Toyota Introduces Second-Generation Mirai Fuel Cell Electric Vehicle as Design and Technology Flagship Sedan

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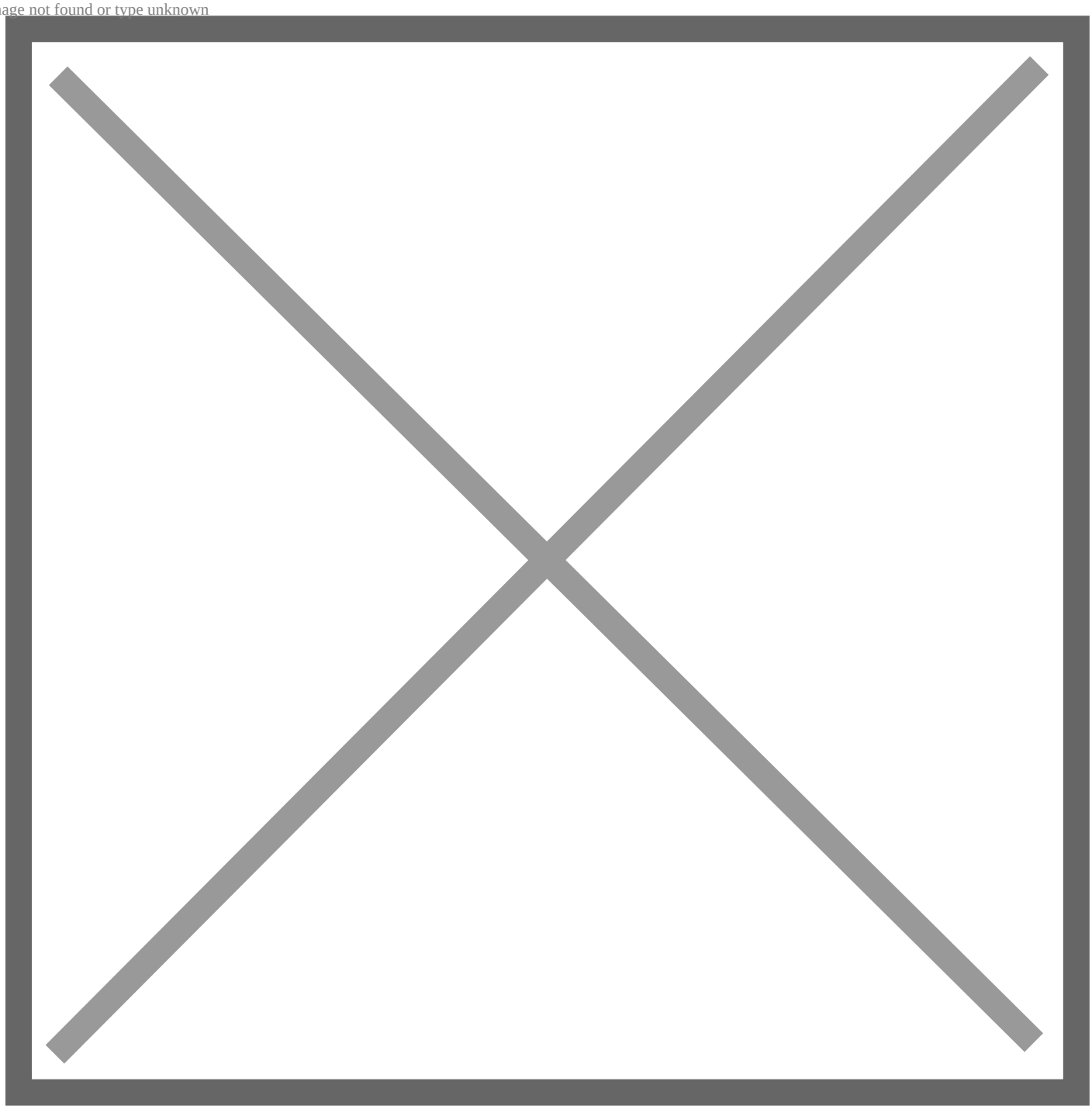

