

# Story of the Development of the ELF-KR Series

In 2002, the ELF-KR light-duty truck series took the No.1 share in the Japanese market for of 2-3-tonne vehicles for two consecutive years. Deserving the title "Next-generation, Environmentally Friendly Truck," this series offers excellent environmental performance, becoming the first to clear the new short-term exhaust emission regulations that came into effect in 2003.

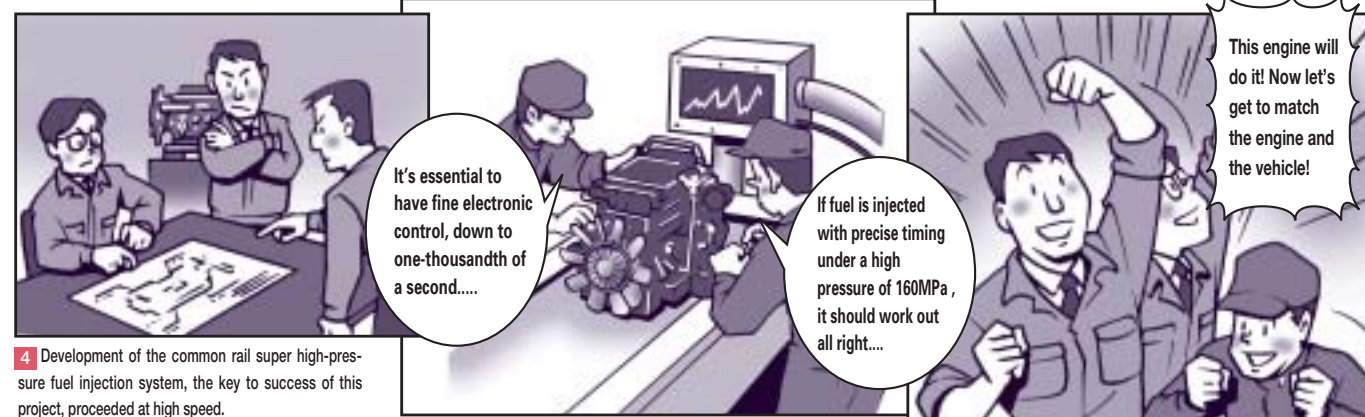
This is an illustrated story of Isuzu's technicians who threw themselves into the task of developing the ELF KR.



1 "Clear the new short-term exhaust emission regulation standards!" This was one of the high hurdles confronting the ELF development staff.



2 "Can we create a new truck that really satisfies its users on a schedule half the length of the ordinary development period?" All staff members realized how important this project was, but the afforded time was too short.  
 3 We knew exactly what our technical target was. However, no matter how high the added value of the technology was, we could not pass the resulting additional costs on to the user. The engineers began to work on this difficult challenge.



4 Development of the common rail super high-pressure fuel injection system, the key to success of this project, proceeded at high speed.  
 5 We needed to apply the common rail system that had been installed in medium- and heavy-duty vehicles in order to ensure precise fuel injection and high engine durability while achieving increased pressure. However, the size of our small engines could not be increased.  
 6 Development of the common rail system progressed steadily and the engine compartment was insulated to reduce noise; this enabled us to meet the first objective of this project of clearing the 2001 noise regulations standards.



7 However, it took longer than expected to match the engine to the vehicle, and it still remained to start road testing. Commercial production could not be commenced on schedule in fiscal 2002 unless cold weather testing is passed by January 2001. The staff was impatient.



8 Coming to the end of the year, the atmosphere in the office was glum. One of the leaders of the development project encouraged the staff: "I'm sure that this problem will not go on forever. Let's get back on it after the beginning of the new year. It'll be ok. I'm sure we have the skills to solve this." The feeling of desperation lifted, and the staff regained their unity in a common determination to do whatever it took to succeed."

# Next Generation Environmentally Friendly Trucks



9 Our cold weather test team had to fight for every success it scored. A great deal of test data was compiled, the causes of failures were identified, and improvements were refined. Eventually, every requirement for cold-region operation was satisfied - one great hurdle had been passed.



