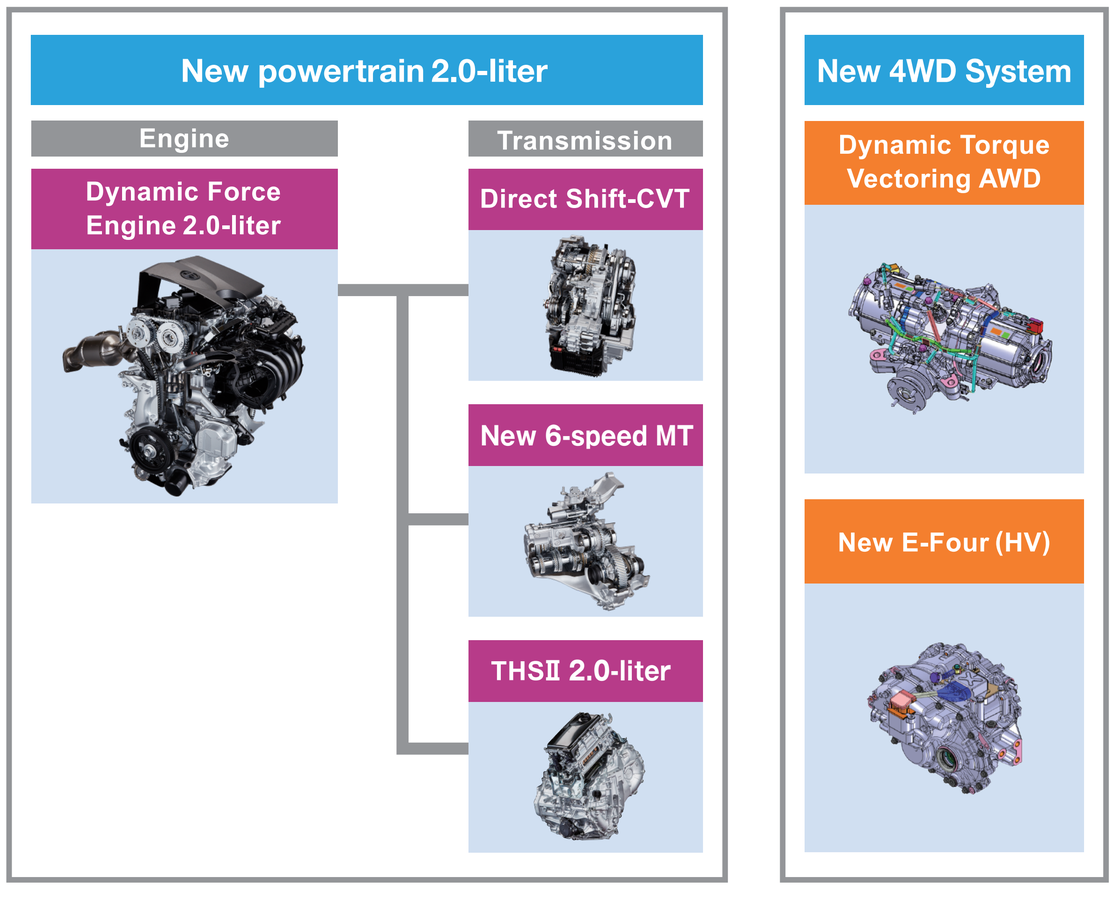
Direct & Smooth

Toyota's New Powertrain Based on the TNGA Concept

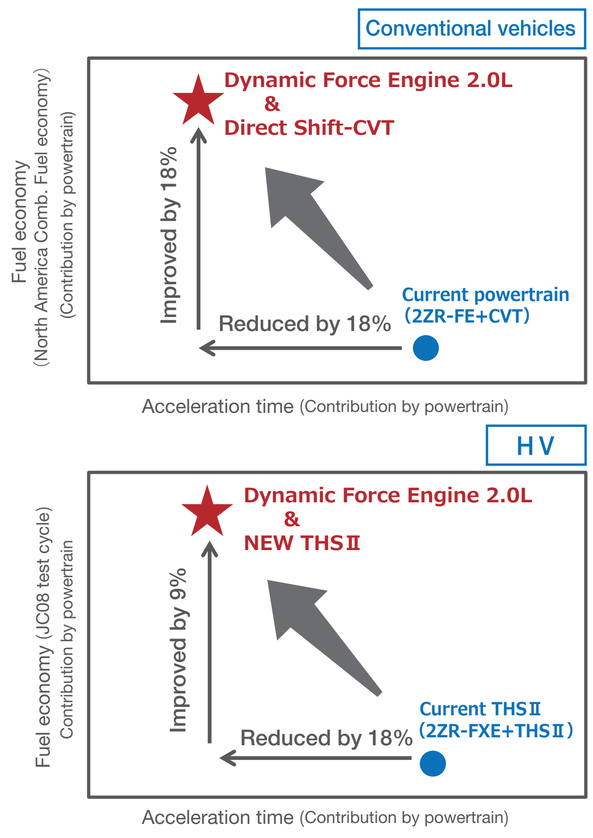
■ As part of the second step of the TNGA powertrain, which combines excellent driving performance and high environmental performance, a new powertrain series will be introduced to market.

