LEANGREENFLEET TECHNOLOGIES

Technological, Environmental and Legislative Forces Driving Purchase Decisions in the U.S. Commercial Fleet Market

A Syndicated Market Research Study and Website Providing the Commercial Fleet Industry with Research, Best Practices and Supplier Links for Evaluating and Procuring New Fleet Technologies

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EXECUTIVE SUMMARY

INTRODUCTION

Transportation is a large sector of the U.S. economy. In 2002, transportation related goods and services accounted for more than 10 percent of the Gross Domestic Product, over $1 trillion.[1] One out of seven jobs in the U.S. was transportation related.[2]

Not only is the transportation sector large, it is also resource intensive. There are over 255 million registered highway transportation vehicles on the road, and they consume about 28 percent of all end-use energy in the U.S.[3,4] Furthermore, the transportation sector uses nearly three-quarters of all the petroleum consumed, and is responsible for about 42 percent of all carbon emissions in the country.[5] Not surprisingly, highway transportation creates 78 percent of all transportation sector emissions.[6]

Our company has provided research and consulting services to the transportation industry for more than two decades. Consistently, cost reduction and safety have been the top two issues facing fleet administrators. Technology is the solution to both issues. And when fleet administrators are asked what they are looking for from new technology, their number one answer is fuel savings. The LeanGreenFleet website is focused on technology, the advances suppliers are making, and the solutions that reduce cost and improve safety, considering the unique requirements of different fleet operations in different vocations.

CURRENT SITUATION

Petroleum products virtually dominate the worldwide on-road fuels market. Michael Porter's five forces analysis shows that this is a very attractive industry.[7]

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[1] Research and Innovative Technology Administration, *Economic Impact of Transportation*, http://2bts.rita.dot.gov/programs/freight_transportation/html/transportation.html, (May 17, 2013).

[2] http://2bts.rita.dot.gov/programs/freight_transportation/html/transportation.html, (May 17, 2013).

[3] Wikipedia, *Passenger Vehicles in the United States*, http://en.wikipedia.org/wiki/Passenger_vehicles_in_the_United_States, (May 17, 2013).

[4] American Council for an Energy Efficient Economy, Transportation Sector: Vehicles and System Efficiency, http://www.aceee.org/sector/transportation, (May 17, 2013).

[5] Carnegie Endowment for International Peace, *Offshore oil drilling will not solve U.S. dependence on foreign oil or reduce costs*, http://www.carnegieendowment.org/2009/11/03/offshore-oil-drilling-will-not-solve-u.s.-dependence-on-foreign-oil-or-reduce-costs/dhu, (July 25, 2011).

[6] U.S. Department of Transportation, Federal Highway Administration, *Assessing the effects of freight movement on air quality at the national and regional level*, http://www.fhwa.dot.gov/environment/air_quality/publications/effects_of_freight_movement/chapter02.cfm, (May 17, 2013).

[7] Wikipedia, *Porter five forces analysis*, http://en.wikipedia.org/wiki/Porter_five_forces_analysis, (May 17, 2013).

Proven crude oil reserves in OPEC Member Countries increased slightly in 2011, almost reaching 1.2 billion barrels. OPEC's percentage share of reserves stood at 81% at year-end, largely unchanged from 2010.[8] OPEC member nations accounted for 40 percent of the world's crude oil production.[9]

This guarantees the power of suppliers and virtually eliminates two other competitive forces: rivalry among competitors, and the threat of new market entrants. The bargaining power of customers is nil because almost all fuel is purchased by end-users. The result is extremely high profit margins since the production cost is in the neighborhood of $5 per barrel for OPEC nations and $9 per barrel for non-OPEC producers.[10]

Not only are petroleum prices high relative to production costs, they are also volatile. Until the end of 2003, OPEC pursued a strategy of targeting an explicit price band for crude, between $22 and $28 per barrel. OPEC gave up that strategy in 2004 when demand jumped due to the increased demand from developing nations, particularly China.[11]

Believing that higher prices were sustainable, OPEC began a policy of letting the price of crude float. Unsure about OPEC's intentions, oil buyers increased their precautionary inventories and their use of financial hedging instruments. Some say that as the dollar continues to depreciate, investors have bought oil futures as a hedge against inflation. In 2008, they claim that as much as 60 percent of today's crude oil price is pure speculation driven by large trader banks and hedge funds.[12]

Of Michael Porter's five forces, the only remaining threat to the petroleum industry is the threat of substitute products. But here, the questions is not 'if' petroleum based fuels will be replaced by alternative fuel sources, but 'when'.

