# IEA-Advanced Motor Fuels ANNUAL REPORT 2025

## REPUBLIC OF KOREA

Technology Collaboration Programme
by iea

# Republic of Korea

## *Drivers and Policies*

### Renewable Fuel Standards (RFS)

Since 2006, South Korea has been blending 0.5% biodiesel into diesel fuel. In July 2015, the Renewable Energy Fuel Blending Mandate was implemented under the Renewable Energy Act. Following the 2021 amendment, the government established a roadmap for mandatory blending ratios. In line with the 'Eco-Friendly Biofuel Expansion Plan,' the blending ratio was further adjusted to accelerate carbon neutrality. Starting in 2024, the mandatory ratio for biodiesel was raised to 4.0%. According to the current enforcement decree, this ratio will be maintained until 2026 and then increase to 4.5% in 2027, ultimately reaching 5.0% by 2030. However, the government has announced plans to potentially increase this ratio to 8.0% by 2030 to incorporate next-generation biofuels like hydro-treated vegetable oil (HVO). Research and demonstration of HVO are being intensified to support a potential RFS expansion to 8.0% by 2030, ensuring that the carbon reduction targets for the remaining internal combustion engine (ICE) fleet are met.

Table 1. Roadmap for Mandatory Ratio of Renewable Fuel Blending[a]

| Period | Mandatory Blending Ratio (Biodiesel) (%) | Remark |
|---|---|---|
| July 2021–Dec 2023 | 3.5 | Implemented |
| 2024–2026 | 4.0 | Current (increased from 2024) |
| 2027–2029 | 4.5 | Planned |
| 2030– | 5.0 (up to 8.0) | Under review for expansion |

[a] To determine the compulsory blending amount by year, multiply the compulsory blending ratio (by year) by the domestic sales volume of transportation fuel, including mixed renewable energy fuels.

### Expansion to Sustainable Aviation Fuel (SAF)

To decarbonize the aviation sector, the South Korean government announced the 'SAF Expansion Strategy' in August 2024. This strategy introduces a mandatory SAF blending requirement for all international flights departing from South Korea.

- Mandatory blending: Starting in 2027, aircraft used in all international departures will be required to use a fuel blend of approximately 1% SAF.
- Expansion plan: The blending mandate will be gradually increased in alignment with global standards, such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and the EU's RefuelEU Aviation initiative.
- Infrastructure support: The government is providing tax incentives for SAF production facilities and supporting research and development (R&D) for domestic SAF production technology to ensure a stable supply chain.

## *Advanced Motor Fuels Statistics*

### Vehicle Registration Trends (2016 – 2025)

As of 2025, the cumulative number of registered vehicles in South Korea reached 26,514,873 — a 1.26% increase compared with the previous year. The South Korean automotive market is undergoing a rapid structural shift from ICE vehicles to eco-friendly vehicles.

- Decade overview (2016–2025): Over the past 10 years, the market share of diesel vehicles dropped significantly, from 42.06% in 2016 to 33.16% in 2025. Conversely, eco-friendly vehicles (hybrid electric [HEV], electric [EV], and hydrogen [$H_2$]) grew more than 14-fold, reaching a combined market share of 13.1%.
- Recent (3-year) analysis (2023–2025)
    - The rise of HEVs: HEVs have become the primary driver of fleet greening. HEVs recorded a staggering increase of mor than 1.02 million units within just 2 years (2023 2025), surpassing 2.5 million cumulative registrations.

- Diesel decline: Diesel registrations decreased by an average of 430,000 units annually over the last 3 years, reflecting more stringent emission regulations and shifting consumer preferences.
- EV growth: EVs maintained a steady upward trajectory, nearing the 1-million-unit milestone, with a 29.2% growth rate in 2025 alone.

Table 2 lists the number and ratio of vehicles registered in Korea (by year and fuel type) from 2017 to 2025.