New powertrain

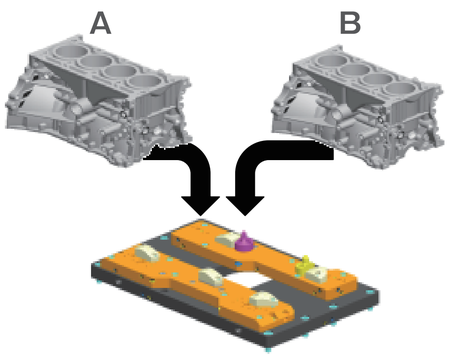


Environmental performance and Fun to Drive

New powertrain contributes to fuel economy and driving performance significantly



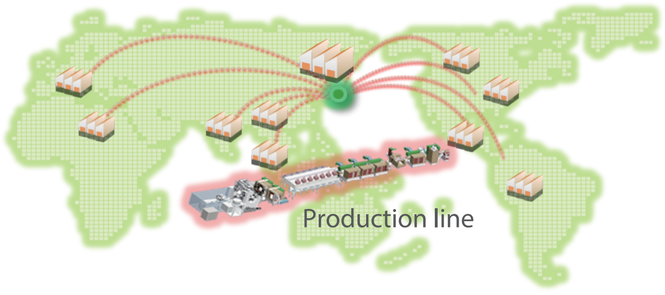
New powertrain production technology



High-speed and flexible production

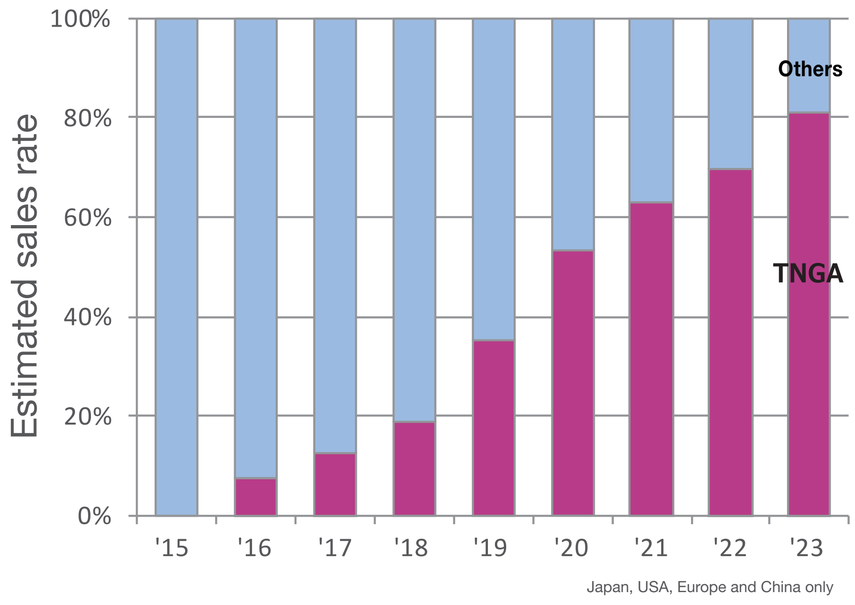
Develop lines that can flexibly produce different models at high speed by Uniform processing and assembly standards

Promptly provide products to customers



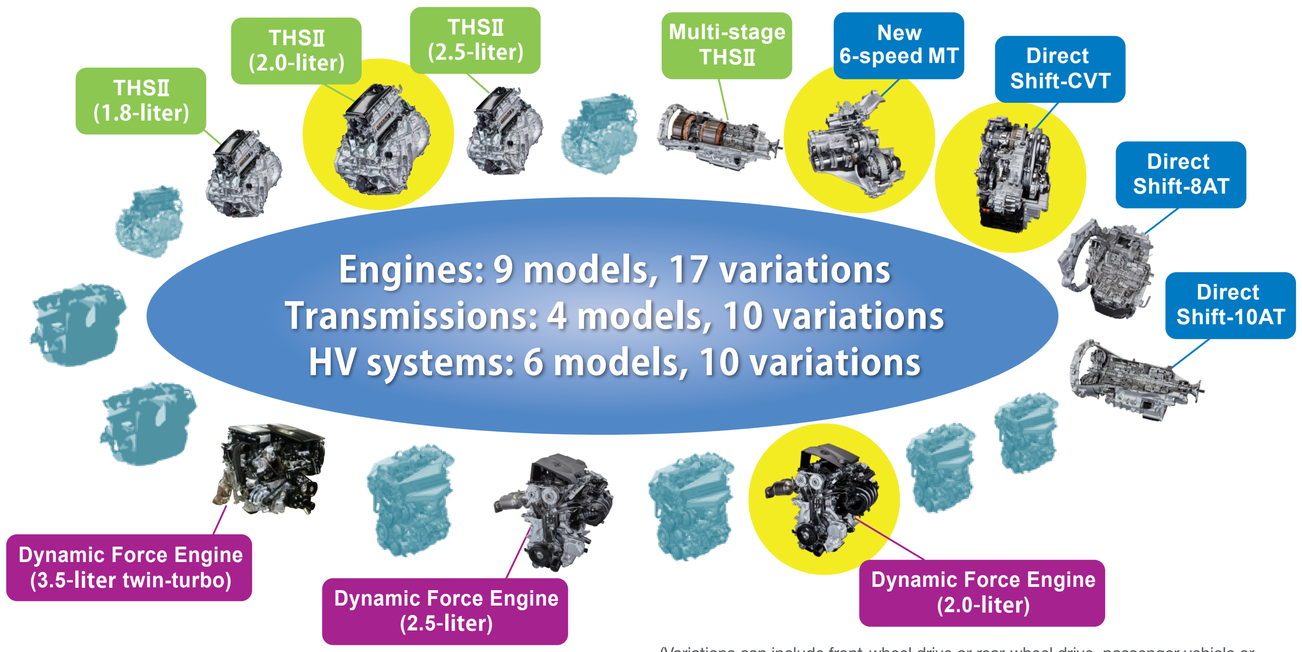
Accelerating global deployment with the standardization of process and facility specifications

Introducing a million vehicles a year with the new powertrain



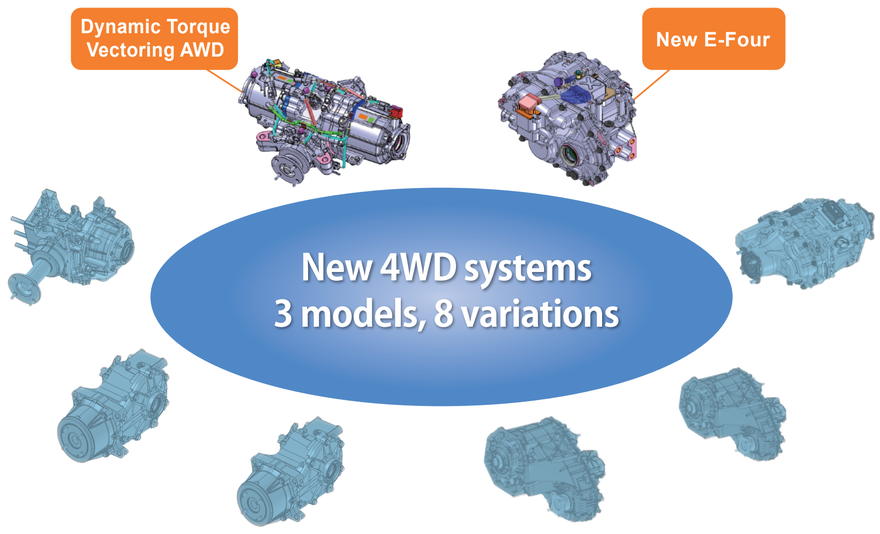
Japan, USA, Europe and China only

Lineup of new powertrain models



(Variations can include front-wheel drive or rear-wheel drive, passenger vehicle or commercial vehicle, conventional engine vehicle or HV, and/or differences in torque capacity)

