SMITH

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Recovery Act-Transportation Electrification

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"Medium Duty Electric Vehicle Demonstration Project"

Final Technical Report

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Submitted by:

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Contents

1. Executive Summary

The Smith Electric Vehicle Demonstration Project (SDP) was integral to the Smith business plan to establish a manufacturing base in the United States (US) and produce a portfolio of All Electric Vehicles (AEV's) for the medium duty commercial truck market. Smith focused on the commercial depot based logistics market, as it represented the market that was most ready for the early adoption of AEV technology. The SDP enabled Smith to accelerate its introduction of vehicles and increase the size of its US supply chain to support early market adoption of AEV's that were cost competitive, fully met the needs of a diverse set of end users and were compliant with Federal safety and emissions requirements.

The SDP accelerated the development and production of various electric drive vehicle systems to substantially reduce petroleum consumption, reduce vehicular emissions of greenhouse gases (GHG), and increase US jobs.

The initial goal of the SDP was to place at least 500 (this goal was later reduced to 450, and the final tally was 439) AEV's in customer hands by the end of the program, and to use its Smith Link (internally developed) telemetry system to extract 2,000 data points per second from each vehicle on the road. This data had multiple purposes: first, a monthly data transmission was made to the National Renewable Energy Laboratory (NREL) for its evaluation and publication of AEV operational statistics; second, to allow the Smith Service Teams, as well as a few selected customers, to monitor and diagnose operating issues; and finally, for Smith Engineering to use to develop advancements in AEV operating systems.

Smith UK began its work in collaboration with Smith UK. Smith UK was a 60 year-old company that had built AEV's initially for London milk deliveries, and had established a global base for its vehicles. Smith US purchased the exclusive North American license to assemble and sell the Newton vehicle platform. After US homologation efforts were completed, the first Smith US Newton AEV sale was made in December 2009. Early in 2011, Smith US acquired Smith UK from its owner The Tanfield Group, located in the UK.

Early in 2014, Smith began negotiations with a Hong Kong corporation, FDG Electric Vehicles, to make significant investments in Smith after certain specific milestones were reached. These negotiations were finalized in late summer 2014. Part of the agreement was an exclusive right to sell FDG batteries in Smith vehicles. While there were some differences in the chemistry, weight and efficiency of these batteries compared to the A123 batteries Smith was using, the price differential was significant. While none of the Chinese-made batteries were installed in DOE fleet vehicles, Smith will incorporate the FDG batteries in its new vehicles beginning Q1 2016 (calendar). This is a significant part of the cost-down process for Smith.

Smith Electric Vehicles currently has over 750 vehicles on the road globally, and has accumulated over 13 million miles of operational data.

2. Project Objectives

The objective of the Smith Demonstration Project was to obtain performance information from an All Electric Vehicle (AEV) fleet to accelerate production, reduce costs, enhance the technology, and procure early acceptance of AEV's in the US commercial vehicle marketplace.

Smith was to demonstrate at least 450 electric vehicles based on the Newton medium duty platform. The vehicles were to be placed in locations including California, Missouri, Ohio, Michigan, Washington, DC, New York, and Texas. A Generation II Newton platform would be developed during the project utilizing the performance data collected. The development of the vehicle would reduce cost, expand the vehicle to class 4 through 7, and improve powertrain and vehicle efficiency.

3. Goals and Objectives vs. Accomplishments

Buy-in for Electric Vehicles from Large Fleets

Current customers include operators of some of the largest fleets of commercial vehicles in the world as well as leading early adopters that are incrementally transitioning portions of their fleets to commercial electric vehicles. Smith has focused on building deep relationships with its existing customer base and makes it a priority to study any challenges related to EV technology adoption. The goal is to provide these customers with high quality vehicles that meet their range and operational needs, while at the same time learning and continuously developing implementation processes aimed at speeding successful change adoption, leading to annualized repeat orders and predictable, sustainable order volume growth. We expect that attaining higher order volumes will not only enable us to further improve our cost position and increase the quality and robustness of our supply chain, but will also facilitate deeper expansion into urban markets with smaller regional, municipal and local fleets.

Smith's product portfolio strategy minimizes component variability while offering expansive application flexibility. We currently design, produce and sell vehicles that can be configured for multiple applications. The Smith Newton has a gross vehicle weight rating (GVWR) ranging from 14,000 to 26,400 pounds, a payload capacity of approximately 6,100 to 16,200 pounds, and a range of up to 120 miles depending on vehicle specification and battery configuration. The Newton, which is sold globally, functions in a wide range of general delivery applications, as well as specialty applications such as refrigerated delivery, military transport, and aerial access lift. In November 2011, less than 24 months after the first sale of the Smith Newton in the United States, Smith introduced a second-generation Newton, which incorporates Smith Drive, Smith Power and Smith Link technologies. The first quarter of 2012 marked the United States release of a Newton model configured as a step van. The Newton step van has a GVWR of 14,000 to 22,000 pounds and a payload capacity of approximately 2,700 to 10,000 pounds. This vehicle operates primarily for delivery of parcels, uniforms and baked goods. Smith is also working to expand the Newton model line by developing a model with a GVWR of approximately 33,000 pounds to meet the needs of delivery and beverage customers, and a Newton model configured as a school bus for student transportation.