NEWPORT COAST, Calif. (December 16, 2020) – Beauty, technology and a hint of the future come together in Toyota's new flagship sedan, the all-new 2021 Mirai. The 2016-2020 Mirai was the first production fuel-cell electric vehicle (FCEV) offered for sale to retail customers in North America. Now, for 2021, Toyota has fully rebooted the Mirai as a premium rear-wheel drive sports-luxury FCEV with striking design, cutting-edge technology, more engaging driving performance and a significantly longer EPA-estimated range rating.

The model name, which means future in Japanese, is wholly appropriate, as the 2021 Mirai is powered by the latest evolution of the brand's advanced fuel cell electric vehicle (FCEV) powertrain. The new Mirai is one part of an electrification strategy that also includes Toyota's current and future hybrids and upcoming battery electric vehicles (BEVs). Toyota put the auto industry on the road to modern electrification in 1997 with the first Prius hybrid and today remains the global leader in gas/electric hybrid sales.

Built on the rear-wheel drive GA-L platform that also underpins the larger Lexus LS sedan, the 2021 Toyota Mirai makes a major design departure from the front-wheel drive first-generation version. The body is lower, longer, and wider, with its bolder stance accentuated by standard 19-inch alloy wheels.

A more powerful fuel cell system provides a more engaging driving experience than its pioneering forerunner. The rear-wheel drive layout and four-wheel independent suspension deliver a true sports-luxury sedan driving feel, with greater handling agility than before, yet also with a more comfortable ride. The RWD layout also allowed for increased hydrogen storage to boost EPA-estimated range to 402 miles (Mirai XLE grade), a 30 percent increase over the first-generation Mirai.

The new Mirai's clean, modern profile was inspired by coupes, yet the new design is also more practical than before. Improved use of space enables a five-seat cabin versus the four-seat layout in the first-generation Mirai. The new Mirai's interior matches the elegant tone of the exterior.

The 2021 Mirai features more advanced user and safety tech, including Toyota Safety Sense 2.5+. This latest generation of Toyota's driver-assist technology suite includes Full Speed Dynamic Radar Cruise Control, automatic emergency braking, and Lane Keep Assist. In addition, Blind Spot Monitor with Rear Cross Traffic Alert is standard on the 2021 Mirai.

Electrifying Design, Slippery Aero

The switch to a rear-wheel drive platform delivers a "twofer" in the 2021 Mirai. The new layout facilitates the coupe-like proportions and bolder stance. At the same time, the new platform allowed for a roomier cabin with more usable space on the inside and in the trunk. The result is neither "form follows function" nor the opposite; it is perhaps better described as "form marries function," and it's a beautiful marriage, indeed.

The 2021 Mirai conveys a sense of motion with a classic GT car stance (long-hood, sweeping roofline, short rear deck), rendered in a practical four-door sedan package. The cabin silhouette flows rearward with flush, smooth side surfaces, accented by a dynamic sculpted rocker area with a kickup near the rear wheel.

The body tapers to the rear and blends into an integrated rear spoiler. The effect is that of a single metal form sculpted into a bold shape. The Limited grade is equipped with an exclusive dual-panel panorama roof, which features fixed glass panels and a power sunshade.

The 2021 Mirai will be offered in five exterior colors: Black, Oxygen White, Supersonic Red, Hydro Blue, and Heavy Metal. Hydro Blue, exclusive to the Limited grade, is created with primer, silver base, clear, blue clear, and final clear layers.

The “function” aspect of Mirai manifests in a larger body with more passenger room. Wheelbase, height, length and width are all increased over the first-generation Mirai. Weight increases by just 176 lbs., yet weight distribution improves to near 50:50, and the center of gravity is lower to significantly enhance handling agility.

