

## **Freight Pilot Project Concept Summary for California Sustainable Freight Action Plan**

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### **Sustainable Renewable Hydrogen Freight Network**

#### **Location of Project:**

South Coast Basin in the surrounding area of Port of Long Beach, Port of Los Angeles, Alameda Corridor and adjacent basins connected by rail.

#### **Executive Summary:**

This pilot project concept proposes a zero emission freight network in which multiple hydrogen-powered heavy-duty commercial vehicles are deployed and refueled by a centralized renewable hydrogen onsite generation infrastructure.

Proposed heavy duty vehicles for this pilot project consists of 2 hydrogen-powered RTG cranes, 10 hydrogen fuel cell electric drayage trucks and 1 hydrogen fuel cell hybrid locomotive. The centralized hydrogen refueling station is PEM water electrolyzers capable of producing approximately 1,200 – 1,500 kilograms of hydrogen a day, with proper planning, the station can be tied to renewable source such as solar energy.

#### **Description of this Hydrogen Freight Network:**

At present, hydrogen fuel is the only alternative fuel that can offer zero emission operation, continuous operation by fast fueling and flexible routes simultaneously.

The sustainable zero emission hydrogen freight network starts from containers arriving at the port lifted by hydrogen powered RTG cranes into fleet of hydrogen electric drayage trucks and then hauled to a hydrogen-powered locomotive that takes all the containers to further destinations. With this scale of deployments with various vehicle types, RTG, trucks and locomotive, economies of scale allows substantial consumption of hydrogen in one close proximity supported by a centralized site of hydrogen onsite generation and refueling station. This can potentially translate into considerable reduction of hydrogen fuel cost for a long term.

All the proposed fuel cell heavy-duty commercial vehicles will be integrated with our state-of-the-art heavy-duty fuel cell power system – Celerity - which is developed and custom-built for heavy

duty mobility applications and can be easily integrated into different vehicle platforms by scaling. The proposed centralized hydrogen fueling station is fully equipped with containerized water electrolyzers, compressors, storage and dispensers, tied partially or completely to renewable energy sources depending on the final location of the station. This centralized hydrogen heavy-duty refueling station will be located close to the ports where all drayage trucks commute to daily, the hydrogen RTG cranes and hydrogen locomotive can also be easily refueled by mobile fueling with the hydrogen generated from the central refueling station. All the advanced hydrogen fuel cell and hydrogen generation technologies proposed in this pilot project concept are proven and commercially ready.

With large guaranteed consumption of hydrogen fuel by a fleet of drayage trucks, RTG cranes and locomotive proposed in this pilot project and also by other fuel cell drayage trucks soon to be demonstrated in the area, economies of scale such as lower acquisition cost of infrastructure equipment, volume discount of vehicle BOM, bargaining power with utilities, etc. will help to bring the cost of hydrogen fuel down significantly. The lessons learned, experience and data gathered from a large scale hydrogen project can put California into a long term sustainable path to a zero emission freight system.

The estimated initial capital outlay for implementing a hydrogen freight network can range from \$45 to 55 million USD for 2 hydrogen powered RTG cranes, 10 fuel cell drayage trucks, 1 fuel cell hybrid locomotive and 1 centralized hydrogen onsite water electrolysis based heavy duty refueling station, excluding annual operating, maintenance and services costs.

The total development time for the entire hydrogen freight network is approximately 3 years to 4 years. It is expected that the ten fuel cell drayage trucks and the centralized hydrogen refueling station will be commissioned in 2.5 years, followed by the hydrogen RTG cranes in 2.5 years and the hydrogen locomotive in 3 years. It is estimated that the entire hydrogen freight network will be fully commissioned and operational in 4 years. The hydrogen freight network is expected to be operational for a period of approximately 8 to 10 years before major replacement of equipment required. Since this is entirely a zero emission freight network, the amount of greenhouse gas displacement will be significant. In due course and depending on the value of the project, renewable hydrogen can be produced by integrating renewable energy sources to the electrolyzers in the centralized refueling station.

Since this is a large scale first-of-a-kind hydrogen fleet and fuel multi-vehicles deployment project involving multiple fleet operators, multiple clean technology providers and requires a substantial initial capital outlay, financial and administrative support from CEC, ARB, South Coast AQMD, Caltrans and Ports are crucially needed, and also public outreach support from Universities and non profits will also be welcomed to make this pilot project a success and publicly beneficial.