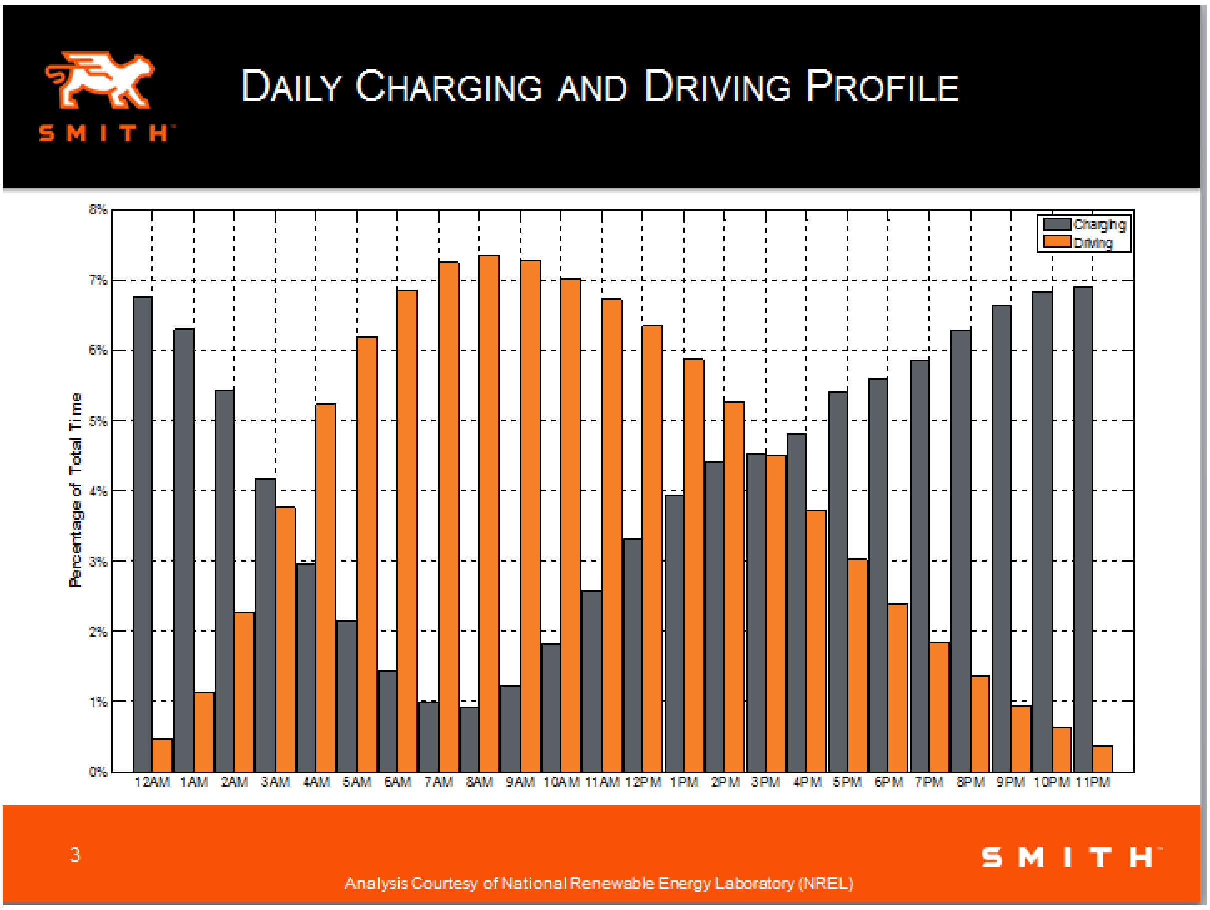
Performance Information

The operational data shown below has been taken from the Smith Link System on over 750 vehicles for a global volume of over 13,000,000 miles traveled. These charts below have gleaned a portion of the 2,000 data points extracted and reported from every vehicle every second the vehicle is in operation. Smith has, since December 2010, transmitted data to NREL monthly. As of today, that monthly volume has grown to over 100 gigabytes of data and 520 million data points. NREL publishes its results on its website http://www.nrel.gov/transportation/fleettest_electric_smith_navistar.html. However, we wished to provide our own analyses that included Smith's global fleet of 750+ vehicles, whereas the DOE project fleet has 439 vehicles.

The "Daily Charging and Driving Profile" chart below shows the operational times of these vehicles. When are the vehicles being driven; when are they charging?

Without data mining it would be difficult to understand the grid strain impact. These profiles will allow further research into grid strain, peak demand, smart charging, peak shaving, bi-directional projects, etc.

Smith Link data can help fleets manage the entire electrical infrastructure of their facility using commercial EVs.



The “Distance and Energy Consumption- Typical Operational Profile” scatter plot below shows every route through 2015. Each dot is a route. There are nearly 100,000 of them. Energy vs. distance is plotted.

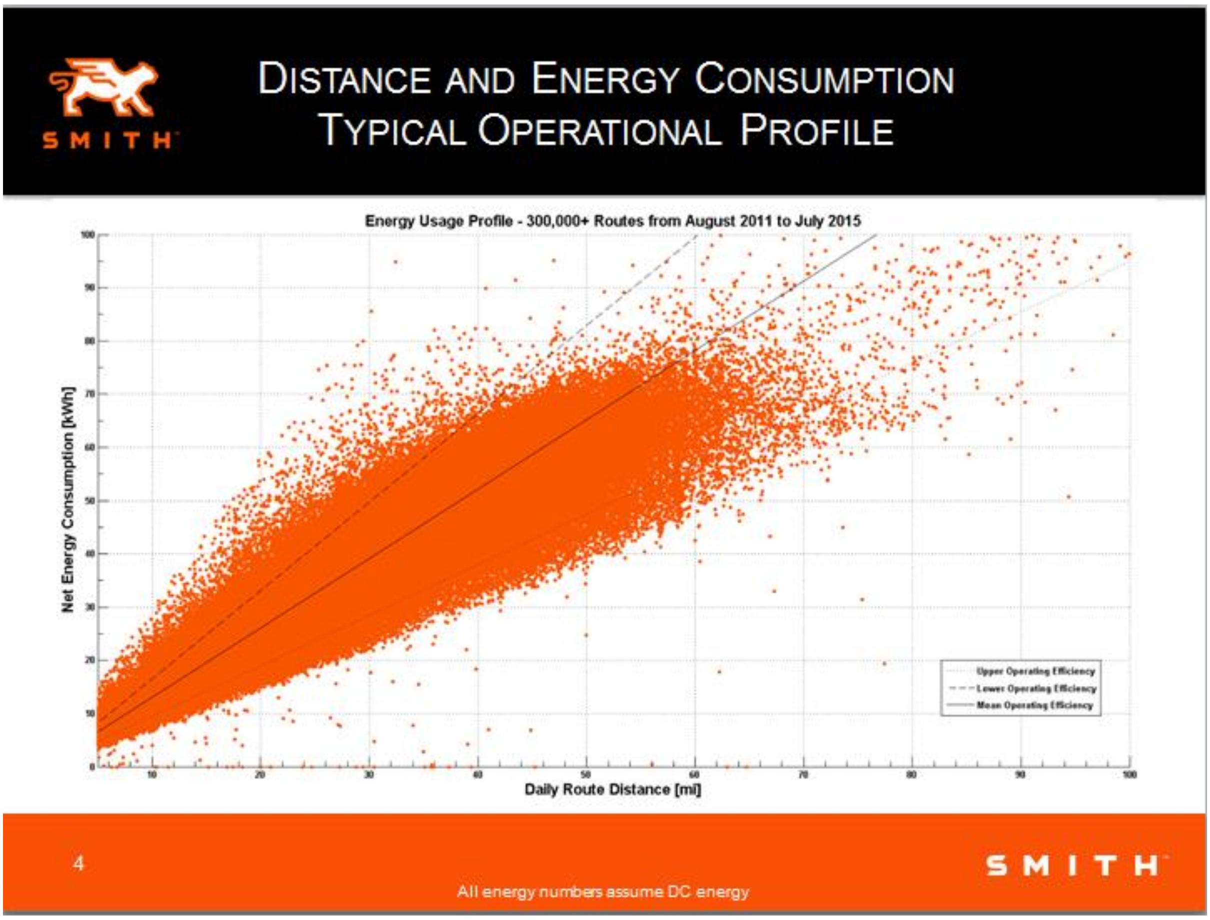
The center line is the average operating condition of the entire Smith fleet.

Top line is the 95% confidence interval on the worst operation (think heavy vehicles with high payloads and high HVAC usage).

The bottom line is the 95% confidence interval on the best operation (light vehicles, high start-stop, no HVAC, truly representative of the technological capabilities).

