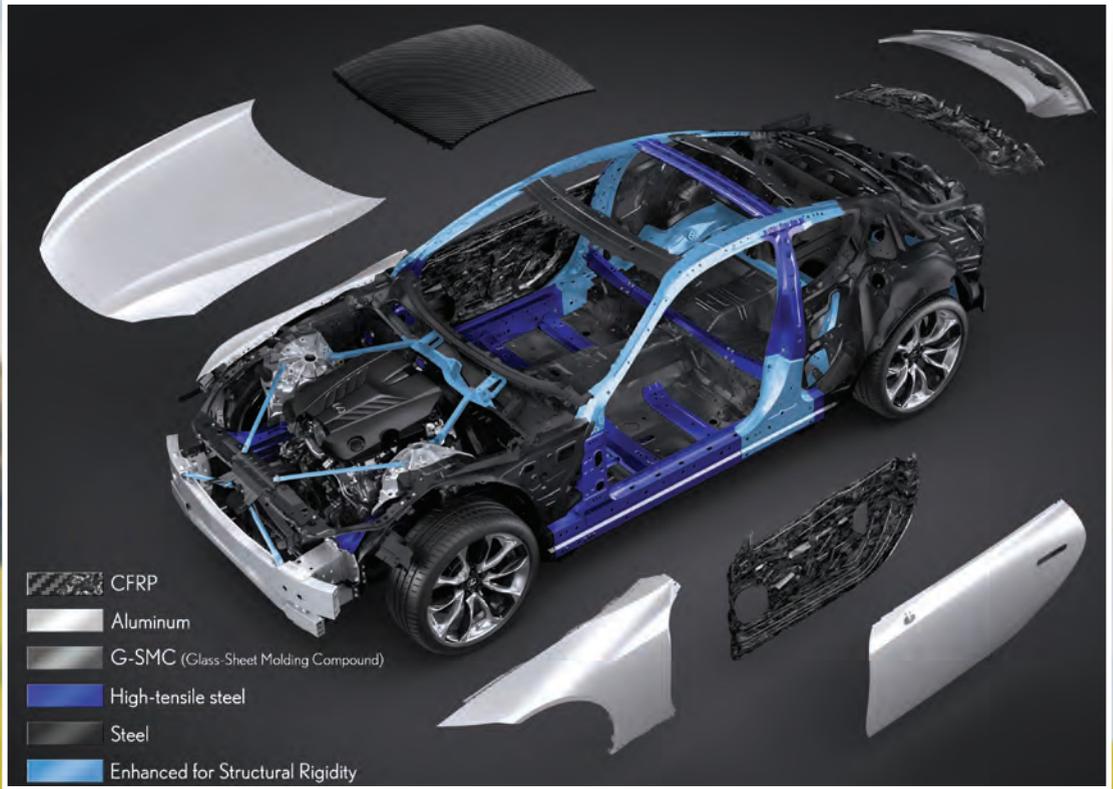


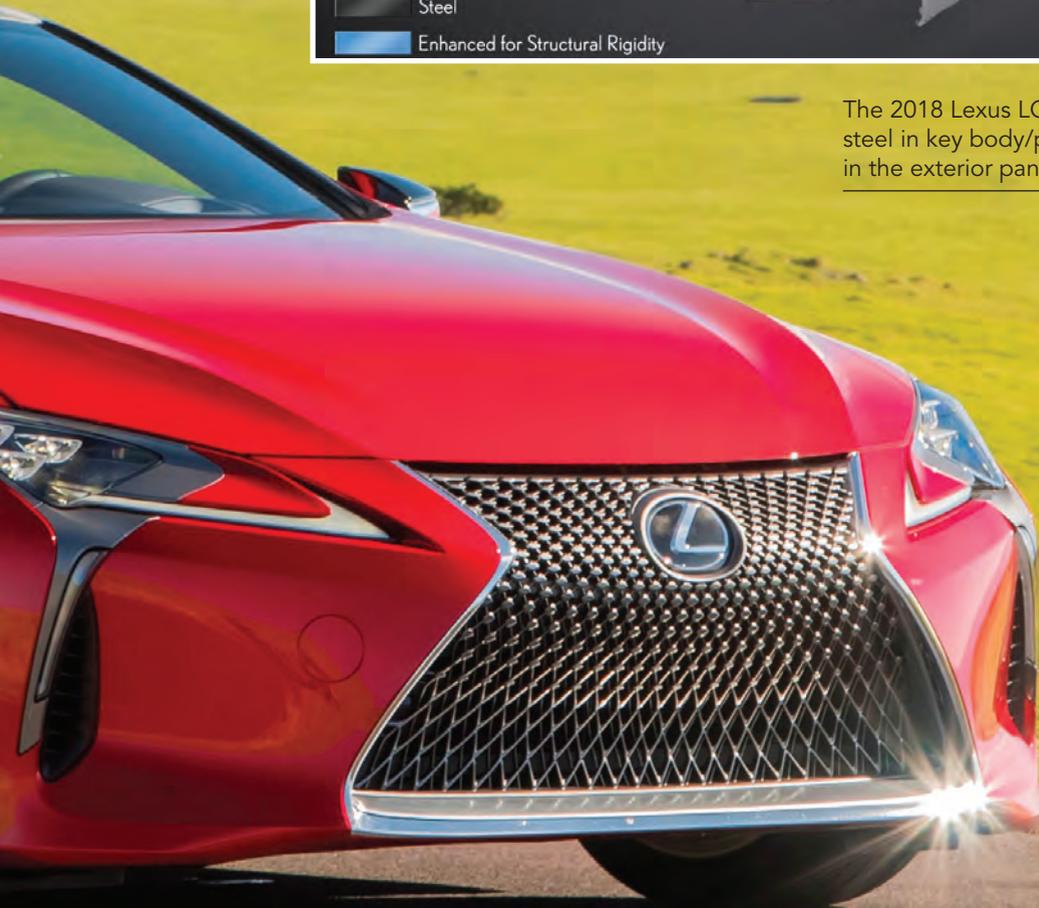
# *Thoughtful* **INNOVATION**

By Dan Larson, Contributing Writer





The 2018 Lexus LC 500 coupe features high-strength steel in key body/platform members and aluminum in the exterior panels. Courtesy Toyota



## Toyota Steers Toward Global Standardization

**W**ith a horizon increasingly filled with hybrid, electric and non-petroleum power, meeting increased fuel-economy demands will involve both energy efficiency and lightweighting.

For Toyota, that means steering toward global platform and drivetrain standardization to protect its leadership position.

“We are always searching for the best materials and best methods for constructing our vehicles,” says David Sawin, Vice President of Toyota North America Research & Development–Body Design Division.

“We want to bring our customers the best value by optimizing weight through thoughtful innovation of automotive body materials which reduce weight and improve performance without adding cost. Instead of relying on a single solution for lightweighting, our engineers try to find the best material for each specific application.” In order to meet those oft-competing demands, the company is moving toward worldwide standardization.

## GLOBAL STANDARD

Three years since it was announced, Toyota has pulled together its companywide design, manufacturing, technology and business goals under the banner Toyota New Global Architecture (TNGA). The program integrates development of platforms, drivetrains and components across its model lineup.

TNGA provides “a fundamentally strong core” from which models can be developed, according to a company statement. “Total optimization under TNGA results in lightweight, streamlined, high-performance platform and powertrain units, enhancing dynamic driving performance.”

The goals of such a massive simplification of platforms are chassis stiffness increased by half, lower centers of



gravity and lower cowls for better driver vision. In manufacturing, TNGA calls for a shift away from traditional “just in time” assembly of similar cars in lots to one-off assembly that allows for unprecedented flexibility and cost savings.

The development of cars that “will still be performing at the top of their class in 10 years’ time is the engineering spirit that drives TNGA,” the company states.

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Final assembly of 2018 Camry at Toyota's Georgetown, Ky. plant. The redesigned Camry features increased use of ultra-high strength steel to retain handling and ride quality, the company says. Courtesy Toyota

