Distributed Hydrogen with SureSource Hydrogen Trigeneration Systems

February 2018

Company Overview

Company

Design & Manufacture

Project Development

Turn key Project Delivery

Plant Operation

- Delivering clean innovative solutions for the global supply, recovery and storage of energy
- Corporate office, R&D and global service in Danbury, CT
- Manufacturing in Torrington, CT
- More than 50 installations, several hundred MW installed on 3 continents
- Produced >7 billion kWh's of ultra-clean power

Markets

Energy Generation

- Ultra-clean
- Affordable
- Enhances Resiliency
- Easily sited

Carbon Capture

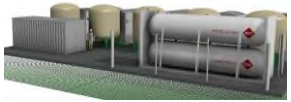
- Generates power while capturing CO_2
- Affordable capture from coal and NG sources

Distributed Hydrogen

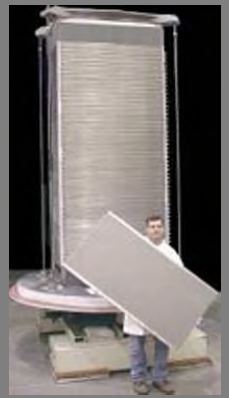
- Generates power while producing H_2
- Affordable, clean, local H_2 production

Solid Oxide Based Power Generation, Electrolysis and Storage

- Efficient power generation, H_2 production, and hydrogen-based energy storage



FuelCell Power Generation Systems



Individual fuel cell
&
350 kW fuel cell stack

Four-Stack Module
1.4 megawatts

Completed module
1.4 megawatts

1.4 MW SureSource1500™
- *Utilizes one module*
- *47% Electrical Eff, up to 90% Total Eff.*

2.8 MW SureSource3000™
- *Utilizes two modules*
- *47% Electrical Eff, up to 90% Total Eff.*

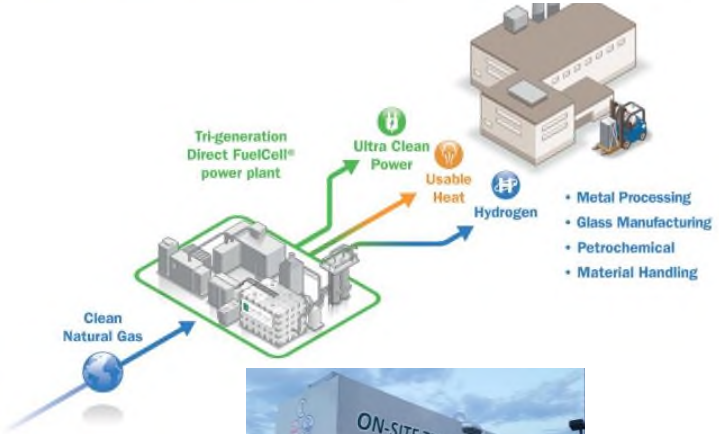
3.7 MW SureSource4000™
- *Utilizes three modules*
- *60% Electrical Eff. Up to 80% total Eff*

