

# CASE STUDY



**Location:** San Francisco, CA

**Company:** Pacific Gas and Electric Company (PG&E)

**Study:** Electric Drive Vehicles

Pacific Gas and Electric Company (PG&E) is a company based in San Francisco, California. As an energy company it directs significant attention to energy efficiency and clean energy options. The company's website offers additional information on the company's community and environmental responsibilities. One of the major changes the company has undergone to reduce its carbon footprint has been the greening of its fleet vehicles. The company has deployed multiple hybrid electric vehicles within its fleet as a solid business model. The company has service vehicles such as bucket trucks, "cherry-pickers", and light-duty fleet cars.

There are three basic types of bucket trucks, says Director of Transportation Services Dave Meisel. The first and least fuel-efficient type is the standard conventional fuel truck that operates the bucket with a hydraulic system powered by the vehicle's internal combustion engine. The second type



*The PG&E 100% electric bucket truck, configured and manufactured by Smith Electric Vehicles. Photo courtesy of PG&E.*

uses conventional diesel engines for propulsion, but uses an electric system to operate the boom and additional systems such as the truck heating and cooling system when the vehicle is stationary. This type of hybrid system allows for reductions in idle fuel consumption and emissions. The third type is the PG&E 100% electric bucket truck, which are the most fuel-efficient because electric motors power the motor for propulsion and all subsystems.

PG&E put its first 100% electric truck on the road this year, as the first U.S. prototype based on a European model. With the help of Smith Electric Vehicles (one of a few electric truck manufacturers in the nation), the PG&E chassis has become the model on which other electric bucket trucks have been designed.

## Decision Points

Several factors played into the decision to use electric bucket trucks and light-duty plug-in electric hybrids, not the least of which is fuel cost. From a business perspective, the cost of petroleum-based fuel has increased over the last four years. According to Meisel, the compounded annual growth rate of petroleum fuel was 7.5% in the last 15 years and was 12.5% in the last four years. Comparatively, the growth rate of electricity was 2.8%. "Electricity is much more reasonably priced," Meisel said. The inflationary cost of petroleum fuel is expected to increase, so the PG&E business model is looking toward the future to keep its operating costs reasonably low.

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Operation of a plug-in hybrid bucket truck that uses a diesel engine for vehicle propulsion but onboard batteries to power subsystems when stationary. Photos courtesy of PG&E.

Government incentives that provide per-unit rebates for each truck put into service also played a role in the decision-making process. There are many state and federal incentives available for businesses in California that choose to use electric drive vehicles. Incentive rebates were built into PG&E's cost analysis, showing that the trucks would be a good investment. Though the cost-benefit ratio was the main driving force in the decision, the company also believes it has an obligation to environmentally friendly operations, which has enhanced the company's public image. "Public opinion is important," Meisel said, "but incentives and public image don't change the way we do business. The main decision was based on the cost model that showed the trucks were cost efficient."

### Fleet Facts

In total, there are 14,000 alternative fuel vehicles; many of which utilize compressed or liquefied natural gas. However, the fleet also includes its all-electric bucket truck, hybrid electric bucket trucks, an extended range electric pickup truck, as well as 20 Chevrolet Volts. The PG&E electric bucket truck, manufactured by Smith Electric Vehicles, can travel up to 120 miles when the batteries are fully charged. The fleet operates within relatively small regions and the miles driven are low at approximately 450 miles per month per truck.

Both types of electric bucket trucks are plug-ins, as well as the Volts. They are plugged into either Level 2 charging stations at the end of each shift to charge overnight or Level 3 Fast Chargers if the truck is expected to return to service more quickly. Batteries are topped-off daily in case of emergency situations.

### QUICK FACTS

**Fuel Type:** Various versions of plug-in hybrid electric vehicles (PHEVs)

**Light-duty Fleet:** 20 Chevrolet Volts

**Heavy-duty Fleet:** Various PHEVs and one 100% electric bucket truck

**Miles Driven Annually:** 5,400

**Estimated Fuel Consumption:** 120 miles per 120 kW charge

**Break Even on Investment:** 6-7 years (not including incentives)

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The gross vehicle weight of the bucket trucks is between 16,500 and 26,400 pounds, depending on the specific configuration. Payload can be as much as 16,200 pounds.