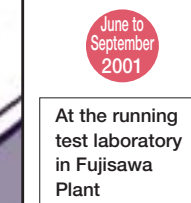
10 Another challenging issue was to demonstrate engine performance at high temperatures. The engine must be tuned so that coolant water temperature does not rise too far, reducing engine power, even when the gas pedal is floored while the truck is climbing a steep slope.



11 The test vehicle has passed both the cold weather and high-altitude testing! Now, all we have to do is the durability testing.



12 Bench testing on the new 4HL1 engine continued. Pattern driving was performed for 20 hours per day and durability was demonstrated for a distance of 83,000 kilometers. This is how we created the super clean diesel engine in Japan. The Ministry of Land and Traffic exhaust emission regulation standards were successfully cleared.

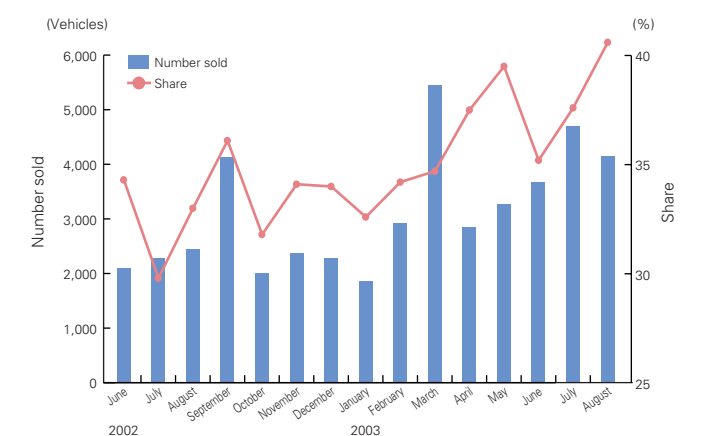


13 The ELF KR series "Next-Generation Environmentally Friendly Truck" has thus been completed, overcoming the numerous technical obstacles and the tight deadline of two years.



14 Boasting a commanding technical lead in environmental performance, the ELF-KR has taken a higher and higher market share for its vehicle class since the launch of the series. In December 2002, the ELF-KR series light-duty trucks were ranked top in the Japanese market for the second consecutive year. We at Isuzu are immensely proud of our record and determined to continue providing top-of-the-line diesel vehicles.

Sales and Market Shares of The ELF



# Isuzu's Clean Diesel Engines — At Work

# Around the World

## ● In Europe Diesel Engines Earn High Reputation for Reduced CO<sub>2</sub> Emissions



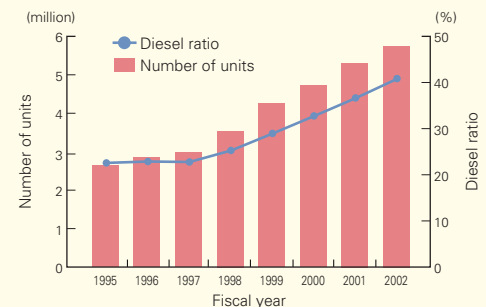
**Jun Arimoto**  
President  
Isuzu Motors Germany GmbH

Diesel engines are well appreciated for their high fuel efficiency in Europe, where people's awareness about environmental conservation has grown ahead of the Japanese. All passenger cars sold in 2008 and after are required to have reduced CO<sub>2</sub> emissions, 140 g/km or less, calculated as a weighted average. Diesel engines are essential to meeting this regulatory standard.