Lineup of new 4WD systems



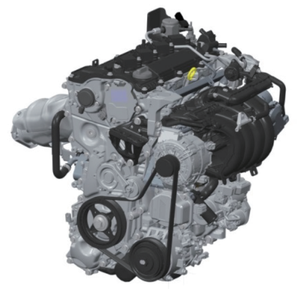
Rewarded with a smile

TOYOTA

Direct & Smooth

New Inline 4-Cylinder 2.0-Liter Direct Injection Gasoline Engine

- The new engine realizes equal or greater power performance while realizing best-in-class fuel economy accomplished through the 2.5-liter Dynamic Force Engine and with Direct Shift-CVT.
- Dynamic Force Engine 2.0-liter developed as a core engine of Toyota.



Key technologies / performance

◯ Fuel economy (Thermal efficiency)/ Performance

- High speed combustion technology
  - Long stroke (Stroke/Bore≒1.2)
  - Widen the angle between the intake and exhaust valve
  - High efficiency intake port (Laser cladded valve seat)
  - High Compression Ratio (Conv. 13, HV 14)
  - High energy ignition coil
  - New D-4S
  - Multi-hole direct injector
- Variable cooling system
  - Motor driven water pump
  - Heated Thermostat
- Continuous variable-capacity oil pump
- Low viscosity engine oil
- Water jacket spacer
- Piston with Laser Pit Skirt
- Drilled passage between cylinder bores

◯ High response

- VVT-iE
- Small-concave-profile camshaft
- Compact HLA
- High strength connecting rod
- High response intake air control

◯ Low emission

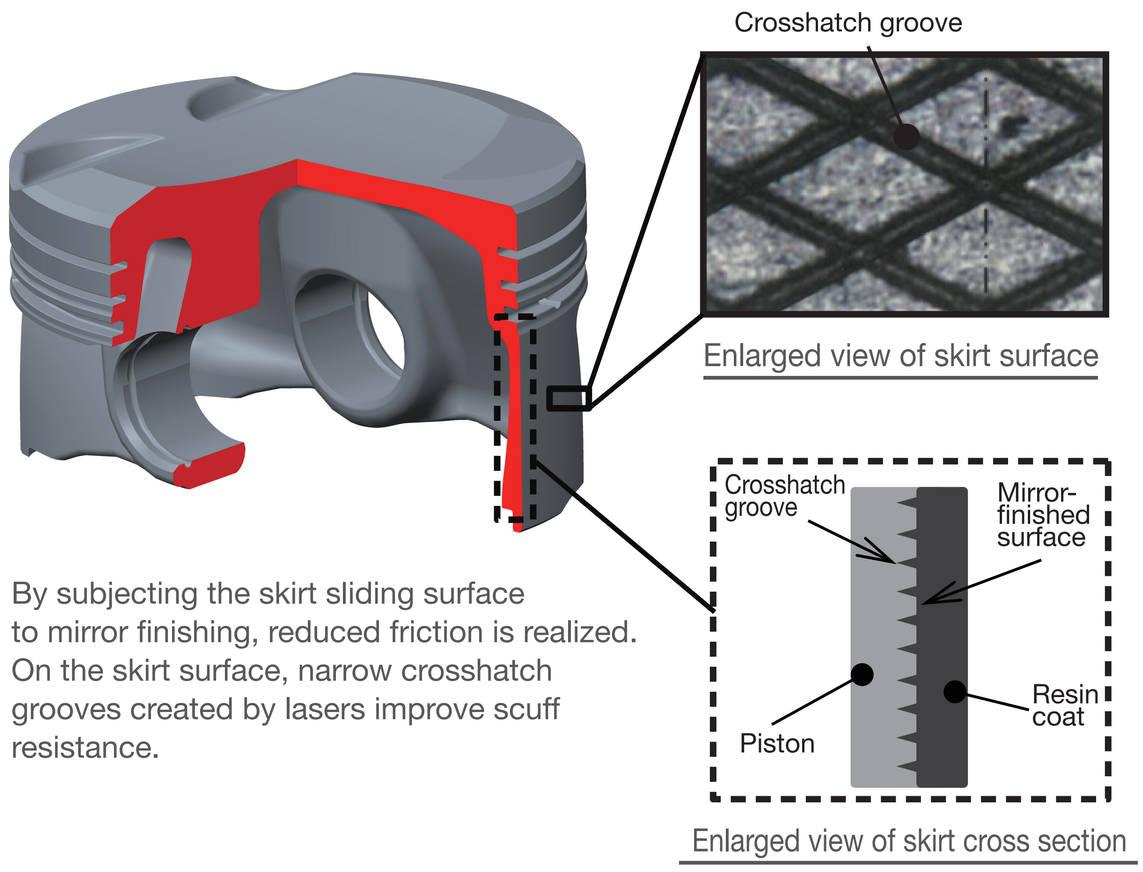
- Fuel injection control (Multi-injection)
- Cylinder heads with built-in EGR cooler function
- New catalyst
- Exhaust manifold layout change
- Piston oil jet control

	New engine	New engine for HV
Displacement(cc)	1,986	1,986
Bore x stroke (mm)	Φ80.5 x 97.6	Φ80.5x97.6
Compression ratio	13	14
Injection system	D-4S	D-4S
Max. Power (kW/rpm)	126/6600	107/6000
Max. Torque (Nm/rpm)	205/4800	180/4400
Emissions control	ULEV50	ULEV50

Details of new technologies

Piston with Laser Pit Skirt

World's first

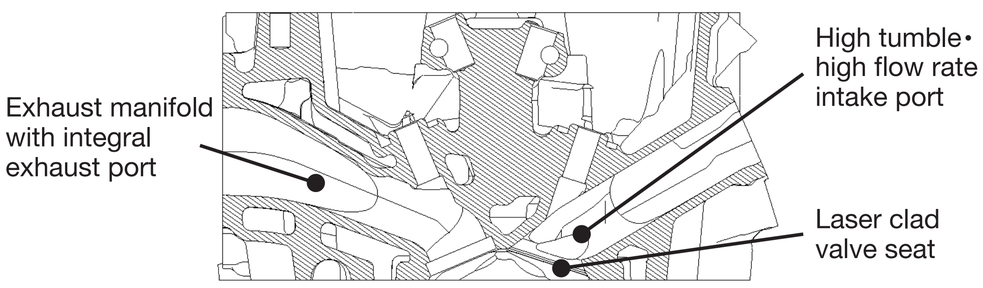


By subjecting the skirt sliding surface to mirror finishing, reduced friction is realized. On the skirt surface, narrow crosshatch grooves created by lasers improve scuff resistance.

