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| **Docket Number:** | 17-EPIC-01 |
| **Project Title:** | Development of the California Energy Commission Electric Program Investment Charge 2018 â€“ 2020 Triennial Investment Plan |
| **TN #:** | 215864 |
| **Document Title:** | Brian Yanity Comments: Heavy-rail Wayside Energy Storage System (WESS) at passenger train stations and freight yards. |
| **Description:** | N/A |
| **Filer:** | System |
| **Organization:** | Brian Yanity |
| **Submitter Role:** | Applicant Consultant |
| **Submission Date:** | 2/10/2017 2:44:36 PM |
| **Docketed Date:** | 2/10/2017 |

*Comment Received From: Brian Yanity*
*Submitted On: 2/10/2017*
*Docket Number: 17-EPIC-01*

## Heavy-rail Wayside Energy Storage System (WESS) at passenger train stations and freight yards.

*Additional submitted attachment is included below.*

CALIFORNIA ENERGY COMMISSION
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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:

The proposed initiative would investigate heavy-rail, Wayside Energy Storage System (WESS) at passenger train stations and freight yards. The WESS installations proposed would have a minimum energy storage capacity of 1 MWh, and be coupled with a locomotive battery charging system with a minimum output of 1 MW. A variety of battery, ultracapacitors, and flywheel energy storage systems are being investigated for WESS installations. At a passenger train station or freight yard, a WESS could charge a battery or hybrid locomotive (offsetting power directly drawn from the grid), or recover energy from a braking electric train using an overhead catenary or third-rail. For electric rail operators, WESS could provide electricity cost management (time-raised rate and demand charge management), power quality improvement, and provide backup power for the rail facility.

WESS for passenger and freight rail could be a new business opportunity for electric utilities. Train station and freight yard WESS sites could be charged at off-peak hours, or when there is an excess of renewable energy generation on the local grid. WESS systems, with smart inverters, could provide ancillary services for the utility: voltage and frequency support, reactive power, and peak demand reduction. Existing transmission and distribution grid infrastructure in industrial areas, which tend to be alongside rail lines in Southern California, could be used to service electrified track, battery locomotive charging and WESS 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 WESS, for both passenger commuter and freight rail applications in California, is unknown. The benefits of heavy-rail WESS to electric utilities, as well as passenger and freight rail operators, is unknown.

The proposed "Heavy Rail WESS" initiative will consist of:

1. Technical and economic study of how heavy-rail WESS could be a new business opportunity for electric utilities.

2. Evaluation of strategies for rail WESS utility control with smart inverters- charging during off-peak hours, provide power to grid peak demand periods, providing ancillary services and aid integration of distributed renewable energy

3. Construction of a heavy-rail WESS demonstration site, at a rail yard or passenger train station, with charging infrastructure for battery electric and hybrid locomotives, including emerging technologies such as wireless power transfer.

**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 and passenger railroads (Amtrak, Metrolink, BART, CalTrain, California High Speed Rail) could reduce both energy costs and emissions, improve electric rail system reliability, and gain extra revenue by providing grid support services to electric utilities.

-Electric utilities could benefit from improved reliability from energy during peak demand periods, reactive power, voltage and frequency support from heavy-rail WESS systems.

-The public would benefit from a more reliable grid, lower railroad emissions, and an increased use of renewable energy aided by WESS grid support.

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, $/passenger, $/ton-freight).

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

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


C. Lamontagne (Navigant Consulting, Inc..). "Advanced Wayside Energy Storage Systems for Rail Transit", Final Report for Transit IDEA Project 66. Prepared by Burlington, MA for the Transportation Research Board of the National Academies, April 2013.

BASE Energy Inc., "Energy Efficiency Assessment of Bay Area Rapid Transit (BART) Train Cars", Report No. BASE-PGE-05-09. November 2007.

M. Schroeder, J. Yu, and D. Teumim. "Guiding the Selection and Application of Wayside Energy Storage Technologies for Rail Transit and Electric Utilities". Report TCRP J06/Task 75. TCRP, U.S. Transportation Review Board. November 2010.

L. Romo, D. Turner and J. Ponzio. "Return on Investment from Rail Transit Use of Wayside Energy Storage Systems." American Public Transport Association. Conference Proceeding, Rail Transit Conference. June 2005.

S. Sone. "Wayside and on-board storage can capture more regenerated energy". Railway Gazette International, July 2007.

K. Holmes. "Smart grids and wayside energy storage: opportunities for transit". Passenger Transport, Vol V66, No. 40, December 2008, pages 4-5.

M. Schroeder. "White paper on Energy, Environment and Transit Research Program". American Public Transportation Association, February 2008.


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?

Heavy-rail WESS would be a larger version of WESS technologies that have been developed for electric rail transit applications. For several years, California transit agencies have been testing both on-board energy storage systems, and WESS, to store energy produced by regenerative braking of subway trains . For example, in April 2014 the Los Angeles Metropolitan Transit Authority installed a 2 MW VYCON flywheel WESS system at its Westlake/MacArthur Park subway station. Metro's electric rail transit vehicles are DC-powered, with relatively low voltage of 750VDC. Heavy-rail all-electric or hybrid locomotives could use much higher voltage DC or AC power, reducing line losses.

Battery or hybrid electric locomotives, charged by WESS sites at train stations or freight yards, do not require overhead catenary wire or third-rail electric power supply to be built along the track (the established methods for electric rail).

**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

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