Shell Team 3 – Urban Concept Vehicle

Overview
The Shell Eco-Marathon is an annual competition that challenges students from across the world to design and build extremely energy efficient vehicles. The Urban Concept class features several different fuel classes of vehicles that are scaled versions of regular road vehicles. The Penn State Urban Concept vehicle uses a CNG-fueled engine, which is more efficient and produces lower hydrocarbon emissions than traditional gasoline engines. At the start of this project the vehicle did not run and was in need of a major electrical overhaul. The competition was held in Detroit, Michigan from April 27\textsuperscript{th} – 30\textsuperscript{th}.

Objectives
The team’s objective was to have the CNG engine running optimally and be a strong competitor in the marathon’s ICE (Internal Combustion Engine) class by the competition start date. The team also had to update other subsystems, such as the methane sensor, air intake manifold, parking brake, and wiring.

Approach
- The team began the project by developing an appropriate list of customer needs that the team would attempt to fulfill for the customer, Shell Oil.
- The customer needs list included a new methane detection system and a new air intake manifold, while troubleshooting and calibrating the engine to run efficiently.
- A new concept was created during the concept selection stage by comparing alternative solutions using the Analytic Hierarchy Process.
- Rules and specifications were gathered from the 2017 Shell Eco-Marathon Official Rules book.
- The team researched patents on methane sensors and engine management systems.
- A model of the intake manifold was created using CATIA, a 3D-modeling software.
- Modified the vehicle to remove excess weight, thereby increasing fuel efficiency.
- Although allocated $1000, the team’s budget was limited to a goal of $800 or less.
- The CNG-converted Honda GX160 engine was calibrated using EcoCAL software.
- The vehicle body was repainted before the journey to Detroit.

Outcomes
- Only $753 of the budget goal was needed, saving the sponsor $247 of the allocated $1000.
- The car weighed 128kg, which is about 50\% of the limit.
- The air intake manifold was 3D-printed by a third party.
- Successfully assembled and programmed the methane sensor to shut down the vehicle upon detection of methane in the air.
- The PSU Urban Concept car was the only CNG vehicle at the Shell Eco-Marathon Americas 2017.
- Improvements and other recommendations were suggested for future PSU Urban Concept teams.

From left to right: Dali Yu, James Kaing, Lisandro Luzzi, Kalen Orchard, and the capstone instructor Gary Neal