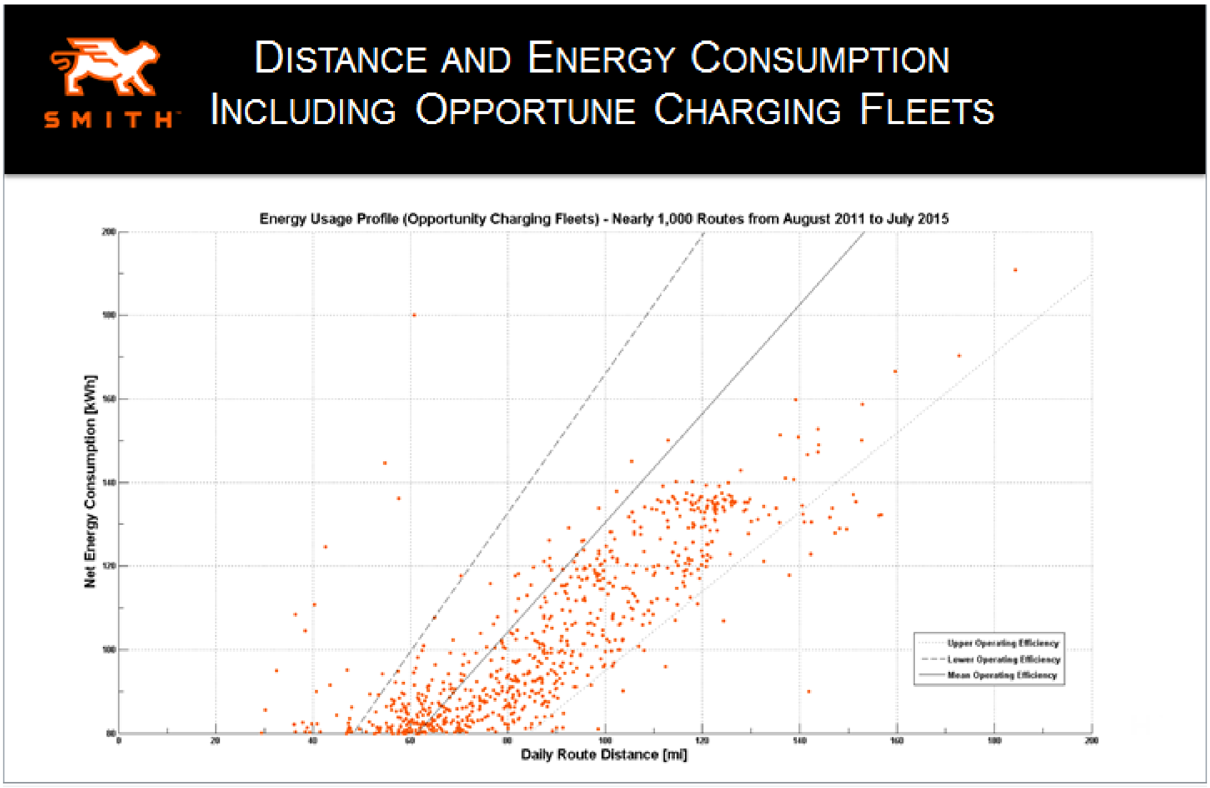
Routes less than 5 miles have been eliminated as efficiency numbers are often skewed because of depot operations and high-idle times that do represent actual routes.

Following the mean line, the typical 80 kWh vehicle is capable of 60 miles. High-efficiency applications are 80+ miles at 80 kWh.



The “Distance and Energy Consumption- Including Opportune Charging Fleets” below is the same plot as above zoomed out to show opportune charging routes in the top right. These vehicles are using more than 120 kWh a day (largest pack size) so they must be opportune charging.

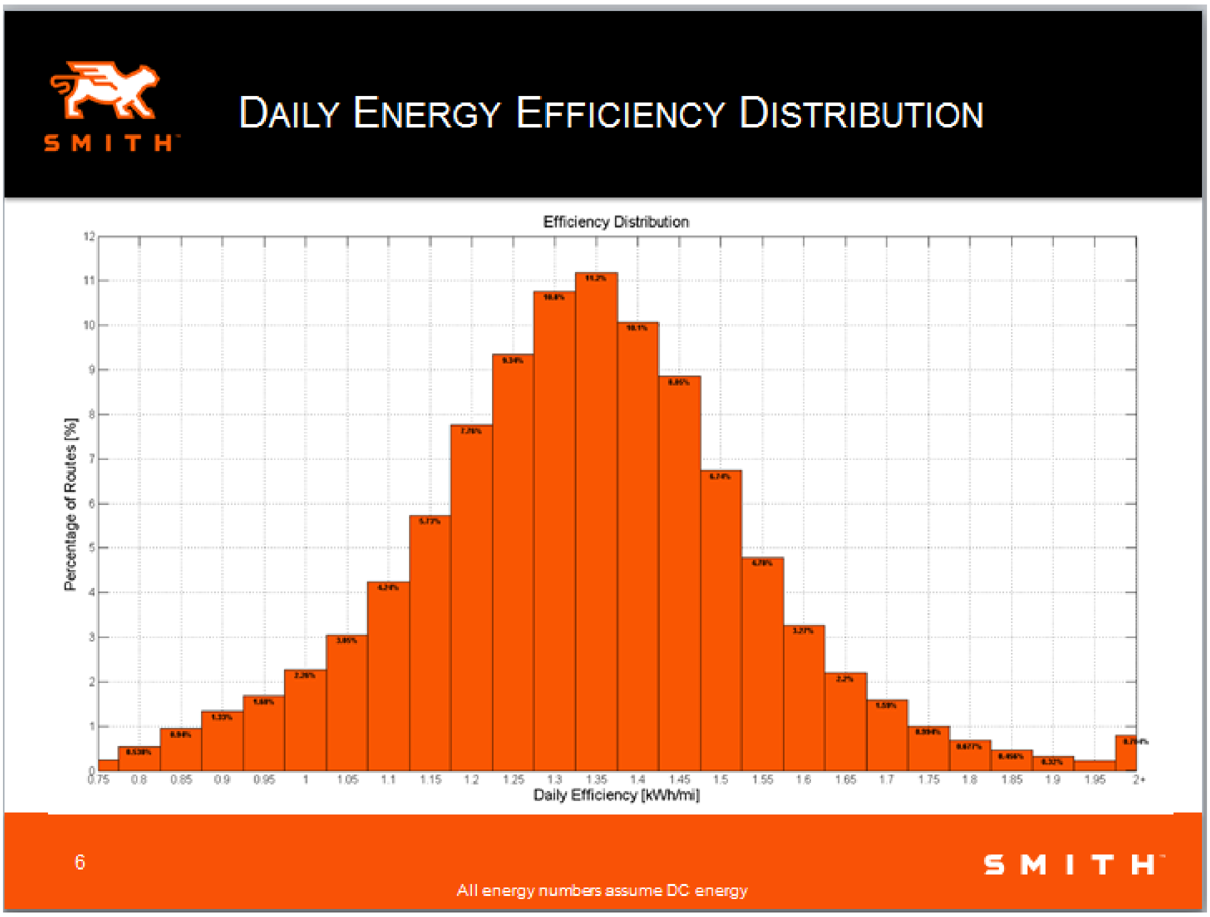
These profiles can be investigated to better determine how to reach 150+ mile ranges without increasing capital asset costs.



The "Daily Energy Efficiency Distribution" graph below is a simple distribution showing entire fleet efficiency. It is just a different method for displaying the previous two charts.

