

A CALIFORNIA ELECTRIC ENERGY UPDATE

(The Equipment Pathway of Electrification)

Blog #93 CaliforniaGeo 5-26-23

Where We're Headed-

The late Henry J. Kaiser (entrepreneur extraordinaire who built Liberty Ships and the Hoover Dam) had a motto of “Find a need and fill it.” To some extent, American industry is still carrying out that approach. For example, take government. It swings a big bat through regulations, tax policy, and financial inducements. The Transcontinental Railroad was built by granting land ownership along the route to the Union and Central Pacific Railroads. Farms and dairies became electrified in the 1930s because of federal loans to rural electric associations. The decision to build the Interstate Highway System we depend on today was a federally sponsored, massive project.

The federal government had goals in mind throughout these projects: link the nation; make electricity available to rural communities; win WW2, and build a high speed road system for transporting citizens and land freight. Since then, the federal government has been interested in consumer safety, clean air and water, national security, public health, and lately, a strong focus on suffering and damage by climate change that's brought on by global warming resulting from increased carbon dioxide.

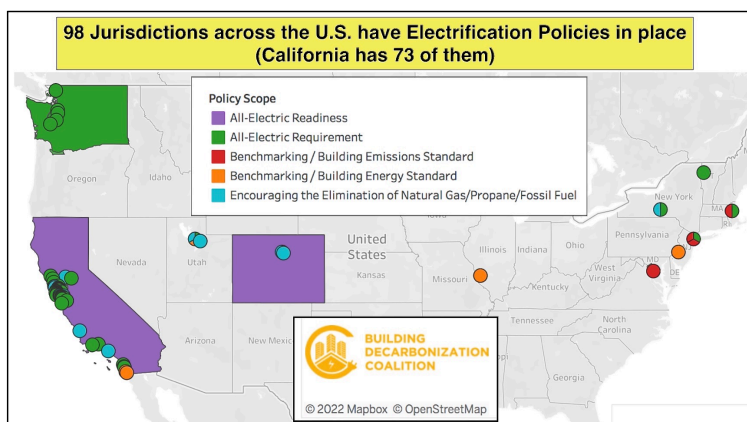
Federal inducements and regulations to reduce carbon emissions have been underway for many years and reached a new crescendo with 2022's Inflation Reduction Act, the greatest concentration of incentives in history for carbon reduction activities. Economists often refer to such actions as a “Market Signal,” to citizens and industry that this is not a “policy blip,” but a long term certainty that will drive change in a continuing direction.

Consumers can chase purchases, loans, and investments based on this certainty and industry can feel more comfortable taking certain research and development risks. Try to imagine U.S. vehicle manufacturers' 10-year plans if there were no clean air emissions deadlines to electrify transportation. One of them might step forward—only to lose millions in a risky bet—reducing their future competitive strength against those who held back turning their reluctance into perfect hindsight.

Drivers of Electrification-

Certainly there are ambitious policies at the state and federal levels to reduce carbon emissions. There are an increasing number of city and county jurisdictions where gas is restricted in new construction. Many home remodels are retrofitting for all-electric use, including an upgrade to more efficient induction cooktops. The motivation for some citizens is indoor emissions reduction, while others want to become “greener” citizens. Many are buying electric vehicles and adding solar systems for charging help.

Electric utility generation is also changing via regulation and will increase green over brown electrons being supplied to consumers. Renewable sources of electricity are responsible for this. But in this case for both utilities AND consumers, one fact is often missed. Once the infrastructure of capture is in place, the “fuel” for renewables is FREE. So that means that home bills and utility supplies will both be more stable. This stability will be an improvement over the pump prices for gas as the Russian war against Ukraine began in 2022. At that time, wholesale prices for natural gas also rose very quickly and resulted in high bills for consumers.



De-carbonization through Electrification can only work effectively when the technologies to accomplish it are available. Fortunately, these technologies are improving on many fronts.

- **LED (light emitting diode) interior and exterior lighting**

Highest efficiency, longest life, and least heat generated.

- **Electric Induction Cooktops**

Heat confined to pot/pan bottoms, instant control response, less power draw.

Table 4. Efficiencies of cooktops and ovens

	Cooktop Efficiency	Oven Efficiency	Combined Efficiency
Gas	27.2%	22.4%	25.5%
Electricity (resistance cooktop)	67.0%	29.0%	47.5%
Electricity (induction cooktop)	85.0%	29.0%	53.0%

Source: U.S. Department of Energy. 2016. Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial and Industrial Equipment: Residential Conventional Cooking Products; Frontier Energy. 2019. Residential Cooktop Performance and Energy Comparison.

- **Electric Heat Pumps**

They concentrate and transport heat—not create it. One unit both heats or cools. They are more efficient than fossil-based heating with electric A/C cooling.

