CASE STUDY

Tests Demonstrate Safety of Natural-Gas Vehicles for King County Police

In King County, Washington, police officers patrol the neighborhood in Chevrolet Caprice Classic police-package sedans that run on compressed natural gas. These officers are tough customers; their lives depend on their vehicles. After rigorous testing, they found their alternative-fuel cars to be as safe and reliable as conventional vehicles.

Motivation for Change

In response to the Clean Air Act of 1990, the King County Council passed two ordinances supporting the use of alternative-fuel vehicles (AFVs). The Fuel Conservation Policy (April 1991) emphasizes use of alternative fuels to reduce dependency on imported fossil fuels. The policy on use of county vehicles (October 1991) requires county managers to ensure that "alternative fueled vehicles are used whenever possible." The council mandated that 50% and 75% of vehicles purchased in 1992 and 1993, respectively, be converted to alternative fuel.

In making the decision to use AFVs, King County considered the availability of fuel and appropriate technology, the relative costs, and the way the vehicles are used. The Department of Transportation, Fleet Administration Division, oversees a fleet of 2,600 vehicles that support police, public works, and administrative activities. In 1991, the Chevrolet Caprice police cars helped pioneer the county's switch to alternative fuel.

Police cars were a good candidate for alternative fuel because of their high mileage and low fuel economy. Compressed natural gas (CNG) was chosen as the fuel because of the need for high performance. King County decided on vehicle conversions because no available original equipment manufacturer (OEM) CNG vehicles ***For***

were suitable for police operations. Conversions could also be done quickly and without disrupting operations.

Getting Started

Precinct 3, a suburban area outside Seattle, was chosen as the first site to implement AFVs, partly because local fire codes allowed a CNG fueling facility to be set up. Gasoline-fueled Caprices equipped with police packages were converted into bi-fuel vehicles that can run on either CNG or gasoline. A local Chevrolet dealer installed IMPCO, TechnoCarb, and MOGAS conversion kits. About three conversions could be done in one week's time, and the vehicles were phased into the fleet as they arrived from the dealer.

Testing Leads to Driver Acceptance

In the excitement of building a CNG fueling facility and converting the first vehicles, county officials inadvertently neglected to involve the police officers in the start-up phase of the AFV program. The officers found out about the AFVs only after the CNG fueling facility had been delivered and was being installed. Accompanied by a Police Guild representative, officers visited the fleet manager, the sheriff's office, and the County Council to express their concerns over the safety and performance of the AFVs.

Windell Mitchell, King County's Fleet Manager, suggested a solution: let an objective outside consultant test the vehicles. If the AFVs proved to be unsuitable, Mitchell would scrap the project. The officers agreed. Steve Eggert, President of the King County Police Officer's Guild, summarizes: "Police drive their vehicles like nobody else drives their car…Nobody else had done testing like this. Most of the testing had been done on fleet vehicles used for normal driving, not the extreme conditions of police driving."

Engineering Accident Analysis of Kent, Washington, conducted the tests. Three AFVs and one unconverted gasoline vehicle were compared. Testers drove the bi-fuel AFVs first on CNG and then on gasoline; they then compared those experiences with driving the gasoline car. Both professional drivers and police driving instructors participated so that both objective and subjective data could be gathered. The objective tests were performed in the parking lot of the Seattle Kingdome. For the subjective tests, a simulated Emergency Vehicle Operation Course was set up at the Seattle International Raceway. About 2 1/4 miles long, the course included stops, lane changes, slalom maneuvers, and turns.

The tests showed that the AFVs handled differently from the gasoline car:

- In objective tests, the AFVs did not oversteer and had less understeer than the gasoline car, which means that the heavier AFVs are more stable and easier to steer.
- The subjective "feel" of the AFVs was different because the weight is more evenly distributed – the weight of the fuel cylinders in the trunk balances the weight of the engine in front.
- In acceleration tests, the AFV response was slightly slower than that of the gasoline car.
- In braking tests, the AFV response was slightly slower than that of the gasoline car.

In police driving, accurate steering and fast braking are essential, and the officers had been particularly concerned about the effect of the added weight of the conversion equipment (about 280 pounds) on vehicle performance. After the tests, the officers felt that although AFVs handled differently, drivers could be trained to adjust to those differences, and the AFVs even had a slight advantage in handling over gasoline vehicles.

The tests impressed Mike Dillon, Vehicle Operations Instructor: "I was pleasantly surprised. I was expecting all kinds of failures, problems, and concerns, and every step of the way, it proved not to be such a big deal…After driving a car all day on the track, I preferred the extra weight in the trunk. It felt more stable… than the unconverted car. Overall, [the AFV] is a good car – I wish I could get one for myself."

A videotape that shows the handling tests, drivers' reactions, and the CNG system is used in training and publicity. To keep communication lines open and avoid future problems, King County set up a committee of police officers, guild representatives, and public works administrators who provide input to decisions on the use of the AFVs.

In-Use Performance

The 74 AFVs are all assigned to Precinct 3, a suburban and rural area. Each vehicle is assigned to a specific driver, who takes the car home after work. The vehicles average about 23,000 miles per year and an average of 60 months in service. To date, these CNG-powered police sedans have accumulated more than 5 million miles on the road.