59MW fuel cell park

Distributed Hydrogen Production

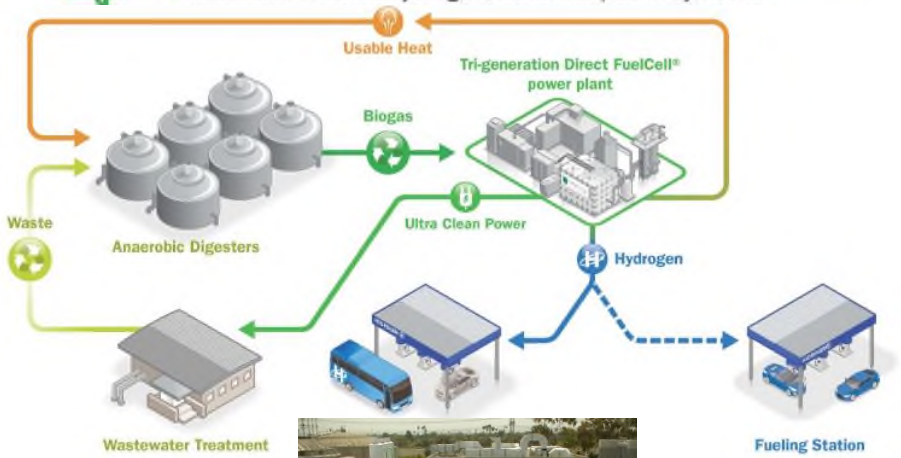
Industrial Hydrogen

Affordable efficient hydrogen, heat and power systems



Renewable Transportation Fuel

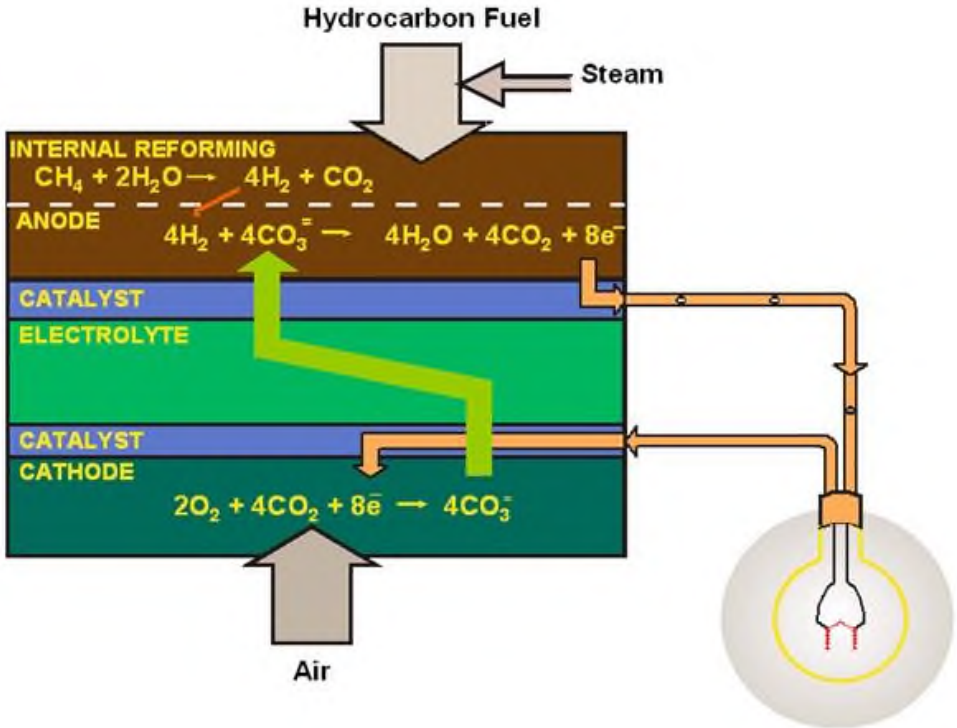
Affordable efficient hydrogen, heat and power systems



Hydrogen is produced as byproduct of fuel cell process, efficiently and without water consumption

SureSource Fuel Cell Operating Principle

- Internal reforming of methane to hydrogen
- Methane reforming heat is provided by fuel cell waste heat
- Methane reforming water is provide by fuel cell product water
- Electrochemical conversion of fuel to power is more efficient and avoids products of combustion emissions



