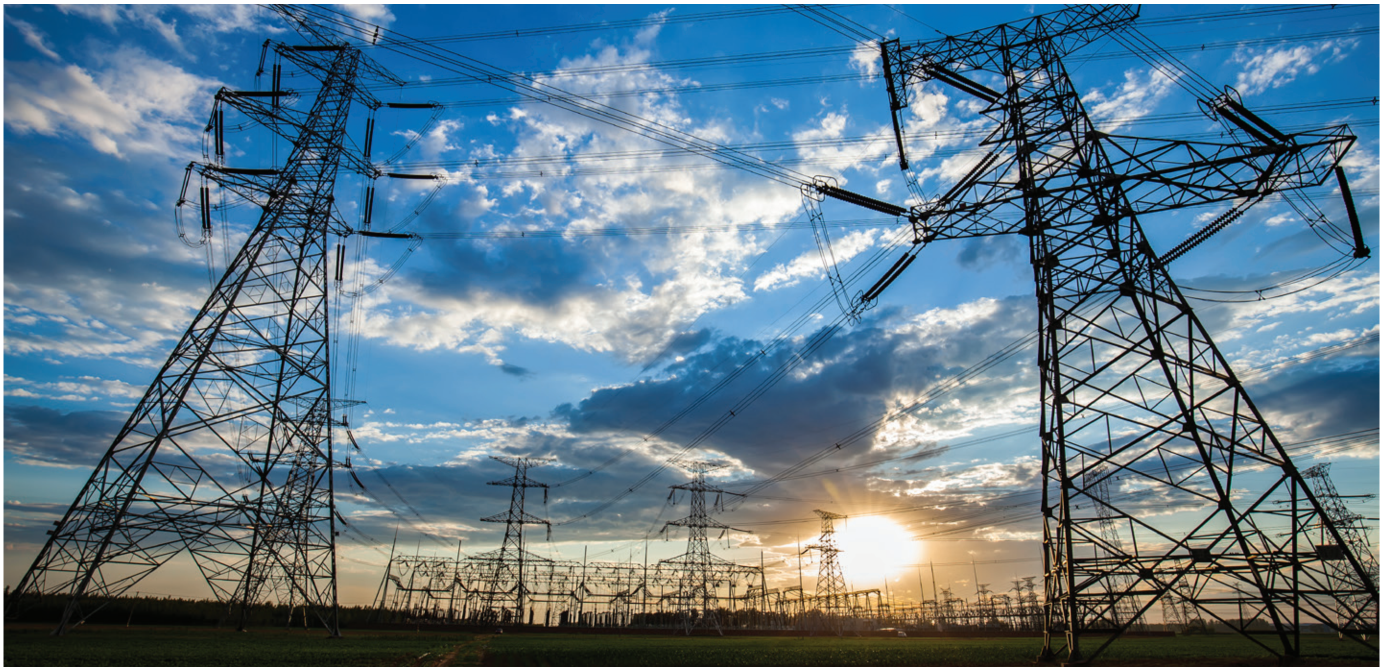
Modernizing Transmission Planning

Integrating Silos to Deliver Multi-Driver, Multi-Value Outcomes

EXECUTIVE SUMMARY



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Current Planning Practice—What It Produces and Why It Persists

The U.S. grid is changing rapidly. Electrification, new energy-intensive loads, more frequent extreme weather, aging assets, and a shifting resource mix are reshaping when and where electricity is needed. The system will need more—and higher-capacity—transmission to meet a multitude of compounding needs. Yet in most regions, transmission planning still runs in siloed tracks: generator interconnection; reliability and near-term needs; economic and congestion studies; asset management and end-of-life programs; public-policy planning; and new efforts for large loads interconnection. Each track uses its own calendar, inputs, and study methods. Coordination occurs, but mostly as one-off touchpoints rather than a recurring process with shared inputs and firm decision points.

