SUMMARY

The RAIL ELECTRIFICATION COALITION'S October 24, 2024 WORKSHOP

During its third major Workshop, the REC continues its search for feasible pathways to railroad electrification in North America. 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. We believe the interest in rail electrification is climbing the list of national priorities as other modes of transportation electrify, as the supply chains become more competitive, as the electric power business is transforming technologically and operationally, and as public and private infrastructure investment amps up. The coming changes in the energy and transportation economies stir new questions about the role of government in driving, guiding, or funding new developments, whether industries as critical as electric power and railroads can change, communicate, and collaborate to advance their respective economic interests and historical advantages, and how the timing and depth of electrification measures will impact regulation and system planning, manufacturing priorities and technological advances, investment patterns, and state and federal public policy, and consumer and community developments around the country.

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?

The REC October 2024 WORKSHOP focused 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.

Note: "This summary is not a transcript. It is based on notes taken in good faith, without identifying names or companies, to encourage open comment. We regret any errors."

THE WORKSHOP began at 9:00 a.m.

MORNING SESSIONS: 9:15 a.m. – 11:45 a.m.
The morning sessions were designed to stimulate discussion about (and across) three diverse policy developments and where we are on the journey toward transportation and grid modernization. Presenters highlighted 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.

A. NATIONAL RAILROAD DECARBONIZATION PLAN

Presenter: Natalie Popovich, Vehicle Technologies Office (DOE), and Lawrence Berkeley Lab. 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.

Key points mentioned during the presentation and follow-on discussion included the following.

1. There are a number of technology pathways (e.g., dual-power diesel electric locomotives, Tier 4 locomotives, Discontinuous catenary) that are viable towards wide-spread rail electrification dependent on particular market segments (e.g., line-haul, short-line, rail yards, commuter rail).
2. Detailed feasibility studies for catenary and discontinuous catenary electrification for line-haul freight, intercity passenger, and commuter service on high potential routes, can help to further vet the findings from initial research that implementing these technologies on a10-60% portion of their networks makes reasonable sense.
3. Rail Yards can be a suitable candidate for full zero-emission locomotives and idling-reduction techniques. A framework for conducting and assessing a zero-emission railyard is expected to be completed by the end of 2024.
4. Further Rail-to-Grid Integration Assessments are needed to identify priority corridors for transmission co-location. NREL has conducted a study to ID priority corridors.

B. THE CURRENT MODEL FOR THE ECONOMICS OF RAILWAY ELECTRIFICATION

Presenter: Rydell Walthall, Doctoral Student, University of Texas. 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. 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.

Key points mentioned during the presentation and follow-on discussion included the following.

1. Past studies, particularly from the 1970's and 1980's do not include a detailed economic valuation of public benefits. Electrification proposals entered advanced stages of engineering design, but do not appear to have reached advanced stages of contractual negotiations. Also adjusting construction costs for inflation leads to a wide range in OCS cost/mile.
2. There are alternative technologies and strategic implementation approaches that would improve the cost-benefit-risk assessment of electrification. These include streamlining catenary construction, new locomotive technologies such as battery-electric and dual-mode, intermittent electrification, and right-of-way sharing agreements with electric utility providers.
3. The CURRENT Model provides a framework to analyze the many different electrification strategies along any given corridor. It utilizes a Monte Carlo Mathematical technique to simulate a range of possible outcomes for an uncertain event.
4. The Mainline Corridor Case Study identified in the study was analyzed in four different electrification scenarios (full conventional electrification, OCS with short gaps at public works and last mile batteries, intermittent electrification via battery tenders and OCS recharging segments, and progressive electrification via dual-mode locomotives). While electrification in each scenario produces positive returns, it requires significant upfront private investment. Public support can help bring-about private investments by mitigating some of their uncertainties. Right-of-way sharing agreements can also create significant positive return rates on private investments in electrification.
5. Communications and signals needs requires further study as shielding signal systems was a significant and highly variable cost- with the advent of Positive Train Control (PTC) this requires further study.
6. Public investment tactics that could support electrification include loan support, lower interest rates on loans, and aligning payments with accrued benefits. With respect to policies a carbon tax that is not aimed specifically at rail might be worth investigating

C. GRID INTEGRATION WORK AT THE "JOINT OFFICE"

Presenter: Julie Peacock, Joint Office on Energy and Transportation, and Pacific Northwest National Lab. The Infrastructure Investment and Jobs Act, together with the Inflation Reduction Act, promised 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.