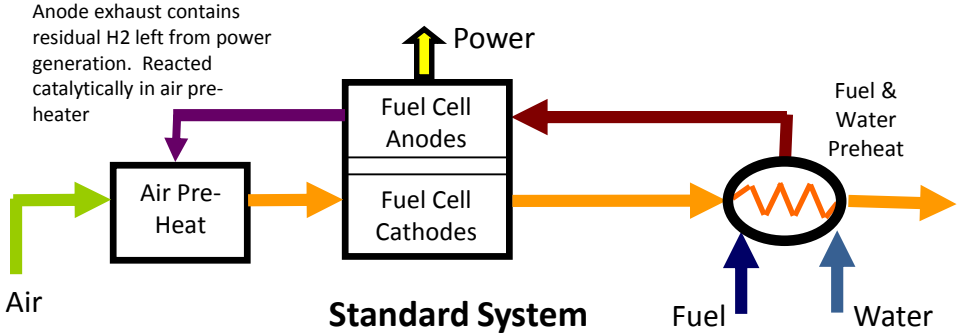
Trigeneration System

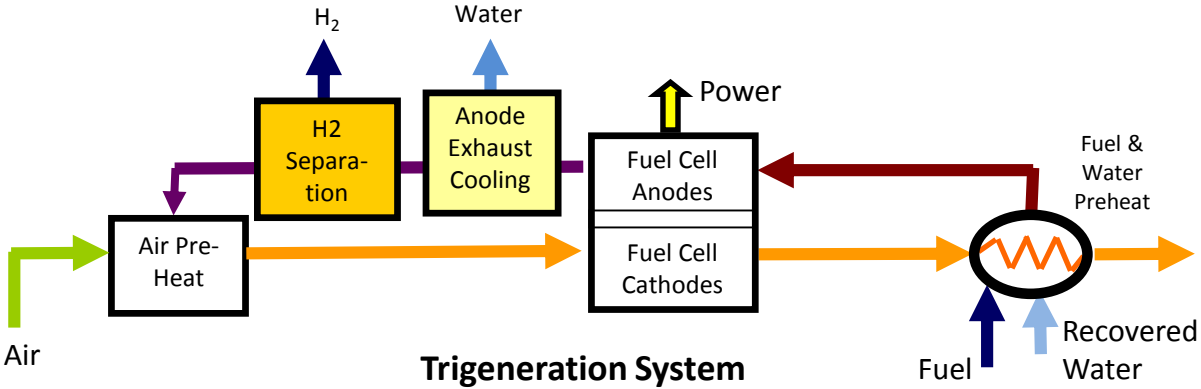
Standard System:

- Natural gas or biogas fuel is efficiently converted to hydrogen inside fuel cell stack, using fuel cell waste heat
- Most H_2 used to produce power.
- Residual H_2 used to pre-heat fresh air

Trigeneration System:

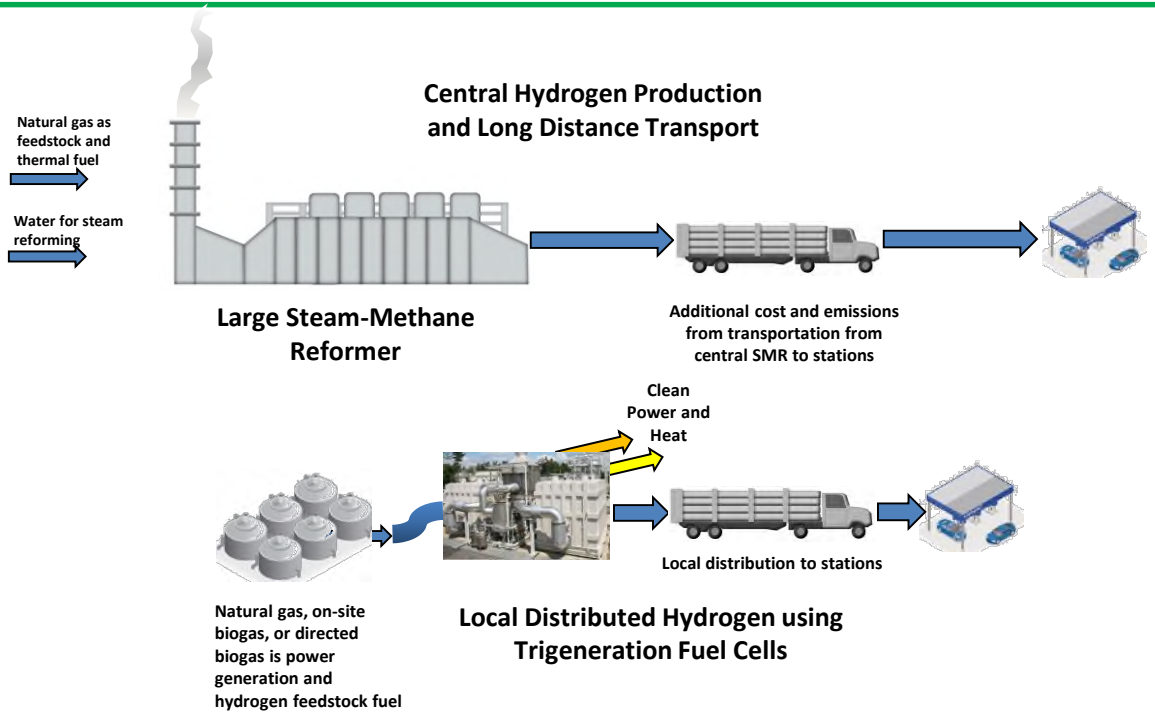
- Same process, but residual H_2 is extracted and purified for external use
- H_2 is produced very efficiency, using waste heat from fuel cell power generation, and water produced by anode reactions
- Air pre-heat done by heat exchange with exhaust gas
- Similar to CO_2 capture, but H_2 is extracted from anode exhaust instead of CO_2