Enlarged view of skirt cross section

Performance

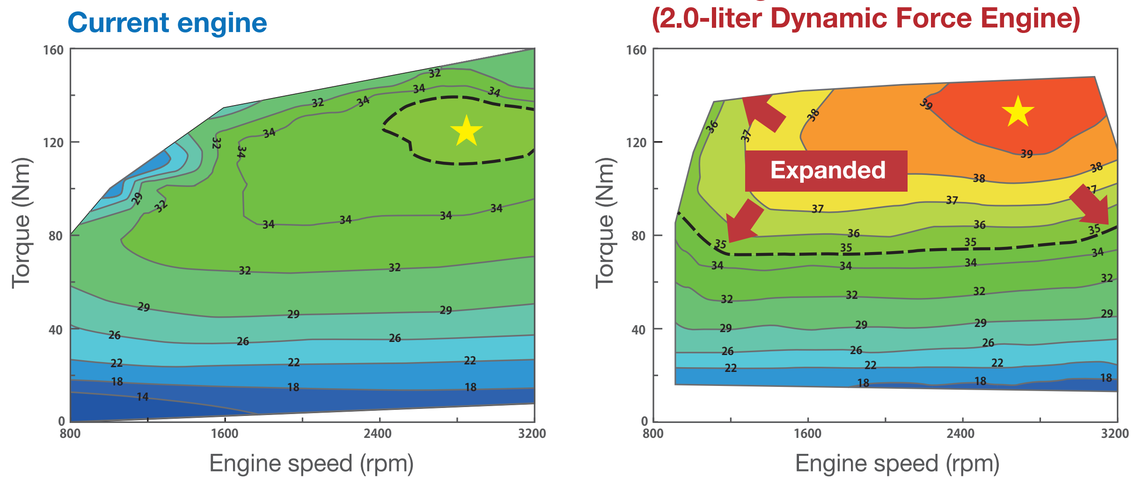
Cylinder head (for conventional engine vehicles and HVs)



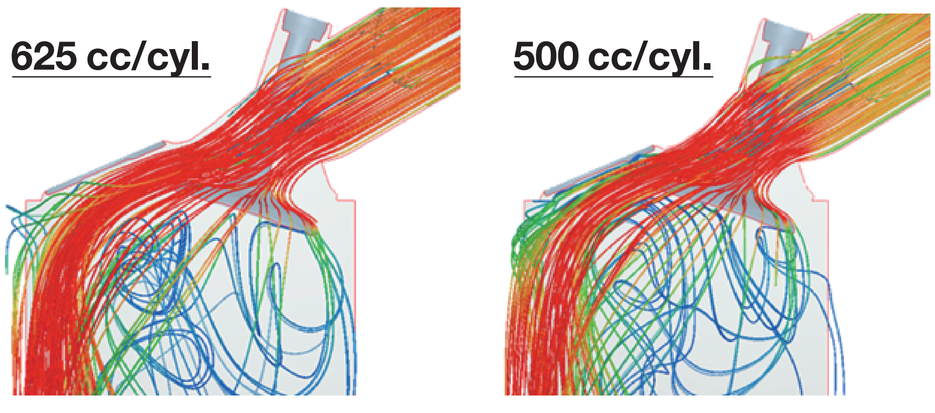
Sectional view of cylinder head

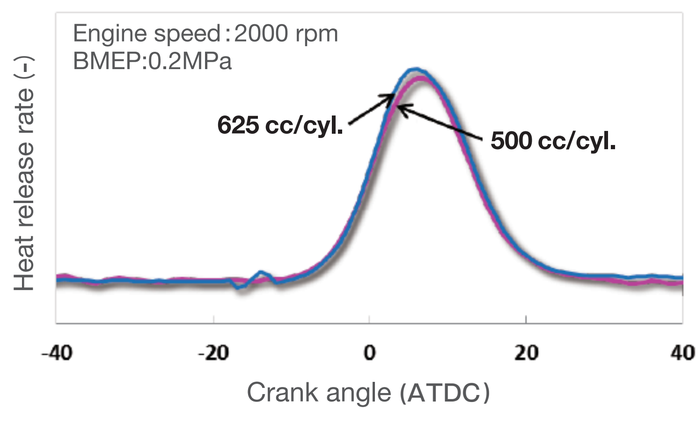
Adopting a laser clad valve seat for the intake valve seat to make the intake port compatible with strong tumble flow (fuel consumption performance) and intake flow rate (output performance).

