Green Fleet Study: Fleet-Specific Hybrid Business Cases

Fleet managers are under significant pressure to green their fleet while balancing tighter budgets and rising fuel prices. Since green vehicles employ the latest and least-proven technology, real-world performance often varies widely and differs vastly from 'sticker' values. As a result, it is very difficult to choose the best vehicles for a given fleet.

Choose wisely: operating costs go down and emissions reductions are achieved. Choose poorly: operating budgets will be overshot and emissions reductions missed. This case study investigates the use of a simple route profiling and simulation system to develop fleet-specific business cases prior to purchase.

This project studied twelve fleet vehicles from two municipal fleets and one private fleet. Data-logging devices were attached to each vehicle in the study for a period of approximately 4 weeks, capturing speed-vs-time data from each vehicle's normal operation. The speed traces were input to three high fidelity hybrid vehicle models in order to provide accurate predictions of fleet-specific fuel consumption.

The vehicles data-logged included Ford Escape, Ford Escape Hybrid, Pontiac Vibe, and Chevy Cobalt from model years 2007-2009. The simulated vehicle included the Toyota Camry Hybrid, Toyota Prius, and Ford Escape Hybrid.

Comparing simulated Ford Escape Hybrid and actual Ford Escape Hybrid data the fuel consumption predictions were found to be accurate within 4%. On the other hand, real-world fuel consumption differed between 6 and 68% from the 'sticker' fuel consumption values. As a result, simulation estimates were found to be far more accurate.

The fuel consumption predictions identified cases where purchasing hybrid vehicles resulted in substantial cost savings; while other cases clearly had insufficient fuel savings to justify the incremental hybrid vehicle cost. In cases where a fleet was currently using a conventional Ford Escape, the fuel savings of using a Ford Escape Hybrid ranged between $356 and $2852 per year. The value of simulation is to generate these numbers for each fleet manager – enabling them to choose their hybrid vehicles wisely.

Qualitative surveys were conducted to understand procurement processes and initial experiences with hybrid vehicles.

Fleet-Specific Hybrid Business Cases

Key Highlights

The main goals of the study were to:

- Analyze the usage and fuel consumption of the current fleet vehicles, comparing real-world and the advertised "sticker" value,
- Accurately predict fuel consumption of currently-available hybrid vehicles for each fleet's specific drive cycles, using advanced simulation tools, and
- Understand green fleet and procurement policies implications for different fleet sizes.

The main results of the study were:

- Real-world fuel consumption ranged from 8.4 to 17.3 L/100km, representing 6-68% above the corresponding 'sticker' fuel consumption,
- Fuel consumption was highly dependent on usage patterns, to the point that a 4-cylinder Cobalt had higher fuel consumption than a 6-cylinder Escape,
- Replacing a conventional vehicle with a hybrid model saved between $356 and $3810 in fuel savings per year, dependent on usage patterns,
- Specifically replacing a Ford Escape to a Ford Escape hybrid saved between $356 and $2852 in fuel costs annually, dependent on usage pattern,
- Simulation accuracy was found to be within 4%,
- Using simulation to accurately predict annual fuel savings for each fleet successfully enabled fleet managers to identify positive and negative business cases for hybrid vehicle purchases,
- Due to the public-accountability of municipal fleets, hybrid vehicle models that are easily visually identified as a hybrid are preferred,
- Current procurement practices that are based upon lowest purchase price drastically hinder the widespread adoption of hybrid vehicles by not allowing the consideration of fuel savings directly in the purchase decision, and
- Purchase decisions based upon lowest total cost of ownership can lower the total operational cost of a fleet while achieving substantial emissions reductions. Total cost of ownership approaches will require accurate predictions of fuel consumption to be successful.

The following sections cover the approach for the case study, both the actual and simulated results, and qualitative survey highlights.