The U.S. Energy Information Administration states that worldwide there are about 1.3 trillion barrels of known crude oil reserves. According to OPEC, over the

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[8] OPEC, OPEC's Annual Statistical Bulletin for launch 16 July 2012, http://www.opec.org/opec_web/en/2342.htm, (May 17, 2013).

[9] Bloomberg, OPEC Trims Oil Demand Growth Forecast; March Output Drops, http://www.bloomberg.com/news/print/2013-04-10/opec-trims-oil-demand-growth-forecast-march-output-drops.html, (May 17, 2013).

[10] Joint Economic Committee, OPEC Strategy and Oil Price Volatility, http://www.jec.senate.gov/republicans/public/?a=Files.Serve&File_id=3e2039d7-caa3-428c-ac2e-1b87f811e723, (January 4, 2015).

[11] Joint Economic Committee, OPEC Strategy and Oil Price Volatility, http://www.jec.senate.gov/republicans/public/?a=Files.Serve&File_id=3e2039d7-caa3-428c-ac2e-1b87f811e723, (January 4, 2015).

[12] Wikipedia, *Talk:Price of petroleum*, http://en.wikipedia.org/wiki/Talk:Price_of_petroleum, (May 17, 2013).

next 21 years the world will consume about 36 billion each year. This puts the world oil supply at 36 years, 40 years according to BP.[13]

Of course, just as technology ushers in a new generation of vehicle fuels, technology will also prolong the life of petroleum based fuels. New drilling techniques will be developed as well as new processes for extracting petroleum from oil shale and tar sands.

According to Bill McDonald, engineer in Silicon Valley, there is probably in excess of 50 years before oil production drops below half what is currently. Counting natural gas in total hydrocarbons, probably 90 to 140 years before total hydrocarbon use drops to below half what it is currently. It is likely that this will be enough time to transition to renewables, nuclear, and biomass, with some oil still used for long distance transportation.[14]

But ultimately, the petroleum supply is finite. In the short term, our oil problem is not that we're running out. David Frum, CNN Contributor states that our oil problem is that we're producing so much of the stuff that we are changing the planet's climate.[15]

NEW TECHNOLOGY MARKET DRIVERS

The question facing fleet operators and their suppliers alike is how long will it take for substitute technologies to gain a significant share of the transportation market? Will it take 40 to 50 years when supplies are expected to decline, or will it occur sooner? Traditional wisdom would say that the petroleum industry is not going away soon. However, over time the forces of diminishing supply and growing demand are expected to force prices higher, making new technologies more competitive.

Forecasting the future price of petroleum is a key element in a supplier's decision to invest in a new technology and a fleet's decision to buy those products and services. This has become a greater unknown since OPEC decided to let the price of crude float in 2004. Over the following two year its price steadily rose from $33 to $76 per barrel, then it spiked in 2008 to $144 per barrel. These recent fluctuations in crude oil prices have convinced many that the days of low, stable crude oil prices are gone forever.

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[13] Answer.com, *How long before the world runs out of oil?,* http://wiki.answers.com/Q/How_long_before_the_world_runs_out_of_oil, (May 17, 2013).

[14] Forbes, *How Many Years Of Oil Do We Have Left To Run Our Industrial Civilization, Keeping In Mind That Oil Is a Resource And Has An Economical End?* http://www.forbes.com/sites/quora/2012/07/09/how-many-years-of-oil-do-we-have-left-to-run-our-industrial-civilization-keeping-in-mind-that-oil-is-a-resource-and-has-an-economical-end/, (May 17, 2013).