The important statistic derived from this chart is ~80% of all routes operated between 1.15 and 1.55 kWh/mile. This is equivalent to 24 to 33 MPGe. This is a surprisingly small spread considering this chart spans 3 weight classes of vehicles.

Routes and technology make the band of operation very consistent and predictable.



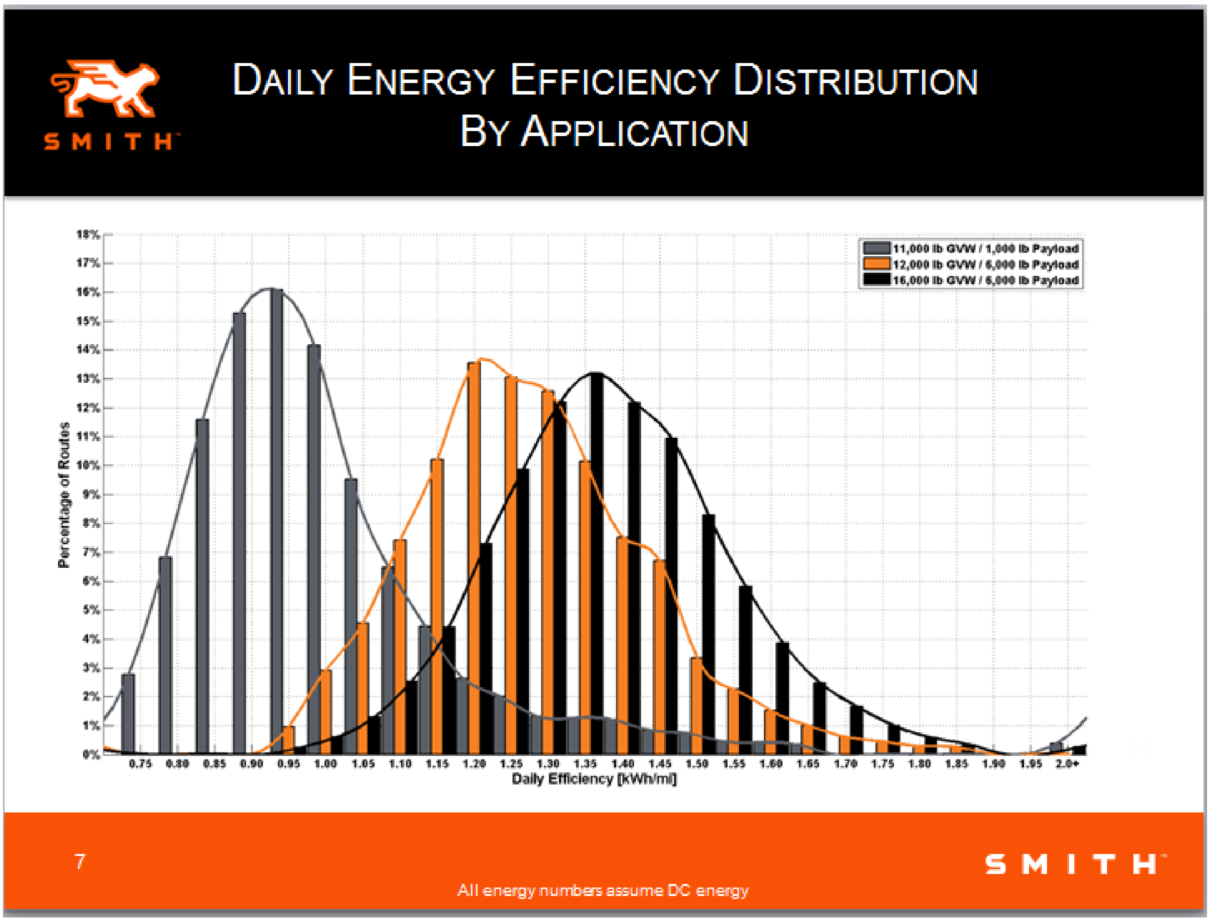
The “Daily Energy Efficiency Distribution by Application” chart below shows the impact by class/weight. Further narrowing the operational band prediction and with class and usage determination, on-route EV performance becomes very predictable.

Far left = small, light vehicle and light payload (parcel).

Middle = small, light vehicle and high payload (beverage).

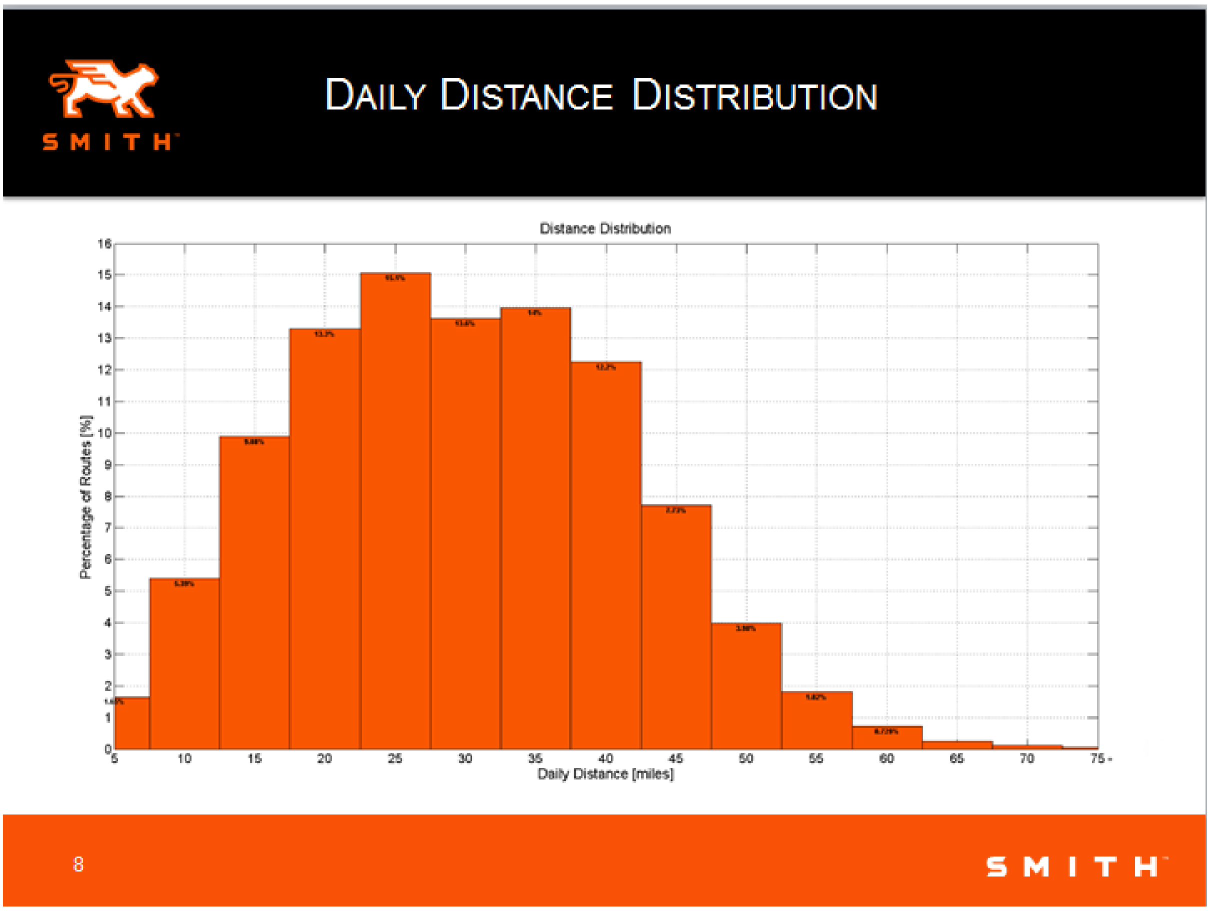
Far right = very large, heavy vehicle and high payload (snacks).