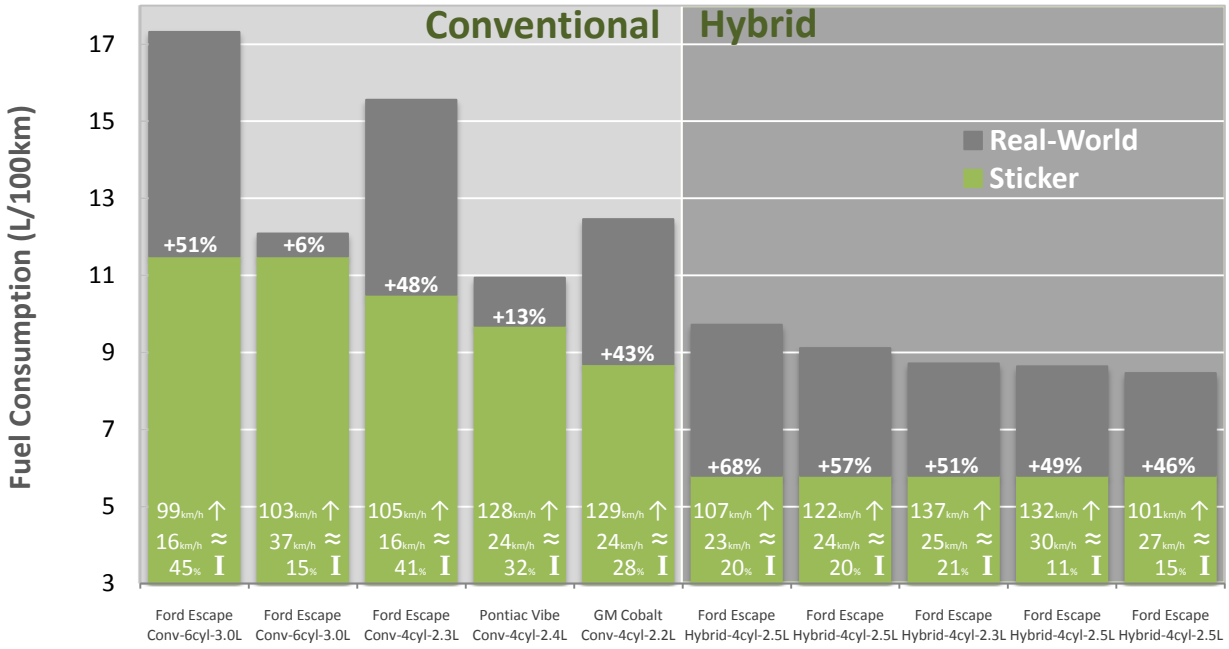
Summary of Results – Actual Vehicle Use

This section summarizes the actual vehicle usage for all studied vehicles across the three fleets. The figure below shows the actual measured fuel use (grey) compared to the advertised fuel consumption (green) for each conventional vehicle studied.

Real-world fuel consumption ranged from 6 to 68 percent above 'sticker' value

Important drive cycle characteristics for each vehicle's drive cycles are noted in the green bars – including maximum speed, average speed, and idle fraction. The results show that the vehicles with the largest idling time percentages consume the most fuel above their advertised values. It is interesting to note that the 2009 6-cylinder Escape had lower fuel consumption than the 2009 4-cylinder Cobalt and half of the idling time percentage.

Fleet-Specific Hybrid Business Cases



Also shown in the figure are the values for each hybrid vehicle studied. The results show that all hybrid vehicles studied had significantly higher fuel consumption than the advertised value; this is likely due to the fact that hybrid vehicle fuel consumption varies widely depending on the specific drive cycle.

Also note that the idling time percentages are generally lower than in the conventional vehicles studied; this is due to the fact that the engine often turns off when the vehicle is not moving. The results show that the hybrid Ford Escapes achieved lower fuel consumption than all of the conventional vehicles studied; this result is likely due to a combination of vehicle efficiency and drive cycle characteristic factors.

Two of the data-logged vehicles are not shown in the figure above. One of the data-loggers failed while the other was unable to record the required information on the Smart Car it was installed on.

Simulated Alternative Hybrid Vehicles

The previous analysis showed that a vehicle's advertised fuel consumption rating is not a good indicator of what the actual fuel consumption will be in a particular fleet application; using customer-specific driving data with a virtual vehicle model can provide a more accurate estimation of fuel consumption.

Simulations were run on the 10 groups of drive cycles using vehicle models for the 2008 Hybrid Toyota Camry, the 2008 Hybrid Ford Escape, and the 2004 Toyota Prius.

The simulated fuel consumption for each vehicle is combined with the estimated annual distance driven by each actual vehicle to calculate the estimated annual fuel costs for each vehicle. The simulation results show that in general, replacing the current conventional vehicles with the simulated hybrid