[15] David Frum, CNN Contributor, 'Peak oil' doomsayers proved wrong, http://astro1.panet.utoledo.edu/~vgade/teaching/phys-3400-sp2014/Homework4/oil.pdf, (January 4, 2015).

Cost Reduction

As petroleum prices climb many alternative fuels and advanced technologies will become financially viable. There are two fronts where new technology is being developed to reduce costs. First, there are technologies that reduce fuel usage, such as aerodynamics, light weight vehicle materials, telematics, low rolling resistance tires, idle reduction strategies, fuel card networks, and low viscosity lubricants. According to the Union of Concerned Scientists, the simplest, most cost-effective way to reduce the United States' consumption of oil is to increase the fuel economy of motor vehicles. A fleet of cars and light trucks that reaches 40 mpg will cost only about $1,000 to $2,000 extra per vehicle. However, the $2,500 to $5,300 saved on fuel over the life of the vehicle will more than compensate for the initial cost. Overall, a 40 mpg fleet could see annual gasoline savings of $50 billion in 2015. Reaching 55 mpg by 2025 could save $138 billion in that year.[16]

The second front is represented by fuel technologies that replace petroleum fuels, such as electricity, hydraulics, hydrogen, natural gas, ethanol, methanol, propane, biodiesel, and a host of emerging fuel technologies. Over time, these technology advances will fill the void created by the depletion of petroleum reserves.

Fuel price alone, however, is not the only factor driving the search for substitute technologies. Over the past decade, board rooms across the country have expanded their mission statements to include both the environment and the well being of people making and using their goods and services. Accordingly, an increasing number of fleets are now looking at the impact of the decisions they are making on their triple bottom line: economic, environmental, and driver safety.

Protect the Environment

Green technologies are a top issue with both fleet administrators and their suppliers, and have been for some time. While alternative fuels have been around for decades, the debate about global warming brought on by the 1997 Kyoto Protocol heighten public awareness. Environmental politics hit a new high in 2006 when Al Gore published his controversial documentary, *An Inconvenient Truth*.[17]

This growing environmental consciousness strikes at the heart of the transportation industry since it accounted for about 28 percent of all U.S. greenhouse emissions in 2006.[18] These greenhouse gases trap heat, and thus warm the earth by preventing a significant portion of infrared radiation from escaping into space.

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[16] 40MPG.ORG, *Understanding the Issues*, http://www.40mpg.org/getinf/issues.cfm, (May 20, 2013).

[17] Wikipedia, *An Inconvenient Truth*, http://en.wikipedia.org/wiki/An_inconvient_truth, (May 20, 2013).

[18] U.S. Department of Transportation, *Transportation and Greenhouse Gas Emissions*, http://climate.dot.gov/about/transportations-role/overview.html, (May 20, 2013).

Concentrations of greenhouse gases, especially CO_2, have increased substantially since the beginning of the industrial revolution.[19]

Some greenhouse gases occur naturally in the atmosphere, while others result from human activities. Naturally occurring greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, and ozone. Certain human activities, however, add to the levels of most of these naturally occurring gases.

Carbon dioxide is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned. Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from the decomposition of organic wastes in municipal solid waste landfills, and the raising of livestock. Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels. Very powerful greenhouse gases that are not naturally occurring include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6), which are generated in a variety of industrial processes.

It turns out that water vapor accounts for the largest percentage of the greenhouse effect, between 36 and 66 percent for clear sky conditions and between 66 and 85 percent when including clouds. Since air holds more water vapor per unit of volume as it warms, feedback effects results. Greenhouse gases that cause atmospheric warming lead to more water vapor and more warming until a new equilibrium is reached.[20]

While the science of global warming may be debatable, the reality is that the transportation industry will continue to be pushed from many directions to lower emissions. Many alternative fuel technologies reduce greenhouse emissions into the atmosphere, a major advantage over petroleum fuels.

