

The All-Electric 2012 Toyota RAV4 EV First Drive

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Newport Beach, Calif., August 2, 2012 – Toyota Motor Sales, USA, Inc. (TMS) offered news media first drive opportunities today for the Toyota RAV4 EV, an all-new, all-electric SUV arriving in select California dealerships later this summer. During the media event, Toyota engineers lifted the hood and shared developmental and technical details of this unique electric vehicle, while sales and marketing executives discussed launch and distribution strategy. Offering outstanding performance, comfort and versatility RAV4 EV is expected to achieve an EPA-estimated driving range rating of approximately 100 miles. It charges in approximately six hours on a 240V/40A charger.

“The RAV4 EV’s driving performance, dynamics and cargo capacity are equal to or exceed the gas powered RAV4 V6,” said Bill Fay, Toyota division group vice president and general manager. “Arriving fully-equipped with an MSRP of \$49,800, with available combined federal and state incentives of up to \$10,000, the RAV4 EV is a practical, versatile option for the EV enthusiast.”

The RAV4 EV is the product of a unique collaboration with Tesla Motors spurred by Akio Toyoda, president and CEO of Toyota Motor Corporation. Twenty-two months after the project announcement, Toyota and Tesla engineers revealed the vehicle at Electric Vehicle Symposium 26 in May 2012. To manage such a compressed timetable, Toyota engineers knew they’d need to be fast and flexible with development and evaluation. They devised the eFAST process (early field and suitability testing), a new protocol specifically put in place for the RAV4 EV to validate and confirm vehicle performance.

The RAV4 EV combines a Tesla designed and produced battery and electric powertrain with Toyota’s most popular SUV model. The collaborative team set its sights on optimizing the customer experience. From remote charging options to interior comfort to futuristic interactive displays, the RAV4 EV combines the practical features of a compact SUV with aerodynamic styling and an electric powertrain for the longest EPA estimated driving range rating of any non-luxury EV.

“Developing the RAV4 EV with Tesla gave us the opportunity to work with a leading-edge Silicon Valley company,” said Greg Bernas, chief engineer for Toyota Engineering and Manufacturing. “Tesla brought their EV powertrain expertise and entrepreneurial spirit. We brought our customer – first focus and decades of production experience to the project. It wasn’t always an easy process but I think we succeeded in blending our strengths and learning from one another.”

Power and Performance

The Toyota RAV4 EV offers an exceptionally smooth, quiet ride and comfortable handling due in part to its low coefficient of drag and low center of gravity. In fact, at 0.30 Cd, RAV4 EV achieves the lowest coefficient of drag of any SUV in the world. Compared with the gas powered RAV4, at 0.35 Cd, Toyota re-styled the front bumper, upper and lower grill, side mirrors, rear spoiler, and under body design to optimize air flow around the vehicle. The RAV4 EV’s battery pack is mounted low and to the center of the vehicle, contributing to a more sedan-like ride.

The front wheel drive RAV4 EV allows drivers to select from two distinctly different drive modes, Sport and Normal. In Sport mode, the vehicle reaches 0-60 mph in just 7.0 seconds and has a maximum track speed of 100 mph. Normal mode achieves 0-60 mph in 8.6 seconds with a maximum track speed of 85 mph. Maximum output from the electric powertrain is 154 HP (115kW).

The RAV4 EV has two charge modes – Standard and Extended. In standard mode, the high voltage battery charges up to 35 kWh and the vehicle is expected to achieve an EPA-estimated driving range rating of 92 miles. Extended Mode allows the battery to charge to its full capacity of 41.8 kWh, providing an anticipated EPA-estimated driving range of 113 miles. Standard mode is designed to optimize battery life over range. The RAV4 EV's sophisticated battery and thermal management systems provide consistent vehicle performance in a variety of climates vs. competitor electric vehicles. The liquid-cooled battery is a first for Toyota.

EV Range Optimization

Toyota engineers devised a number of strategies to help optimize the available EV range on the Toyota RAV4 EV. The climate control system has three modes which allow the driver to select their preferred level of comfort and EV driving range. In NORMAL mode, the climate control system operates in the same manner as a conventional vehicle and provides the maximum comfort level, but also draws the most power, which in turn reduces the EV range. ECO LO mode is recommended to achieve a balance of cabin comfort and improved range through reduced power consumption of the blower, compressor and/or electric heater. In cold weather, ECO LO also automatically activates and controls the seat heaters to optimal levels based on the cabin thermal conditions. ECO HI further reduces blower, compressor and heater levels and also automatically activates the seat heaters if necessary. The use of ECO LO can reduce the climate control system power consumption up to 18 percent compared with NORMAL while ECO HI offers up to 40 percent power reduction compared to NORMAL. Thus use of either ECO LO or ECO HI mode extends the vehicle's EV driving range.