Fleet-Specific Hybrid Business Cases

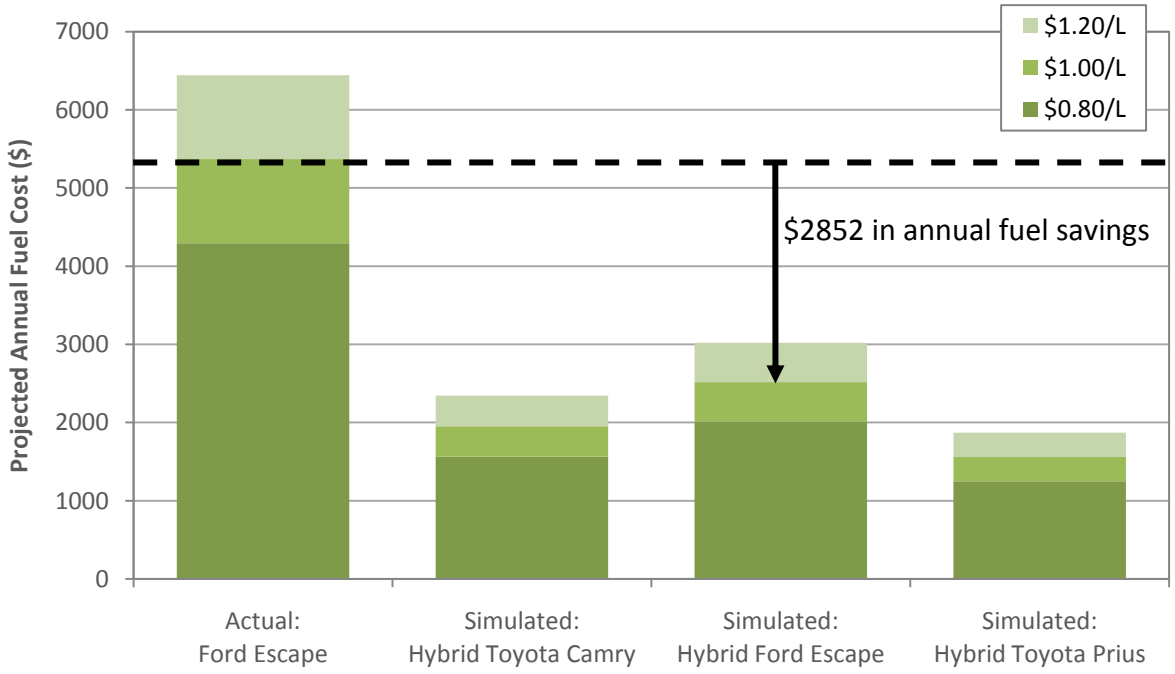
vehicles would provide significant fuel savings. Two examples are shown below, with the remainder of the results provided at the end of this report. The figures show the simulated fuel savings based upon usage patterns captured from two different Ford Escapes. Selecting the hybrid version would save $2852 in one case, compared to $356 in the second case. A simple payback calculation using fuel costs and incremental purchase price resulted in a payback range of 3.5 to 28 years.

The payback for a Hybrid Ford Escape was between 3.5 and 28 years, based upon usage patterns.

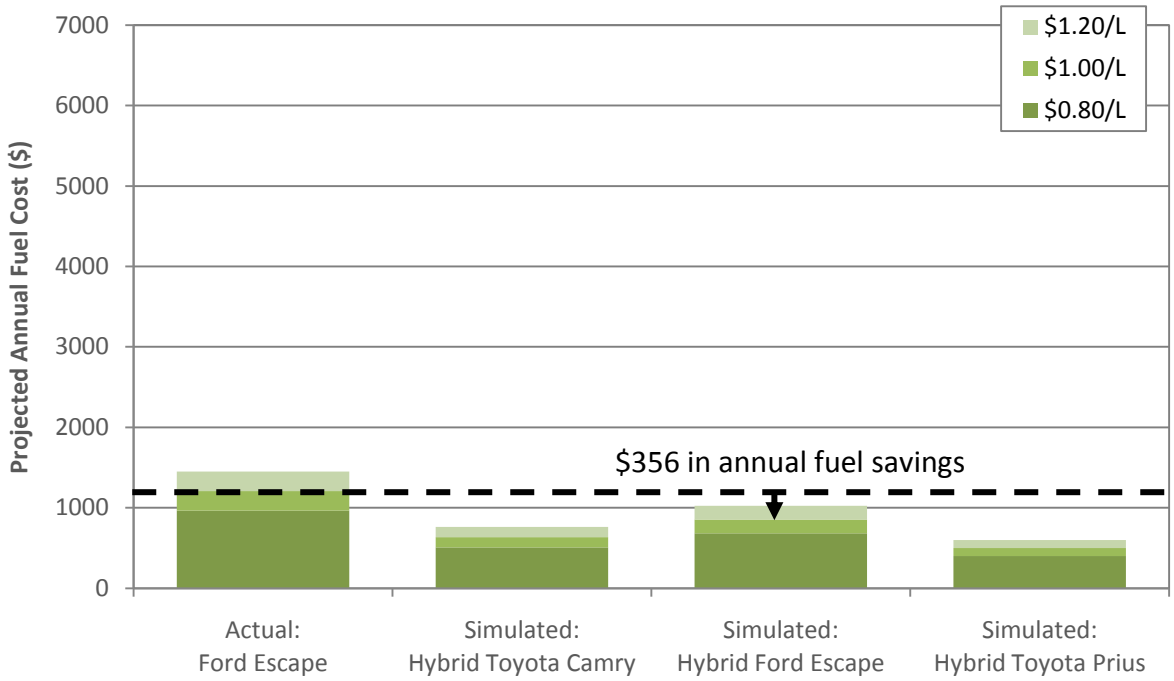
Using the usage pattern to predict the specific fuel consumption gives fleet managers actionable data for each fleet vehicle's drive cycle. This data can be used to help optimize hybrid vehicle purchases and placement within a fleet.