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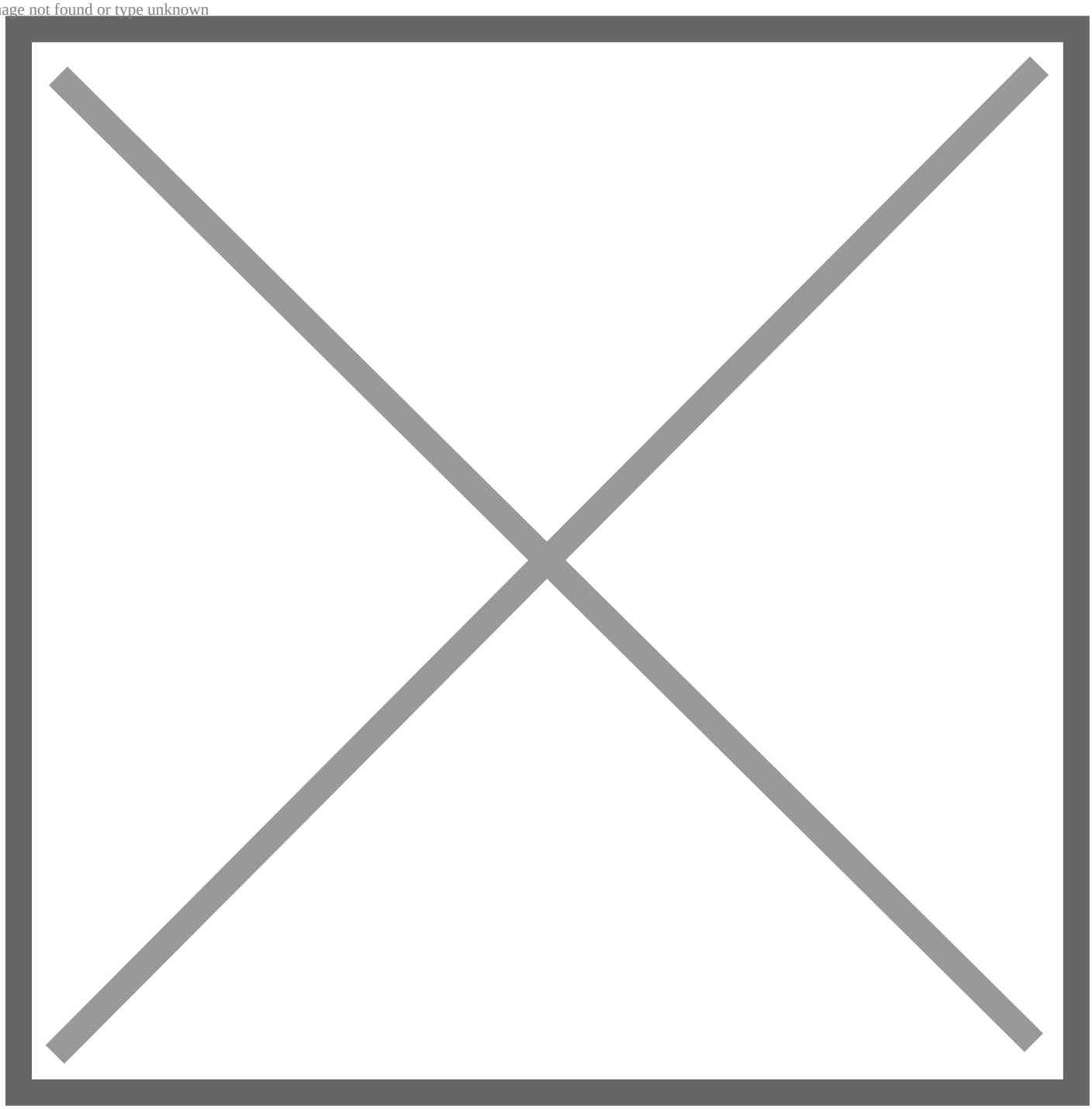

Sleek Details

The 2021 Mirai introduces a new lighting signature for a Toyota sedan, with long, narrow headlights that sweep rearward into the fenders. Both grades are equipped with auto-leveling bi-beam LED headlights, multi-LED

front and rear turn signal indicators, Daytime Running Lights (DRL), and clearance lights. The LED side marker lamps are etched with the Mirai logo.