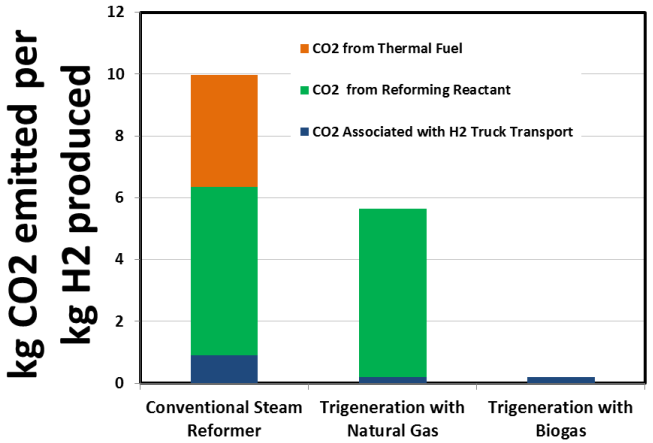




Trigeneration is modification of standard SureSource system

Distributed Hydrogen Low Carbon Footprint

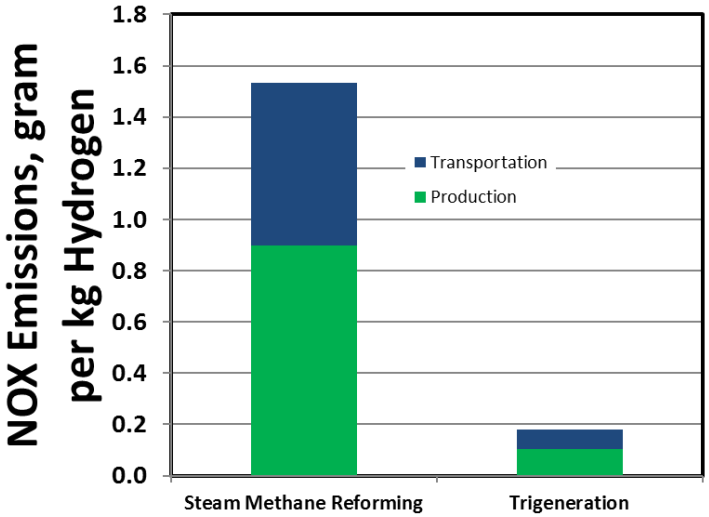


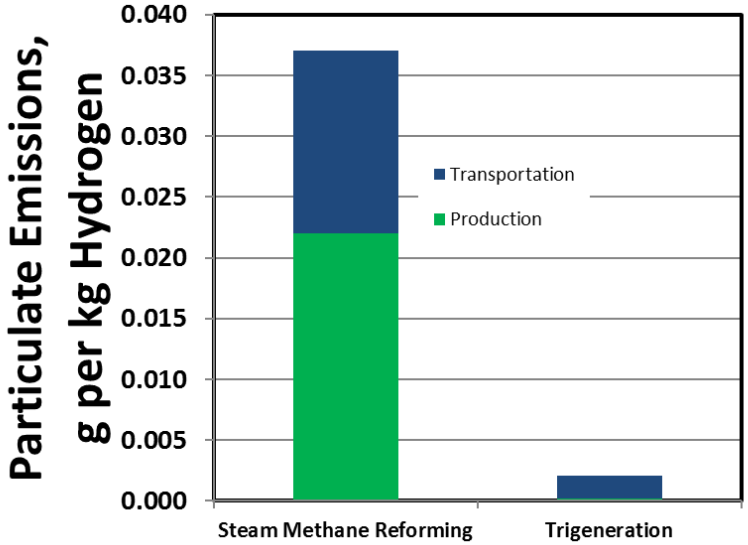


Comparison of CO_2 Emissions for Central SMR and Distributed Hydrogen

Distributed Hydrogen Trigeneration systems produce hydrogen with fuel cell waste heat, avoids methane combustion and avoid cost & emissions of long distance truck transport

