AGENDA
The RAIL ELECTRIFICATION COALITION'S
October 24, 2024
ELECTRIFICATION WORKSHOP

Location: National Electrical Manufacturers Association
Hubbell Conference Rooms
1300 North 17th Street
Arlington, VA 22209
(https://www.nema.org/about/visit/directions)

RSVP for October 24th, 2024 Workshop

Welcome! To the Council's third full-day meeting on railroad motive power and electric transmission, development, and siting. As always, this meeting will address the two components of the Coalition's agenda – electrification and eventual decarbonization of railroad operations and utilization rail network real estate to host expansion of electric grid facilities. Many of the same players are important to both subject matters. Because the Coalition encourages collaboration about future developments in the railroad and electric power industries, workshop participants are invited to actively express themselves on any matters presented today. Given the pace of technological, regulatory, and commercial change in these critical industries, the Coalition looks forward to a series of such discussions about the probable pathways to transportation and grid modernization.[1]

As with the Coalition's other meetings: we seek to answer one core question----
Can we identify ways to ensure that technology developers, railroads, investors, and policymakers make the wisest energy and operational efficiency decisions so that North American railroads can (1) contribute to lowering the emissions and resource requirements of freight and passenger movement, (2) capitalize on their current and potential efficiencies to sustain and grow rail's market share, strengthen supply chains, enhance customer services, and participate in expanding and strengthening the electric system, and (3) attract private and public capital sufficient to support the transition to a cleaner energy and transportation economy?

This third REC WORKSHOP will focus on new case studies of the risks and potential rewards of transportation electrification, including new business practices and opportunities, the role of entrepreneurship, new technologies, and public policies in fostering new projects that advance electrification, digitalization, cleaner and more efficient energy, and regulatory and business collaboration.

[1]. Please consult the attached **Appendix A** on how the Workshop will be conducted to elicit the best information and discussion about the future of electrified transportation. Additional discussion questions are provided in **Appendix B.**

9:00 a.m. Workshop begins.

- Introductions
- 9:15 a.m. Presentation of Goals for Today
  Questions to keep in mind during the Workshop.

9:15 a.m. – 11:45 p.m.
HAS ELECTRIFICATION LEFT THE STATION? THREE INITIATIVES TO WATCH

The REC is exploring viable technological, commercial, and operational pathways to electrifying passenger and freight rail as well as the role that railroad rights of way can plan in helping expand the electric grid. The Morning Workshop is designed for stimulate discussion about (and across) these diverse policy developments and where we are on the journey toward transportation and grid modernization. Discussants will highlight the new FRA study and analytical toolkit for electrification, a national rail decarbonization plan, and other ongoing work to advance the goals of the IIJA and increase the focus on transportation's role in electric grid development. The Coalition and these discussion leaders invite participants to share their views and exchange information about all subject matters. Raise your hand! **Suggested topics and questions are listed in Appendix B.**

A. NATIONAL RAILROAD DECARBONIZATION PLAN

As part of a plan to eliminate most if not all greenhouse gas emissions from the transportation sector by 2050, the National Rail Decarbonization Plan proposes long-term solutions that leverage technically available solutions of electrification via catenary and discontinuous catenary technologies for emissions reduction and prioritizes research and demonstration for emerging zero-emission locomotives and infrastructure, including hydrogen fuel-cell and battery technologies. The plan would promote a "modal" shift to electricity through near-term adoption of zero-emission equipment at rail yards to address air pollution, especially in communities with cumulative environmental justice concerns. The plan proposes the acceleration of adopting energy-efficiency measures and investments in expanded access to passenger rail.

Discussant: ***Natalie Popovich, Vehicle Technologies Office (DOE) and Lawrence Berkeley National Lab***
Q & A everyone

B. FRA'S NEW STUDY -- COST AND BENEFIT RISK ANALYSIS FRAMEWORK FOR MODERN RAILWAY ELECTRIFICATION OPTIONS

Performed by University of Texas and outside experts on behalf of the Federal Railroad Administration, this analysis is the first study in many decades to identify technologies and strategic operations and implementation approaches that can contribute to reducing the financial risk of electrification. To be adopted on long mainline corridors or on branch or short lines, modern options for electrification must reduce the risks associated with changing operations or that jeopardize fair returns on investment through some combination of: 1) reduced initial capital infrastructure or locomotive costs; 2) increased operating benefits or the ability to yield interim benefits during initial construction/implementation; 3) reduced overall construction duration to yield benefits sooner and increase the likelihood of achieving the forecast benefits and return on investment.