Table 2. Vehicles Registered in Korea, 2017–2025

| Fuel | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 21,803,351 | 22,528,295 | 23,202,555 | 23,677,366 | 24,365,979 | 24,911,101 | 25,657,123 | 25,949,201 | 26,297,919 | 26,514,873 |
| Gasoline | 10,092,399 | 10,369,752 | 10,629,296 | 10,960,779 | 11,410,484 | 11,759,565 | 12,069,043 | 12,314,186 | 12,419,660 | 12,397,121 |
| | (46.29%) | (46.03%) | (45.81%) | (46.29%) | (46.83%) | (47.21%) | (47.04%) | (47.45%) | (47.23%) | (47.77%) |
| Diesel | 9,170,456 | 9,576,395 | 9,929,537 | 9,957,543 | 9,992,124 | 9,871,951 | 9,758,173 | 9,500,164 | 9,100,840 | 8,604,354 |
| | (42.06%) | (42.52%) | (42.80%) | (42.06%) | (41.01%) | (39.63%) | (38.03%) | (36.61%) | (34.61%) | (33.16%) |
| LPG[a] | 2,167,094 | 2,104,675 | 2,035,403 | 2,004,730 | 1,979,407 | 1,945,674 | 1,904,860 | 1,832,535 | 1,849,816 | 1,839,557 |
| | (9.94%) | (9.34%) | (8.77%) | (8.77%) | (8.12%) | (7.81%) | (7.42%) | (7.06%) | (7.03%) | (7.09%) |
| HEV | 233,216 | 313,856 | 405,084 | 506,047 | 674,461 | 908,240 | 1,170,507 | 1,542,132 | 2,024,481 | 2,550,472 |
| | (1.07%) | (1.39%) | (1.75%) | (2.14%) | (2.77%) | (3.65%) | (4.56%) | (5.94%) | (7.70%) | (9.83%) |
| CNG[b] | 38,880 | 38.918 | 38,934 | 38,147 | 36,940 | 35,208 | 32,780 | 30,352 | 27,058 | 24,624 |
| | (0.18%) | (0.17%) | (0.17%) | (0.16%) | (0.15%) | (0.14%) | (0.13%) | (0.12%) | (0.10%) | (0.09) |
| EV | 10,855 | 25.108 | 55,756 | 89,918 | 134,962 | 231,443 | 389,855 | 543,900 | 684,244 | 899,101 |
| | (0.05%) | (0.11%) | (0.24%) | (0.38%) | (0.55%) | (0.93%) | (1.53%) | (2.10%) | (2.60%) | (3.46%) |
| $H_2$ | 87 | 170 | 893 | 5,083 | 10,906 | 19,404 | 29,623 | 34,258 | 37,930 | 44,655 |
| | (0.00%) | (0.00%) | (0.00%) | (0.02%) | (0.04%) | (0.08%) | (0.12%) | (0.13%) | (0.14%) | (0.17%) |
| Other[c] | 90,364 | 99,421 | 107,652 | 115,119 | 126,695 | 139,616 | 148,237 | 151,674 | 153,890 | 154,989 |
| | (0.41%) | (0.44%) | (0.46%) | (0.49%) | (0.52%) | (0.56%) | (0.58%) | (0.58%) | (0.59%) | (0.60%) |

[a] LPG = liquefied petroleum gas
[b] CNG = compressed natural gas
[c] Other fuels (kerosene, alcohol, solar, liquefied natural gas [LNG]) and towed vehicles (trailers, etc.)

## *Research and Demonstration Focus*

### Biodiesel

The Republic of Korea has expanded the use of biodiesel in the transportation sector through a policy-driven blending mandate under the (RFS. Since its introduction in 2015, the blending ratio has gradually increased, reaching 4.0% in 2024, with further increases toward 5.0% planned by 2030.

Despite this policy expansion, recent data suggest that market outcomes are diverging from regulatory targets. Biodiesel distribution reached approximately 911,000 kiloliters (kL) in 2024, representing continued growth in physical supply. However, industry-level indicators suggest increasing structural pressures, including cost increases and changing market dynamics. Feedstock availability remains a key constraint. Biodiesel production in Korea depends heavily on imported feedstocks, particularly palm-based oils, while domestic resources (e.g., used cooking oil) are insufficient to meet demand. This reliance exposes the sector to global price volatility and sustainability concerns.

At the same time, the industry structure is evolving. Petroleum refiners are increasingly integrating biodiesel production into their operations, altering the competitive landscape and affecting independent producers. Meanwhile, imports of both feedstocks and finished biodiesel are increasing, indicating a gradual shift toward a reliance on external supply.

Looking forward, biodiesel demand is expected to diversify beyond road transport into aviation and maritime application. In the longer term, advanced biofuels such as HVO and SAF are expected to play a more prominent role in Korea’s decarbonization pathway.

### Hydrogen

Under the "First National Strategy for Carbon Neutrality and Green Growth," the South Korean government continues to pursue the large-scale deployment of hydrogen mobility alongside battery electric vehicles. The government has set a target to deploy 4.5 million electric and hydrogen vehicles by 2030, supported by purchase subsides, tax incentives, and regulatory frameworks such as the restructuring of the low-emission vehicle supply mandate toward a zero-emission vehicle (ZEV)-focused system.

In recent years, policy implementation has evolved to improve effectiveness. Subsidy schemes have been increasingly differentiated based on vehicle performance, including driving range and energy efficiency, while a flexible compliance system and contribution fee mechanism have been introduced to increase manufacturer participation in the ZEV transition. In parallel, public sector procurement requirements for ZEVs have been expanded to stimulate early market demand.