Low fuel consumption



Common architecture of combustion





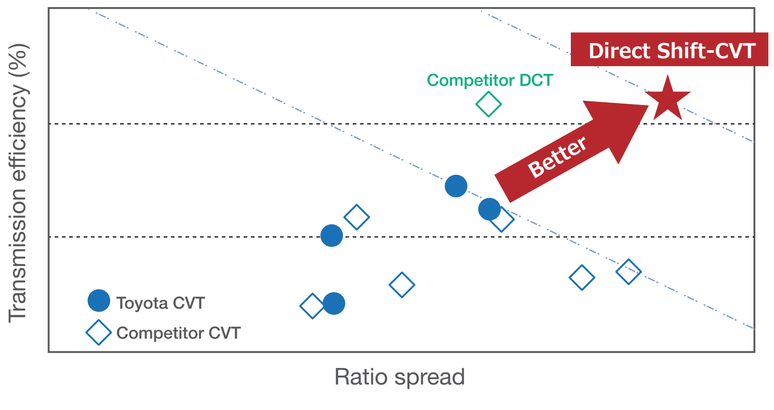
Direct & Smooth

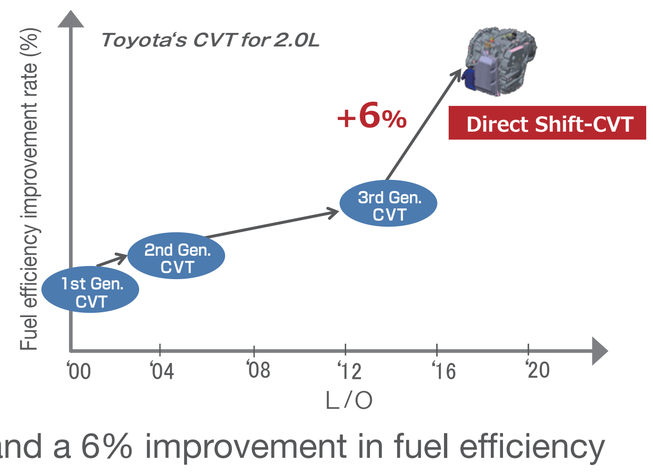
New FF Wide-Ratio CVT

- With the new structure which adopts launch gears, significant improvement of transmission efficiency and a 15% increase in ratio spread are realized.
- Shift speed is improved by 20% due to the narrow belt angle and miniaturization of the pulley; improvement of shift control contributes to the realization of direct response driving.

Performance

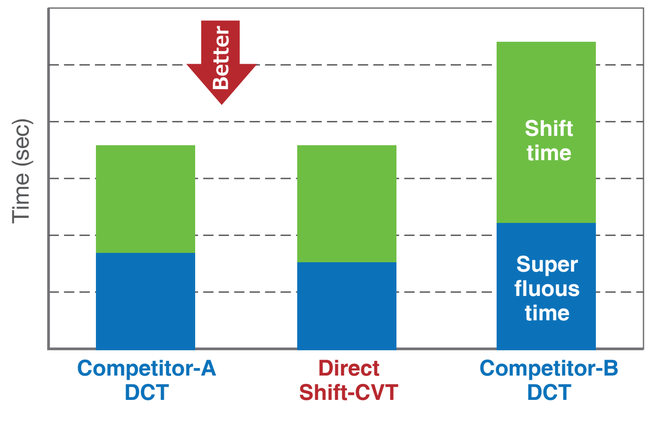
High transmission efficiency and enhanced fuel economy





Realization of best-in-class shift speed ratio spread and a 6% improvement in fuel efficiency

Direct and quick response

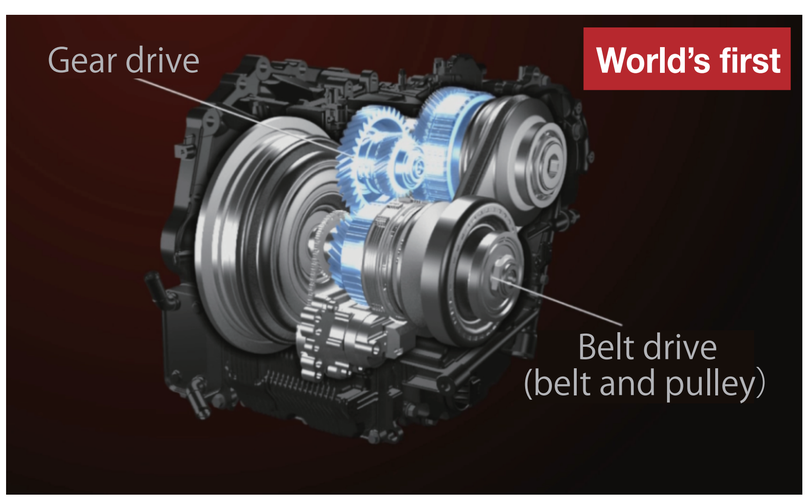


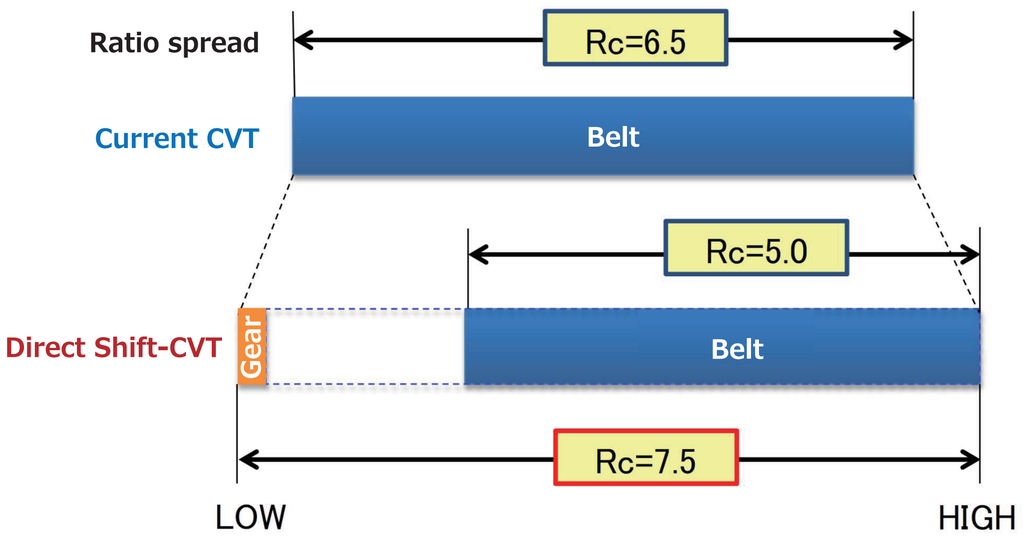
Shift performance equal or greater than DCTs produced by other companies

Details of new technologies

Launch gear

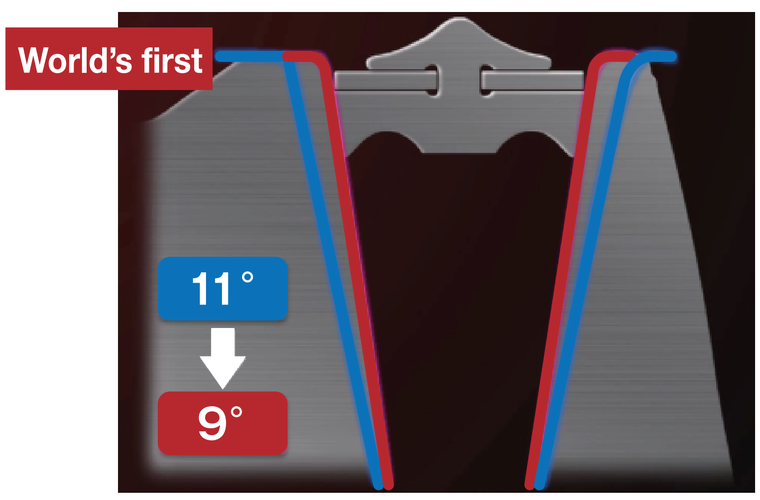
By adopting launch gears, it is possible to improve belt efficiency and increase ratio spread by 15% without performance deterioration.