The study contains 1) a Monte Carlo-based evaluation framework for cost/benefit uncertainty, case studies, and a toolkit for performing further analysis. (Publication date this Fall is uncertain); 2) documentation using two vastly different RR corridor Case Studies, 3) a detailed background technical report, and 4) a User's Manual for the open access spreadsheet model.

NOTE*: The report to the FRA does NOT provide a physical asset plan for specific corridors or routes to electrify. It instead is a framework for testing various physical asset routes and suggestions as to how to improve the data used in further route analyses. Second and importantly, the model employed in the report identifies various ways to monetize the value of a railroad right-of-way as a means of examining cash flows that could potentially impact the business case of the railroad corridor – from the railroad point of view but not necessarily from a grid investor's perspective.*

Discussants: ***Rydell Walthall, UT Ph.D. Candidate***
Jim Blaze, Railroad Economist and Commentator
Mike Iden, Consultant, Tier 5 Locomotive LLC
Michael Johnsen, Climate & Sustainability, Federal Railroad Administration
Q & A everyone

C. GRID INTEGRATION WORK AT THE "JOINT OFFICE"

The Infrastructure Investment and Jobs Act, together with the Inflation Reduction Act, promise to change two powerful parts of the American economy and to leverage modern technology in the interest of cleaner, more efficient transportation, and energy consumption. Congress and the Administration recognized the interdependence and importance of our legacy transportation and energy systems. The work of the Joint Office on Energy and Transportation (DOT and DOE) has until recently committed its resources primarily to electrifying highway transportation (EVs). Its work on grid expansion and integration will, like that of DOE's Grid Deployment Office, contribute to identifying the need for, and strategies for supplying, expanded transmission capacity for purposes of service reliability, grid resilience, clean energy, and stronger power markets. Beyond this gap-filling, the JOET will increasingly focus on potential use of railroad and other existing assets to advance grid integration through more efficient siting and permitting of facilities.

Discussant: ***Julie Peacock, Joint Office on Energy and Transportation, and Pacific Northwest National Lab (DOE)***
Q & A everyone

11:45 a.m. – 12:30 p.m. KEY DOE INSIGHTS INTO GRID EXPANSION

Hon. Michael Pesin, Deputy Assistant Secretary, Grid Systems and Components, Office of Electricity, US DOE
[May start early due to Secretary Pesin's constraints]
Q & A everyone

LUNCH BREAK

2:00 p.m. IMPROVING GRID PLANNING AND THE VALUE OF EXISTING RIGHTS OF WAY – A CROSS-SECTOR DIALOGUE

As the US weans itself from fossil fuels, meets exploding electricity demand from AI and EVs, and prepares for reliability threats from extreme weather, electricity grids will feel extra strain. The IEA believes that many economies will face having to shut down vast green generation resources if the transmission grid is not expanded in the next few years. In response, the Federal Energy Regulatory Commission has ordered all electric transmission providers and regional transmission organizations to revise and update their planning methodologies, including by using planning scenarios over a 20-year horizon and a focus on interregional transmission expansions. *[FERC Order No. 1920 (Docket Nos. RM21-17-000) and Order No. 1977 (Docket No. RM22-7-000)]* DOE has issued its National Transmission Planning Study to advance grid-scale planning tools, new solutions and benefits, better processes for regional and interregional transmission planning, and reliability and decarbonization strategies. Together with potential revisions to laws governing siting and permitting grid facilities, new planning processes will impact future grid structures and operations and should accommodate techniques for optimizing use of existing rights-of-way and grid-enhancing technologies. Non-utility transmission providers that have recently received important federal support for major projects must also engage with and support the new plans. Any transmission modeling needs to fully quantify project benefits, including the layers of factors influencing the choice of location for a project and the impact on communities and landowners. Using railroad and perhaps other existing or disturbed rights-of-way will require new and innovative commercial negotiations but offer the opportunity to craft project deployment with less litigation or disturbance of "greenfield" property.