Generally, battery life for all electric vehicles continues to improve as technology advances. PG&E has not experienced any problems with battery life or performance, Meisel said, although the trucks have not been in service long enough to know conclusively how long the batteries will last before having to be replaced.

### Fuel Supply and Infrastructure

PG&E uses Level 2 and Level 3 charging stations depending on the vehicle. All the trucks are charged in-house when they return to the facility at the end of each shift. The charging procedure is very straight forward and the charging stations have operated without any breakdowns or difficulties, "It's just plug and go," Meisel said.

Being an electricity provider has its advantages when it comes to electric infrastructure, but the two main reasons the company uses in-house charging are because trucks are used locally and return to the facility each day, and because public infrastructure does not support the charging requirements for such a large battery capacity. PG&E has installed 50 of its own charging stations in various locations. They also plan to increase the vehicle fleet size, which will be able to use the same charging infrastructure.



*Director of Fleet Services Dave Meisel (right) and Senior Vice President of Safety and Shared Services Des Bell (left) were in the nation's capital to demonstrate the cost effectiveness and performance of 100% electric bucket trucks in fleets. Photo courtesy of PG&E.*

### Costs

Depending on the particular specifications of an individual truck, the purchase cost is more than conventionally fueled vehicles, but the purchase price is offset by fuel savings. The trucks cost approximately 5% more to purchase (including incentives and rebates), but 8% less to operate for a lifetime net savings that outweighs the initial investment. As mileage increases over the life of the vehicle, the percentage of savings also increases incrementally based on the specific vehicle. According to Meisel, the trucks break-even in about six to seven years.

The low cost of electricity – approximately \$0.05 per kW-hr per mile – compares favorably to the current cost of conventional fuels. The conventional fleet vehicles at PG&E use 10 million gallons of fuel each year at a cost of approximately \$5 million. Thus, the cost/risk profile (the cost compared to the risk) of using electric vehicles is positive. Operating costs also are offset by less required maintenance.

### Maintenance and Satisfaction

Because of the nature of PG&E's business, the trucks must comply with specific inspection regulations; therefore, the man-hour costs for maintenance are similar to conventional trucks.

When it comes to performance, electric trucks are similar to conventional trucks. However, acceleration to cruising speed can take approximately twice as long. There is also a slight difference in top cruising speed, but since most bucket trucks operate locally and rarely need to drive on a freeway, the impact of slightly slower acceleration and lower top cruising speed is minimal.

<b>PERFORMANCE COMPARISON</b>		
<b>Metric</b>	<b>Electric Trucks</b>	<b>Conventional Diesel Trucks</b>
0 – 60 MPH	17 – 18 seconds	8 – 9 seconds
Top Cruising Speed	50 - 60 mph	65 – 75 mph
Average Driving Range	120 miles per charge	200 miles per tank

*Data provided by PG&E.*

Operator acceptance of the electric trucks has been good, Meisel says. Operators expect smooth and reliable operation, and PG&E has had no problems with boom performance. Plus, since the bucket boom operates on an electric-powered motor with no PTO, there are fewer mechanical breakdowns, which makes truck operators and mechanics very happy.

### Summary

Large corporations are constantly looking for ways to maximize the bottom line. Although conventional heavy trucks ultimately win the competition for driving range, speed, and acceleration, electric vehicles can be deployed cost-effectively when operating parameters are considered. When business models and cost profiles are structured to include the cost of electricity, maintenance and repairs, and the future of petroleum-based fuel costs, the benefits of electric vehicles show a clear advantage.

As electric charging infrastructure becomes more widely available and as battery technology continues to improve, electric vehicles can be incorporated into many fleets without changing day-to-day operations.