The Legend at the top right shows vehicle and payload weights.



The "Daily Distance Distribution" chart below shows the daily route lengths these vehicles are being driven. From previous slides we know mean range is about 60 miles yet these vehicles are being operated at far less than that. This reduces driver range concerns and demonstrates that our impact market is high-urban routes.

We can use this information to begin targeting higher mileage routes with better ROI/offsets as well as reduce battery pack sizes.



Geographical distribution in US

The table below indicates the locations of the DOE fleet placement geographically in the US:

State	# of Vehicles	State	# of Vehicles
California	216	Missouri	7
Colorado	2	North Carolina	1
Connecticut	2	New Jersey	16
Washington DC	8	New York	50
Florida	20	Ohio	10
Georgia	11	Oregon	24
Illinois	7	Texas	14
Kansas	3	Virginia	15
Maryland	18	Washington	15
Grand Total			**439**

This wide dispersion of vehicles throughout the US has given Smith insight into a wide range of operational data: route configurations, ambient temperature affects, and topographical variations. Additionally, it has identified the states that are most interested in advancing EV technology in commercial and personal vehicles through significant incentive offerings.

Cost reduction

Cost reduction remains a Smith corporate focus driving the overall Newton platform costs to be more competitive with equivalent diesel pricing. Significant progress has been made in the four main areas listed below with a targeted cost reduction of 30+%. Those four main areas are:

Non-critical component parts localization and volume-driven cost reductions as a cost reduction program has been and will continue to be employed.

Transition of the Smith Drive from our bridge-to-production supplier to a volume production supplier has been completed, and Smith began receiving production-level motors in December 2014. All new vehicles built after January 2015 will be equipped with the higher quality drive system from our volume producer.

The development of a Smith branded cell-to-pack mechanical integration and battery management system that is capable of working with prismatic and pouch cells remains a vision for the future. This strategy will enable Smith to source against multiple battery suppliers, effectively reducing costs (and increasing supply) through competitive biddings against projected volume. This project has been temporarily delayed due to the introduction of an FDG battery system into the Smith vehicle platforms. The FDG cells represent a significant cost reduction compared to the A123 cells.

Development of a Smith charger to reduce the cost and size, increase efficiency and reliability, and decrease charging times is closer to fruition. Sourcing the suppliers to build the chargers using Smith developed specifications is currently in process. (This project has been augmented to include future vehicle-to-grid capability and off board charging capabilities.) The Smith-branded charger will become standard equipment during calendar 2015 to early 2016.

Employment in the US

The SDP was jointly funded by ARRA and the DOE. Because the ARRA funding was included, one of the goals of the program was to create US jobs. Smith employment levels rose and fell with the volume of vehicles sold. Smith's peak sales years were 2011 and 2012. Shipments fell to -0- by August of 2013 because of a variety of issues (see the section titled "Issues/Setbacks"), including a battery supply interruption by the Gen 2 battery supplier A123, who became bankrupt in 2012 and was later sold to a Chinese company. The new owners immediately cancelled all current contracts and raised battery prices 30%. This completely reversed the Smith Power Gen 2 cost reduction. Motor/controller failures, charger failures, HVAC (heater) performance shortfalls, and drive shaft vibration in step vans forced a halt in new vehicle production until these issues could be resolved.

Employment in the US peaked at around 130 in 2012 and fell to 51 by as of the end of the Project. Smith never did reach its employment goal of 225.

Development of Second Generation (Gen 2) Vehicles

As discussed briefly earlier, Smith rolled out to customers its second generation vehicle in November 2011. Specifically, the Gen 2 Smith Drive system (described in detail in the "Products Developed under the Award" section) was matched with the Smith Power Gen "1.5" system. Smith Power incorporated several notable advancements (also described in detail), but did not yet have the capability of using both prismatic and pouch cells of varying chemistries, from multiple potential suppliers. It incorporated A123 cells, with a Smith developed battery management system, allowing more flexibility and directly integrated with the Gen 2 motor controller, as well as other ancillary systems.

Issues/Setbacks

Smith management made the decision to halt further production of new Gen 1 vehicles from June 2011 to November 2011 while Gen 2 development (now under significant pressure) was completed and validated.

Failures of Gen 1 motors and controllers- a high rate of failure with Enova motors required Smith to spend significant resources in testing and replacing faulty motors as needed.

Discovery of counterfeit printed circuit boards in Gen 1 battery components- the Valence Gen 1 battery systems were discovered to have counterfeit boards that failed early. Smith service techs again had to test the batteries in already-commissioned trucks and replace battery modules found with counterfeit parts. This action required significant travel, time and shipping costs.

A123 battery manufacturing defects- in 2012, A123 discovered that a manufacturing run of battery modules were of inferior quality. Battery production halted for a period of time. Smith had no alternate battery supplier. A few months later A123 declared bankruptcy, was acquired by Wanxiang, who cancelled all previous supply contracts, disavowed any warranty claims, and immediately significantly raised prices. In addition to the supply interruption, Smith also lost the module price reduction A123 originally provided.

Gen 2 Magtec motor and controller failures- extreme failure rates upwards of 50% plagued Gen 2 vehicles in both trucks and step vans. These motors and controllers were manufactured in the UK, so rush replacement shipments were often air freighted. A significant portion of failed components were beyond warranty terms, and Smith was obligated to replace them at its own cost. Since these motors and controllers were installed in all Gen 2 vehicles, Smith's main customers were affected. Coupled with delays due to cash flow issues, Smith main customers grew increasingly dissatisfied with Smith and its products.

Early charger failures- throughout Smith's sold fleet of vehicles, EDN (Italian) chargers were notorious for failing much sooner than any other major component. Smith service techs again were called upon to replace chargers at a high rate.

Early on Smith used a high voltage heater that had long lead times, was found over time to be not quite capable enough during extreme cold and also proved to be unreliable long term as well. Our engineers worked with our suppliers to develop a higher wattage and more efficient heater. Unfortunately, the first batch run was also unreliable. Smith had to reengage with the supplier to make additional process changes and ultimately a significant design change before achieving a reliable product. While the supplier participated to some degree in replacing/reworking the actual heater itself, Smith bore not only part of that

expense but the expense of replacing them in the field. Smith had to replace many of these heaters, some even multiple times, before the final design with improved supplier manufacturing process arrived at an acceptable product.

In step vans, excessive driveline vibration was experienced at certain resonant frequencies within the normal operational speed of the vehicle. Root cause analysis determined it to be torsional brought on by system masses, driveline angles and system spring constants. Initial attempts to introduce a resilient driveshaft thus altering the spring constant failed after 1 year of service. The eventual solution was found by altering the drive axle and driveshaft angles to decrease the excitation resulting in acceptable vibration levels with a standard driveshaft.