Discussants:

Policy Makers

David Borden, Order 1920 Lead, Office of Energy Policy & Innovation, Federal Energy Regulatory Commission
Michael Johnsen, Senior Advisor on Climate and Sustainability, Federal Railroad Administration (DOT)
Liza Reed, Engagement, Outreach, & Strategic Initiatives, Grid Deployment Office (DOE)

Industry

Representative, Class 1 Railroad/AAR (invited)
Kellen Schefter, Senior Director, Electric Transportation, Edison Electric Institute

Q & A everyone

3:30 REC UPDATE

- PLANNED 2025 FINANCE & INVESTMENT CONFERENCE
- UPCOMING REC ANNUAL MEETING

CLOSING COMMENTS

4 p.m. ADJOURNMENT

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APPENDIX A

GUIDE TO OUR RAIL MOTIVE POWER WORKSHOPS

TO ALL STAKEHOLDERS: Welcome to the RAIL ELECTRIFICATION COALITION'S workshop on railroad motive power, sustainability, decarbonization, technology, and electrification. This is a day-long meeting, intended to be responsive to the participants. It is dedicated to finding viable pathway(s) forward involving the need to improve how freight and passengers are moved on North American railroads and how rail electrification can participate in the transformation of the electric grid. The agenda presents a series of questions for consideration in anticipation of our discussions. The organizers seek the views of all attendees that participate and entities with an interest or stake in energy and transportation supply chains. The workshop is not designed to arrive at specific conclusions, although all responses will be illuminating, whether from commercial actors, technical experts, or policymakers.

- The discussion will be moderated to ensure it moves forward within the time allotted. Chatham House rules mean that comments will be recorded without attribution, unless the group decides otherwise. A summary will be distributed after the meeting.
- Specific project sponsors will present the case studies and respond to participant questions. The floor will be opened to discuss the cases and their implications for other companies or projects.
- The moderators will seek comments from attendees in the room or online in response to the issue(s) raised and the questions provided below.

APPENDIX B

SUGGESTED QUESTIONS AND TOPICS TO EXPLORE DURING TODAY'S SESSIONS

GENERAL.

1. What does 'sustainable' mean in the context of rail motive power? How will this be measured?
2. What are the primary challenges rail electrification faces? What can we learn from the history of rail electrification? What can we learn from rail electrification in other countries?
3. How do the operating costs (besides fuel) compare with diesel locomotives?
4. How much faster are electric locomotives and what difference does that make in track capacity?
5. How much lifecycle emissions reduction can be gained from the use of electric locomotives?
6. What questions about rail electrification have to be answered more effectively?
7. What stakeholder groups need to align with rail electrification?
8. What concerns do railroad management have about moving away from established (diesel) traction? To what extent do investors, consumers, and policy makers share those apprehensions How can their fears be addressed or balanced by anticipation of new economic opportunities or

social gains?
9. How much cheaper is electricity as a motive fuel?
10. Is rail transportation a public utility or otherwise affected with the public interest? Do the regulatory policies of the FRA and STB encourage or discourage (or are relatively neutral) electrification?
11. Should the Congress and the Biden Administration and the Congress address the need to electrify rail to the same extent as they focus on highway transportation and electric vehicles?
12. What is the feasible future role of battery technology in supporting expansion of the electric grid, either as a mobile resource, a resilience or reliability asset, a network real estate support, major load, or a combination?
13. How might the use of battery-powered locomotive propulsion impact the need for catenary, and vice versa? Is there a strategic case for deploying catenary and battery technology jointly as a major or intermediate step toward rail electrification?
14. As part of locomotive propulsion systems, does the use of batteries as either propulsion or as grid support necessarily require development of a network of external charging facilities?
15. Does current development of prototype battery-electric locomotives indicate there is a nascent movement in the industry to a move away from established (diesel) traction?
16. What are battery capabilities now and potentially in the future, especially for heavy freight transport? What are their best uses and major disadvantages?
17. What battery technologies are best suited to railroad use, both on-board and trackside, at the present time? What technological developments will enhance that suitability?
18. Does the potential for delivering electric power from mobile sources like a unit train represent a potential alternative or complement to development of macrogrid facilities? Can such development become an alternative base load resource in some regions? What is the potential impact on grid resilience and reliability? What appetite do investors have for such long-term investment?
19. What differences, if any, from the international state-of-the-art catenary installation will North America require?
20. What companies can build the machines that build the catenary? Can the electrification process be "industrialized" to support rapid implementation?