Infrastructure deployment remains a critical pillar of Korea's hydrogen mobility strategy. The government is accelerating the expansion of hydrogen refueling stations, with a focus on improving accessibility and reducing refueling times to levels comparable to those for conventional fuels. At the same time, continued investment is being made to enhance the durability, efficiency, and cost competitiveness of hydrogen fuel cell systems. By 2030, Korea aims to achieve performance levels in hydrogen vehicles comparable to those of ICE vehicles, including driving range, reliability, and total cost of ownership.

Recent developments also highlight a growing diversification of hydrogen technologies in the transport sector. In addition to fuel cell electric vehicles (FCEVs), there is increasing interest in hydrogen internal combustion engine ($H_2$-ICE) technologies. Domestic automotive manufacturers, including Hyundai Motor Company, KG Mobility, and HD Construction Equipment, have advanced the development of hydrogen-powered engines as an alternative pathway for decarbonizing the heavy-duty and commercial transport segments. These engines offer advantages such as compatibility with existing engine manufacturing infrastructure, lower system costs compared with fuel cells, and robustness under high-load operating conditions.

Manufacturers are actively exploring hydrogen ICEs for heavy-duty trucks, construction machinery, and special-purpose vehicles, where fuel cell systems encounter cost and durability challenges. Recent demonstrations and pilot projects indicate that $H_2$-ICE technology can significantly reduce carbon emissions while maintaining operational characteristics similar to conventional diesel engines. However, challenges remain, including nitrogen oxide ($NO_x$) emission control, hydrogen storage, and overall system efficiency compared with fuel cell technologies.

To support hydrogen mobility diversification, the government is promoting the development of a full range of hydrogen-powered vehicles, including passenger cars, commercial vehicles, and special-purpose applications. Subsidies and policy support are increasingly concentrated on high-impact sectors such as buses, trucks, and potentially maritime transport, where electrification is more difficult to implement.

Looking ahead, Korea's hydrogen transport strategy is expected to follow a multi-track approach. FCEVs will remain the primary pathway for zero-emission mobility, particularly in the passenger and public transport segments. At the same time, $H_2$-ICEs are likely to play a complementary role in hard-to-abate sectors, offering a transitional solution that leverages existing technologies and infrastructure.

Overall, Korea is strengthening its position as a leading market for hydrogen mobility by combining strong policy support, industrial participation, and technological diversification. The integration of hydrogen fuel cell systems and $H_2$-ICEs reflects a pragmatic approach to decarbonizing the transport sector while addressing cost, infrastructure, and performance constraints.

### Ammonia

As part of its broader carbon neutrality strategy, the Republic of Korea is actively exploring ammonia as a zero-carbon fuel, particularly for hard-to-abate transport sectors such as shipping and power-linked applications. Ammonia is gaining attention due to its high hydrogen content, established global supply chains, and relative ease of storage and transport compared with pure hydrogen.

The Korean government has incorporated ammonia into its long-term hydrogen economy roadmap, recognizing its role as both a hydrogen carrier and a direct fuel. In recent years, policy efforts have focused on building an ammonia supply chain, including international partnerships for green ammonia imports and the development of domestic utilization technologies.

In the transport sector, ammonia is primarily considered for maritime applications. Demonstration projects are under way to develop ammonia-fueled ships and engines, supported by collaboration among shipbuilders, engine manufacturers, and energy companies. Major Korean shipbuilders, including HD Hyundai Heavy Industries and Hanwha Ocean, are actively engaged in the development of ammonia-powered vessels and related propulsion systems.

Ammonia-fueled ICEs are also under development, offering a potential pathway for decarbonizing large marine engines. These systems benefit from the ability to leverage existing engine technologies, like $H_2$-ICEs but face challenges related to combustion efficiency, toxicity, and $NO_x$ emissions.

Infrastructure development remains at an early stage. While Korea has significant experience in handling ammonia because of its chemical industry, the adaptation of infrastructure for fuel — particularly in ports and bunkering facilities — requires further investment and regulatory development. Safety standards and environmental regulations are also key areas of focus, given ammonia's toxicity and potential environmental risks.

Looking ahead, ammonia is expected to play a strategic role in decarbonizing the maritime sector and supporting hydrogen imports. However, its adoption for road transport is likely to remain limited due to safety and infrastructure constraints. Continued technological development and international standardization will be critical to enabling large-scale deployment.

**e-Fuel (Synthetic Fuel)**

The Republic of Korea is also exploring electrofuels (e-fuels) as part of its strategy to decarbonize the transport sector, particularly in segments where direct electrification is challenging. e-Fuels, produced using renewable electricity, hydrogen, and captured carbon dioxide, offer the advantage of compatibility with existing ICE infrastructure.

