POLICY BRIEF

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The System Value of Grid-Enhancing Technologies

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SUMMARY

Grid-Enhancing Technologies (GETs) can deliver cost savings to the power system by increasing the usable capacity of existing transmission infrastructure. In a 2035 representation of the U.S. electricity system, GETs reduce annual system costs by up to $1.34 billion. The locations receiving GETs vary depending on the deployment strategy but the aggregate system cost reduction is robust even when GETs is deployed across different locations. GETs is shown to either increase or decrease emissions, depending on how lines are chosen and how much GETs is deployed.

KEY POINTS

1. **GETs reduces system cost and can complement conventional transmission expansion.** GETs can provide additional usable capacity, leading to cost reductions while longer-term transmission projects are being developed.
2. **GETs can either increase or decrease emissions depending on how much and where it is deployed.** Deploying GETs does not automatically reduce emissions. The generation resources enabled by selected corridors determine the emissions outcome.
3. **Targeting corridors is most valuable when deployment is constrained.** When only a small fraction of lines can receive GETs, the choice of where it is deployed affects which generation resources benefit.
4. **A single "optimal" set of GETs deployment locations may not be necessary.** Alternative strategies to choosing where GETs are deployed often produce similar aggregate system cost benefits.

FINDINGS

1. GETs can produce system cost reductions

GETs reduce annual electricity system costs across the modeled scenarios. With a **30% capacity increase**, full deployment reduces annual system cost from approximately $169.13 billion to $167.79 billion: **$1.34 billion/year** maximum modeled system-cost savings.

Different approaches to deploying GETs produce broadly similar system-cost trajectories despite selecting different transmission corridors (see Fig. 1a).

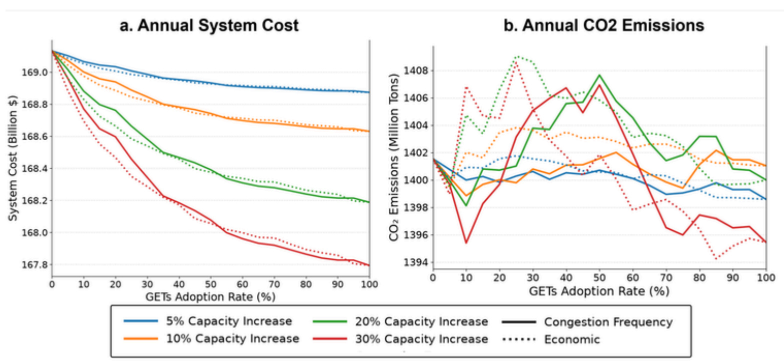

Figure 1: (a) Annual System Cost and (b) Annual CO2 emissions at varying GETs deployment strategies and adoption rates.

Research summary based on a 2035 GenX representation of the U.S. electricity system. Results reflect modeled scenarios and should not be interpreted as forecasts of realized GETs deployment or savings.

2. Location matters most at low deployment

Economic-focused and congestion-frequency-focused deployment approaches initially select very different corridors when deploying GETs. Economic-based deployment concentrates first in the Central region, while congestion frequency-based deployment initially emphasizes the Northeast and New York (see Fig. 2).

As deployment expands, the two approaches increasingly select the same corridors. Thus, the choice of targeting criterion is most important when only a limited number of lines can receive GETs.

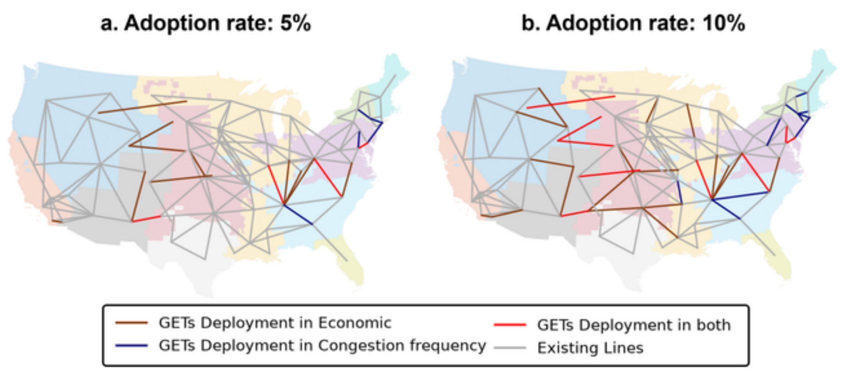

Figure 2: Spatial distribution of GET deployment under economic- and congestion- frequency-based strategies

3. Most savings come from fuel expenditure

Additional transmission capacity enables greater utilization of lower-cost wind generation and reduces reliance on natural gas generation. Consequently, reduced fuel expenditure is the principal contributor to GETs system-cost savings, although changes in generation investment and other operating costs partially offset these savings.

4. Deployment affects emissions

GETs generally increase wind generation and reduce natural gas generation. However, coal generation can increase in some deployment scenarios (see Fig. 1b). The emissions consequences therefore depend on which transmission corridors are reinforced and which generation resources gain access to the additional capacity.

WHY GETS?

The U.S. electric grid faces rapidly growing electricity demand, including large new loads such as data centers, while conventional transmission projects can require a decade or more to plan, permit, and construct. GETs provide a near-term option for increasing the effective capacity of existing transmission infrastructure.

- **Dynamic Line Ratings (DLR)**: Increase usable line capacity by accounting for real-time weather conditions rather than conservative static ratings.
- **Advanced Power Flow Control (APFC)**: Redirect electricity flows from congested lines toward underutilized transmission paths.
- **Topology Optimization**: Reconfigure the network to reduce congestion and improve utilization of existing assets.

WHAT WE EVALUATED

Using the GenX capacity expansion model, we represent a 2035 U.S. electricity system and increase the effective capacity of selected existing transmission lines. Four approaches are used to determine which lines receive GETs:

Strategy	How lines are selected
Economic-based	Selects lines with the greatest marginal economic value of additional transmission capacity.
Congestion-frequency-based	Prioritizes lines that operate close to their transmission limits most frequently.
Weighted-random	Selects lines probabilistically, giving more congested lines a higher probability while retaining deployment diversity.
Uniform-random	Selects eligible lines with equal probability and serves as an untargeted benchmark.

GETs deployment ranges from **0 to 100% of eligible transmission lines**, with selected lines receiving **5 to 30% additional capacity**. Multiple realizations are evaluated for the stochastic strategies.