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Feasiblity study of freight rail electrification in Southern California

Additional submitted attachment is included below.

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The Energy Commission is currently soliciting ideas and stakeholder input for the 2018 – 2020 EPIC Triennial Investment Plan. For those that would like to submit an idea for consideration in the 2018-2020 EPIC Triennial Plan, we ask that you complete the form below. Submittals are due by **5:00 p.m. on February 10, 2017.**

Part 1. Initiative Description and Purpose:

1. Please provide a brief description of the proposed initiative:

There is a great need to electrify freight railroads in the United States. The most established way is installing overhead catenary wires over existing railroad tracks. While the up-front capital costs may be substantial, all-electric freight rail with overhead catenary is a tried-and-true technology that would pay for itself with significant reductions in emissions and transport energy costs.

Used successfully all over the world for over a century, electric freight locomotives have many advantages. In particular, electric locomotives are zero-emissions, and have much greater overall energy efficiency than conventional diesel-electric U.S. freight locomotives. Capable of being powered by renewably-generated electricity, further enhancing emissions benefits and reducing dependence on fossil fuels. Electrified rail corridors can also serve as electric transmission line routes, potentially accessing many renewable energy generation sites.

2. What technical and/or market barriers would the proposed initiative help overcome? For scientific analysis and tools, what knowledge gaps would the proposed initiative help fill?

The economics of heavy-rail electrification, for both passenger commuter and freight rail applications in California, is unknown. The benefits of heavy-rail electrification to electric utilities, as well as passenger and freight rail operators, is unknown.

1. A comprehensive feasibility study on electrifying the Alameda Corridor, along with short-haul rail service from the Ports of Los Angeles and Long Beach to an 'Inland Port' or other types of intermodal facilities in the Inland Empire. This comprehensive study would include:
• Preliminary design and cost estimation
• Cost/benefit analysis
• Environmental and social impact assessment of possible electrification alternatives.
• Cost assessment of modifying/replacing existing infrastructure such as bridges and tunnels for overhead catenaries, impacts on rail operations and safety, impacts to regional power grids.
• Operational impacts to existing freight and passenger rail service.
• Carefully assess present and future patterns of truck and rail traffic from the Ports to the Inland Empire.

2. Technical and economic study of how freight rail electrification could be a new business opportunity for electric utilities.

Part 2. Benefits and Impacts

3. If this initiative is successful, either fully or partially, what would be the expected impact? Who are the primary users and/or beneficiaries?

-Freight railroads in Southern California could reduce both energy costs and emissions, improve rail system reliability, and gain extra revenue by providing transmission/distribution right-of-ways and grid support services to electric utilities.

-Electric utilities could see the new loads from freight trains as a business opportunity. Utilities also would benefit from being able to transmit or distribute power via rail rights-of-way, and from electric energy storage systems sited at freight rail facilities.

-The public would benefit from lower railroad air pollution emissions, and less energy consumption from freight transport, and increased use of renewable energy to power freight transport.

4. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed initiative:

-Energy savings from reduced overall rail energy consumption (kWh, gallons of diesel)

-Reduction of overall rail transport energy costs ($/year, $/ton-freight).

-Emissions reductions from reduced diesel fuel use (lbs. of CO2, NOx, particulates, etc.).

-Net Present Value ($) of freight rail electrification alternatives, and compared to non-electrification alternatives.

5. Please provide a list of peer-reviewed references that support the responses for questions 3 and 4. Proposed initiatives that include peer-reviewed references will be given stronger consideration.

California Environmental Protection Agency, Air Resources Board, Transportation and Toxics Division, "Recent studies concerning freight rail electrification in Southern California: Draft Technology Assessment: Freight Locomotives", April 2016.

University of Illinois at Urbana-Champaign Rail Transportation and Engineering Center (RailTEC) for the State of California Air Resources Board, "Transitioning to a Zero or Near-Zero Emission Line-Haul Freight Rail System in California Operational and Economic Considerations, Final Report". Spring 2016.

Cambridge Systematics, Inc. for Southern California Association of Governments, "Task 8.3: Analysis of Freight Rail Electrification in the SCAG Region (Final Technical Memorandum)", April 2012.

Kenneth James, "Evaluating the Feasibility of Electrified Rail at the Port of LA/LB", College of Engineering, California State University Long Beach. for METRANS Project 07-323306, June 2011.

6. (For technologies only) What competitive advantages does the proposed technology solution have over current benchmark technologies? If the technology is beyond the prototype stage, what strategies do you suggest to bring to scale?

In the past decade, a number of studies have been commissioned by state and local government agencies on low- and zero-emissions freight rail in Southern California. In addition to freight rail electrification with overhead catenary, other low and zero-emissions locomotive technologies evaluated in previous Southern California rail electrification studies included:

- Tier 4 diesel-electric locomotives with emissions after-treatment
- Dual-mode diesel-electric hybrid that can use diesel or overhead catenary
- Third-rail electric
- Compressed natural gas (CNG)
- Liquefied natural gas (LNG)
- Onboard all-battery electric or hybrid diesel-electric
- Diesel-electric locomotives with battery-tender cars
- PEM fuel cell (PEMFC)/battery hybrid
- Solid Oxide fuel cell-gas turbine (SOFC-GT) hybrid

However, all of these studies concluded that all-electric rail with overhead catenary is the only proven zero-emissions technology for heavy-rail freight movement over any distance. It is a tried and true technology, used all over the world.

Part 3. Connection to Energy Commission's EPIC Framework
Energy Commission staff have developed a draft strategic framework to guide the CEC's planning and implementation of EPIC across triennial investment cycles. One of the objectives of the draft strategic framework is to communicate a consistent set of priorities for organizing current and future EPIC investments.

7. Please indicate which of the following strategic framework themes you feel the proposed initiative best fits within:
    - Advance Technology Solutions for Deep Energy Savings in Building and Facilities
    - Accelerate Widespread Customer Adoption of Distributed Energy Resources
    - Increase System Flexibility from Low-Carbon Resources
    - Increase the Cost-Competiveness of Renewable Generation
    - Create a Statewide Ecosystem for Incubating New Energy Innovations
    - Maximize Synergies in the Water-Energy-Food Nexus
    - Develop Tools and Analysis to Inform Energy Policy and Planning Decisions
    - Catalyze Clean Energy Investments in California's Underrepresented and Disadvantaged Communities

If Other, Please Specify

Reduce energy consumption and air pollution from the transport of goods and bulk freight in Southern California.