Reduce Oil Imports

How much oil we import affects our economy and our national security. In 2005, more than half of the oil we used was imported.[21] This level of dependence on imports (55 percent) is the highest in our history. The vast majority of the world's oil reserves are concentrated in the Middle East (65 to 75 percent), and controlled by the members of the OPEC oil cartel.[22]

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[19] U.S. Department of Energy, *Reduce Climate Change*, www.fueleconomy.gov/feg/climate.shtml, (May 20, 2013).

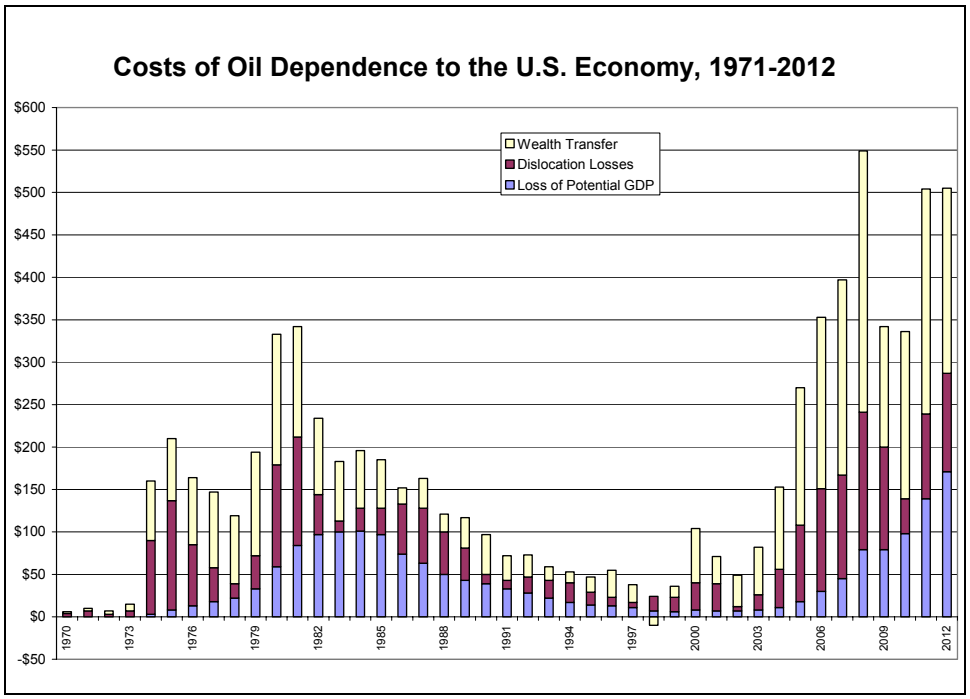
[20] Wikipedia, *Greenhouse Gas*, http://en.wikipedia.org/wiki/Greenhouse_gas, (May 20, 2013).

[21] U.S. Department of Energy, *Reduce Oil Dependency Costs*, http://www.fueleconomy.gov/feg/oildep.shtml, (May 20, 2013).

[22] PBS, *NOW, Science & Health, Air Wars, Auto Emissions and the Environment Overview*, http://www.pbs.org/now/science/autoemissions2.html, (May 20, 2013).

The U.S. depends on oil to move people and goods. Ninety-five percent of the energy for transportation in the United States comes from oil.[23] Transportation's demand for oil drives the market. Transportation accounts for nearly three-quarters of total U.S. petroleum use and almost all of the high value petroleum products, like gasoline and distillate fuel.[24]

In the past, dependence on oil has cost our economy dearly. Oil price shocks and price manipulation by the OPEC cartel from 1979 to 2000 cost the U.S. economy about $7 trillion, almost as much as we spent on national defense over the same time period and more than the interest payments on the national debt.[25] As shown in the chart below, each major price shock of the past three decades was followed by an economic recession in the United States.[26]



In the past, petroleum price shocks have been costly to the U.S. economy. To quantify this effect, a team of researchers at Oak Ridge National Laboratory