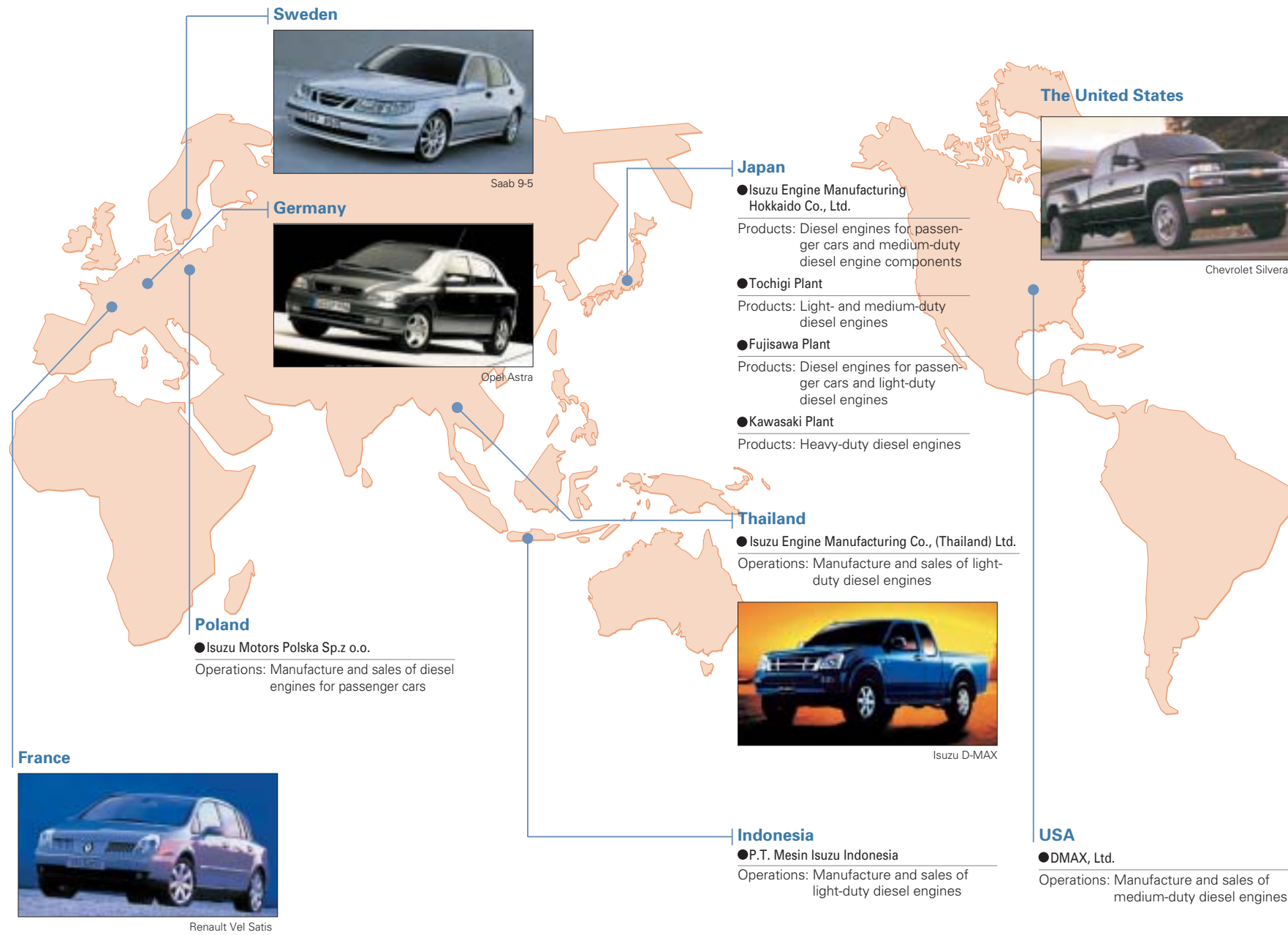
In 1986, Isuzu became the first vehicle manufacturer to introduce a two-stage valve opening nozzle, resulting in direct injection diesel engines with reduced vibration and noise.

Based on these and more recently achieved technical innovations, Isuzu was able to develop outstandingly fuel-efficient diesel engines, including the 4EE2 and 6DE1-V6 engines, which offer high performance comparable or superior to that of gasoline engines. In 2003, ten models equipped with the 4EE2 and five models of luxury cars with the 6DE1-V6 were launched in the market worldwide. Adopting the 4EE2 engine, the Opel Astra became the first vehicle in the world to clear the EURO IV exhaust emissions regulations, contributing to improving the global environment.