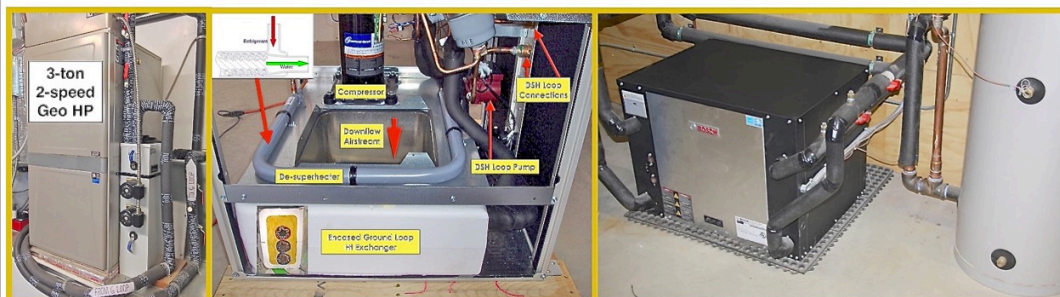
Air-Source Heat Pumps



Split System (interior ducted)

Ducted Mini-Split

Ground-Source (Geo) Heat Pumps



Water-to-Air (downflow delivery)

Water-to-Water (Buffer tank shown)

• Electric Vehicles

Improved technology, greater availability, continued rebate incentives.



UK's multiple makes and 22 models in the 2018 market



Covered "charge" parking for business loaner cars



Medium-hop cargo delivery



Flexible, medium duty construction



Short-Hop delivery medium volume



High passenger volume all-day range



Heavy duty utility service bucket truck

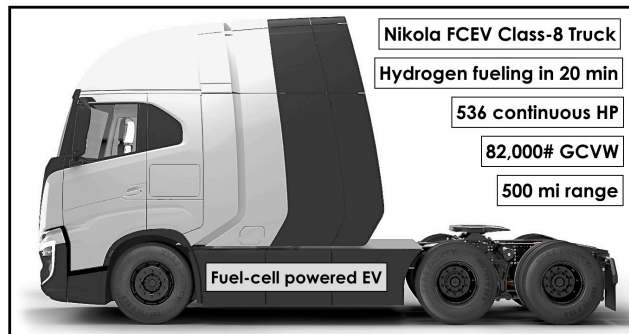


Case 580 "Zeus" EV Backhoe



Volvo Trucks' Customer Albertsons Achieves Nation's First Commercial 100% Zero-Emission Refrigerated Grocery Delivery with a Class 8 Truck

By Volvo Trucks North America May 28, 2021



Nikola FCEV Class-8 Truck

Hydrogen fueling in 20 min

536 continuous HP

82,000# GCVW

500 mi range

Fuel-cell powered EV



Semi Specs

Fully Loaded at 82k lbs Gross Combination Weight

Mile Range
Approximately 300 or 500 miles

0-60 mph
20 seconds

Speed Up a 5% Grade
Highway speed limit

Powertrain
3 independent motors on rear axles

Energy Consumption
Less than 2 kWh per mile

Fast Charging
Up to 70% of range in 30 minutes

Fuel Savings (est.)
Up to \$200,000 over 3 years

- **Electric Aircraft**

Battery Electric and Hydrogen fuel cell powered.
Increased size and capability improving.



(Left) Cessna 208 Electric Caravan is now in certification testing for commercial use.
(Right) Sounds Air 19-seat electric airliner will serve Australia & New Zealand in 2026.

AirBus is working on a hydrogen powered turbofan prototype in 2025 **(Below)**



Universal Hydrogen has begun testing a hydrogen powered electric fuel cell DeHavilland Dash-8



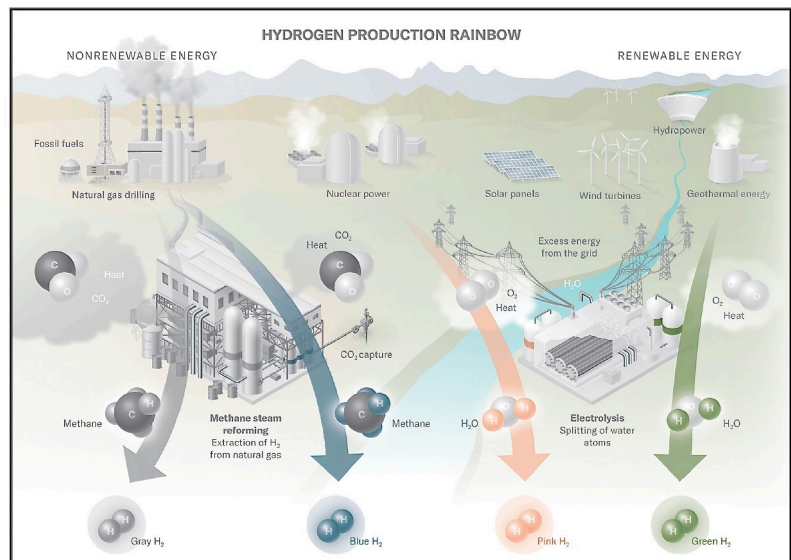
The Universal Hydrogen-branded plane also relied on jet fuel. Notice the Pratt and Whitney turboprop engine under one wing. **Image Credits:** Mark Harris



BNSF Railway and Wabtec pilot-tested a battery-electric locomotive in California in 2021. (Wabtec)

Diesel locomotives are one of our highest pollution sources, even though they are efficient freight transports. Fuel cells to create high voltage for their electric drive motors is a similar pairing to municipal transit powered with 600-volt AC electric motors. These locomotives would add to the hydrogen supply that will be needed.

—Bill Martin



**Four paths to a non-carbon fuel.
Which one is the best choice?**

**High Country
News 7-5-22**