At the rear, a thin LED taillight panel spans the car's width, tapered in the center, and creates a unique nighttime signature with three distinct gradation lines. Color-keyed heated power-folding outside mirrors feature turn signal indicators, defrosters, blind spot warning, and puddle lights.

As much as the new Mirai design catches the eye and tugs at the heart, it is bound to cheat … the wind, that is. The super-low 0.29 coefficient of drag owes not only to the body's shape, but also to details such as optimized airflow through the wheel wells, a flat full undercover, aero stabilizing fins at the front edge of the side windows and windshield wipers that retract to a lower position when not in use.

The wipers show the kind of detail Toyota infused to raise comfort and convenience to a higher level in the Mirai. They feature direct-spray washer fluid arms, and, when in use, operate more quietly thanks to slower speed at the reversing point.

The Mirai XLE grade rides on standard 19-inch five-twin-spoke aerodynamic wheels, with the Limited grade distinguished by black machined-finished versions. The Limited also offers optional 20-inch Super Chrome alloy wheels.

Flagship Accommodations

The Mirai's clean, modern layout is infused with a hint of luxury. The cabin embraces occupants in comfort and understated elegance while making cutting-edge multimedia tech easily accessible.

The concept starts with more interior room than the first-gen Mirai, with clever design that further heightens the feeling of spaciousness. The dash panel appears as a single sculptural form, seamlessly integrating all controls, displays and ventilation. The dash is nearly 3 inches wider than in the first-gen Mirai and is also angled more steeply (28.4 degrees vs. 32.7 degrees), enhancing the feeling of spaciousness.

As on Toyota's GR Supra sports car, the Mirai's dash design flows into the door panels to wrap the driver and passenger, and the driver section is further defined by a console that's more enclosing on that side. The console armrest is a significant 3.7 in. wider and 2.3 in. longer than in the first Mirai.

The feeling of luxury comes through in the choice of materials. Major portions of the dash, as well as the console armrest, are wrapped in SofTex synthetic leather. A seamless punched-metal panel resembling a speaker grille runs atop the dash, concealing the audio speakers and creating a sophisticated textural design element. This motif is repeated on the rear package shelf, as well.

Elegant copper-color or satin chrome metal trim outlines the console and then rises to follow the edge of the SoftTex dash covering. With copper trim, the upholstery stitching is beige; with satin chrome trim, it's gray. The climate control outlet vents blend into a thin horizontal trim panel running just beneath the metal trim line.

Two rows of switches, one below the center display and another within the dash trim below that, are zoned by function. Three-dimensional steps give the steering wheel switches a high-quality feel.

Comfort and Tech: Above and Beyond

The Mirai combines exacting craftsmanship and high tech to give the Mirai comfort that's above the ordinary. Starting with what's "above," the headliner is hardly conventional. An infrared reflective layer on the roof-facing surface blocks that part of the spectrum to help reduce heat buildup inside the cabin, resulting in reduced

electrical load on the air conditioning system. Also within the headliner, a layer of Thinsulate™ also helps to block heat as well as provide additional sound damping. The side windows are UV-Protected and water-repellent.

The Mirai XLE grade features SoftTex upholstery and heated, power-adjustable front seats (8-way for driver, 4-way for passenger). The Limited steps up to perforated SoftTex-trimmed heated and ventilated front and rear seats, including an 8-way power front passenger seat.

The Limited interior is available in dramatic two-tone color schemes: white and brown or black. LED ambient lighting includes eight driver-selectable colors and blue footwell illumination. A standard digital rear view mirror with a HomeLink® transmitter in the Limited can be switched from conventional to digital modes. The latter relays an expansive camera view from behind the vehicle and can also brighten the nighttime image.