Policy interest in e-fuels has increased in recent years, particularly in relation to aviation and shipping. The government is supporting R&D initiatives aimed at producing synthetic fuels such as e-diesel, e-gasoline, and SAF. These fuels are considered a potential solution for reducing life-cycle GHG emissions without requiring significant changes to existing vehicle fleets or fuel distribution systems.

Industrial participation is expanding, with major energy and industrial companies investing in pilot projects and international collaborations. For example, SK Energy and GS Caltex are exploring pathways for integrating e-fuel production into existing refining and petrochemical operations. These efforts are aligned with broader initiatives to develop carbon capture and utilization (CCU) technologies and renewable hydrogen production.

Despite its potential, the deployment of e-fuels in Korea remains at an early stage. Key challenges include high production costs, limited availability of renewable electricity, and the need for large-scale CCU infrastructure. As a result, e-fuels are currently less competitive than other low-carbon alternatives, such as electrification and hydrogen, in most transport applications.

In the near term, e-fuels are expected to be prioritized for sectors with limited decarbonization options, such as aviation, maritime transport, and certain industrial applications. In the longer term, cost reductions driven by technological advancements and economies of scale could enable broader adoption.

Overall, Korea's approach to e-fuels reflects a complementary strategy within its broader energy transition framework. By leveraging existing fuel infrastructure and industrial capabilities, e-fuels offer a potential pathway for reducing emissions in legacy systems while supporting the transition to a low-carbon transport sector.

## Outlook

The Republic of Korea is accelerating the transition toward low-carbon transport fuels through a multi-pathway strategy that combines the expansion of conventional biofuels with the development of advanced alternative fuels. While policy frameworks continue to support increased blending mandates and zero-emission mobility, recent market and technological developments indicate a shift toward a more diversified and adaptive fuel transition strategy.

In the case of biodiesel, the government continues to raise the mandatory blending ratio under the RFS, reaching 4% in 2024 with further increases planned toward 2030. However, recent trends suggest that supply growth is no longer keeping pace with policy ambition. Structural constraints, including limited domestic feedstock availability, rising dependence on imported raw materials, and increasing cost pressures, are reshaping the biodiesel market. At the same time, the industry is undergoing consolidation, with petroleum refiners expanding their role and independent producers facing declining competitiveness. As a result, biodiesel is expected to remain an important near-term decarbonization tool, but its long-term growth potential in road transport may be limited.

At the same time, Korea is actively expanding its portfolio of alternative fuels to address hard-to-abate sectors. Hydrogen remains a central pillar of the country's transport decarbonization strategy, particularly through the deployment of FCEVs. In parallel, emerging technologies, such as $H_2$-ICEs are gaining traction, especially for heavy-duty vehicles and industrial applications, where they offer advantages in terms of system cost and compatibility with existing infrastructure.

Ammonia is also emerging as a strategic fuel, particularly in the maritime sector. Korea is leveraging its strong shipbuilding industry, including companies such as HD Hyundai Heavy Industries, to develop ammonia-fueled vessels and propulsion systems. While ammonia offers advantages as a carbon-free fuel and hydrogen carrier, its deployment will depend on overcoming challenges related to safety, emissions, and infrastructure development.

In addition, electrofuels (e-fuels) are gaining policy and industry attention as a long-term decarbonization option. Major energy companies, including SK Energy and GS Caltex, are exploring integration of e-fuel production with existing refining processes. However, high production costs and limited availability of renewable electricity are expected to constrain large-scale deployment in the near term. As such, e-fuels are likely to be prioritized for sectors such as aviation and shipping, where direct electrification is less feasible.

Overall, Korea's transport fuel strategy is evolving from a policy-driven expansion of individual fuel types toward a more integrated and diversified system. Rather than relying on a single solution, the country is pursuing a portfolio approach in which biodiesel, hydrogen, ammonia, and e-fuels each play complementary roles depending on sector-specific requirements.

In the near term, biofuels and hydrogen are expected to remain the primary drivers of emissions reduction in road transport. In the medium to long term, the role of advanced fuels such as ammonia and e-fuels is expected to expand, particularly in the maritime and aviation sectors. This transition will depend on continued technological innovation, infrastructure development, and international cooperation to ensure fuel availability and sustainability.

Ultimately, Korea's approach reflects a pragmatic pathway toward carbon neutrality, balancing immediate emissions reductions with long-term technological transformation across the transport sector.

## Additional Information Sources

- K-Petro
- Korea Register
- Ministry of Trade, Industry and Energy
- Ministry of Environment
- Korea Automobile Manufacturers Association