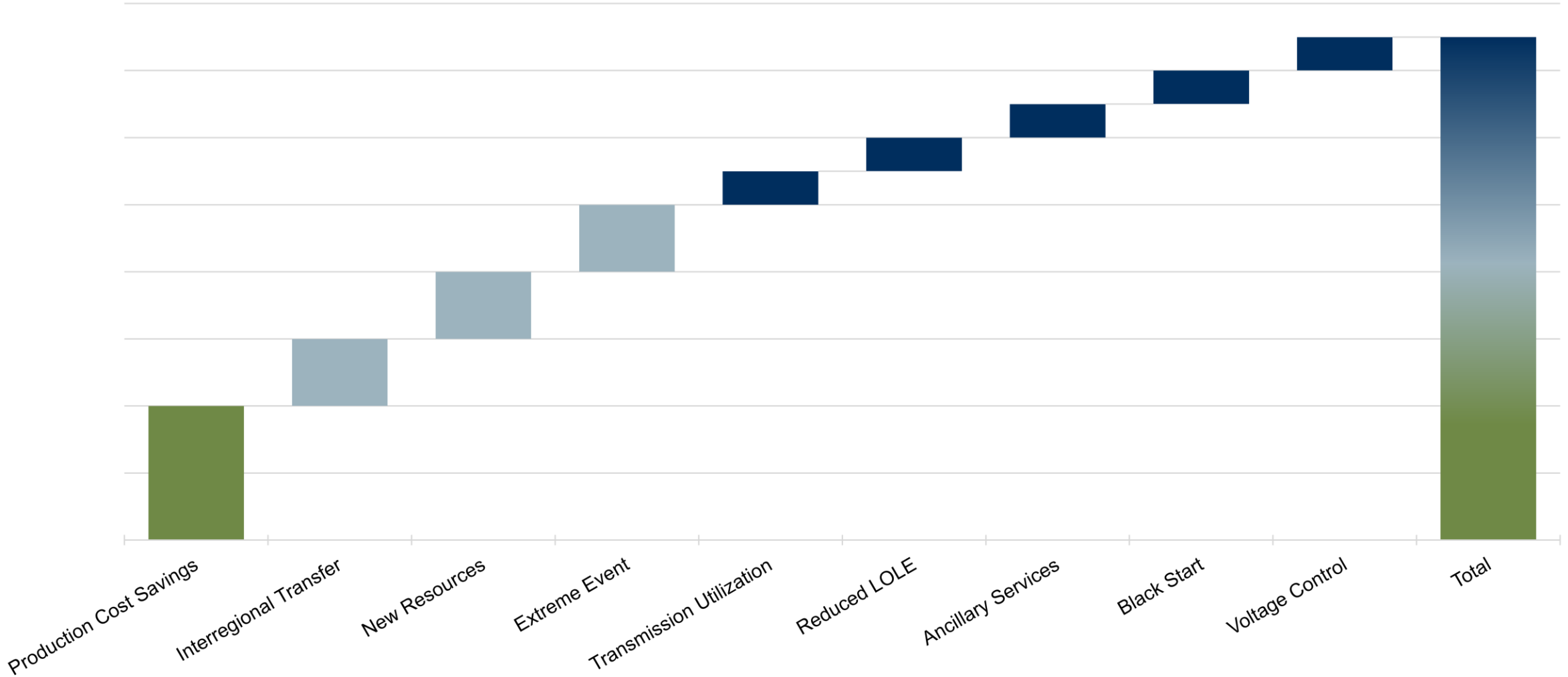
Transmission development yields a wide array of high-impact benefits—extending far beyond reduced energy costs for consumers—as identified in a report by the Brattle Group and Grid Strategies.



Grid United's portfolio is built around maximizing as many of these attributes as possible to enhance our grid today, & prepare it for future scenarios, such as climate change, natural gas price volatility, & legislative mandates.

Source: The Brattle Group & Grid Strategies / Pfeifenberger, J., Gramlich, R., et al. "Transmission Planning for the 21st Century: Proven Practices that Increase Value and Reduce Costs." (2021).