“The 2018 Camry utilizes TNGA with more ultra-high-strength steel than its predecessor to improve structural rigidity and performance while reducing weight,” he says.

The all-new Camry includes 1500-MPa hot-stamped UHSS and 1180-MPa cold-stamped UHSS, Sawin notes. Laser screw welding (LSW) at key junctures throughout the body/platform increase joint rigidity. Further weight reductions result from using aluminum in the hood structure.

For now, Camry remains a predominantly steel automobile. “The foundation of Camry’s handling and ride quality is its high-strength steel body/platform,” according to Toyota’s chief engineer in a report published in July.

However, the company is exploring replacing steel platform components with aluminum, according to published reports.

Recently, Jim Lentz, CEO of Toyota Motor North America, said the company is considering a variety of ways to comply with tightening fuel-economy regulations, including replacing steel with aluminum. “Powertrain modifications alone won’t do the trick,” Lentz emphasized.

Toyota’s global standardization will help the company prepare for an uncertain future as it considers how to consolidate a reported 100 different platforms and 800 engine variants. It is in the company’s U.S. manufacturing operations that TNGA will be fully implemented.

## INVESTING IN THE U.S.

For Toyota, which produces more than 10 million vehicles globally per year and is one of the largest—if not the largest—automotive manufacturer in the world, integrating platforms and drivetrains is a process that is measured in years.

In the United States, the scale of the company’s operations is vast. In the 31 years Toyota has manufactured here, it has produced 25 million vehicles. In 2016 alone, the

## EXPANDING ULTRA-HIGH STRENGTH

The new global-sharing program expands Toyota’s use of ultra-high strength steels (UHSS).

The first two models to incorporate a TNGA platform were the Camry and Prius. For 2018, the redesigned C-HR crossover “takes full advantage of the adaptable TNGA C-Platform.”

The platform for C-HR “melds responsiveness, linearity, consistency, and comfort,” the company says. An industry report noted the all-new C-HR features 1500- and 980-MPa ultra-high strength steel in A- and B-pillars, roof rails, frame rails, A-pillar reinforcement and the center roof rail, among other locations.

Sawin points to another expansion of UHSS under the TNGA banner.