Smith halted its production of Gen 2 vehicles in early 2013. Its last shipment was in August. Work had to be done to correct design engineering and manufacturing of major components before more trucks could be built. Smith needed to have a stronger hand in assuring quality-built vendor supplied componentry. Smith embarked on building a production line for motors and controllers with a noted, high quality tier 1 automotive grade manufacturer in Malaysia. With no new trucks being sold, Smith relied upon its current private investment group to maintain a cash flow necessary to fund the motor project, keep the lights on, and meet payroll for an extended period of time. By December 2014, Smith was receiving production motors and controllers from its new supplier.

Smith will continue to use A123 batteries as an alternate supplier, but FDG batteries will be used in the vast majority of new Smith vehicles beginning in Q2 (calendar) 2016. They will be paired with the Gen 2 Smith BMS.

4. Project Activities.

The overall Project was broken into 6 major tasks, as follows:

Task 1 provided the overall project management framework to manage the technical, facility, and Human resource aspects of the Project.

Task 2 covered the activities to ready the facility to begin vehicle production.

Task 3 defined the design, testing, and certification needed for the Federalization of the Newton platform prior to release for production for the Demonstration Fleet.

Task 4 covered the fabrication assembly and deployment of the approximately 450 vehicle fleet. The final total of vehicles in service with customers in the DOE fleet was 439-just short of the revised goal.

Task 5 covered the data acquisition and reporting for the Project. Smith has installed and activated 439 telemetry devices as of May 31, 2015 on delivered vehicles. Monthly reporting of operating data to NREL has continued unabated from December 2010 to the present.

Task 6 involved those activities associated with cost out and the ongoing technical enhancement of the platform resultant from client feedback and data acquired. The cost down focus continues to be realized in our current manufacturing bills of material.

Cost reduction and Gen 2 development have progressed as follows:

Smith Power- to mitigate supply risk and be able to negotiate lower battery prices, Smith has focused engineering on the introduction of alternative cell chemistries. The development of the Smith Power Gen 2 module will continue. In parallel, Smith will introduce a Smith Power Gen 1.76 solution to utilize FDG batteries at a significant cost per kilowatt reduction. This project will be completed by end of Q1 2016.

Driveline development- the transition of Smith Drive from our bridge-to-production supplier to our volume manufacturing partner was completed by December 2014. This has improved quality and reduced manufacturing cost as well as significantly reduce service and warranty costs.

Charger development- The charger development is complete. The Smith Charger is being installed in 2015 production.

5. Products Developed under the Award.

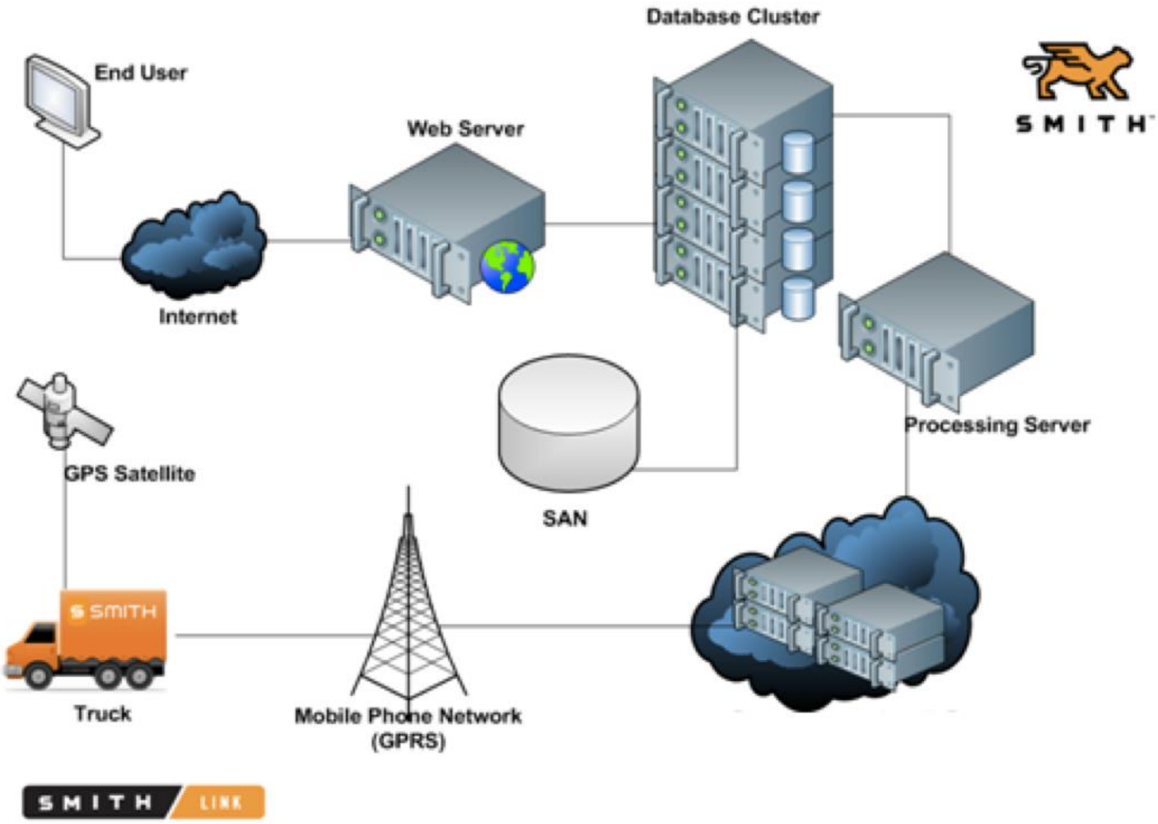
Development of Smith Link

Smith Link is a vehicle telematics system that monitors and transmits the vehicle's vital statistics by general packet radio service (GPRS) to a central server, allowing remote vehicle monitoring, fleet management, diagnostics, and reporting; proving the day-in and day-out impact of Smith EVs. Every vehicle within the Smith Link system reports over 2,000 data points every second the vehicle is in operation. This data is stored on a central server with a web based application for convenient global access. Users can easily explore live vital statistics for each vehicle in the fleet while grouping performance data by depot, fleet, region, or any other logical set of vehicles. Smith Link eliminates reactive service calls with effective, real time data, diagnostics and performance information, which allows for more efficient fleet management. The engineering and development teams, to support continuous vehicle development and improvements, also leverage the operational data collected by Smith Link.

Additionally Smith Link provides convenient access to historical performance data. This data is sorted by vehicle group with selectable date ranges and can be viewed within the web interface or exported for external analysis. The user can deep dive information from the selected date range all the way down to a per second basis. Key performance areas and variable sets are summarized and arranged for quick access. These menus provide a snapshot of key variables on a daily basis allowing Smith personnel to quickly and remotely diagnose, even forecast, vehicle issues.