Narrow belt angle

Shift speed is improved with a reduction of the belt angle from 11 degrees to 9 degrees. (shift speed increase of 20%)



More compact pulley

The adoption of launch gears reduces the belt load. Shift responsiveness has improved through downsizing of the pulley and reduction of inertia by 40%.

Current CVT　　Direct Shift-CVT

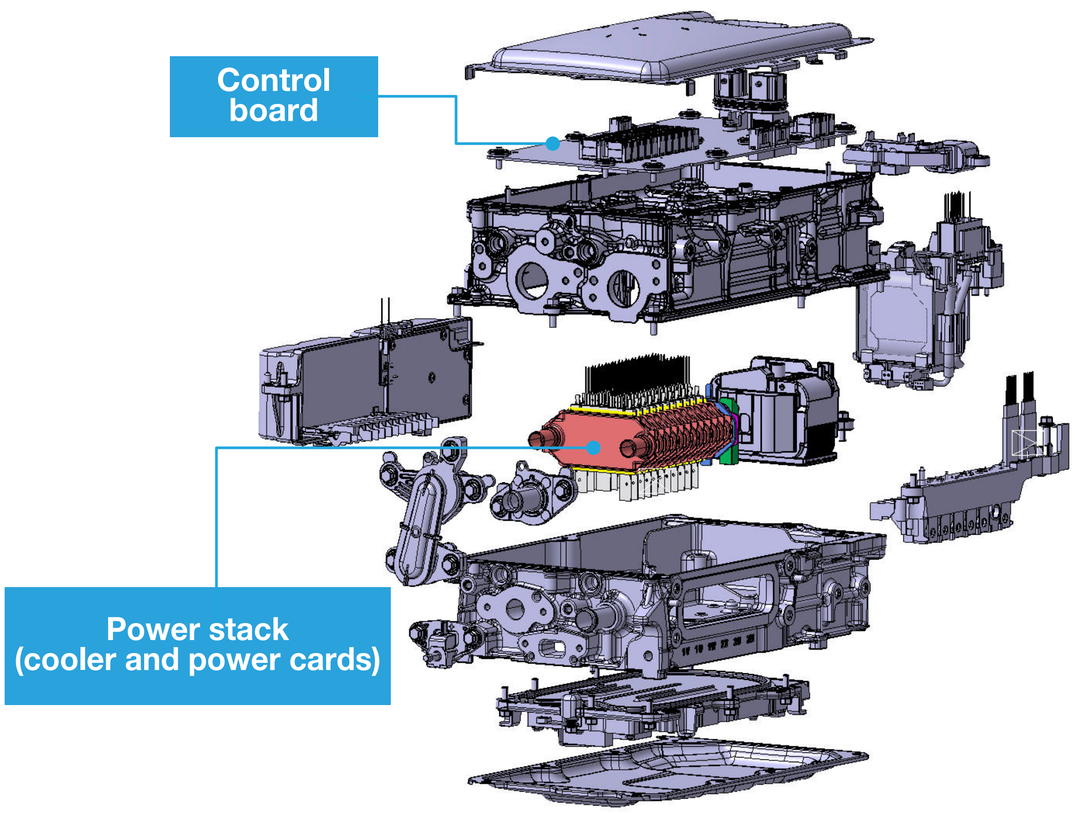
Direct & Smooth

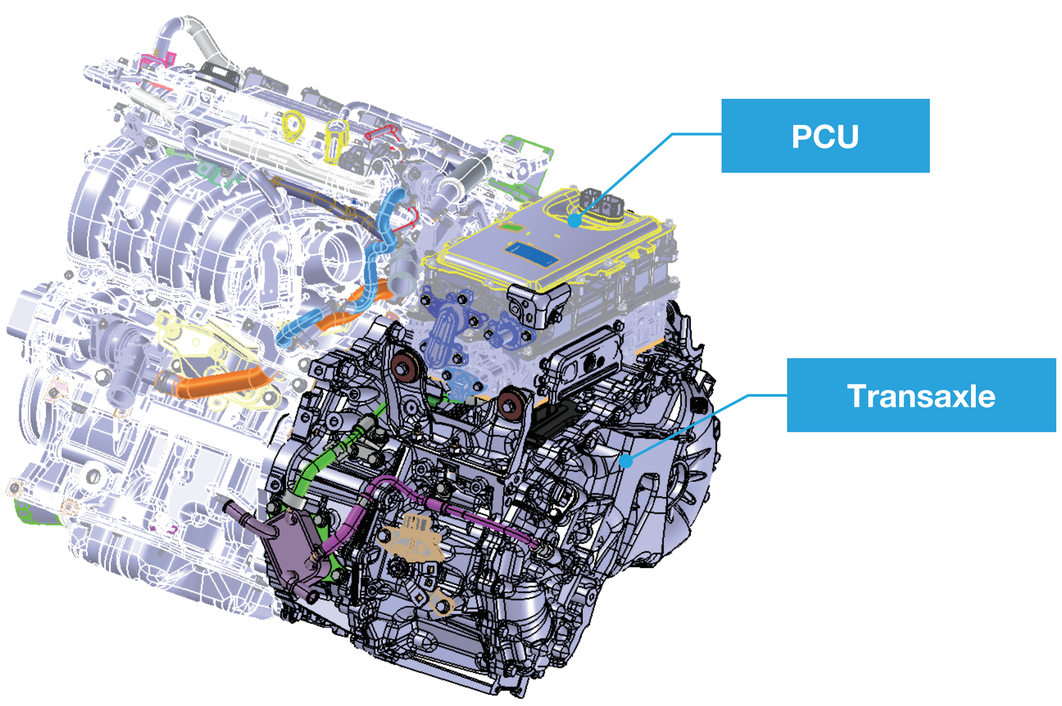
New Toyota Hybrid System Ⅱ for the 2.0-liter Dynamic Force Engine

■ The new 2.0-liter system implements technologies that allow for a smaller, lighter, and more energy efficient structure. A 2.5-liter system was previously introduced in the redesigned Camry.