For rear seat passengers in the Limited, digital touch switches on the rear of the center console operate the audio and climate controls and the panorama roof's power sunshade. The Limited features manual sunshades for the side windows and a power shade for the rear window.

Dual Digital Displays

The Mirai XLE and Limited both employ an 8-inch color TFT LCD digital gauge cluster and a 12.3-inch touchscreen multimedia display. Within the 8-inch gauge cluster, a 4.2-in. multi-information display includes an ECO drive indicator that helps the driver to maximize fuel efficiency by providing acceleration guidance and assigning a score on economical driving. Hydrogen fuel level and remaining range are always shown.

The 12.3-inch display provides easy access for the driver or front passenger, and the multimedia, climate control, and navigation content can be toggled from left and right. Both model grades come standard with a Dynamic Navigation three-year free trial and Premium Audio playing through 14 JBL® speakers, including subwoofer. The system features the latest in-demand connectivity tech, including Bluetooth® wireless technology, Android Auto™, Apple CarPlay®, Amazon Alexa compatibility and SiriusXM® with 3-month All Access trial.

The 12.3-inch display also relays imagery from the Bird's Eye View Camera with Perimeter Scan, Overhead 360-Degree View in drive and reverse, and Curb View (standard on Limited and available for XLE).

FCEV: Making Electricity from Hydrogen

Even those familiar with EVs may still be unacquainted with FCEVs. The easiest way to understand an FCEV is that it is a "plug-less" electric vehicle. There's no need to charge the battery, which can take several hours in an EV even with fast charging. Instead, the FCEV driver simply fills the tank with hydrogen in about five minutes, just as millions of drivers do every day with gas vehicles.

With an FCEV, the fuel is non-toxic, compressed hydrogen gas rather than liquid gasoline. As it did with the first-generation Mirai, Toyota will include up to $15,000 of complimentary hydrogen.

An FCEV generates its own electricity onboard from hydrogen, with water as the only emission. A fuel cell "stack" combines the stored hydrogen with oxygen from the air, and a chemical reaction that produces electric current, and water, which drops out of a hidden vent pipe beneath the car.

The fuel cell is composed of an anode, a cathode, and an electrolyte membrane. Hydrogen is passed through the anode, and oxygen through the cathode. The hydrogen molecules are split into electrons and protons. As protons pass through the electrolyte membrane, electrons go through a circuit, generating an electric current. At the cathode, the protons, electrons, and oxygen combine to produce water molecules. There are no other byproducts.

The excess electricity generated by the Mirai's fuel cell and by regenerative braking is stored in a lithium-ion battery. As a result, pressing the accelerator pedal yields immediate flow of electric power jointly from the fuel cell and battery to the rear-mounted AC synchronous electric motor, which drives the rear wheels through a fixed gear ratio.

Smaller, Lighter, More Powerful

The second-gen Mirai features a more highly evolved FC system. Still 650v as in the first Mirai, the next-generation fuel cell stack is about 20 percent smaller and 50 percent lighter than the previous stack, and so fits easily under the hood. The new, smaller stack allowed the switch to rear-wheel drive. In comparison, the first-gen Mirai was FWD, and the larger stack was placed under a raised section of the passenger compartment floor.

A compact, lightweight power control unit is now integrated with the FC stack case, further reducing overall system size. Relocating the air intake manifold and optimizing the gas channel separator electrodes and seals has resulted in a 12-percent increase in power output over the first-gen stack (128kw, up from 114kw). That translates to 182 hp and 221 lb-ft. of torque vs. 151 hp and 247 lb-ft for the first-gen Mirai.

In the 2021 Mirai, a lithium-ion battery is smaller and lighter (98.3 lb. vs. 103.4 lb.) and has higher capacity than the nickel metal-hydride battery used in the first-gen model (310.8v and 4.0 Ah, compared to 244.8v and 6.5 Ah in the earlier car). The more compact battery package fits between the rear seat and trunk, and the trunk can carry 2-3 golf bags. Cooling air for the battery is silently pulled in from the cabin.