RAIL DECARBONIZATION PLAN

1. Freight accounted for 91% of all domestic rail-use energy in 2019. About 28% of US freight moves by rail but that accounts for about 2% of total US transportation emissions due to its inherent efficiency. Does that essentially end the debate about rail's carbon impacts? Rail is also an energy efficient mode passenger transportation, constituting a cleaner option than single-occupancy vehicles or air travel; however, intercity and commuter passenger rail travel relies heavily on diesel.
2. Railroads tout their energy efficiency because they emit a quarter of the carbon produced per ton of freight by trucks; yet rail transportation has lost meaningful market share to highway transportation (trucking) in this century. How do railroads do to prevent further erosion of their dominance in freight transport?
3. The US National Blueprint for Transportation Decarbonization is a strategy aimed at decarbonizing the transport sector in order to deliver safe, effective, affordable, and sustainable solutions to meet current challenges. What are those challenges? Does the government intend to mandate specific steps to achieve reduction in greenhouse gases?

4.What measures that could affect railroad operations are currently contemplated by the Department of Energy, the Department of Transportation, or the Environmental Protection Agency?

UT REPORT ON RAIL ELECTRIFICATION

1. Why did the FRA undertake to sponsor the UT electrification risk analysis at this time? Does this signal any new or potential shift in public policy with respect to electrifying freight rail? Is the government prepared to require railroads of various classes to transition to electric power in a specific time?
2. Railroads tout their energy efficiency because they emit a quarter of the carbon produced per ton of freight that is emitted by trucks. Can they improve from an emissions standpoint? The leading railroad trade group has characterized electrification as a non-starter, but production of some experimental electric locomotives has begun in earnest in recent years. Does this tentative investment in electric locomotion reflect a new strategy, a desire to compete more effectively, or a way to attract investors?
2. Freight rail currently fueled by fossil fuel is critical to transportation of heavy freight from manufacturing and port facilities across the nation's supply chains. How feasible, economically, or technologically, would a transformation to electric power be? Electrifying the entire 140,000-mile rail network at an estimated $7million per track mile would be astronomically expensive. Would the impact on railroad returns on investment for mainline systems be simply unacceptable?
3. What are the best technology options for electrification such as grid power (catenary), batteries, renewable resources, hydrogen fuel cell, or some combination of these approaches? Will the choice depend on the loads, the terrain, the current state of the technology, or other factors? Could the electrification of locomotive propulsion be advanced by the choice to co-locate high voltage transmission (esp. HVDC) within the railroad rights of way?
5. Is there a pathway to electrification that might begin with switch engines, railyards, and other operations? What might the timeline be for electrification, especially given the goal of "net-zero" emissions for American industry in the next quarter century?
6. How do different potential joint corridor users "value" railroad rights of way in their business case feasibility plan documents ((financial model)? What can be shared?
7. What is the estimated "time value benefit" obtained in a jointly- used right-of-way corridor in terms of calculating pro forma future shifts in the benefit stream of cash flows? Who has evidence to share and discuss? Or is such an assessment still only hypothetical?
8. Is there any public experience with, or a template for, the best business practices involving transmission co-location within railroad rights of way (shared use), including the potential for further study or commercial negotiations?

THE JOINT OFFICE ON ENERGY & TRANSPORTATION

1. The Joint DOE-DOT Office has thus far pursued solutions for planning deployment of electric vehicles, under the National Electric Infrastructure (NEVI) Formula program and is directed by the 2022 infrastructure legislation to promote renewable energy resources, storage, and grid integration—this latter through use of "transportation rights of way." Are railroad rights of way viewed as more or less desirable or available than existing highway rights of way as a potential location for major HVDC and other regional and interregional transmission? Highway rights of way are regulated generally by state DOTs and the USDOT (FHWA)?