Remote Climate Control allows drivers to pre-cool or pre-heat the vehicle prior to driving while the vehicle is plugged-in, which conserves battery charge and EV range. The Remote Climate Control system can be set by a timer on the navigation display. It can also be activated using a smart phone.

The unique Toyota/Tesla designed cooperative regenerative braking system works to minimize the vehicle's kinetic energy loss during stopping. The system recovers the energy and converts it to electrical energy, which recharges the battery and extends driving range. The vehicle slows down while energy is captured. The addition of cooperative regenerative braking increases driving range by up to 20 percent.

Safety

The RAV4 EV incorporates all of the safety features of the conventional model: for the front occupants there are advanced airbags seat-mounted side airbags, and active headrests. First and second row roll-sensing side curtain airbags are also standard.

Like all Toyotas, the RAV4 EV comes standard with the STAR Safety System. On this vehicle this includes Enhanced Vehicle Stability Control (VSC), Traction Control (TRAC), Anti-lock Brake System (ABS), Electronic Brake-force Distribution (EBD), Brake Assist (BA) and Smart Stop Technology (SST). RAV4 EV also comes with a complimentary three-year trial subscription to Toyota Safety Connect®, which includes Emergency Assistance, Stolen Vehicle Locator, Roadside Assistance, and Automatic Collision Notification.

There are several safety features that are unique to the RAV4 EV. The battery modules are encased in a structural pack surrounded by a four-sided extruded aluminum enclosure. Large aluminum rocker extrusions act as a structural attachment between the enclosure and the body as well as provide further impact protection. In addition, the chassis is specially designed to help protect the battery and inverter assemblies in the event of a collision. A rigid inverter protection brace bridges the gap between the body front cross member and the front suspension member to mitigate inverter damage by keeping the two members at a set distance from each other during a frontal crash. Special steel ramps built into the front of the undercarriage serve to deflect intrusion into the battery enclosure. In a rear impact, the battery's rear mounting brackets can separate the battery from the body further protecting the battery enclosure from intrusion.

As is the case with all Toyota electrified vehicles, there are multiple redundant systems in place to automatically safeguard against the unintentional discharge of energy. In the event of an accident, electrical contacts automatically open, quickly isolating the battery from the rest of the high-voltage system. After the contacts open, active and passive discharge strategies are employed to remove any remaining energy from the high-voltage system within five seconds in compliance with Federal Motor Vehicle Safety Standards.

“A prime design target for all Toyota, Lexus and Scion vehicles featuring traction batteries is to maintain battery structural integrity and electrical isolation internal to the battery,” said Sheldon Brown, executive program manager for Toyota Engineering and Manufacturing North America. “The RAV4 EV battery and chassis are designed as a system to protect against battery ‘isolation loss’ during a crash, meaning the electrical energy is completely contained within the battery preventing any conductive path to the vehicle body. Electrical components and chassis are designed as a system to protect occupants, first responders and the battery pack itself.”

In addition to robust accident protections, the RAV4 EV is designed with multiple systems to help protect and maintain a proper state of charge on the battery. For example, the onboard charger is equipped with a hardware voltage limiter to prevent overcharging the battery. To prevent over discharge, the air conditioning system and driving power will be limited at defined low States of Charge, prompting the driver with a warning in the meter display to plug the vehicle into a power source. Finally, the battery system is designed to handle a lengthy period of non-operation. At a 50% state of charge the RAV4 EV can sit without charging for approximately one year with no permanent loss of function. If the battery pack does become depleted, its 12-volt battery will allow the vehicle to turn on and shift into neutral. If the 12 volt battery is also depleted it can be jumped.

Exterior Design

On the exterior, RAV4 EV features upscale LED low beam projector headlights with halogen projector high beams. A manual leveling system allows drivers to redirect the headlights when the vehicle changes significantly in pitch due to a heavy load. Five vertical LEDs make up the daytime running lights, which dim to parking lights. The rear combination lights are LEDs accented by a unique light smoke outer lens. Other exterior variations from the gasoline powered RAV4 include new exterior emblems on the front, rear and the front door panel utilizing the signature Toyota “environmental blue.”

The vehicle will be available in late summer in three exterior colors: Blizzard Pearl, Shoreline Blue Pearl and Classic Silver Metallic. Fleet units also will be available in Super White. The interior features a unique “Neutron” fabric, woven with a subtle sheen and blue accent, on the seat inserts and door trim.

Interior Features

Inside, a six-way adjustable driver-seat includes variable front seat heaters, which extend heater coverage to the occupant's upper back. The seat heaters help reduce the need for the climate control system's heat operation – saving power and increasing EV range. The split reclining rear seats with folding center arm rest fold flat for

increased cargo space, with a total cargo capacity equivalent to the conventional RAV4 of 73 cu. ft. behind the front seats. No interior space is lost in the vehicle due to EV components.

