Feature Story 1

SKYACTIV-X Next-Generation Gasoline Engine: Our Contribution to the Earth, People, and Society

At Mazda, our goal is to protect the earth by reducing carbon dioxide emissions in real-world driving as much as possible. Since the internal combustion engine is expected to power the majority of vehicles for many years to come, we believe that perfecting it is the greatest contribution we can make to cutting carbon dioxide emissions.

The SKYACTIV-X next-generation gasoline engine, announced in August 2017, brings us one step closer to realizing our dream engine. Combining the advantages of both gasoline and diesel engines, the SKYACTIV-X was born of Mazda’s mission to bring about a beautiful earth, to enrich people’s lives as well as society, and to seek ways to inspire people through the value found in cars.

Q: What is the SKYACTIV-X and how is it different from previous engines?

A: Simply put, the SKYACTIV-X is a gasoline engine that combines the advantages of gasoline and diesel engines in a manner befitting the title “next-generation.” It helps the earth and people by offering unprecedented environmental performance and responsive driving. For example, it improves fuel efficiency up to 20-30 percent over Mazda’s current gasoline engine and also increases torque*1 10-30 percent. Basically, it offers the driving performance of

*1 A measure of the rotational or driving force generated by an engine. It affects acceleration from a steady speed.

Interview with the lead engineer of the SKYACTIV-X next-generation engine

Pursuit of the ultimate engine

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a 2-liter gasoline engine sports car (MX-5) with the carbon dioxide emissions of a 1.5-liter diesel compact car (Mazda2).

Q: Of all available technologies, such as electricity and hydrogen, why have you focused on the internal combustion engine?

A: While it's true that various technologies are being developed and brought to market, each has its issues. Energy infrastructure varies between countries and regions. The operating environment — road conditions and driving styles — also varies between customers. Given that, we considered what kind of environmental technology was best. The point was to reduce carbon dioxide emissions on a well-to-wheel basis — from the point of fuel extraction to driving the vehicle — and to do that in actual driving on a global level.

Our research pointed to the internal combustion engine. We realized that making existing engines more efficient would drive reductions in carbon dioxide emissions globally and in real-world driving.

The future prospects of the internal combustion engine have been demonstrated by external organizations. An International Energy Agency report projects that internal combustion engine vehicles will represent around 84 percent of all vehicles in 2035. Of course, we are also developing other technologies so we can deploy them to markets where they are suitable. Our electric vehicle scheduled for launch in 2019 is one example. We are also researching ways to reduce overall emissions more efficiently by adding compact electrification technologies for driving speeds at which the efficiency of the combustion engine suffers.

Q: Does the internal combustion engine have that much potential for improvement?

A: We're constantly working to develop the ideal engine, so we know there's still plenty of room for improvement. There has been a lot of research on the potential — and technical difficulty — of improving the internal combustion engine’s efficiency. When Mazda developed its existing engines (SKYACTIV-G and SKYACTIV-D), it demonstrated that potential and attracted attention from the science community. This helped to breathe new life into combustion engine research and development. That accomplishment followed major challenges: pushing the boundaries of abnormal combustion (knocking) under high-temperature, high-pressure conditions in gasoline engines (SKYACTIV-G) and pushing the boundaries of ignition performance (misfiring) under low-temperature, low-pressure conditions in diesel engines (SKYACTIV-D).

Automobile engines generate energy by compressing air, exhaust gas, and fuel and igniting it to combust. Theoretically, the more air you put in and the more you compress it before combustion, the greater power you can obtain — but it doesn’t work like that. High compression ratios in gasoline engines cause abnormal combustion, while low compression ratios in diesel engines cause misfiring. While tackling these challenges in both types of engines, Mazda’s engineers honed their skills for developing our next-generation engine, the SKYACTIV-X.
Spark-Controlled Compression Ignition (SPCCI) is Mazda’s proprietary combustion method that offers complete control of compression ignition combustion by way of spark ignition. Once ignited by the spark plug, the expanding spherical flame serves as a second piston (air piston), further compressing the air-fuel mixture in the combustion chamber and providing the necessary conditions for compression ignition. By controlling the timing of spark plug ignition, SPCCI expands the range of conditions under which compression ignition can take place.

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