Why Drop-in Hydrogen Fueling?
Hydrogen fueling stations are the primary limitation to Fuel Cell Electric Vehicles (FCEVs). Hyundai, Honda, and Toyota each recently announced plans to sell FCEVs in the U.S. before 2015. The cost of stationary hydrogen (H₂) fueling stations currently ranges from $2 to $4 million, making the addition of hydrogen fueling capabilities impossible for owners of existing gasoline fuel stations. Thus, a low-cost, transportable hydrogen fueling station is needed for Fuel Cell Electric Vehicles to become widely adopted in the U.S.

Our Unique Approach to System Design
Currently, 80-90% of all non-pipeline hydrogen distribution is via cryogenic liquid tanker truck. This new hydrogen station would utilize the existing 5 bar liquid delivery infrastructure to fill a 725 kg cryogenic storage tank. Liquid hydrogen will allow the station to maximize storage capacity, and through autogenous pressurization, minimize the cost and complexity for existing gas station owners to site the system on their current locations.

User Interface
Customers will interact with the hydrogen fueling station via a touch screen tablet computer located next to each nozzle. The interface walks users safely through the refueling process, which is similar to conventional gas stations. A status screen will show the customer the real-time state of charge of their vehicle tank based on the system’s measurement. “Emergency” and “Help-line” icons will always be present on the screen.

Our Results
A drop-in hydrogen fuel station has been designed to refuel 50 FCEVs per day at a cost of $9.62 per kilogram. This price translates to $48 to fill a 5 kg fuel tank which has a range of approximately 300 miles. The station will be completely contained in a 40-foot ISO standard shipping container; delivered to a site via semi-truck; and can be set up in less than a day. The system is designed to be autonomous with offsite monitoring. The drop-in hydrogen fuel station can be built with currently available commercial products for a price of $423,000.

Filling Sequence
Filling a vehicle tank will be completed in 2 steps. Medium Pressure (MP) storage tanks will fill the vehicle tank to a state of charge (SOC) of 75% capacity and a High Pressure (HP) tank will fill to the maximum allowable mass of 5 kg H₂. Because hydrogen heats up as it expands, hydrogen stored in the MP and HP tanks is cooled before it is dispensed to the vehicle fuel tanks to avoid overheating. The design criteria requires fueling times of 5 minutes or less to fill a 5 kg fuel tank to 700 bar. To achieve this, the MP and HP tanks are stored in a liquid bath at -40 °C. The excess H₂ gas left in the HP tank after fueling a FCEV is run through a compressor to recharge the MP tank.

Can it be made?
The H₂ student competition requires cost estimates for all components. Our design utilizes established technologies. Yes it can be made.