With regards to the current hybrid vehicles, fuel savings of simulated alternative hybrids differed depending on the drive cycles under test. The Toyota Prius offered the most savings compared to the Hybrid Ford Escape across all drive cycles.

The results clearly identified cases where a hybrid vehicle would provide substantial fuel savings and corresponding emissions reductions. Alternately, cases where a hybrid vehicle would not provide substantial fuel savings were also identified. The results underscore the strong dependence of hybrid vehicles on usage patterns.



Fleet-Specific Hybrid Business Cases



Qualitative Survey Results

Two qualitative surveys were conducted with each study partner. The first study focused on green fleet policy and procurement practices. The second study focused specifically on the study results and advanced vehicle experiences.

Two of the three study partners self-identified as having green fleet policies, while the smallest study partner didn't have a particular green fleet policy. For the two partners that had green fleet policies, the objective was to reduce the overall fuel consumption and fleet emissions. The policies had not yet set specific fuel or emissions targets; however, the focus included the procurement of hybrids and smaller vehicles. In both cases the procurement of the hybrid vehicles was to generate in-house experience in the operation and real-world performance of these vehicles.

The two partners that have green fleet policies also have formal procurement processes. The procurement process consists of two phases: specification and tendering. The specification phase consists of discussions between the fleet management team that is responsible with the maintenance and servicing of the vehicles and the end-user team (eg. Bylaw services). The specification phase results in a vehicle requirements list. That list then goes to purchasing for tendering.

The tendering process consists of comparing all bids to the vehicle requirements list. In both cases the procurement team selects the bid with the lower purchase price that meets all of the vehicle requirements. This was identified as a substantial barrier to green fleet objectives as this process does not allow considerations of future fuel savings as the selection is solely based upon purchase price.

To resolve this barrier, one of the partners is working with the procurement team to integrate fuel savings into the purchase decision. Initial feedback suggests that only vehicles with a payback of less than three years will be considered. Successful integration of fuel savings would be a substantial step towards minimizing total cost of ownership.

Given that the total cost approach enables consideration of fuel savings to offset premiums in purchase price, this approach inherently promotes the reduction of overall fleet emissions and less sensitive to fuel price volatility.

The partners had mixed previous experiences with hybrid vehicles. Given the public accountability of public fleets, it was identified that the ease of hybrid powertrain recognition was a key consideration. For instance, the Prius was identified as a preferred option over the Hybrid Civic as the Prius was more readily identified as a hybrid. In general, the operators of hybrid vehicles received positive feedback from the public. While the fuel savings were often less than anticipated, the most significant challenge of small vehicle hybrids was traction in Winter environments. This particular issue was due to the specific application of hybrids for parking enforcement to assist snow plow operations. Consequently the vehicles were operating on roads prior to snow removal and the non-SUV hybrids were found to operate poorly in this environment. Overall, the previous hybrid vehicle experience among the partners was generally positive.

In general, the predicted fuel savings for the hybrid vehicles assisted in the consideration of the hybrid options. One additional piece of information that was requested in the predicted costs was maintenance costs. In effect, having the 'what will my fuel savings be?' answered, the primary question became 'will there be any maintenance cost additions?'. To maximize the usefulness of this type of process in procurement projected maintenance costs would be required.

Summary

This study shows that the current fleet vehicles are obtaining substantially worse fuel consumption than advertised 'sticker' values. The actual values varied widely based upon drive cycle characteristics including idling time.

The simulations show that significant annual fuel savings can be realized through the use of various hybrid vehicles compared to the conventional vehicles. When comparing the simulated hybrid vehicles to the actual Hybrid Ford Escapes, the fuel cost differences are much smaller. In this case, the Prius consistently gives the most fuel savings across all simulated drive cycles.

The process of generating accurate fuel saving predictions of hybrid vehicles was found to be valuable in hybrid vehicle performance. A required addition would be predicted maintenance costs. To fully utilize this information to minimize costs and emissions, procurement processes must be adapted to include total cost of ownership considerations.

Fleet-Specific Hybrid Business Cases

Contact Information

For more information please contact:

Alain Boutros, Business Development Manager
CrossChasm Technologies

295 Hagey Blvd.
Waterloo, ON N2L 6R5

p. 519.342.7385
f. 519.513.2421
m.226.929.4777

aboutros@crosschasm.com
www.crosschasm.com

Summary Report