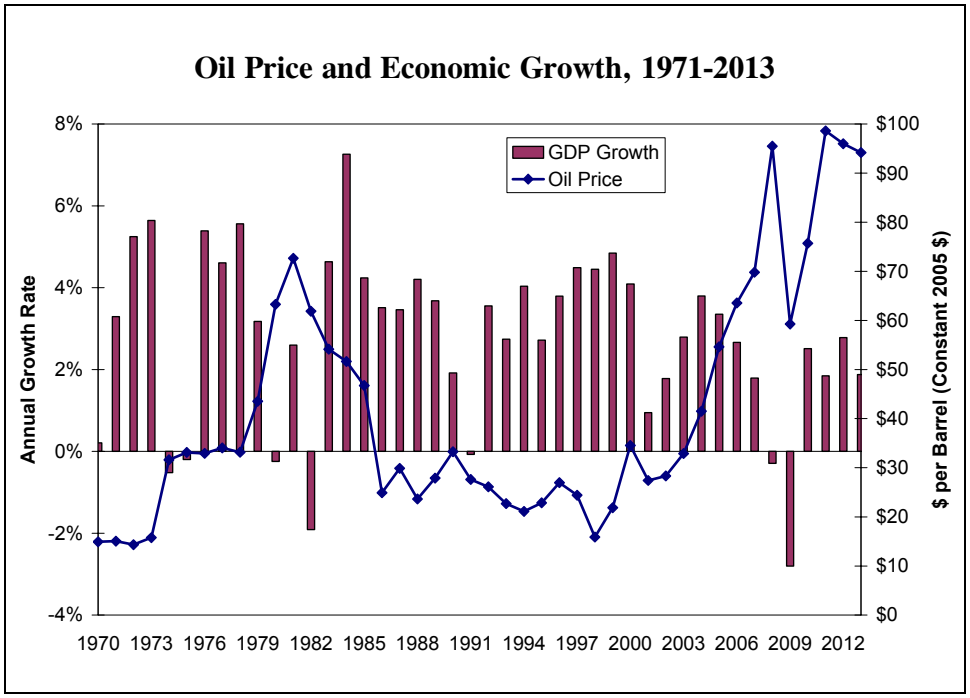
[23] EIA, Annual Energy Outlook 2010, *Estimated Consumption of Vehicle Fuels in the United States, by Fuel Type*, http://www.eia.gov/renewable/alternative_transport_vehicles/xls/attf_c1.xls, (May 20, 2013)

[24] Carnegie Endowment for International Peace, *Offshore oil drilling will not solve U.S. dependence on foreign oil or reduce costs*, http://www.carnegieendowment.org/2009/11/03/offshore-oil-drilling-will-not-solve-u.s.-dependence-on-foreign-oil-or-reduce-costs/dhu, (May 20, 2013).

[25] OverUnity.com, *The Potomac Energy Project*, http://www.overunity.com/index.php?topic=1759.0;wap2, (May 20, 2013).

[26] U.S. Department of Energy, Transportation Energy Data Book, Edition 33, http://cta.ornl.gov/data/index.shtml, , (January 4, 2015).

created a model to estimate the historical cost of oil dependence to the U.S. economy. The most recent study using this model shows that the U.S. economy suffered approximately half a trillion dollars in wealth transfer and loss of potential GDP in 2008.[27] The following chart displays the results of this study:



Ultimately, the solution to the oil dependence problem lies in technological progress: finding new domestic sources of petroleum fuels from unconventional sources – tight oil, oil sands and biofuels; creating new energy sources that can replace petroleum cleanly and inexpensively, and developing advanced vehicle technologies that use energy more efficiently.

New oil sources, many of them unlocked by new technology—the Canadian oil sands, tight oil in North Dakota and Texas, ultra-deepwater oil in the Atlantic—has helped keep the supply of oil growing, even as greater efficiency measures and other social shifts have helped blunt demand in rich countries like the United States. Oil isn't likely to be cheap and getting it out of the ground isn't going to get any easier. But it's increasingly likely that we will have more than enough oil in the future to keep the global economy growing.[28]

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[27] U.S. Department of Energy, Transportation Energy Data Book, Edition 33, http://cta.ornl.gov/data/index.shtml, , (January 4, 2015).