### ■ The Shift Toward Diesel Passenger Vehicles in EU Countries



Source: AAA (Association Auxiliaire de l'Automobile)



## ● Isuzu's Diesel-Powered Vehicles Earn High Reputation in Thailand, Ranked Top in Market Share in Commercial Vehicle Class for 20 Consecutive Years



**Kunikazu Ishiwatari**  
Vice President  
Tri Petch Isuzu Sales Co., Ltd.

The Isuzu brand has earned a high reputation in Thailand. Isuzu's commercial vehicles and pickup trucks have ranked first in market share for twenty and seven consecutive years, respectively. With their tall, tough bodies adaptable for multiple purposes, pickup trucks are best suited for use in this tropical country, where roads are often flooded with heavy rain. In Thailand, farmers account for half the nation's total population, and many people have independent businesses. I think vehicles like Isuzu's D-MAX, which can carry cargo for work, and which can be used for leisure on holidays, are likely to be well accepted in this country. The great popularity of Isuzu's vehicles in Thailand is also attributable to the customer-oriented marketing and services provided by our company, Tri Petch Isuzu Sales Co., Ltd. (TIS). Before we began operations, we have conducted in-house durability testing locally based on the actual uses we expect for the D-MAX. We have identified problems and reported them to the Isuzu engineering and manufacturing departments for further improvements.

As of May 2002, a total of one million units had been produced since Isuzu Engine Manufacturing Co., (Thailand) Ltd. started operations in 1988. As of May 2003, more than 100,000 units of this model have been sold in one year after its launch, representing the first such case of vehicle sales in Thailand. We look forward to further progress.



D-MAX Gains Popularity in Thailand

### ● Germany and The United Kingdom

The Opel Astra and Corsa models and the Honda Europe Civic are equipped with Isuzu's compact diesel engine 4EE2, which features high fuel efficiency, high output and clean exhaust emissions. Since the engine offers comprehensive completeness and high potential, it is highly appreciated in Europe. In March 2003, Opel Astra adopted the new 4EE2 engine, which was the first engine to clear the EURO IV exhaust emissions regulations in the world. Currently, this engine is produced and supplied in large numbers. This Astra received the "German Best Small and Compact Car of the Year 2001 Award" from "MOT," one of Germany's top motor vehicle magazines.



4EE2

### ● Sweden and France

The Saab 9-5 luxury sedan, the Renault Vel Satis luxury sedan, and the Renault Espace multi-purpose vehicle are equipped with an Isuzu-made 6DE1 V6 direct injection diesel engine. Developed for use in next-generation passenger cars and sport utility vehicles, this engine offers light weight and compact size thanks to the adoption of the world's first closed-deck cylinder block made of die-cast aluminum. It also features outstanding acceleration and excellent driving economy with its second-generation common rail fuel injection system and 24 valves. The engine is widely accepted for use in luxury cars, demonstrating Isuzu's reputation as a diesel engine manufacturer.

It received the "Executive Car of the Year 2002" prize from a British diesel car magazine.



6DE1

### ● The United States

GM's full-size pickup truck, the Chevrolet Silverado and GMC Sierra, is equipped with a direct injection diesel engine developed with more generous power performance that was developed by Isuzu for the new generation of sport utility vehicles. The Duramax 6600 (8GF1) engine features high output, low fuel consumption, and low noise and vibration comparable to those of gasoline engines. It has dramatically changed the consumer image of diesel-powered vehicles and is highly appreciated as a clean diesel engine in the United States, the world's biggest automobile market. The Duramax 6600 received Ward's "Ten Best Engines Award" for two consecutive years in 2001 and 2002, as well as Motor Trend's "Truck of the Year 2001 Award".



Duramax 6600 (8GF1)

### ● Thailand

Isuzu launched a fully redesigned model of a one-ton pickup truck manufactured in Thailand under the name Isuzu D-MAX in May 2002. Offering novel styling and equipped with a new type of powerful and environmentally friendly direct injection diesel engine, the Isuzu D-MAX is highly appreciated for its comprehensive performance. It is gaining a status surpassing that of passenger cars. More than 100,000 units of this model have been sold in less than one year after its launch, representing the first such case of vehicle sales in Thailand. The current market share is no less than 45%. The Isuzu D-MAX received the "Best Four-Door Pickup Truck Award," "Best Technically Innovated and Designed Pickup Truck Award," in the Thai Car of the Year 2003 accolades.



Isuzu D-MAX