These parallel tracks produce piecemeal upgrades that under-utilize corridors, raise costs, and miss multi-benefit opportunities. What gets built sets the grid's capabilities. As evident in the outcomes of the current planning approach over the past two decades, a pipeline of transmission upgrades that is heavy on lower-voltage, lower-capacity projects addresses local, near-term problems but adds little regional headroom. Regular additions of larger, higher-voltage facilities create durable transfer paths, reduce corridor rework, and make room for new generation and loads without the need for potentially

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FIGURE ES-1

A Practical Framework for the Evolution of Transmission Planning

INTEGRATE
planning across silos and timelines

Integrated transmission planning includes coordination across transmission planning silos—including greater interaction between generator interconnection, load inter-connection, reliability, economics, asset manage-ment, public policy, and operations—to support projects that serve multiple purposes, have multiple benefits, and avoid duplicative investments.

BROADEN
the range of drivers, scenarios, and stakeholders

Integrated transmission planning expands the set of planning scenarios informed by a fuller range of inputs and drivers, providing a spectrum of outcomes and values. In addition to reliability and congestion metrics, it includes emerging factors such as large loads, resilience risks, decarbonization goals, interregional coordination, and system flexibility needs.

DEEPEN
the analysis to support better decisions and outcomes

Integrated transmission planning improves planning analyses to reflect the growing complexity and interdependence of grid needs. This includes using high-resolution modeling tools, examining multiple plausible and diverse future scenarios, assessing impacts of new technologies and their behaviors, and analyzing future system operability.

Source: Energy Systems Integration Group.

costly workarounds. To identify the most cost-effective regionally focused upgrades requires an integrated approach (Figure ES-1).

What Reform Delivers

The Energy Systems Integration Group convened a task force of utility planners, system operators, developers, and technical experts, and the task force's recommen-dations center around three actions: integrate planning across silos and timelines; broaden the drivers, scenarios, and stakeholder input; and deepen analysis to support better decisions and outcomes—using tools, processes, and deep experience planners already have. The result is a planning process that can deliver:

- Faster, more predictable interconnection of generators and loads, as shared corridor upgrades address repeat constraints and align with the long-range plan
- A steadier buildout of high-voltage, multi-benefit transmission lines, complemented by targeted lower-voltage work that fits the same scenarios
- Studies that produce coordinated portfolios and documented decisions using shared assumptions, common benefits, and portfolio-level scoring
- Near-term fixes and asset replacements right-sized to address long-term needs, reducing serial mitigations and rework

Why Silos Persist

Planning stays in separate tracks because of who pays, how work is timed, how tools and assumptions differ, and how teams and regions are organized. Some remedies require decisions by utilities, system operators, states, or the Federal Energy Regulatory Commission (FERC), while others fit within existing processes. Common patterns include:

- **Compartmentalized organizations.** Siloed, discipline-based teams are the norm and may limit information flow and cross-functional insights, thereby reinforcing narrow outcomes. Without deliberate coordination among teams, the result is that information, system needs, and solutions stay within a single study track.

- **Fragmented timelines and horizons.** Planning functions run on different clocks. Interconnection cycles are annual or semi-annual and look 2 to 5 years ahead; reliability planning for compliance is annual and looks 5 to 10 years ahead; and regional long-range planning spans even longer horizons. Each process treats uncertainty differently. The misalignment can make coordination difficult and leads to undersized, duplicative, or delayed upgrades.
- **Varied tools, assumptions, and models**. Each planning function uses its own tools and assumptions. For example, reliability studies do power flow analysis focused on select snapshots with generalized dispatch, while economic models simulate hourly dispatch over the entire year. Both are useful, but the inconsistency hampers comparison and weakens feedback across studies.
- **Fragmented mandates and cost recovery.** Because each process has a narrow mandate and costs fall to different payers, planning gravitates to minimum "but-for" fixes, making multi-purpose portfolios harder to approve—even when those projects or portfolios deliver greater value.

If Nothing Changes

Without reform, transmission planning runs the risk of continuing to produce piecemeal fixes that leave assets undersized or stranded. Opportunities to make better use of existing rights-of-way may be missed and planning will stay reactive—returning to the same corridors with serial mitigations. Interconnection queues will continue to churn, and upgrades for generators and loads will

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remain uncoordinated. Over time, the gap between modeled benefits and operating reality can widen. The result is higher costs, slower delivery, and elevated risk to reliability and resilience.