In the Toyota Mirai, compressed hydrogen fuel is stored in three 10,000-psi carbon-fiber-reinforced high-pressure tanks: one mounted longitudinally in the center of the car; another mounted transversely under the rear seat, and a third below the battery. The three tanks together hold about 11 pounds of hydrogen.

Electric "Supercharger"

There's no combustion in an FCEV, of course, but there is a kind of air supercharger. An electric air compressor pressurizes the intake air, and a water-cooled intercooler reduces the temperature of the compressed air before it enters the FC stack. A water-cooled oil cooler integrated with the air compressor helps to provide reliability.

The intake system is designed to mitigate noise, which will be virtually unnoticeable to occupants. The inlet design and sound-absorbing material in the air cleaner prevent air column resonance. By necessity, the intake air for the fuel cell must be purified; the electret air cleaner element captures ultra-fine particles (PM 2.5), and a charcoal filter removes chemical substances. The resulting air released from the system is cleaner than the intake air.

Driving the Mirai

Driving the Toyota Mirai is like driving a Toyota Hybrid – meaning a thoroughly "normal" experience. Get in, buckle up, push the Start button, and the Mirai is ready to drive immediately. Shift the gear selector into D, and off you go. While the 2021 Mirai will initially be offered only in California, it is fully optimized for cold weather operation; the FC system has been tested in extremely cold conditions and can start at an outside temperature as low as -22°F.

Operation of the FC system and battery is seamless. Normal initial acceleration uses battery energy, like a battery EV would. After initial acceleration, it smoothly transitions to FC+EV operation, and then fully to FC power to the EV drivetrain when cruising. As a result, the driver feels a natural, linear response to the accelerator.

Like a Toyota hybrid vehicle, the FC also sends electricity to be stored in the battery, and the battery is also charged by the motor-generator during deceleration. Direct current from the battery is converted into three-phase alternating current for the FC air compressor and the electric drive motor. In the 2021 Mirai, a second DC/DC converter augments the main DC/DC converter to respond to the auxiliary load increase.

The Mirai provides excellent everyday driving performance, for example accelerating from 25 mph to 45 mph in 2.8 seconds. The driver can tailor the driving feel via the Drive Mode Select switch, which offers ECO, NORMAL and SPORT modes. NORMAL provides an excellent balance between driving performance and fuel efficiency. Selecting ECO mode prioritizes efficiency by optimizing air conditioning operation, while SPORT mode quickens accelerator response and tightens steering feel for a more dynamic driving experience.

As on Toyota Hybrids, Predictive Efficient Drive can learn repeatedly traveled routes to optimize charging and discharging of the battery to help maximize fuel economy and driving range.

Luxury Car Chassis

To make the second-generation Mirai its new sedan flagship, Toyota based it on the GA-L platform also used for the Lexus LS sedan. (The LS uses a larger version of the platform.) The change to rear-wheel drive and resulting new layout for the FC system and EV powertrain yield a near 50:50 weight distribution, versus 58:42 for the front-wheel drive first-gen Mirai.

The high-strength platform provides the foundation for superb handling agility and an exceptionally smooth, quiet ride. Laser screw welding and adhesive structure bonding, proven on many other Toyota and Lexus models, are among the construction techniques used to give the Mirai a truly premium feel on the road.

The suspension is completely new and fully befitting a flagship luxury-sport sedan. Sophisticated multilink suspension replaces strut-type front suspension and beam axle rear suspension used for the first-gen Mirai. Suspension geometry and stiffness provide highly responsive, direct-feeling steering. The result is a much higher level of handling precision, giving the second-gen Mirai a distinctly sporting feel to match its future-looking powertrain.

