TOKYO -- The fourth-generation Toyota Prius, the car that made “hybrid” a household word, won't arrive for at least another year. But emerging details paint a picture of a car that could be a breakthrough on multiple fronts: design, technology and manufacturing.

But it won't be a breakthrough for Toyota Motor Corp. in hybrid production outside Japan. It looks increasingly unlikely that the next Prius will be built in North America anytime soon.

This month, Toyota executives shed more light on the car, saying engineers aim to equip it with powerful and lightweight lithium ion batteries and a new, ultra-efficient gasoline engine.

The new engine will achieve thermal efficiency rates above 40 percent, compared with a maximum of 38.5 percent in the current Prius -- the best in Toyota's fleet. Higher efficiency means more energy from internal combustion is captured to power the wheels and less is lost through heat.

The next Prius also will pioneer Toyota's new modular product development push, which targets mass commonization for versatile engineering and low-cost, flexible manufacturing.

Soichiro Okudaira, chief of Toyota's r&d group, said the next-generation Prius "will have a new type of hybrid system."

Toyota has said the first car based on that platform strategy, dubbed Toyota New Global Architecture, will debut next year. But the automaker won't say whether the Prius will be the first or simply among the first.

Toyota's global design chief has pledged that the Prius will feature a revolutionary design, inside and out. For starters, TNGA calls for lower-slung vehicles with a more planted stance and lower center of gravity to improve handling and engender a sportier image.

It is all part of Toyota's bid to keep the Prius, the world's best-selling hybrid, at the forefront of an increasingly crowded field of electric-gasoline rivals. Even excluding hybrid vehicles that don't compete with the Prius, such as SUVs and luxury sedans, it's almost inevitable that the Prius, which once had the segment to itself, will continue to lose share as rivals proliferate.
But Toyota isn't going to let that happen easily.

Toyota, which sold more than 1 million hybrid vehicles in 2013 for a second straight year, has more riding on the flagship's redesign than just segment-leadership bragging rights.

### Prius vs. all comers

The Toyota Prius once had the electrified vehicle segment to itself. While it still dominates in sales, it is losing share as more rivals enter the fray.

<table>
<thead>
<tr>
<th>Nameplate</th>
<th>2013 U.S. sales</th>
<th>2013 share of segment*</th>
<th>2012 share of segment*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota Prius**</td>
<td>234,228</td>
<td>39.4%</td>
<td>48.5%</td>
</tr>
<tr>
<td>Ford Fusion**</td>
<td>43,359</td>
<td>7.3%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Ford C-Max**</td>
<td>35,210</td>
<td>5.9%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Chevrolet Volt</td>
<td>23,094</td>
<td>3.9%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Nissan Leaf</td>
<td>22,610</td>
<td>3.8%</td>
<td>2%</td>
</tr>
</tbody>
</table>

*All electrified light vehicles
**All hybrid versions

Source: Hybridcars.com and Automotive News Data Center

Senior Managing Officer Soichiro Okudaira, chief of Toyota’s R&D group, pledged a better Prius across the board.

"When we look at the next-generation Prius, we will have a new type of hybrid system. We will make it even smaller, lighter and less expensive. That will strengthen its commercial attractiveness," Okudaira said at this month's Automotive World, an annual technical conference here. He didn't offer details about the new hybrid system but said the battery will have better power output density.

Separately, Hideki Iba, general manager for the Japanese carmaker's battery research division, said engineers want to equip the car with lightweight lithium ion batteries, as opposed to the heavier nickel-metal hydride batteries the Prius has had since its 1997 debut.
Looking at lithium

"We aim to use lithium ion for Prius, but we are not sure yet," Iba told Automotive News on the sidelines of the conference. "Or we could differentiate within the Prius lineup between ones that use lithium ion battery and other ones that use nickel-metal hydride batteries."

The higher cost of lithium ion batteries is the main concern, Iba said. Toyota is satisfied both with their power and energy performance as well as their safety, he added.

Iba said lithium ion batteries' safety and performance have been proved in the Japan-market Prius V wagon, which uses lithium power packs in a version that offers three rows of seats.

Toyota executives want a big surge in fuel economy for the next Prius. But as hybrid technology matures, it is becoming harder to wring eye-popping jumps in fuel economy from the car's drivetrain.

Satoshi Ogiso, managing officer in charge of global product planning, drivetrain and chassis engineering, told Automotive News in November that he is targeting a fuel economy improvement of at least 8 percent. But increases are bumping against diminishing gains. That compares with fuel economy gains of 10 percent with each previous generation compared with the version each replaced.
"Generally speaking, hybrid powertrains are more mature than before. So, the general tendency is that when a technology matures, the improvement ratio is saturating, dropping," Ogiso said. "We will do our best effort to keep that pace" of 8 to 10 percent increases.

Fuel savings will come through a better hybrid system and a better engine. But TNGA encompasses other changes that should translate into improved fuel economy.

Weight savings will be key. Mitsuhisa Kato, executive vice president in charge of global r&d, said in November that Toyota should be able to slash overall vehicle weight by up to 20 percent on TNGA vehicles. That would apply to the overhauled Prius as well.

Lighter commonized components are already going into Toyota cars.

On Jan. 21, Denso Corp., Toyota’s largest supplier, unveiled a new one-size-fits-all heating and air-conditioning unit. It is suitable for any segment from compact to luxury.

The Prius V: A Japan-market version uses lithium power packs.

"Conventional climate control units are often designed and tailored to each vehicle model, but this product has a new structure which enabled [us] to standardize components," Denso said in a release. The unit is lighter and about 20 percent smaller than its predecessor.

Because of the TNGA platform, Toyota is likely to keep making the Prius in Japan.

As recently as mid-2012, Toyota executives were discussing building the Prius in the United States as early as 2015.
Now, though, there are lots of reasons that is unlikely, including a desire to maximize production capacity in Japan and tight capacity in North America.

Perhaps most important, the TNGA rollout means Toyota likely will want to build TNGA vehicles, with their highly interchangeable parts, in the same factory or a close-knit group of factories.

Toyota’s modus operandi is to fine-tune those new manufacturing techniques in the company’s backyard and fix any glitches locally before moving production overseas.