Integrate, Broaden, Deepen

The integrate–broaden–deepen framework proposed in the report links siloed planning tracks through shared assumptions and clear hand-offs, so transmission projects are designed and selected as a coordinated, multi-driver portfolio. The framework builds on tools that planners already use and makes inputs, limits, and decisions consistent across functions. *Integration* applies one set of assumptions to reveal system-wide needs and supports consistent decisions across planning tracks. *Broadening* brings in the full set of drivers and plausible futures so that studies capture conditions that stress the grid. *Deepening* converts those broader studies into operable, physics-consistent portfolios.

Integration: Core Actions and Near-Term Priorities

Planning functions need to be integrated across silos and timelines so that coordination can take place across planning silos: generation interconnection, load interconnection, reliability, economics, asset management, and public policy. The intent is to scope projects once to serve

multiple purposes and avoid duplicate investment. The same assumptions need to be applied, and system needs and limits carried between studies using a shared list of common system needs and constraints. Hand-offs must be aligned so that solutions are sized for long-term use rather than only meeting the minimum “but-for” fix.

The Integration Continuum

Planning practice falls along a continuum: from separate studies with ad hoc coordination, to shared inputs and documents with occasional joint selection, to recurring planning cycles that design and select portfolios across drivers, and, at the far end, a fully integrated practice where decisions, data, and projects move together. Moving one step along this continuum reduces rework, right-sizes projects, and shortens delivery. Practically, that means working from shared assumptions and inputs, linking the model chain—capacity-expansion to production-cost to AC power flow to stability/electromagnetic transient—with feedback, and selecting portfolios with a common benefits catalog while right-sizing rebuilds by default.

Three Priorities to Integrate First

System operators can start with the following three seams where recurring constraints show up across analyses, where resources and new loads interconnect, where a large share of spend occurs, and where operability limits bind. Connecting these first reduces rework, lowers queue churn, and turns one-off fixes into coordinated corridor upgrades.

Integrate generator and large load interconnection with long-range planning. Planners can synchronize generator and load interconnection assumptions, methods, and study cycles with long-term regional planning. Study teams need to group compatible requests and carry generator-queue signals, large-load indicators, and policy-driven system changes into the same futures used across all planning activities so it is clear where resources and loads are likely to interconnect or drop out. They should apply the same transmission constraints in both interconnection and planning studies and bundle recurring bottlenecks into shared corridor upgrades tied to a long-range plan. Planners can use high-interest queue areas as candidate resource zones and include load-interconnection zones in expansion plans.

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Integrate asset replacement with long-term needs. Planners can tie asset-management programs to long-range transmission planning so that rebuilds meet future needs—which often extend beyond the asset’s initial purpose—rather than defaulting to like-for-like replacements. Study teams should screen end-of-life projects against shared scenarios and a common list of system needs and constraints, and make right-sizing the default. They should bundle overlapping rebuilds and nearby constraints into coordinated corridor upgrades tied to the long-range plan. Mitigation plans need to be scalable or able to accommodate added capability with minimal effort.

Integrate operations with planning. Planners will want to design transmission for how the grid runs, bringing operational considerations, such as ramping, dynamics, and stability, directly into long-range studies and not just as checks after projects are designed and selected. The process for identifying, developing, and testing projects needs to include formal operator input, use production-cost-driven stress periods, and, where needed, electromagnetic transient (EMT) analysis to ensure that transmission plans reflect expected grid operating conditions.

Broaden–Scope, Futures, and Participation

"Broadening" planning clarifies why we plan and expands what studies see and who participates, so that transmission expansion reflects a more complete set of drivers and priorities.

Why we plan: Planners need to set objectives beyond least-cost reliability or congestion relief to include public policy, resource adequacy, resilience, and flexibility needs.

What is modeled: Studies will need to model high-impact, non-traditional loads (e.g., data centers, electrified oil and gas), distributed energy resources, extreme weather, planned and unplanned outages, and resilience requirements (e.g., emergency import capability).