The value stack for interregional HVDC includes a wide range of attributes with equally disparate ways to quantify them



Market Efficiencies

Reliability & Resiliency

Additional Benefits

Challenge # 1: Major Shortfalls in Current Transmission Planning & Market Operations

- Lack of multi-value planning processes to capture full range of benefits
- Does not account for the high costs and risks of an inadequate and inflexible transmission infrastructure (i.e., Insurance Value)
- Lack of robust interregional planning & cost allocation that benefits ≥2 regions
- Disconnect between Resource & Transmission Planning
- Planners don't fully comprehend the complexity of siting and developing generation from an IPP business point of view, and they often use simplified resource siting assumptions.
- Current Markets do not optimize for maximizing existing interties

Challenge # 2: Denial of the Changing Planning Paradigm

- Moving away from bulk dispatchable generation in few locations to geographically diverse, weather-dependent, smaller-sized resources further away from load centers.
- Traditional RTO Transmission Planning Methodology mainly focuses on transmission network constraints for delivering intra-RTO resources, assuming a fixed dispatch.
- Fear of overbuilding or stranding transmission is a relic of the post-Order 888 hysteria.
- Resource siting fundamentals have drastically changed.
- Current HVDC VSC interconnection studies evaluate potential negative impacts in a similar manner as older LCC technology and not aligned with VSC technology's abilities.

Challenge # 3: Modeling

Conventional Production Cost Models

- Still use a fixed weather year and average load and generation profile
- Do not capture routine weather volatility or extreme weather scenarios with lot of precision in other variables

Conventional Interconnection Models

- Aim for more precision than necessary for high-level transmission scenario planning
  - E.g. analysis for market, steady-state, RMS, EMT, RTS

Challenge # 3: Modeling

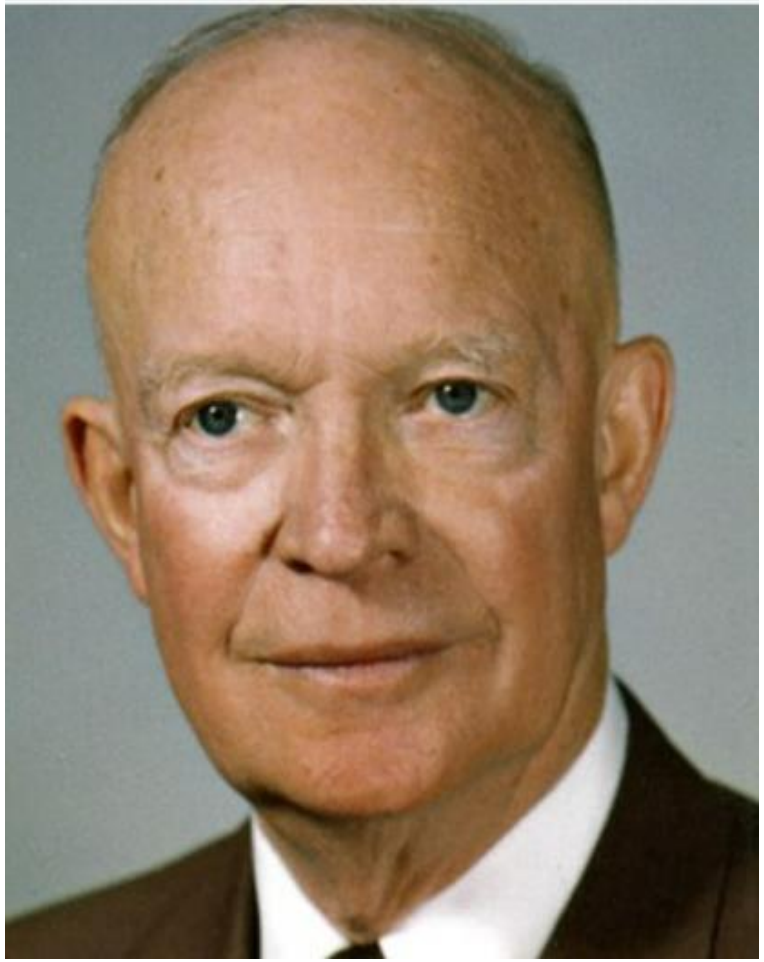
As we move toward a paradigm of "least *worst* regrets" multiple-outcome scenario planning, it's good to remember Mr. Churchill's wise words:

> **"Perfection is the enemy of progress."**
>
> **–Winston Churchill**

Challenge # 4: Human Capital & Supply Chain

- Undersupply of engineers to plan and build more transmission
  - Oversupply of non-engineers with opinions on planning and building more transmission
- Supply chain issues, ranging from conventional grid equipment (such as transformers, reactors, etc.) to HVDC converter stations

Finally, A Word From President Eisenhower



"Plans are useless,
but planning is essential."

–Dwight D. Eisenhower