Strategic Benefits of Low-Carbon Fuels: More than Just Broadening the Decarbonization Pathways in Transportation

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This article examines Taiwan's evolving policy framework for advancing low-carbon fuels as part of a broader, multi-faceted strategy to decarbonize the transportation sector and achieve complementary policy objectives. While current transport decarbonization efforts are heavily centered on replacing vehicles with electric alternatives, this approach has a limited emission impact and remains accessible to only a small subset of vehicle owners. In contrast, low-carbon gasoline provides an opportunity for a broader segment of the population- almost all owners of internal combustion engine (ICE) vehicles- to immediately participate in carbon reduction efforts. Furthermore, the use of low-carbon fuels enhances the effectiveness of demand-side strategies—such as promoting shared mobility, ride pooling, and reduced vehicle usage—by lowering the baseline carbon intensity per kilometer traveled. In addition to its environmental contributions, the adoption of low-carbon fuels offers co-benefits in trade diversification and energy security—particularly through the importation of bioethanol, which can help ease Taiwan's trade imbalance with the United States and reduce dependence on crude oil.

Despite the United States' withdrawal from the Paris Agreement under the Trump administration, major global actors have remained committed to their climate commitments. The European Union has advanced the Green Deal and implemented the Carbon Border Adjustment Mechanism (CBAM), while France has actively pursued bilateral cooperation with China in responses to a leadership vacuum. Against this backdrop, Taiwan revised its national carbon emissions reduction targets in May 2025, raising its 2030 goal from 24±2% to 28±2%. and pushed forward 20 flagship action plans.

As one of the six pillars in Taiwan's national decarbonization agenda, the transportation sector is supported by a range of policy measures. Among these, vehicle electrification has been established as the core strategy. Policy development has progressed in three distinct phases. The first phase focused on three primary areas—

public transportation, electric scooters, and vehicle efficiency. The second phase expanded to include government procurement of electric buses, and the third phase, scheduled for 2026-2030, will further extends electrification efforts to commercial vehicles, including taxis and light-duty trucks.

However, this strategy leaves limited space for the majority of current ICE vehicle owners to take part in decarbonization efforts. By contrast, incorporating fuel-based decarbonization into the policy framework introduce a new dimension to achieving carbon neutrality in Taiwan's transport sector. It allows all vehicle owners—not just those who have adopted electric vehicles—to take immediate action, change behavior, and contribute tangibly to emissions reduction.

When integrated alongside existing strategies such as electrification, public transit, and shared mobility, low-carbon fuels can help enable a diversified, multi-pathway approach that engage the entire vehicle fleet in the decarbonization process. This broadly inclusive approach ensures that no group of vehicle owner is excluded in the transition. Moreover, fuel-based decarbonization can amplify the impact of shared mobility solutions by further lowering the per-kilometer carbon intensity, creating positive synergistic effects that enhance the overall effectiveness of transport policies.

Globally, over 70 countries have incorporated ethanol-blended gasoline into their transportation decarbonization strategies. Taiwan initiated a pilot program for E3 (3% ethanol blend) gasoline in 2007; however, the program was limited in scope, with only a handful of fueling stations offering E3 and lacking public awareness campaigns or policy support. As a result, current usage remains extremely low, and the initiative has not yielded any significant carbon reduction impact.

Despite the limited uptake of E3, the emissions reduction potential of E10 remains highly promising. Previous estimates suggest that a nationwide shift to E10 for all gasoline-powered vehicles and motorcycles in Taiwan could reduce carbon dioxide (CO_2) emissions by approximately 2.02 million metric tons annually—representing a 7.3% reduction in fuel-related emissions. Naturally, the actual mitigation outcome will depend on factors such as the number of compatible vehicles, public acceptance, and the availability of E10 fuel.

Based on information provided by the Taiwan Transportation Vehicle Manufacturers Association in May 2025, this paper estimates that, as of the end of 2024, approximately 35% of gasoline-powered passenger cars and 92% of motorcycles are compatible with E10, indicating a robust technical foundation for

nationwide implementation. Given this sizable base of compatible vehicles, the introduction of E10 presents an immediate opportunity to reduce emissions within the existing fleet and to ease the pressure on Taiwan's transportation sector in meeting its newly enhanced 2030 emissions reduction target.

Beyond its environmental values, promoting E10 also serves broader strategic purposes. From a trade perspective, Taiwan's lack of domestic bioethanol production presents an opportunity to import ethanol—particularly from the United States—as a means of easing bilateral trade tensions. From a technological standpoint, the use of E10 provides a foundation for exploring higher ethanol blends or even synthetic fuels such as e-fuels. In terms of energy security, increased bioethanol usage can diversify Taiwan's fuel sources and reduce the country's dependence on crude oil imports.

In conclusion, as Taiwan enters the third phase of its national climate policy, incorporating low-carbon fuel initiatives into its transportation decarbonization roadmap could enhance inclusion, policy effectiveness, and long-term resilience. The strategic deployment of E10—supported by sound regulatory frameworks, targeted public engagement, and infrastructure preparedness—may therefore constitute a critical component in Taiwan's pursuit of net-zero carbon emissions by 2050.