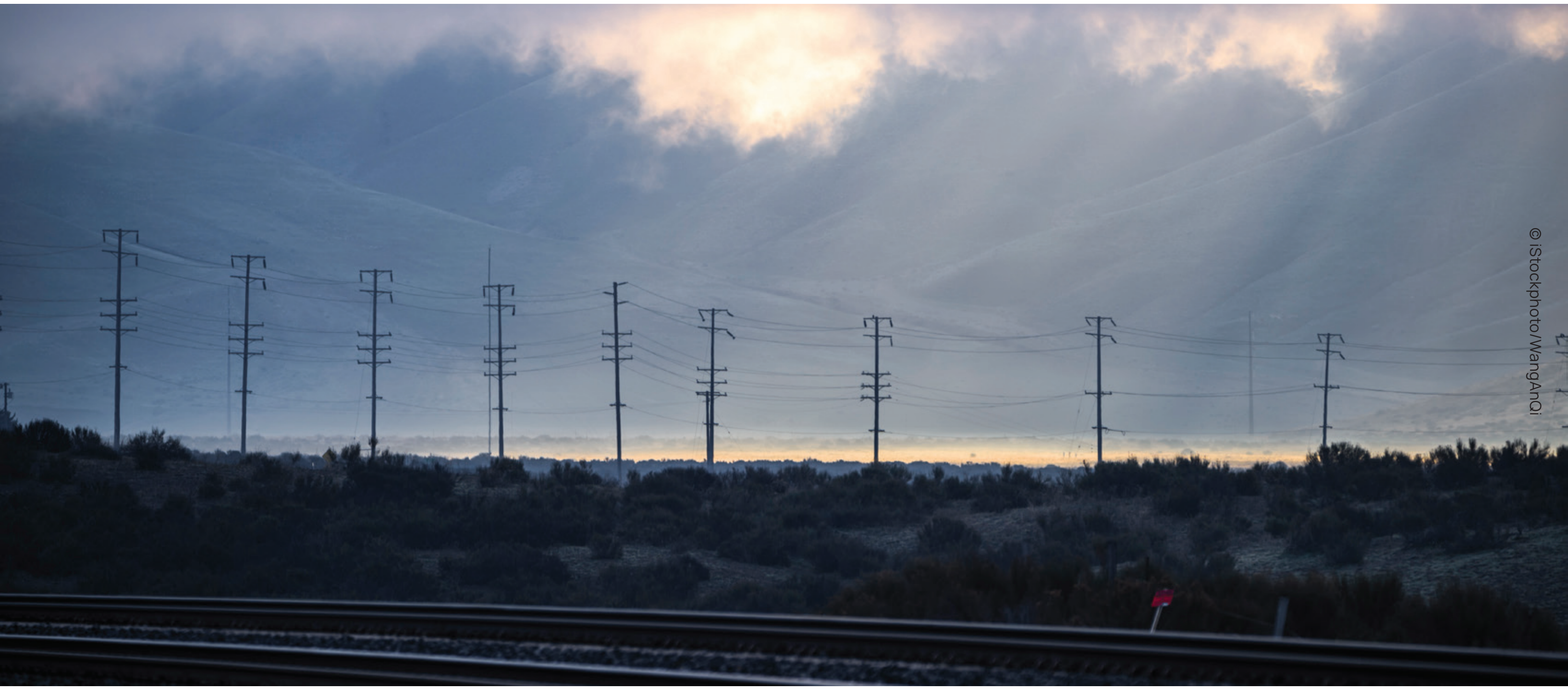
Who is involved: Planning can coordinate across state agencies, vertically integrated utilities, system operators, municipal systems, impacted tribes, and neighboring regions.

System planners, operators, and stakeholders can define and maintain a shared set of futures that reflects large loads, extreme weather, policy-driven resource shifts, interregional transfers and seams, and flexibility/operability needs. Study teams can apply the same futures across all planning functions so that outcomes are compared on a common basis. Where possible, they should work from the same inputs with state energy offices and neighboring regions to reduce rework and shorten the path from procurement to infrastructure.

Deepen–Analytics, Operability, and Calibration

"Deepening" planning means strengthening its analytical foundation to support decision-making. It refines how value is measured, improves modeling of uncertainty and extreme conditions, addresses emerging operational challenges, and makes methods and results more transparent and connected across study types.

- **Linking the toolchain.** Studies should carry constraints and candidate solutions through capacity-



expansion, production-cost (8,760-hour), AC power-flow, and stability/EMT tools with clear hand-offs.