Smith link telemetry is the world's most advanced linkage between C-level vision and street level visibility of performance; across all fronts- people, profit, and planet. Smith Link has enabled Smith to accrue over 13 million miles of EV performance intelligence in the commercial delivery market segment. As the industry experts in commercial electrification, Smith is able to leverage real-world analytics to set expectations, successful markets, and applications. Looking forward Smith Link data will allow further advances including; predictive maintenance, direct EV communication, route prediction, and training. Smith Link is one of the many ways Smith continues to lead electrification and accelerate EV adoption worldwide.

Below is a diagram that depicts the flow of data from vehicle to end user.

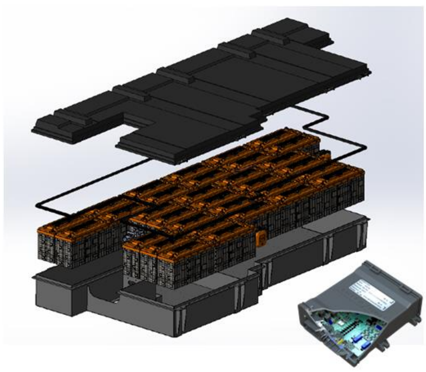


Development of Gen 2 power system- comparison to Gen 1

Smith's proprietary battery system has the unique capability of managing power using an integration scheme that allows the use of batteries of varying sizes from different manufacturers. This ensures Smith leverages state of the art lithium ion battery cell technology at the lowest possible cost to the end customer.

The Smith Power battery management system possesses the capability to manage multiple energy sources within the vehicle including up to six individual high voltage battery strings, the low voltage system/accessories, as well as onboard auxiliary energy sources. The battery management system has the capacity to monitor and control, at a cell level, all aspects of battery performance to ensure the battery system is performing at the full potential while providing exceptional vehicle and battery safety.

The design of the Smith Power system permits flexibility with respect to any battery cell chemistry, form factor, and vendor. Smith maintains a database of the many available lithium-ion cell vendors and as well as other chemistry types in an effort to stay in front of cell advancements. Additionally, the strategic relationship with FDG has allowed access to competitively advantageous cells. These cells, and the Smith systems they are assembled into,


Smith Power battery pack and management controller

will provide significant reductions in material costs as well as a close control of cell quality and supply activities. It is Smith's intention to further this relationship allowing FDG and Smith to develop cells and systems, which are fully optimized to the commercial vehicle market. In parallel to our strategic links with FDG, Smith continues to maintain technical and commercial relationships in the broader battery cell market, with supply agreements such as A123/Wanxiang and MHI/Delta offering alternative cells and chemistries should specific markets and technical performance preclude the use of cells produced by FDG. The battery technology and control mechanisms currently used in our vehicles are designed to monitor, measure, and control battery cells to prevent rapid releases of the energy contained in the cells. The power system is based on a battery chemistry selected for its stability, and the cells incorporated into these systems contain current separation mechanisms and venting technologies that passively contain any single cell's release of energy, which minimizes the spread of energy to neighboring cells.

The Smith Power portfolio also includes multiple on-board and off-board charging options that allow existing vehicles to be recharged in less than one hour, but are typically scaled back to meet the localized infrastructure capability. All current generation products are designed using the SAE J-1772 standard which allows the vehicles to be plugged into any standard, level 2 charging system. Every Smith vehicle comes equipped with a fully integrated on-board charging system that optimizes charging efficiency and monitors re-charge state to maximize battery performance and longevity. The Smith on-board charger is a fully automatic, 208-240 volt, three-phase line-to-line, 75 Amp, 12/18kw charger. The charger converts a VAC supply voltage to 376VDC to charge the high voltage battery system. The battery management system then regulates the charge rate between the charger and the battery pack to ensure proper cell charging, balancing, and protection.

The lithium iron phosphate (LiFePO4) chemistry utilized within Smith Power demonstrates excellent life cycle characteristics and does not suffer from the memory effects associated with nickel cadmium and nickel-metal hydride batteries. Smith is currently partnered with National Renewable Energy Laboratory (NREL) to actively monitor battery capacity degradation in multiple vehicles utilizing the current generation Smith Power batteries in customer vehicles during real-world applications. To date, capacity fade has been not yet been realized in any of the vehicles associated with the study.

Smith's cell manufacturer rates the Smith Power cells for 85% of rated capacity at 3,000 full discharge cycles. It is important to note this rating is based on aggressive charge and discharge cycles. The Smith Power battery management system actively works to protect the battery cells and does not allow for a discharge power greater than one-third the allowable limit and standard charging power is roughly one-tenth the allowable limit. These conditions are much more favorable for battery cycle life than the laboratory conditions for which the manufacturer rates the cells. Based on limited real-world data and laboratory data from the battery cell manufacturer, it is expected the Smith Power battery cells would continue to demonstrate greater than 85% rated capacity after ten years of typical operation in a six-day-per-week drive cycle.

Gen I,	Gen II,
• 40 KWh String	• 20 KWh String
• 40 80 120 Configurations.	• 40 60 80 100 120 KWh Conf
• 24 Mod / String	• 4 Mod / String
• 320 VDC Nominal	• 346 VDC Nominal
• 1 string per charger	• 2 strings per charger unit
• Fuse/controls in Battery Pod	• JB- Accessible fusing/controls
• Master/Slave Battery Pod	• Master Distribution Box
• Manually intensive sealed box	• Full gasket sealed ox
• No Interlock Pins for HVDC	• Interlock-Pins for HVDC
• Common power cables	• Power Shielded cables/ferrites
• Pre-charge circuit in Batt Pod	• Pre-charge circuit in CEU
• Battery Supplier BMS	• Smith BMS

Development of Gen 2 drive system

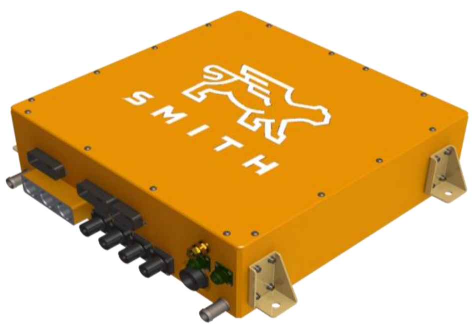
The Smith Drive product line includes the traction drive and control system. The current generation of Smith Drive utilizes a brushless permanent magnet (PM) motor. PM motor designs are well known for high efficiency and power density. In fact, the peak operational window of the Smith Drive system is capable of 94% efficiency across the motor and controller (compared to a 30-35% efficiency of an internal combustion engine). The drive motor possesses a peak torque capacity of nearly 450 foot-pounds and a power rating of over 200 horsepower in a package that weighs about 200 pounds with the attached gearbox. In production vehicles, these performance characteristics are calibrated by vehicle and application to find the ideal bias between on road performance and efficiency. This process ensures each vehicle application is well suited for the route demands while also maximizing range and overall efficiency. Additionally, the permanent magnet design of the Smith Drive motor allows for variation of the stack length of the rotor and stator during the manufacturing process to alter the resulting power ratings. This process allows Smith to leverage a common motor design and controller for multiple applications.

Due to the instantaneous torque profile of permanent magnet electric motors, a multi-speed transmission is rarely beneficial for light and medium-duty vehicles. Smith Drive utilizes a single speed gear box. This gear box multiplies the torque output of the Smith Drive motor with a single gear reduction allowing Smith vehicles to transition from substantial launch torque to highway speeds with a shiftless operational profile.