Toyota platform TNGA.  
Courtesy Toyota

company's U.S. operations produced 1.4 million vehicles. Toyota's U.S. workforce includes 136,000 people and 10 manufacturing plants

This summer, Toyota announced it would invest \$374 million in the five U.S. plants to produce its first American-made hybrid powertrain. The investment will enable the company to implement TNGA initially at its Alabama engine plant with the program reaching full operation at all 10 U.S. plants by 2020.

Toyota reports it will invest \$105 million in its Huntsville, Ala., engine plant to replace the series of 4-cyl. engines made there with a new 4-cyl. engine compliant with TNGA.

Other Toyota capital investments in U.S. manufacturing are:

- Addition of hybrid transaxles at Buffalo, W.Va.
- Expansion of 2.5L engine capacity at Georgetown, Ky.
- Increased production of 2.5L cylinder heads at Bodine Aluminum, Troy, Mo.
- Modification to produce hybrid transaxle cases, housings and 2.5L engine blocks at Bodine, Jackson, Tenn.

## MODEL HIGHLIGHTS

At this year's IAA Frankfurt auto show, the largest in the world, the spotlight was on autonomous driving and electric powertrains. Although Toyota did not have a major

vehicle introduction at IAA, it did show a concept high-performance C-HR hybrid.

Launched in late 2016, the C-HR was positioned to update the company's small crossover lineup and replace the Matrix and Scion xD models.

Although Toyota produces nine hybrid and fuel-cell powered models, the North American C-HR is available only with a gasoline power plant. A hybrid available in Europe and Asia is equipped with the 2ZR-FXE engine, an Atkinson-cycle variant of the 1.8 L 4-cyl. gasoline engine.

The other all-new model for 2018 is the Camry. Based on the TNGA C-platform, the Camry is first to feature the company's Dynamic Force overhaul of the existing 2.5L 4-cyl. engine. Changes to intake and exhaust flow, cooling and friction reduction are said to improve thermal efficiency to an impressive 40 percent.

Consistent with the company's brand philosophy at Lexus, the flagship LC 500 coupe features "the stiffest unibody Lexus has ever produced," the company states.

The strategic use of high-strength steel in the LC 500 is said to be stiffer than the Lexus LFA sports car with its extensive use of carbon fiber reinforced plastic (CFRP).

The Lexus combination of HSS, aluminum and CFRP, the deletion of a spare tire in favor of run-flat tires, and

Cutaway view of the Toyota Prius Prime liftgate. Combining aluminum, carbon-fiber and glass-fiber reinforced plastics and polypropylene, the liftgate earned top honors in the module category in the annual Altair Enlighten awards. Courtesy Toyota



## → ENLIGHTEN AWARD ←

The use of lightweight materials in the LC was recognized recently with an industry award jointly presented by Altair Corp. and the Center for Automotive Research.

A co-winner of the annual Enlighten Award in the Module category, Toyota was recognized for its use of CFRP, aluminum, glass-fiber reinforced plastic and polypropylene in the side doors and trunk lid on the 2017 LC. As a result, the components were 47 percent lighter than comparable metal parts.

The award also recognized similar use of lightweight materials in the 2017 Prius Prime liftgate.

Alternative materials allow the company "to offer closure systems optimized to the unique mission of each vehicle," says JP Flaharty, Executive Program Manager, Toyota North America Research & Development. "With CFRP in the Prius Prime liftgate and the Lexus LC side and luggage doors, our customers can recognize the light touch and high-tech appearance of these sophisticated, lightweight door systems."

Toyota's shift to a global sharing of a limited number of platforms and components marks a significant change in direction for the company that re-invented vehicle manufacturing a half-century ago. And although what it encounters around the next bend in the road is unknown, the company is headed in the right direction, Sawin says.

"We are moving rapidly to develop advanced materials and manufacturing techniques," he says. "It is an exciting time to be working in the automotive industry." LW

moving the 12v battery to the trunk yields a 52:48 weight split for the hybrid version of the LC 500. The model's performance also benefits from the location of much of its mass to the vehicle center and lower in the chassis.

Aluminum and CFRP are used more extensively in the LC model than others, the company states. Aluminum is used in the hood, front fenders and door skins while CFRP is on the inner panels of the doors and trunk.

Lexus applied a new manufacturing technique where it combined aluminum with steel to save weight in the front suspension towers. Self-piercing rivets securely join the dissimilar metals where traditional welding would be unsuitable.

Another new Lexus model, the LS sedan, features ultra-high tensile hot-stamped steel and other steel alloys in critical areas. Steels with tensile strengths from 590- up to 1180-MPa and aluminum in the 2018 LS provides a steel-mass composition rated at 30 percent, more than double the previous generation LS at 14.1 percent.



The 2017 Altair Enlighten Award, Module Category, was presented to Toyota. Accepting the award at the CAR Management Briefing Seminar in July is JP Flaharty, Executive Program Manager, Toyota NA Research & Development. The award was presented by Dr. Jay Baron (left), President and CEO, Center for Automotive Research and Richard Yen, Senior VP of Automotive & Global Markets, Altair.