New Power Control Unit

The new PCU is 20% smaller, and 10% lighter than the conventional 1.8-liter model, which allows it to be placed directly above the transaxle.





Placed directly above the transaxle

New Transaxle

The motor features a new rolling-coil structure with fewer wires, and also uses a newly developed magnetic steel. A new parallel reduction gear format helps to reduce the loss in the transaxle.

Loss reduced by more than 25%

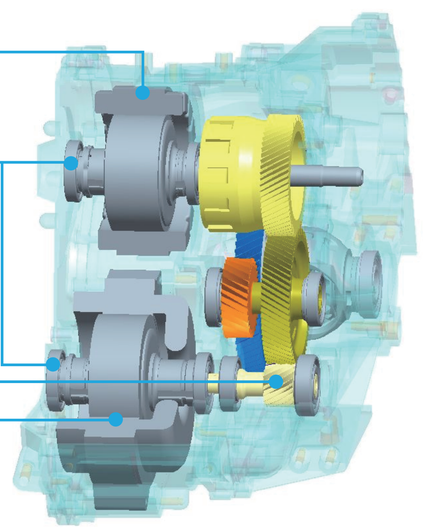
Transaxle	2-motor mechanical power split type
Motor	Synchronous AC
Maximum motor output	80kw(109PS)
Maximum motor torque	202N·m (20.6kgf·m)

MG1 (the generator) adopts a concentrated winding structure.

MG1 and MG2 (motor) have a multi-axis configuration.

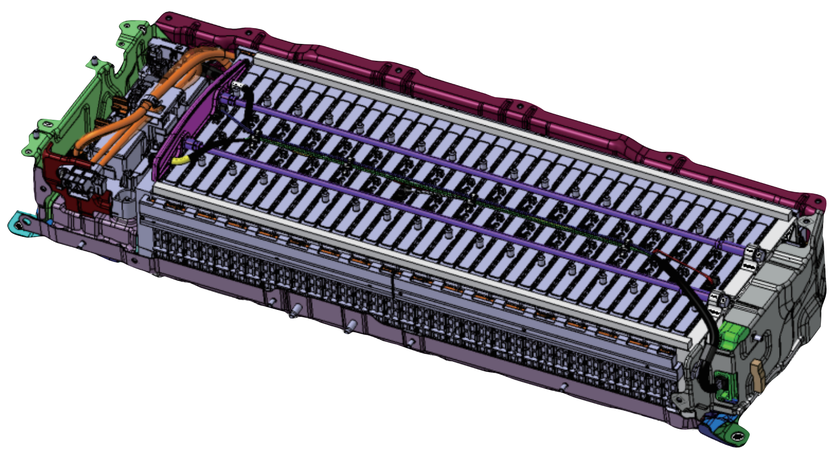
MG2 has a new parallel reduction gear format.

MG2 adopts a segment coil (SC) winding structure.



New Nickel-metal Hydride Battery

Reduction in size dedicated to 2.0-liter by reviewing the structure of the battery pack and making the cooling system compact



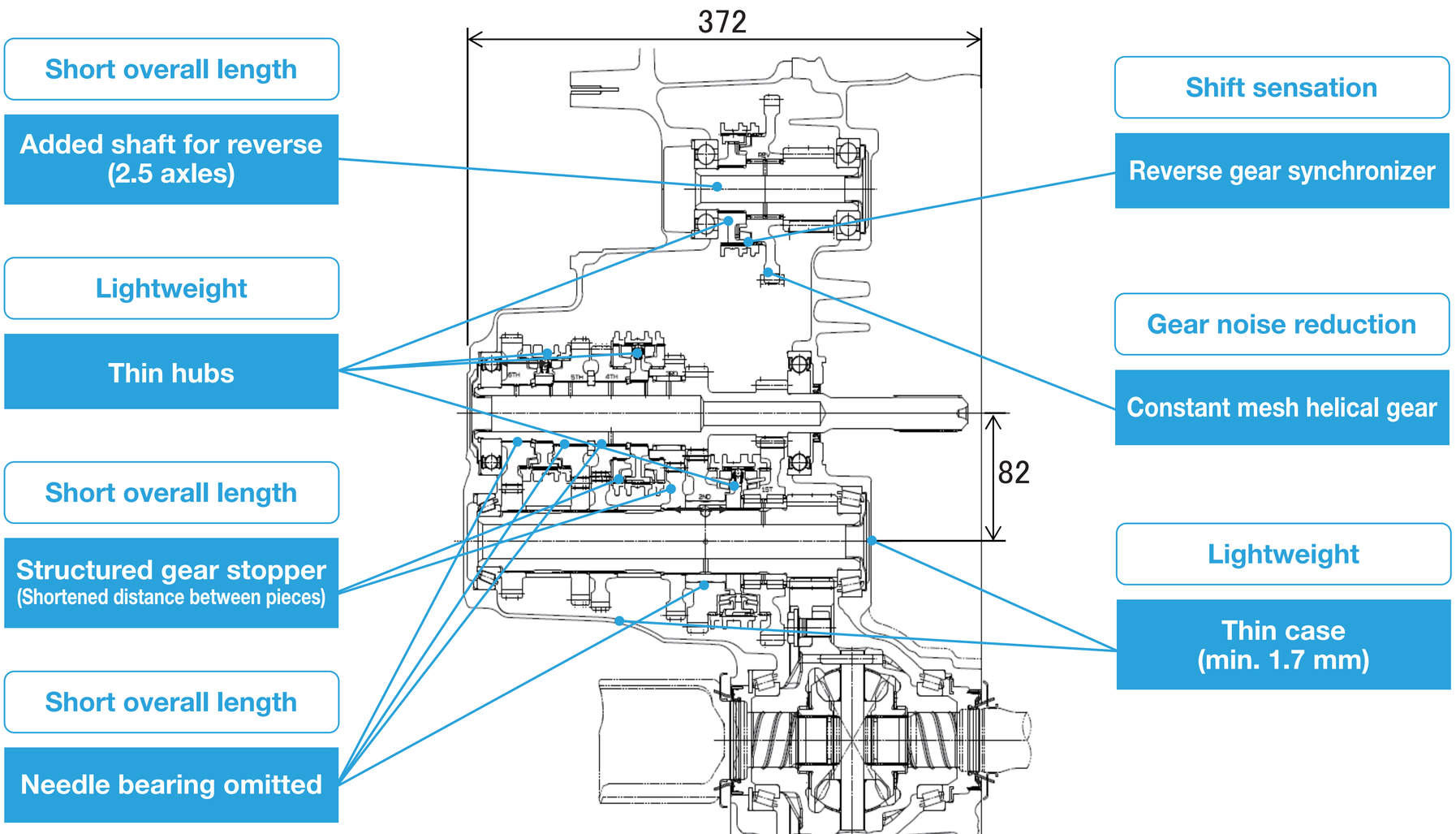
	Current 1.8-liter	New 2.0-liter
Voltage	201.6V	216.0V
Capacity	6.5Ah	6.5Ah
Numbers of cells	168	180