Active Cornering Assist engages the stability control to reduce understeer in certain cornering situations. Hill Start Assist Control, standard for both grades, allows smoother, safe takeoffs from stops on hills.

Electric power steering delivers quick response, with a tight 38.6-ft. turning circle for easy maneuverability. Both the XLE and Limited grades are equipped with 19 x 8-inch alloy wheels and 235/55R19 all-season tires. The Limited in addition offers optional 20 x 8.5-inch turbine-style Super Chrome alloy wheels with 245/45ZR20 tires.

Mirai Safety

Toyota Safety Sense 2.5+ equips the 2021 Mirai to help avoid collisions or mitigate their impact. Also featured on other 2021 Toyotas, including the Camry and Highlander, TSS 2.5+ is the next phase in Toyota’s evolution of active safety systems. A number of functions that are part of the Toyota Safety Sense have been enhanced.

For starters, the Pre-Collision System with Pedestrian Detection (PCS w/PD), features multiple enhancements. By enhancing the system capabilities, it is now possible for the system to help detect not only the vehicle ahead but also a preceding bicyclist in daytime and even a preceding pedestrian in low-light conditions. TSS 2.5+ also enhances the PCS w/PD system with intersection support. At intersections, the system may detect an oncoming vehicle or pedestrian when performing a left-hand turn and may provide audio/visual alerts and automatic braking in certain conditions. Additional PCS functions include emergency steering assist, which is designed to

stabilize the driver's emergency steering maneuvers within their lane while avoiding a preceding pedestrian, bicyclist or vehicle.

Each Mirai comes equipped with Full-Speed Dynamic Radar Cruise Control (DRCC), which can activate the feature above 30 mph, have a system designed to perform vehicle-to-vehicle distance controls down to 0 mph and resume from a stop. DRCC also includes a new feature that allows for smoother overtaking of slower vehicles. If traveling behind a vehicle traveling slower than the preset speed, once the driver engages the turn signal and initiates steering input the system will provide an initial increase in acceleration in preparation for changing lanes; after changing lanes, the vehicle will continue acceleration until it reaches the preset driving speed.

Lane Departure Alert is designed to help notify the driver via steering wheel vibrations or audible alert if it senses the vehicle is leaving the lane without engaging a turn signal. When DRCC is set and engaged, Lane Tracing Assist (LTA) is designed to assist the driver by providing a slight steering force to help center the vehicle in its lane using visible lane markers or a preceding vehicle.

Additional TSS 2.5+ features include Automatic High Beams, which detects preceding or oncoming vehicles and automatically switches between high beam and low beam headlights. Road Sign Assist (RSA), which is designed to recognize certain road sign information using a forward-facing camera and display them on the multi-information display (MID). With DRCC engaged and activated, RSA can also adjust speed up to the posted speed limit if driving slower or down to the posted speed limit if driving faster than posted.

In addition to the TSS 2.5+ system, to help Mirai drivers change lanes with confidence, Blind Spot Monitor is designed to help detect and warn you of vehicles approaching or positioned in the adjacent lanes. Rear Cross Traffic Alert (RCTA) can offer added peace of mind by helping to detect vehicles approaching from either side while backing out and alerting you with a visual and audible warning.

Two-Grade Model Strategy

Toyota will offer the 2021 Mirai in two grades, XLE and Limited, rather than only a top-of-line mono-spec version as with the first-generation model. The new strategy will make the Mirai accessible to a wider market.

The Mirai XLE comes well equipped with standard SofTex-trimmed seating featuring heated, 8-way power driver and 4-way power passenger seats; dual-zone automatic climate control with remote feature; Smart Key System remote keyless entry system with trunk-release, panic button and remote illuminated entry; auto-leveling LED headlamps; LED front interior reading lights; Toyota Premium Multimedia system with navigation and 14 JBL speakers; Qi wireless charger; power tilt/telescoping steering wheel; auto-dimming rearview mirror, and electronic parking brake.

