

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.

![Facility Rollout Strategy Diagram](image)

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<th>Rollout Strategy</th>
<th>Optimal</th>
<th>Myopic</th>
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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**
- 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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