

NUFRIEND Insights

FACILITY ROLLOUT OPTIMIZATION

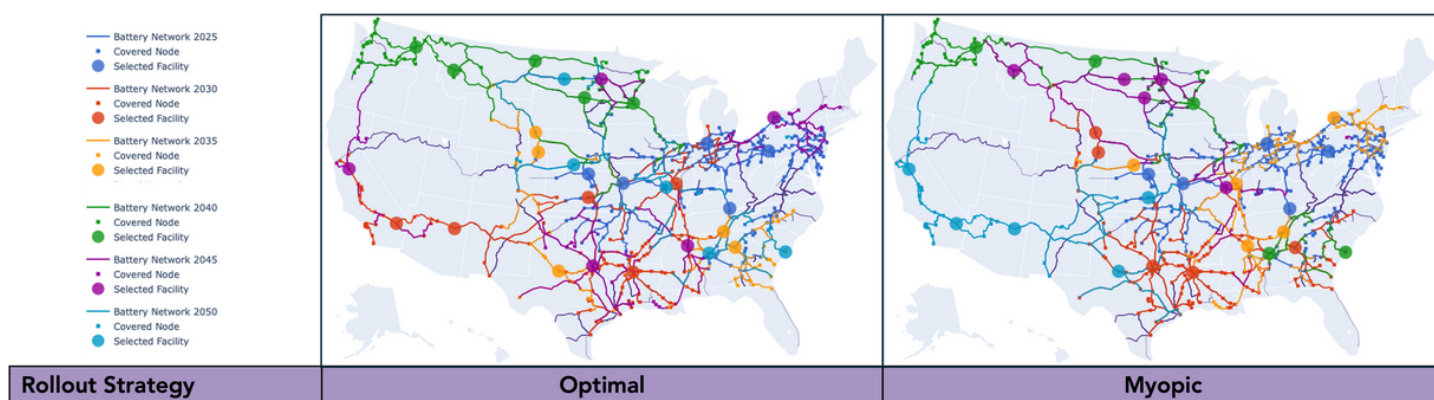
Northwestern University Freight Rail Infrastructure & Energy Network Decarbonization (NUFRIEND) is a comprehensive industry-oriented tool to simulate the deployment of new energy technologies across U.S. freight rail networks. Scenario-specific simulation and optimization modules provide estimates for carbon reductions, capital investments, costs of carbon reductions, and operational impacts for any given deployment profile.

WHAT IS BEING OPTIMIZED?

- The NUFRIEND framework determines the optimal refueling/charging facility locations for serving freight demand.
- Facility location decisions have a temporal dimension with major impacts on the lifetime emissions reductions.

This NUFRIEND Insights highlights the difference between optimal and (sub-optimal) myopic facility rollout strategies for the deployment of battery-electric locomotives:

- 1000-mile range locomotives deployed over the 5-year periods between 2025 and 2050, each with a budget of 5 facilities.
- The myopic facility rollout strategy selects the 5 facilities that increases the total flow capture at each time period and does not account for network effects, nor how future demands change.



Optimal vs. myopic facility rollout strategies when the final set of facilities are the same for both. The optimal strategy reduces lifetime emissions by a further 11% compared to the myopic strategy.

HOW DO THESE STRATEGIES AFFECT RAIL DECARBONIZATION?

Deployment order matters: the optimal strategy minimizes lifetime emissions by optimizing the order facilities are built in.

Rollout optimization is sensitive to time-dependent:

- Time-dependent facility budgets
- Time Target deployment
- Projected freight demand
- Facility capital costs
- Electric grid costs & emissions

SUMMARY

- Stakeholders can maximize emissions reductions by considering the time-dependent nature of facility rollout decisions.
- Myopic or common sense strategies lead to sub-optimal designs as they ignore network effects and future demand.
- Different time-dependent parameters can be easily modeled within the optimization.

NUFRIEND Insights for:

RAILROADS

- Method for developing and evaluating future refueling/charging facility networks.
- Value of time and discount rates for investments in future decarbonization facilities.

ENERGY PROVIDERS

- Method for estimating the anticipated capacity required in future years.
- Forecasts for future electricity prices and generation mixes.

GOVERNMENT

- Timing of climate policies and impacts on emissions reductions.

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