

## Evaluating the Safety of a Natural Gas Home Refueling Appliance (HRA)

### PROJECT IMPACT

This project evaluated the probability of safety incidents related to use of FuelMaker Corporation's natural gas home refueling appliance, Phill. The results indicate that an individual is 10 times more likely to be struck by lightning than to experience a safety incident resulting from normal use of Phill. The safety evaluation produced an added benefit—FuelMaker incorporated suggestions from the study into its final design of Phill. Home refueling has the potential to increase the availability and convenience of natural gas vehicle refueling infrastructure. It is anticipated that this would lead to more extensive use of natural gas vehicles, resulting in reduced U.S. petroleum consumption.

### PROJECT GOALS

Natural gas is a domestically available resource. The U.S. Department of Energy (DOE) supports natural gas vehicle and infrastructure R&D through its FreedomCAR and Vehicle Technologies Program to help the United States reduce its dependence on imported petroleum and to pave the way to a future transportation network based on hydrogen. Natural gas vehicles can also reduce emissions of regulated pollutants compared with vehicles powered by conventional fuels such as gasoline and diesel.

The goal of this project was to evaluate the safety implications of refueling natural gas vehicles at home with a home refueling appliance. Widespread use of natural gas vehicles has been hindered by limited availability of refueling stations. Home refueling could change this by making convenient natural gas refueling available to everyone who has residential natural gas service. The home refueling concept also may be applicable to the hydrogen-powered vehicles of the future.

### FUELMAKER'S HOME REFUELING APPLIANCE

Toronto, Canada-based FuelMaker Corporation has manufactured compressed natural gas (CNG) vehicle refueling appliances for more than 15 years. These appliances are designed to provide fast-fill or time-fill (slow-fill) CNG refueling for small fleets such as school buses and government vehicles. FuelMaker's new home refueling appliance—known as Phill—brings CNG refueling capability to the homes of individual drivers (Figure 1).

Connected to standard residential natural gas and electric service, Phill can be installed inside a garage (Figure 2) or outdoors. It provides automated time-fill CNG refueling at a rate of approximately 0.4 gasoline gallon equivalents per hour, appropriate for overnight refueling of commuter vehicles.

In 2005, FuelMaker will begin selling Phill in California for approximately \$3,400 per unit, and there are plans to market it in Canada and Europe as well. Phill is certified and listed by CSA International (a group that includes the Canadian Standards Association, CSA International, CSA America, and others). It is labeled with a safety listing similar to that used for other natural gas household appliances such as water heaters and clothes dryers.

### SAFETY EVALUATION

A team was assembled by DOE's National Renewable Energy Laboratory to conduct the safety evaluation of Phill. Various investigations and analyses were used to generate data for accurate safety incident probability calculations. References and databases pertaining to component failure and human error statistics were used. CNG vehicle refueling experience was surveyed to determine which kinds of accidents have occurred in the past. CNG vehicle fuel system designs were analyzed to support estimation of gas releases from vehicles. Experience with water heaters and other garage-installed natural gas



Figure 1. FuelMaker's Home Refueling Appliance, Phill  
NREL/PIX 13800



Figure 2. Phill Provides CNG Refueling inside Residential Garages  
NREL/PIX 13714