Criteria Pollutants Emissions Reductions

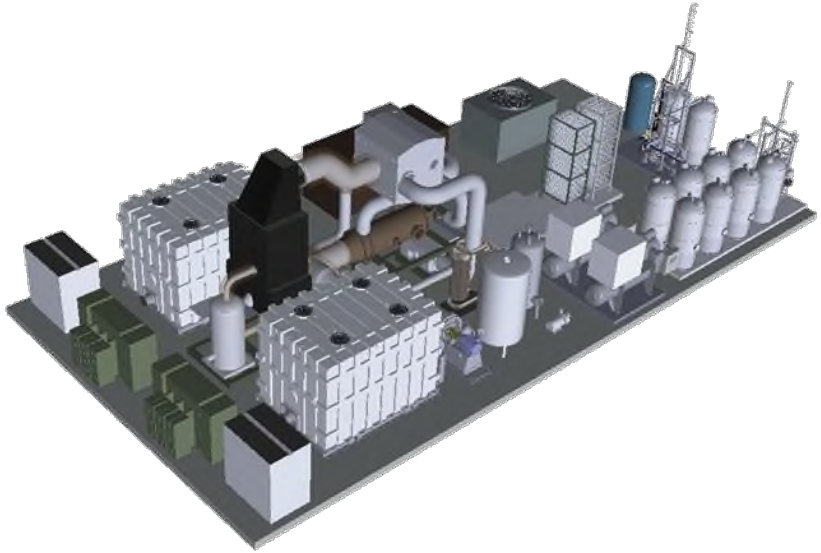




SureSource 1500 and 3000 power plants have achieved CARB DG Certification on Anaerobic Digester Gas under the California Distributed Generation Program 2013 Waste Gas Standards

SureSource Hydrogen System

Power Output, kW	2,350
Hydrogen Production, kg/day	1,270
Vehicle emissions reductions:	
NOX reduction, tons/year	8.9
Particulate reduction, tons/year	1.8
GHG reduction, tons/year	6,200



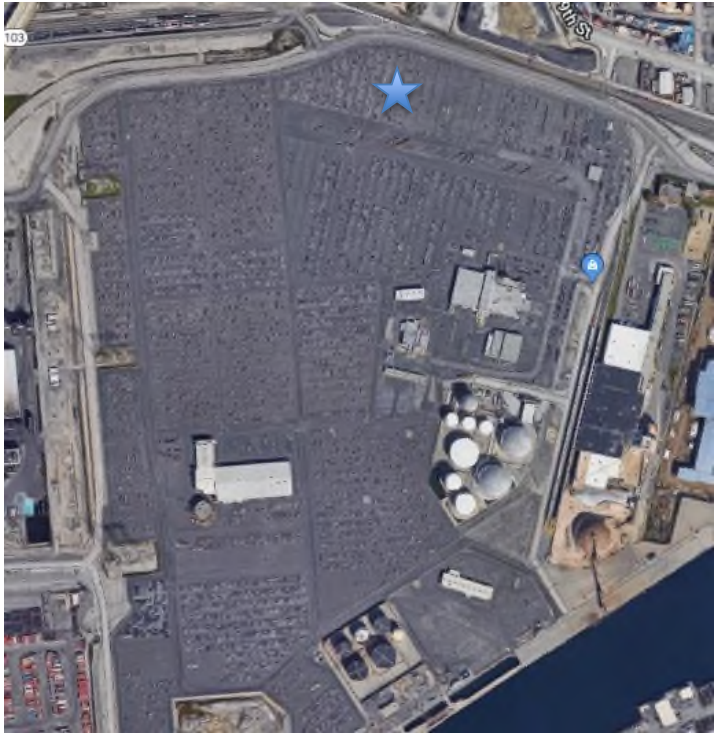
Modification of SureSource 3000 Powerplant
Produces enough hydrogen for ~1500 cars or 30 busses refilling a day
Generates enough electricity for ~2,350 average-sized homes
Emission reductions are vs standard cars - Additional reductions from clean power