Fleet Facts

Fleet Type:	County government
Fleet Size:	2,600, of which 270 run on alternative fuel
Alternative Fuel:	Compressed natural gas and propane
Vehicles:	Chevrolet Caprice Classic with police package, sedans, pickup trucks
Location:	King County, State of Washington, near Seattle

Officers newly assigned to CNG vehicles are trained in handling the heavier cars. They drive on the Seattle International Raceway to get the feel of the vehicles. The biggest challenge has been helping drivers understand the importance of driving on CNG as much as possible.

Eggert says: "The car handles much differently with the added weight of the CNG tanks in the back. You've got a lot more traction in the rear of the vehicle; it's almost a 50-50 weight distribution from front to rear. You have to adjust your driving to the changes in the characteristics of the vehicle. Acceleration is not dramatically different; the nice thing is that we have the ability to change fuels at the flick of a switch, so if you feel you can get added acceleration from gasoline, it's there at the flick of a switch."

Two aluminum CNG cylinders are installed in the trunk of each vehicle: one 13 × 25 in. and one 10 × 42 in. The cylinders are arranged so that they take up a minimal amount of space, and plenty of room is left for cargo. The trunk must hold everything the officers need, including crime scene equipment, because of the large geographic areas covered on the patrols – the officers can't just return to headquarters to get something. Vehicle range changes with ambient temperature, but when the weather is good, CNG can be used for about 80 to 100 miles of a typical 118-mile shift.

The CNG fuel system was installed with safety in mind. When apprehending a suspect, police officers stop their cars at an angle, with the driver's side facing the suspect's car. This position makes the car vulnerable on that side, so the fuel shutoff valve was placed on the passenger side for greater safety.

Since 1991, police AFVs have been involved in four accidents. Even though some of the cars were total wrecks, not a single injury, CNG leak, or explosion has resulted. One car burned to the ground as a result of an electrical short, but the CNG cylinders and fueling system held up.

Maintenance

In-house mechanics maintain the CNG vehicles. The Chevrolet dealer that installed the conversion kits also trained the mechanics. Each vehicle undergoes a stringent preventive maintenance inspection when it returns from patrol. Inspecting the CNG equipment takes about five minutes.

The fleet experienced a few breakdowns at first, but these were mostly due to problems in the installation, not the CNG equipment itself. One common problem is a microswitch that wears out quickly, but it is easily replaced. The vehicles have experienced no fuel injector or engine problems. Only one regulator has broken, and that was covered by warranty. Overall, maintenance costs for the AFVs have been equivalent to those for gasoline vehicles.

Fueling

The bi-fuel vehicles have achieved a high CNG usage of about 51%. Some vehicles burn CNG 100% of the time because their assigned patrol area is small, but most of the vehicles don't run on CNG all the time. Lack of fueling stations is one reason: when officers cannot return to the precinct headquarters for CNG, they run on gasoline.

The on-site pumping station dispenses both CNG and gasoline. Drivers can save time by filling their vehicles with both fuels simultaneously. The CNG is fueled through a separate under-the-hood nozzle, while gasoline is fueled through the standard nozzle on the side of the car.

Costs

Cost was not the prime consideration in King County's decision to use AFVs. A $100,000 grant from the Washington State Energy Office helped offset part of the $340,000 cost of constructing the fueling facility, but the county picked up the tab for the rest and for the conversions.

Future Plans

King County has no plans to add more CNG police vehicles to its fleet at present. The expense of building additional fueling stations is a major obstacle. Mitchell remains enthusiastic, however: "Moving to alternative fuels was the right thing to do. The experience has been very, very positive, both for me as a fleet manager and for my customers. The key is to get involvement up front. Let your customers become part of the team as hands-on participants. Listen to their concerns and try to answer them. We involved everyone – police officers and their guild, mechanics, vendors, the sheriff, police sergeants, precinct commanders, members of the County Council – in the entire process. By doing so, we enhanced trust and commitment in the program. Today, everyone is happy. Nothing makes a fleet manager happier than happy customers."

By the Numbers

CNG Conversion Cost:	$4,777 per vehicle
Vehicle Range:	105 miles on gasoline; 80-100 miles on CNG
Fuel Economy:	16 mpg on gasoline; 14 mpg on CNG
Fuel Cost:	$0.070/mile for gasoline; $0.036/mile for CNG
CNG Operating Cost:	$0.074/mile, including fuel, maintenance, and 10-year amortization of fueling facility

King County's Propane AFVs

In addition to its CNG police cars, King County also uses 95 propane-fueled pickup trucks and sedans for public works and administrative activities. Propane was chosen for these vehicles because the cost of the conversion kits was lower than for CNG kits – each propane conversion cost about $1,400. Although the propane tanks do reduce cargo space, drivers have registered no complaints about the performance of the vehicles.

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This brochure has been reviewed by representatives of vehicle manufacturers, fuel providers, fleet operators, and federal and state governments.

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Disclaimer

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