[28] Time Science & Space, *The IEA Says Peak Oil Is Dead. That's Bad News for Climate Policy,* http://science.time.com/2013/05/15/the-iea-says-peak-oil-is-dead-thats-bad-news-for-climate-policy/, (May 20, 2013).

By taking an interest in the fuel economy, the U.S. can reduce petroleum dependence today and create incentives for carmakers to produce cleaner, more energy efficient vehicles in the future.[29]

Conserve Resources

It took more than 200 million years to form all of the oil beneath the surface of the earth. It has taken 200 years to consume half of that endowment. If current rates of consumption were to continue, the world's remaining resources of conventional oil would be used up in 40 years.[30]

But that would not be the end of fossil fuels. The world's coal resources are much larger, and there are vast amounts of unconventional fossil fuels, such as shale oil, tar sands, and natural gas trapped in ice beneath the ocean. At present, these energy resources are too expensive to use, and would produce much greater harm to the environment.

In the future, ways may be found to use some or all of these resources economically and without undue damage to the environment. Advanced technologies may be developed to produce clean, economical energy from other sources. In the meantime, it makes sense to use fossil resources such as oil more efficiently to reduce environmental impacts and buy time to develop new and better energy sources.

Two-thirds of the oil we consume powers transportation vehicles, and half goes to sedans and light trucks. Being a fuel-economy conscious fleet operator doesn't mean buying vehicles that fall short on performance. It means identifying job requirements and the corresponding vehicles specifications, researching options, and then shopping around for vehicles that are right-sized for the job with the best fuel economy available. This will not only help conserve fuel today, but will signal suppliers to use advanced technology to make vehicles even more energy efficient in the future.[31]

LEANGREENFLEET OVERVIEW

The LeanGreenFleet project began as a new multi-client study that expanded the research found in *Chapter Four: Advanced Vehicle and Fuel Technologies*, of the syndicated study series published by Havill & Company entitled: *The U.S. Commercial Fleet Market Forecast*. It became clear early on, however, that subscribers would receive greater value if the research was posted on the Internet rather than printed and bound like a traditional multi-client study.

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[29] U.S. Department of Energy, *Reduce Oil Dependency Costs*, www.fueleconomy.gov/feg/oildep.shtml, (May 20, 2013).

[30] ORNL Review, NTRC Accelerating the Transportation Revolution, http://www.ornl.gov/info/ornlreview/v33_3_00/ntrc.htm, (May 20, 2013).

[31] U.S. Department of Energy, Increasing Energy Sustainability, www.fueleconomy.gov/feg/consres.shtml, (May 20, 2013).

Posting this research on the Internet has several advantages. First, the study focuses on technologies that lowers cost and improve driver safety for fleet operators. This is a dynamic market. Putting the research on the web enables updates to be pushed out to users in real time. In this way, the research becomes a live source of fresh, up-to-date planning data rather than a fixed document that starts to get stale the day it is published.

Internet access to the research also enables subscribers to share the results more easily within their organization. Not only does this provide valuable planning data to management, it also provides an educational resource that is available to employees throughout the organization.

Advanced Technology Research

The research presented on the LeanGreenFleet website is in the format of a traditional multi-client study. The website has a focus on technology, the advances suppliers are making, and the solutions that reduce cost and improve driver safety.

