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Smart and Energy Efficient Fleet Solutions (SEEFS)

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:

Proposed Initiative: "Smart and Energy Efficient Fleet Solutions (SEEFS)"
This initiative will develop a suite of smart and energy efficient fleet solutions to support future people and goods movement scenarios where fleets of battery electric vehicles and/or plug-in hybrid electric vehicles can take advantage of real-time information and predictive analytics to optimize their operations, resulting in a significant increase in energy efficiency and emissions reduction. SEEFS will also address the needs for charging infrastructure management that come with deploying a highly electrified fleet and/or with a high market penetration of electric vehicles.
SEEFS will include solutions at both the fleet and the vehicle levels. Solutions at the fleet level will include "Fleet Planning & Scheduling" and "Smart Charging". Solutions at the vehicle level will include "Dynamic Eco-Routing", "Connected Eco-Driving", and "Connected Powertrain Optimization". In addition, SEEFS will include a "Deep Learning" solution that uses actual vehicle and fleet operation data that are collected over time to continuously improve the energy efficiency both at the vehicle and the fleet levels. Initially, SEEFS will be developed for drayage application, which offer many unique opportunities and challenges as discussed in Box #2 below.

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?

SEEFS for drayage application will support the convergence of the three developing trends that aim to overcome various technical and market barriers as described below:
1. Intelligent Transportation Systems (ITS): There are multiple layers of inefficiency in traditional drayage operations that contribute to traffic congestion and the associated economic, energy, and environmental impacts. To significantly improve the efficiency of drayage operation, the US Department of Transportation has invested in research and development of a Freight Advanced Traveler Information System (FRATIS), which uses an open communication and real-time information platform to coordinate truck flow and load movement among beneficial cargo owners, marine terminal operators, and drayage operators.
2. Vehicle Fleet Electrification: Compared to light-duty and medium-duty vehicles, the electrification of heavy-duty vehicles (especially Class 8 trucks) is more challenging due to the battery size required to attain a driving range necessary for their operating goals. Since drayage trucks generally have limited daily mileage, return to a home base every night, and spend a large amount of time creeping and idling, the drayage application presents a well-suited opportunity to showcase the commercial viability of Class 8 battery electric and plug-in hybrid electric trucks (BETs/PHETs).
3. Connected and Automated Vehicle (CAV) Technologies: The emerging CAV technologies have great potential to transform our roadway transportation systems. In addition to safety and mobility-centric applications, there are many CAV applications targeted at reducing vehicle energy consumption and emissions. To take it a step further, the US Department of Energy ARPA-E has recently announced the NEXTCAR research program that aims to utilize CAV technologies to reduce energy consumption of individual vehicles by at least 20% through co-optimization of vehicle dynamic and powertrain control.

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?

Previous demonstrations of "Fleet Planning & Scheduling" in FRATIS were estimated to result in a fleet-wide average fuel consumption reduction of 8% (1). Simulation of "Dynamic Eco-Routing" for conventional diesel trucks showed fuel savings of 9%-18% (2). Simulation of "Connected Eco-Driving" for gasoline passenger cars showed fuel savings of up to 18% (3). Modeling of "Connected Powertrain Optimization" for plug-in hybrid electric vehicles showed fuel savings of 11%-32% (4). Therefore, it is expect that SEEFS, which will tightly integrate all of these technologies, would achieve a combined energy efficiency improvement of at least 40%. This will greatly increase the commercial viability and accelerate the market adoption of Class 8 BETs/PHETs. In addition, the success of SEEFS for drayage application could translate to similar solutions for other types of fleet and applications.
The primary users of SEEFS will be fleet operators, but the beneficiaries will span a broad range of stakeholders including transportation agencies, air quality management districts, electric utilities, port authorities, and communities. Note that California communities around major freight transportation hubs (e.g., San Pedro port complex) and corridors (e.g., I-710) are often underrepresented, disadvantaged, and subject to environmental inequality (5,6).

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

At the research & development stage, key evaluation metrics will include fuel consumption reduction, energy consumption reduction, greenhouse gas and pollutant emissions reduction, and travel delay reduction.

At the demonstration stage, additional metrics will include number of participating fleets, number of participating fleets with home base and or significant operation in unrepresented and disadvantaged communities, number of stakeholder agencies, and number of stakeholder communities that are unrepresented and disadvantaged.

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.

1. Fayez, S. (2014). http://www.fdot.gov/planning/statistics/symposium/2014/RouteOptimization.pdf.
2. Scora, G. Boriboonsomsin, K., and Barth, M. (2015). Value of eco-friendly route choice for heavy-duty trucks. Research in Transportation Economics, 52, 3-14.
3. Jin, Q., Wu, G., Boriboonsomsin, K., and Barth, M. (2016). Power-based optimal longitudinal control for a connected eco-driving system. IEEE Transactions on Intelligent Transportation Systems, 17(10), 2900-2910.
4. Qi, X., Wu, G., Boriboonsomsin, K., and Barth, M. (2016). Development and evaluation of an evolutionary algorithm-based on-line energy management system for plug-in hybrid electric vehicles. IEEE Transactions on Intelligent Transportation Systems, DOI: 10.1109/TITS.2016.2633542.
5. Luo, J., Boriboonsomsin, K., and Barth, M. (2017). Assessing traffic-related primary fine particle exposure for Southern California residents and the environmental inequality implications. Proceedings of the 96th Annual Meeting of the Transportation Research Board, Washington, DC, January 8-12.
6. California Environmental Protection Agency. SB 535 Maps of Disadvantaged Communities. https://www.calepa.ca.gov/files/2016/10/EnvJustice-GHGInvest-Documents-SB535Maps.pdf.

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?

As discussed in Box #3 and referenced in Box #5, the individual solutions in SEEFS are shown to provide a significant amount of fuel savings over the baseline or benchmark technologies, which will translate to substantial energy, environmental, and economic benefits. When these individual solutions are integrated together, and coupled with fleet electrification and smart charging, it is expected that even greater benefits will result.

Some of the individual solutions in SEEFS are already beyond the prototype stage. For example, the California Energy Commission (CEC) has recently funded the demonstration of "Fleet Planning & Scheduling" and "Connected Eco-Driving" solutions on drayage trucks serving the Port of Los Angeles. The California Air Resources Board has recently initiated a Zero-Emission Drayage Truck Demonstration (ZEDT) of BETs/PHETs in actual revenue service at multiple sites in California. It is recommended that CEC leverages these investments to further improve energy efficiency of fleet operations in California through electrification, connectivity, and advanced analytics. This would increase the Return on Investment of SEEFS and its component technologies, which would accelerate their market adoption.

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