- **Bringing operability in early.** Planners need to incorporate voltage stability, ramping, inertia, weak-grid pockets, and light-load/high-transfer conditions into screening and design, not just after project selection.
- **Using diverse futures and stress tests.** Portfolios can be evaluated across multiple long-term futures and extreme-but-plausible scenarios, with ranges and key sensitivities reported.
- **Building optionality.** Transmission plans can preserve optionality by favoring designs that can scale or be converted, such as expandable bays and convertible AC/DC corridors.
- **Calibration with operations.** Study teams and operators can align planning and operations by comparing modeled flows, congestion patterns, and shadow prices to measured data. Constraints, assumptions, and results can be exchanged in both directions. They will also need to document any resulting adjustments to models and limits, as well as the impacts of proposed transmission.

Multi-Need and Multi-Benefit Analysis

Do multi-need design. Planners will need to scope projects and portfolios to meet multiple system needs from the outset and only then value the benefits. Evaluating benefits after a transmission concept exists is not a substitute for purposefully designing projects that simultaneously address reliability, congestion, policy, resilience, and load growth. To unlock the full potential of a multi-benefit evaluation framework, study teams can prioritize multi-need planning—a process that explicitly identifies, layers, and integrates multiple system needs during project development.

It is easy to imagine two projects with very different impacts: one designed narrowly to address a specific reliability constraint and another intentionally scoped to also reduce congestion, integrate new resources, and improve resilience. The latter would likely outperform the former in a multi-benefit evaluation, but it may never be proposed unless planning processes are designed to surface multi-need solutions from the outset.

Do multi-benefit analysis (modernize benefit-cost). Planners should use FERC Order 1920's seven benefits as a floor and add region-specific benefits. They can then apply consistent, transparent methods, score at the portfolio level, and align metrics with stakeholder priorities and cost allocation principles.

Why it matters. Projects and portfolios designed for multiple needs yield higher value per dollar and per mile of right-of-way and align better with reliability, economic, and policy goals. It is easy to imagine two projects with very different impacts: one designed narrowly to address a specific reliability constraint and another intentionally scoped to also reduce congestion, integrate new resources, and improve resilience. The latter would likely outperform the former in a multi-benefit evaluation, but it may never be proposed unless planning processes are designed to surface multi-need solutions from the outset.

Closing–Putting It on a Single Recurring Cycle

FERC Order 1920 sets clear expectations for transmission planning: longer-range, multi-driver, scenario-based strategies. The integrate–broaden–deepen approach offers a practical path to meet those expectations using tools planners already have. The task now is to make these practices routine, embedded in how projects are scoped, modeled, reviewed, and approved each cycle, so that portfolios are operable, durable, and ready for changing conditions.

System planners can connect planning functions, work from a shared set of futures, and select least-regret portfolios that keep options open. They should align assumptions across reliability, economics, interconnection, and asset replacement so that results are comparable and traceable.

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System operators can align study timelines and standardize methods and assumptions. They should tie interconnection and regional planning together, reflect long-term scenarios and benefits in near-term studies, and use asset-condition data to guide strategic rebuilds.

Utilities can engage in multi-need planning at regional and local levels. They should align internal teams (transmission, resource planning, operations) on shared inputs and timing; bring forward right-sized, flexible solutions; and coordinate early with states.

State and federal regulators need to encourage transparency, scenario diversity, and alignment across agencies. They should provide durable policy signals and enable cross-jurisdiction coordination, and support cost-allocation frameworks that reflect shared, multi-dimensional benefits.

Other stakeholders will want to engage early and consistently to shape inputs, call attention to overlooked needs, and keep decisions transparent. They can propose and support solutions that bridge near-term actions and long-term goals and make local and regional benefits clear.

The opportunity is to make these practices part of every planning cycle—so that solutions are designed for multiple needs before approval, costly redesigns are avoided, and new transmission lines and upgrades deliver lasting value. With Order 1920's implementation window open, these steps can be taken now to move from parallel tracks to coordinated, multi-driver portfolios.

Modernizing Transmission Planning: Integrating Silos to Deliver Multi-Driver, Multi-Value Outcomes, by the Energy Systems Integration Group's Integrating Transmission Silos Task Force, is available at https://www.esig.energy/integrating-transmission-silos.

To learn more about the topics discussed here, please send an email to info@esig.energy.

The Energy Systems Integration Group is a nonprofit organization that marshals the expertise of the electricity industry's technical community to support grid transformation and energy systems integration and operation. https://www.esig.energy.