The website has been designed so that subscribers can quickly find the information they need. Each research topic has a 'favorite' star that can be checked. There is also a filter that can be turned on that only shows research topics with new information since the last time the user logged on to the website. When both are turned on, only favorite research topics that have been updated since the last visit are displayed. The research is organized as follows:

- **Executive Summary** – an overview of the research, current market conditions, trends driving new technology development, and a description of the research layout.
- **State of the Industry** – industry statistics on highway safety, the current vehicle population, energy consumption, and greenhouse gas (GHG) emission levels for the on-highway transportation market.
- **U.S. Four-Plus Vehicle Fleets** – the core of the fleet industry is made up of businesses operating four or more vehicles. This section of the report characterizes the 4+ vehicle market in terms of vehicles, replacement cycles, travel patterns, and fuel usage.
- **Federal Laws and Incentives** – legislative requirements, grants and tax incentives that are driving the fleet operator's adoption of advanced vehicle and fuel technologies.
- **Fuel Technologies** – electricity, ethanol, methanol, natural gas (CNG, LNG), propane, hydrogen fuel cells, gasoline, diesel, biodiesel, and other emerging fuels. Fuels are ranked based on their well-to-wheel greenhouse gas emissions.
- **Vehicle Technologies** – electric, plug-in hybrid, hybrid, hydraulic, fuel cell, and flex-fuel vehicles. The chapter focuses on fuel reduction

potential, availability, maintenance issues, and the available fueling infrastructure.

- **Cost Savings Technologies** – technologies that fleets are implementing in order to reduce fuel usage and fuel costs, including aerodynamics, light weight vehicle materials, telematics, low rolling resistance tires, idle reduction strategies, fuel card networks, and low viscosity lubricants.
- **Safety** – a review of safety technologies that are designed to reduce vehicle accidents and improve driver safety. These technologies also save fleets both time and money.
- **Fleet Administrator Planning Guide** – the fleet administrator planning guide provides a road map for incorporating these new technologies into an annual business plan. The guide aims to lay out a path for developing a fleet operations plan that is aligned with the mission of the organization and meets the goals and objectives set out by top management.

Website Content

The LeanGreenFleet website includes supplier profiles that provide granular data on the technologies covered in each research topic. Posting the study on the LeanGreenFleet website provides a unique opportunity to link these supplier profiles to their respective research topics. These links provide fleets access to detailed supplier data on their technologies, including: presentations, white papers, press releases, and a 'contact us' mechanism for requesting information, proposals and quotations. As a subscription option, suppliers are able to share this research with their fleet customers.

For fleet operators, the LeanGreenFleet website provides simple tools designed to help sort through the myriad of new technologies that could be adopted in order to focus on the few things they should be adopting. The primary tool for evaluating advanced technologies is a fuel cost and GHG calculator, base in the GREET model developed by the Argonne National Laboratory.[32] Here, fleet operators enter data on their fleet vehicles, fuels, and current technologies; and receive an analysis on their GHG emissions and fuel cost per mile. They are then able to test different technologies in 'what if' scenarios to determine their impact on both GHG emissions and fuel cost per mile. These tools enable fleets to develop a short list of technologies for further evaluation using research from the LeanGreenFleet website.

This is a effective way to identify cost reduction strategies that are environmentally friendly because right sizing the fleet by retiring gas guzzlers in favor of smaller displacement, more fuel efficient vehicles directly impacts fuel consumption, and

[32] Argonne National Laboratory, *GREET Model*, http://greet.es.anl.gov/, (May 20, 2013).

hence emissions. In a similar manner, aerodynamics, light weight vehicle materials, telematics, low rolling resistance tires, idle reduction strategies, fuel card networks, and low viscosity lubricants also reduce fuel usage and GHG emissions.

The GHG calculator also provides a direct benefit to suppliers. Through a subscription option, suppliers have access to the report center where they can analyze the adoption rate of advanced technologies. This report center also contains tools to segment the market in order to identify high usage fleet characteristics and underserved market segments.

The information available through the LeanGreenFleet website includes:

- **Research** – this is the primary website content providing up-to-date analysis on economic, technical, and legislative issues surrounding the environmental impact of fleet operations and the economic viability of available solutions. Topics are organized according to the outline described above.
- **Suppliers** –research topics contains links to their associated technology suppliers. Here, more detailed information can be found on products and services provided; including 'contact us' functionality for requesting proposals and quotations.
- **Resources** – research topics also contain links to resources describing best practices, such as white papers and case histories.
- **News** – this tab contains links to more research, news, and blog postings. These links are organized by research topic.