The Smith Drive controller serves as much more than a means for controlling the motor. The controller architecture possesses multiple inverters for the vehicle auxiliary systems. When utilizing a pure electric drive system, vehicle auxiliary systems such as brake compressors, power steering pumps, and accessory loads require a high voltage power source. Placing these inverters inside the motor controller protects the inverters from the elements while limiting the amount of external high voltage connections on the vehicle. The plug-and-play nature of these inverters also allows Smith to leverage the same controller architecture for multiple platforms and auxiliary power requirements.

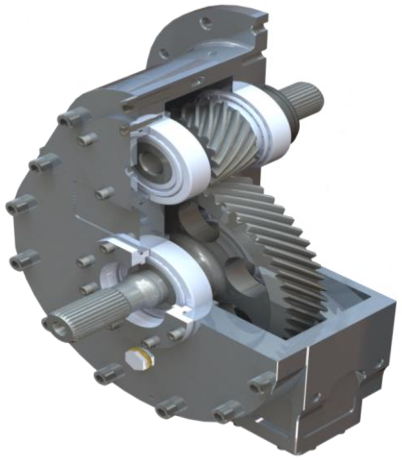
The Smith Drive motor and controller utilize a two-stage regenerative braking algorithm to recover deceleration energy during operation. As the vehicle begins to decelerate, the first, passive stage of regenerative braking activates. As the driver applies braking force via the foot pedal, the regenerative braking routine enters the second, more aggressive, stage. In real-world applications, regenerative braking energy recovery ratios of greater than 40% have been observed. The regenerative rate typically trends linearly with the number of stops during a drive as the opportunity for energy recovery increases. The regenerative braking algorithm in the controller is highly configurable and adjusted by application, maximizing on-route efficiency. The high daily start-stop profile of the USPS delivery route is an ideal candidate for an electric drive vehicle as the frequent vehicle deceleration profiles provide significant opportunity for regenerative braking.

Smith designed drive controller (CEU)



Purpose:

- 150kW 6 IGBT Gate Drive and Power throttle
- 2.5kW Integral Steering Inverter
- 2.5kW Integral Brake assistance Inverter
- 1.2kW DCDC 24v support unit
- Pre-charge and safety control system
- CAN, Digital and Analogue Communication Hub
- Water/Glycol cold plate
- Integral HV sealed Connections and LV connections

	Gearbox- • Purpose: Torque multiplication, prop speed reduction • Type: Single ratio (3.4:1), parallel shaft, helical cut • Lubrication:Oil,Splash lubricated • Mating Flange: Supports Stock Avia • Tachograph Supported: Yes

	Motor- • Purpose: Manage HV electrical energy and produce useful work at the wheels • Type: Permanent Magnet • Cooling: Water/Glycol jacket cooled • Weight: 97Kg • Torque: PEAK 600 Nm, CONT 400 Nm • Power:PEAK150kW, CONT 80 kW • Efficiency: 93%

6. Conclusions.

When you consider the fact that Smith US was born in January 2009, had 4 employees, no plant, no US product, no established US supply chain, and by December 2009 sold and delivered its first fully functional, US homologated, FMVSS and DOT approved battery powered, all electric vehicle to a US customer; by the end of 2011 had begun building its second generation vehicle and was well on its way to developing a functional stripped chassis step van for shipment to a customer by May 2012; and by August 2013 had over 500 US fleet vehicles on the road, it is remarkable.

There were many trials and tribulations along the way, and even though Smith fell 11 vehicles short of its 450 unit fleet goal, the results below show that this project was a significant success story. No other DOE-funded projects involving placing a fleet of never-before-existing commercial AEV's at this volume was successful.

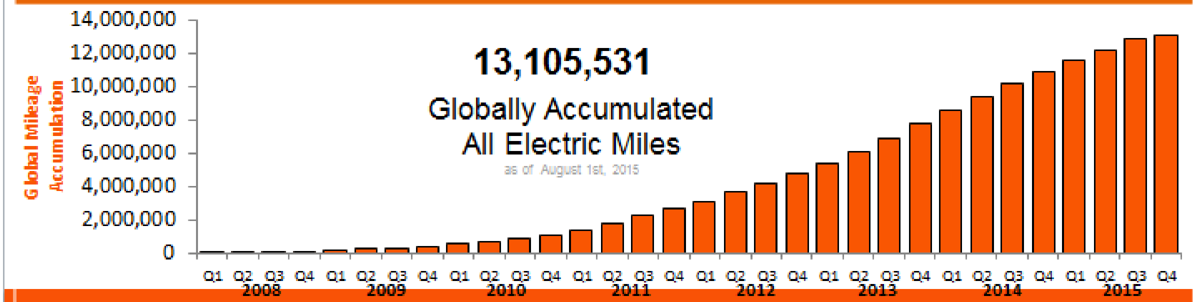
Because this project was all about introducing this type vehicle into commercial application in order to move the US toward renewable energy and away from fossil fuels generating millions of tons of greenhouse gases, the charts below evidence the success of this project.

Annual Vehicle Performance Statistics

All Operational US Fleets

	2012	2013	2014	2015 (through July)
Routes Completed	56,391	85,966	95,602	47,519
Annual Distance Traveled	1,782,877 miles	2,593,550 miles	2,803,179 miles	1,334,137 miles
Energy Consumption	2,555,387 kWh	3,460,553 kWh	3,646,890 kWh	1,703,309 kWh
Energy Regenerated	283,752 kWh	440,256 kWh	498,283 kWh	239,436 kWh

Smith Global Mileage Accumulation



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All energy numbers assume DC energy

Annual Emissions Impact

Energy Consumption		
	All Operational US Fleets	***Global***
	August 2011 – July 2015	**Total Accumulation**
Diesel Fuel Offset *Assumes 8 MPG Equivalent Vehicle*	1,120,905 gallons	1,638,191 gallons
Electricity Consumption	11,691 MWh	17,086 MWh
Well-to-Wheels Greenhouse Gas (GHG) Emissions Impact		
	All Operational US Fleets	***Global***
	August 2011 – July 2015	**Total Accumulation**
Equivalent Diesel GHG *13.116 kg per gallon (28.916 lb per gallon)*	32,412,089 lbs	47,369,931 lbs
Electricity GHG *Based on top 5 US markets for SMITH 0.384 kg per kWh (0.847 lb per kWh)*	9,902,277 lbs	14,471,842 lbs
GHG Offset	22,509,812 lbs	32,898,089 lbs

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All emissions factors courtesy of Argonne National Laboratory Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model

8. New Product Introductions /Technology transfer activities.

Smith has agreed to partner with technology leaders on several new projects supported by the DOE and ARPA-E:

- Partnering with QM Power on an ARPA-E project to develop a high efficiency electric motor, and adapt it to current production-level commercial vehicles;
- Partnering with Federal Express, Plug Power and DOE to develop a hydrogen fuel cell range extender for battery electric vehicles, and adapt it to current production-level commercial vehicles; and
- Partnering with Eaton, NREL, ORNL and DOE to develop a multi-speed transmission for EV's.

These projects have all begun and will continue throughout fiscal 2015.