Key points mentioned during the presentation and follow-on discussion included the following.

1. The Bipartisan Infrastructure Law (BIL) has language of Rights-of-Ways (ROW), specifically the establishment and implementation of a program to promote renewable energy generation, storage, and grid integration, including microgrids, in transportation rights-of-way.
2. As most States don't have ROW in their digital files this program would catalog and map state managed ROWs and provide a toolkit for states to understand the process of development within the ROWs. The model does not currently include Rail ROWs.
3. The National Academy of Sciences is planning a 2-day National Summit on Transmission ROWs February 2025. The summit would bring together stakeholders from all aspects of transmission planning to produce a national strategy identifying issues and gaps that can be used to scope transmission in the ROWs. It can also serve as the foundation for a future funding vehicle.

MOVING TO THE GRID OF THE FUTURE
Presenter: Hon. Michael Pesin, Deputy Assistant Secretary, Grid Systems and Components, Office of Electricity.

Key points mentioned during the presentation and follow-on discussion included the following.

1. The efforts to decarbonize the grid and the US economy are driven by several factors such as non-dispatchable and inverter-based generation, bi-directional power flows, evolving demand for electricity, growing physical and cyber threats, energy justice, workforce, and the globalization of supply chains. There is a loss of inertia when transitioning the historical grid to an emerging grid that uses inverter-based generators to produce renewable energy. Loss of inertia has grid effects. This is evidenced by the supply chain issues associated with distribution transformers. There are more than 80,000 different types of distribution transformers. This necessitates a clear need to develop standards for best practice configurations for transformers.
2. There are a number of Grid Enhancing Technologies that can maximize the transmission of electricity across the existing system such as Dynamic Line Rating, Power Flow Controllers, and Advanced Conductors
3. HVDC converters are the costliest part of long-distance transmission. DOE was directed to do an HVDC moonshot and is supporting R&D in new materials associated with HVDC such as power electronics and circuit breakers. From an engineering perspective Transportation ROWs are a fantastic solution for building out HDVC transmission.
4. Seamless integration and coordination across Generation, Transmission, Distribution, and End Use will become essential in the Grid of the Future as the lines between Transmission and Distribution will be blurred. The linkage of Energy Management Systems and Distribution Management Systems will become increasingly important in a coordinated strategy to transform the electric grid.

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.

Discussant: David Borden, Order 1920 Lead, Office of Energy Policy & Innovation, Federal Energy Regulatory Commission

Order 1920 provides a roadmap of major reforms. Long-term regional transmission planning, at a minimum at a minimum every 5 years, using a 20-year horizon. Benefit measurements to determine whether any identified long-term regional transmission facilities more efficiently or cost-effectively address long-term transmission needs. An evaluation processes and selection criteria for long-term regional transmission facilities. One or more ex ante long-term regional transmission cost allocation methods. A consideration of interconnection-related transmission needs and alternative transmission technologies. Enhanced transparency for local transmission planning. Right-size replacement transmission facilities and interregional transmission coordination.

Discussant: Michael Johnsen, Senior Advisor on Climate and Sustainability, Federal Railroad Administration (DOT)

The Federal Railroad Administration has no statutory authority over the railroads. Its focus resides on enabling the safe, reliable, and efficient movement of people and goods. Use of railroad ROWs are supported with the short lines probably being more amenable to exploring other sources of revenue for their ROWs. It's important to leverage the experiences associated with burying fibre-optics along railroad ROW's. Also, ROWs are typically much wider out west as compared to the east coast. There are a couple of case studies being followed: the Soo Green HDVC link (https://soogreen.com/), and the Champlain Hudson Power Express (https://chpexpress.com/)

Discussant, Liza Reed, Engagement, Outreach, & Strategic Initiatives, Grid Deployment Office (DOE)
The Grid Deployment Office is looking at a Transmission Need Study to provide detailed State mapping of both overhead and underground HDVC options. Existing ROWs do have value and a ROW sharing framework would be a worthwhile undertaking.

Discussant: Kellen Schefter, Senior Director, Electric Transportation, Edison Electric Institute
EEI Member Territories do have a presence across the Class 1 Commercial Rail Network. It's recognized that there is a challenge coordinating across the two sectors, however it's something worth exploring further due to territory alignment.

THE WORKSHOP ended at 4:00 p.m.

The presentations from the October 24, 2024 meeting are available at the following URL:
Rail Electrification Coalition