Direct & Smooth

New 6-speed Manual Transmission

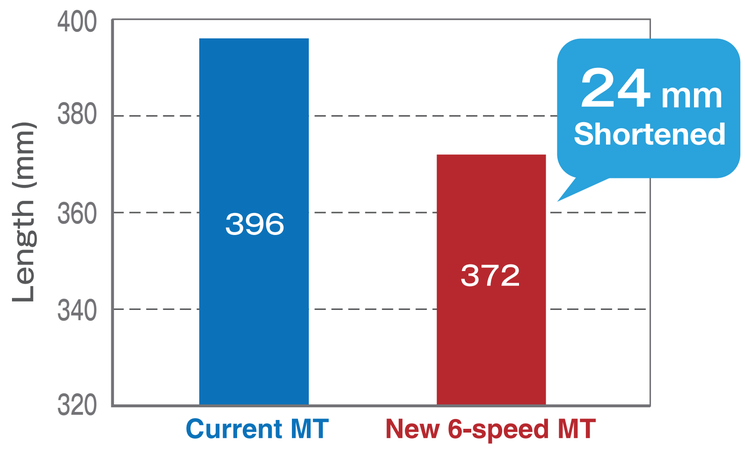
- Top-grade manual transmission that is lightweight and compact with implementation of a dedicated reverse gear synchronizer.
- Manual transmission operation supported by electronic control, relieving driver burden.

Key technologies/performance

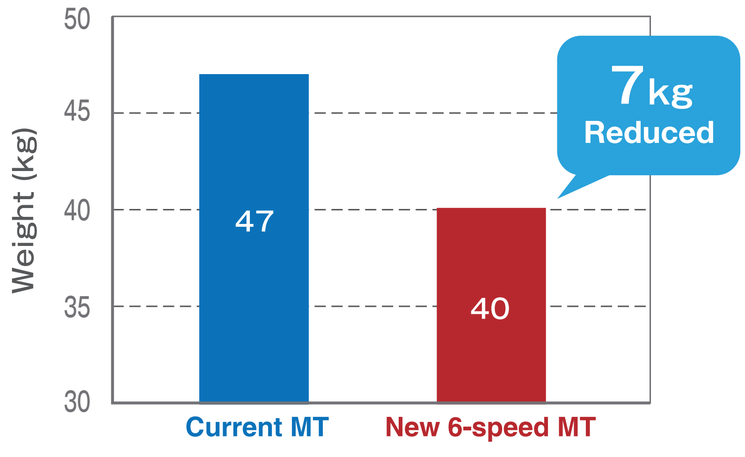


Specifications	Allowed torque	Weight	Control type	Synchronizer
	280N·m	40kg	Cable type	Forward/backward full synchromesh gearbox

Short overall length

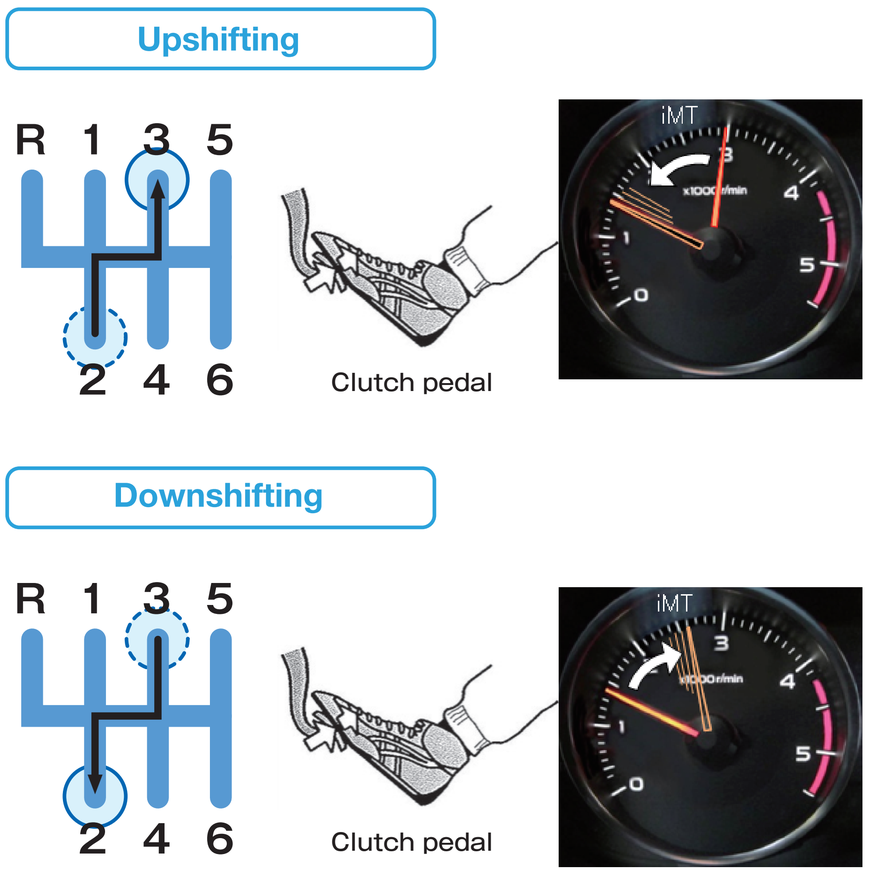


Lightweight



iMT (Intelligent Manual Transmission) control

Upshifting



Downshifting