Connected Services include Safety Connect® with 1-year trial; Service Connect with 10-year trial; Remote Connect with 1-year trial; Wi-Fi Connect with up to 2 GB within 3-month trial, and Destination Assist with 1-year trial. (See toyota.com/connected-services and toyota.com/audio-multimedia for details.)

As an option, the XLE offers the Advanced Technology Package that includes Bird's Eye View Camera, Front and Rear Parking Assist with Automated Braking, and Front Seat Foot Illumination.

The Mirai Limited grade makes those features standard, along with ventilated front seats, heated rear seating, three-zone automatic climate control (two-zone in front, one-zone in rear with separate digital control panel), ambient lighting, and a panorama roof.

Mirai Pricing

The 2021 Mirai will roll into dealers with more grades, more options and a lower starting MSRP. The Mirai XLE grade has a starting MSRP of $49,500, which is $9,050 less than the starting MSRP of the outgoing 2020 Mirai. An Advanced Technology Package, which includes Bird's Eye View camera, front and rear Parking Assist with Automated Braking and front seat foot illumination, can be added to the XLE for $1,410.

The Limited grade has a starting MSRP of $66,000, with optional 20" Super Chrome Alloy wheels available for an additional $1,120. Both the XLE and Limited grades have a Special Color price of $425 for Oxygen White, Heavy Metal, Supersonic Red and Hydro Blue (Limited only).

Mirai XLE grade will have a starting lease price of $499 a month, while the Limited grade lease pricing starts at $549 a month. Special launch incentives will be available when this next-generation Mirai first goes on sale, including special finance rates, retail cash back and launch cash back.

Each Mirai comes with up to $15,000 of complimentary hydrogen. Extended ToyotaCare, good for three years or 35,000 miles, will come standard with each Mirai. Other owner benefits include roadside assistance for three years (unlimited miles), an eight-year/100,000-mile FCEV warranty on key fuel cell electric vehicle components, a complimentary rental experience for up to 21 days during the first three years of ownership, and much more.

Toyota's Fuel Cell Future

Toyota, projects that fuel cell electric technology will one day be as common as the company's hybrid electric technology.

Fuel cell technology pre-dates the automobile by half a century. In 1838, a Welsh physicist combined hydrogen and oxygen in the presence of an electrolyte and produced an electric current, though not enough to be useful. By the 1960s, the technology was being used in America's Gemini and Apollo spacecraft, where it provided crews with both electricity and water from stored hydrogen and oxygen.

Fuel cells had been studied for the automotive sector, but the technology only recently became practical and cost-effective. Toyota began its fuel cell development around the same time as its original Prius nearly 25 years ago, and the Mirai shares technology from the company's hybrid program.

Toyota developed the solid-polymer electrolyte fuel cells used in the first- and second-generation Mirai models. To help foster FCEV proliferation, the company has released over 5000 of its patents, royalty-free.

Toyota remains committed to fuel cell technology as a powertrain for the future. It is a scalable technology that can be made small enough to power a phone or large enough to power a building, or anything in between. For example, Toyota recently installed fuel cell powertrains in a fleet of Kenworth class-8 semi-trucks that are rated for a maximum 80,000-pound load. These big rigs are currently used for moving freight in and around the Ports of Los Angeles and Long Beach, California.

More FCEVs will be entering the market over the next few years, as the cost, size and weight of fuel cell systems are reduced and the fueling infrastructure grows.

Ample Domestic Fuel Supply

Hydrogen can be produced from a variety of domestic resources. The goal of the Hydrogen Council, for which Toyota is a founding member, is to use decarbonized hydrogen for transportation such as that produced from bio-resources or renewable electricity via electrolysis by 2030. As of November 2020, the U.S. Department of Energy Alternative Fuels Data Center indicated 43 hydrogen fueling stations open in California, plus one in

Hawaii. Toyota has joined with other manufacturers, as well as local governments, to help expand the number of hydrogen fueling stations that are built each year and to expand the market.