2. Is the JOET actively involved in "planning and funding" for transmission projects sited in railroad rights of way? What relationship or collaboration does JOET have with DOE's Grid Deployment Office, which is very actively promoting high voltage transmission expansion projects?
3. What can organizations like the REC do to assist the JOET's mission and focus attention on railroad assets as one powerful solution to the siting and permitting delays affecting progress toward a more integrated grid?
4. Railroad rights of way are private property. Their history, dimensions, and legal status vary. The data about those properties can be confidential, proprietary, sensitive, and not disclosed or publicized by the owner-railroad. This makes them difficult to include in transmission plans except schematically, although experience to date indicates that transmission co-location can be negotiated in commercial contexts. Should railroads make those real estate assets available given the public interest in adding transmission that could measurably improve reliability and transfer capability at a lower cost than the alternatives. Are those underutilized assets affected with a public interest for use the nation's critical grid expansion plans?

TRANSMISSION/GRID PLANNING AND THE IMPACT OF SITING

1. What *in toto* constitutes modernization of the nation's ailing, aging, and inadequate grid? Why should this be important to railroads and other infrastructure networks. Does the coming 5 – 10 years promise to be a historic period in development of the mix of US electric generation resources and the transmission grid that will be called on to support the change?
2. FERC has prescribed transmission planning best practices to remedy the glacial regulatory approval process for transmission under current (largely state) law. Order 1920 requires planners to develop planning approaches every five years, using a 20-year horizon and best available data, employing at least three scenarios, and incorporating seven different inputs – after a list of stakeholder inputs, fuel cost trends, performance, grid generation and storage resources, and building and "transportation electrification technologies, resource retirements and performance, interconnection requests and withdrawals, and corporate and governmental policy goals. ISOs are now implementing the order. Will this layer of complexity serve to expand the grid in a timely fashion, i.e., to meet climate and resilience goals, clean energy objectives, and reliability requirements? What role in planning will siting along existing rights of way play? Has FERC been clear about the importance of facilities siting, especially in anticipation of additional certification authority under Manchin-Barrasso, to accelerating transmission development?
3. DOE has identified the needs of the electric industry for new transmission corridors. This portends massive grid investment for a variety of reasons. This is just part of several programs that will provide financial partnership for major projects (Transmission Facilitation Program), mapping national transmission corridors (NIETCs), the Grid Resilience and Innovation Partnerships (GRIP) program that fortifies numerous T&D facilities and increases transfer capacity, and its recent National Transmission Planning Study, which also develops new transmission planning tools and methods, solutions, and interregional expansion plans to save consumers $270-490 Billion through 2050. Interregional transmission projects (sometimes called macrogrid) are a new priority for planners and policy makers. Given the challenges of siting projects across state, regional, and market boundaries, in addition to the cost allocation challenges, why isn't the ubiquitous rail network (along with interstate highways) an obvious way for policy makers and regulators to promote faster and less impactful (on land) ways to authorize new construction between resources

and load?
4. Do railroad rights of way have particular advantages/disadvantages for transmission co-location? Rail rights of way, particularly Class 1s, are interregional and cross energy regulatory boundaries.
5. Do railroads view transmission siting as a legitimate long-term business opportunity? What practical questions must be answered to evaluate the co-location of new transmission lines along rail rights-of-way? Are priorities compatible between rail and utilities or developers?
6. What considerations impact the sharing of risks and economic benefits between railroad ROW owners and high voltage transmission developers? Can an electrified railroad serve both the needs of the larger grid and local needs for power and transportation?
7. Will rail electrification expand the market for the construction of new remote renewable power generation? What is the value of grid-connected idle switching (and road) locomotives offering peak shaving, line conditioning, and backup electric power?
8. What potential benefits to trackside communities could be available as a result of installation of high voltage?
7. What other elements could use grid electric power, such as reefer units and crossing signals, charging stations
8. What are the cost and construction implications of each power delivery method (i.e., overhead wire, third rail, induction from buried cable, etc.?) Can a forensic and credible analysis demonstrate the variations, strengths, and weaknesses?
9. Installation of underground cable will entail disturbing a ROW; what issues does this raise for potential waste disposal, impacts on adjacent landowners, and reduction in permitting time and complexity compared to “greenfield” development.
10. What is the experience with overhead catenary suffering pole and wire damage from shifted loads and/or damaged railcars? How can this risk be minimized?
11. What are the lifecycle economics of using composite catenary poles versus steel poles?
12. What is the experience with catenary clearing double-stacked containers and other taller railcars?
13. Can power suitable for locomotives be drawn from very high-voltage transmission lines? How could this affect transmission development decisions?