The highlight of the interior is a Toyota first; the IntelliTouch™ capacitive touch screen, featured on both the 8-inch navigation screen and climate control panel. The 8-inch, high-resolution, responsive touch-screen features a state of the art graphic display, with split screen capability for navigation, Entune® and EV applications, and EV drive information and settings designed specifically for the RAV4 EV. The touch screen also allows map panning and list scrolling via flick operation similar to an iPhone®. The climate control panel features IntelliTouch™ capacitive touch sensor controls and a 5.7-inch display screen. Entune™ is standard (with three year complimentary access to Entune™ services) along with SiriusXM Satellite Radio (with 3-month trial subscription to XM Select package), AM/FM radio, Bluetooth® streaming audio, and USB port with iPod® connectivity.

An all-new meter cluster includes the power meter, driving range, battery gauge, speedometer, shift indicator and multi-information display. The dash display color illuminates red when the vehicle is operating in sport mode and blue in normal driving mode. The multi-information display scrolls through six different screens that provide driver-performance feedback including driving range, trip efficiency, efficiency, ECO coach, CO2 reduction and AUX power.

- **Driving range** displays an estimated range according to the amount of charge remaining in the traction battery along with the current air condition setting. The range will adjust based on the setting of the air conditioning.
- **Trip efficiency** displays the average power consumption in intervals of five minutes during a trip. **Efficiency** displays average power consumption since the function was reset as well as current power consumption.
- **Eco coach** evaluates the level of eco-sensitive driving according to acceleration, speed and braking and displays an overall score.
- **CO2 reduction** displays the amount of CO2 reduced compared to a conventional gasoline vehicle. The reduction is displayed as a growing tree.
- **AUX power** displays average 12-volt battery power consumption since the function was reset and the current trip's 12-volt battery power consumption.

The Premium Intellitouch™ Navigation screen features EV system screens that help customers understand and maximize their driving range. The EV Charging schedule lets customers schedule when the vehicle will charge and activates pre-climate conditioning based on departure time. Charging can be scheduled one charge at a time or on a weekly basis. A Range Map specifically designed by Toyota for the RAV4 EV, allows customers to see how far they can travel for roundtrip or one-way trip based on their available electric range. A Charging Station Map EV app allows customers to locate nearby charging stations.

Charging Equipment and Sales Plan

Toyota's approved electric vehicle supplier equipment provider is Leviton. Leviton offers multiple options for charging solutions. For the shortest charge time of approximately six hours, Leviton offers a custom 240V (Level 2), 40A, 9.6 kW output charging station. For more information visit Leviton.com/Toyota. The vehicle comes equipped with a 120V (Level 1) 12A charging cable for instances when the recommended 240V (Level 2) charging is not available.

The RAV4 EV will go on sale in late summer 2012 through select California dealers, focusing on major metropolitan markets. Service for the RAV4 EV will only be available at these authorized RAV4 EV dealers. Sales volume is planned for approximately 2,600 units through 2014. The battery is warrantied for eight years or 100,000 miles.

The RAV4 EV is expected to qualify for a \$2,500 rebate through the Clean Vehicle Rebate Program in California and also is eligible for a \$7,500 Federal Tax Credit. The vehicle will qualify for the California High Occupancy Vehicle (HOV) lane white sticker program.

“We believe that the RAV4 EV will attract sophisticated early technology adopters, much like the first-generation Prius,” said Bill Fay, Toyota division group vice president and general manager. “It’s designed for consumers who prioritize the environment and appreciate performance. We look forward to seeing how the market responds.”

Given the RAV4 EV’s distinctive customer, marketing will focus on education to demonstrate the vehicle’s technology and establish RAV4 EV as a credible product within the EV enthusiast community. Focused media outreach with target EV enthusiasts and highlight product attributes such as driving range, performance and telematics.

In July 2010, Toyota Motor Corporation and Tesla Motors jointly announced an agreement to develop an all-electric version of the RAV4, with the intent to bring the vehicle to market in 2012. Tesla contributed its EV technology expertise, daring spirit, quick decision making and flexibility. Toyota contributed design, engineering, manufacturing and production expertise. In an industry where development cycles are typically five years, Toyota and Tesla brought a dynamic product to market in less than half that time.

TOYOTA/TESLA DEVELOPMENT MILESTONES

- May 2010 – Toyota/Tesla announce collaboration to develop electric vehicles, parts, production systems and engineering support
- July 2010 – Toyota/Tesla announce development of RAV4 EV
- November 2010 – Toyota reveals RAV4 EV Phase Zero prototype at LA Auto Show
- February 2011 – Tesla begins delivery of 31 converted RAV4 EV Phase Zero demonstration program vehicles
- April 2011 – Toyota provides first media drive opportunity of Phase Zero demonstration program vehicle at 2011 Sustainable Mobility Seminar
- August 2011 – Toyota/Tesla announce RAV4 EV manufacturing location – Toyota Motor Manufacturing Canada, Inc., Woodstock, Ontario
- May 2012 – 2012 RAV4 EV revealed at Electric Vehicle Symposium 26