Port of Long Beach Project

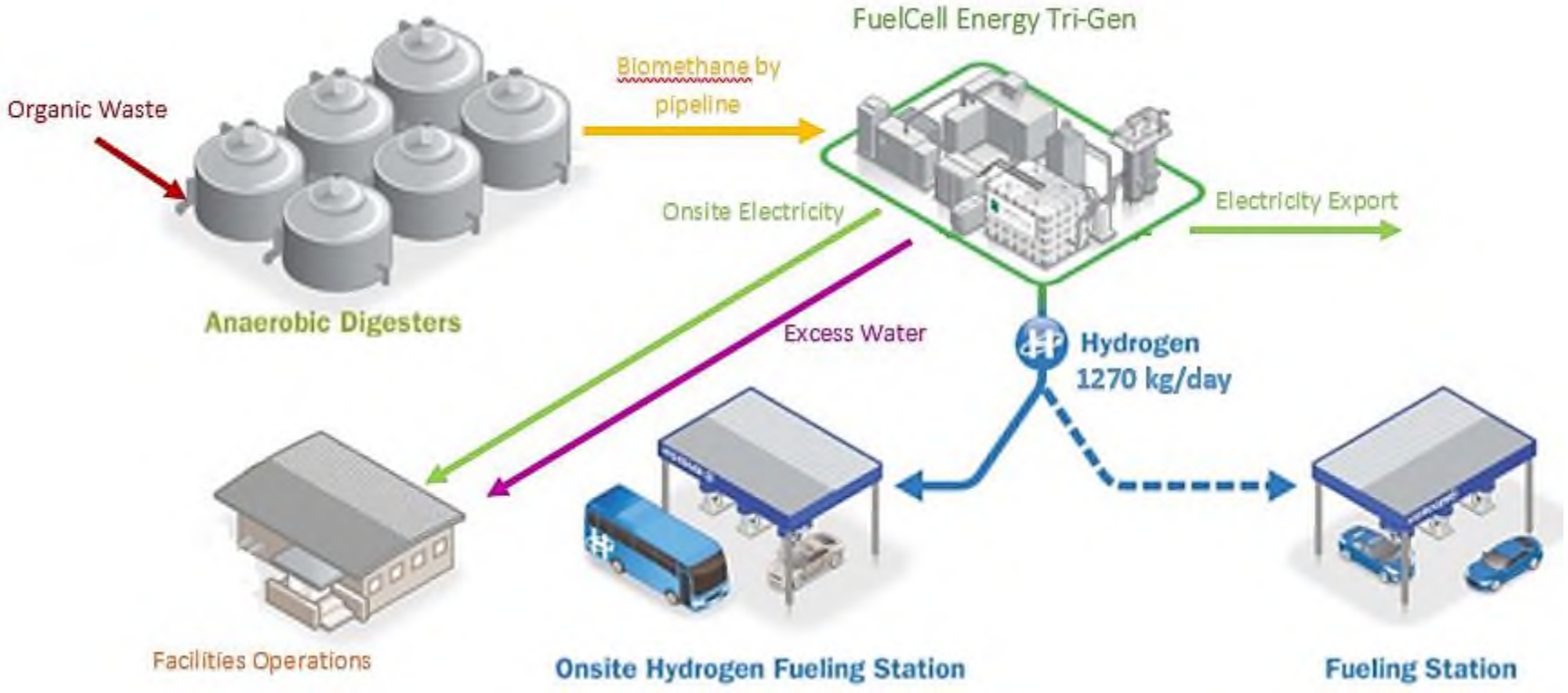
Toyota to Build the World's First Megawatt-scale 100% Renewable Power and Hydrogen Generation Station

Tri-Gen will generate on-site hydrogen to supply Toyota Fuel Cell Vehicles, including Project Portal Heavy-Duty Truck Concept

Toyota Logistics Services at the Long Beach Port will become first Toyota facility in North America to use 100% Renewable Power



Supporting the Advancement of California's Hydrogen Fueling Infrastructure



Thank you