BLENDING MANDATES INTO MARKETS: HOW THE RFS, SAF MANDATES, AND EMISSIONS RULES REWRITE THE FORMULA FOR FUEL

The global transportation fuel industry is undergoing significant changes not only by market forces alone but by the evolving regulatory mandates designed to reduce petroleum dependency and greenhouse gas emissions. Three policy instruments including the United States Renewable Fuel Standard (RFS), international and national Sustainable Aviation Fuel (SAF) mandates, and emission focused standards such as California's Low Carbon Fuel Standard (LCFS) are integral in reshaping what goes into fuel tanks, how refineries operate, and the flow of investment capital. This paper examines the origins, mechanisms, and impacts of these polices, highlighting that mandates serve as not only a foundation but also a ceiling that creates pressures that misalign market signals with true environmental goals. By simultaneously examining federal rulemaking records, industry data, and regulatory analysis, this paper concludes that clear and technology neutral policy design is essential to translating legislative ambition into true measurable emission reductions.

Introduction

Liquid fuels have been fundamental in driving the global economy for more than a century. However, the environmental costs of petroleum combustion, from urban air quality to climate change, have compelled governments to reassess the standards of the fuel marketplace worldwide. As multiple governments must navigate the comprehensive fuel industry together, the resulting regulatory architecture is a multi-layered response that simultaneously incentivizes fuel production, mandates blending minimums, and penalizes high-carbon fuel pathways. The emergence of these policies exerts direct and measurable influence on the chemistry of the fuel in every automobile, aircraft, and diesel truck.

This paper will focus on three central policy instruments: The Renewable Fuel Standard (RFS), Sustainable Aviation Fuel (SAF) mandates, and emission-based regulations. The RFS was established by the Energy Policy Act of 2005 and was expanded by the Energy Independence and Security Act of 2007 which required that transportation fuel sold in the United States (US) must contain minimum volumes of renewable fuel [1]. On the other hand, SAF mandates were aggressively implemented with the European Union (EU)'s ReFuelEU campaign, controlling Aviation regulation by requiring the blending of low-carbon alternatives into aviation kerosene [2]. In academic reviews of the RFS, results show that the program has clearly driven biofuel market growth as "actual implementation diverged substantially from statutory targets, reaching only 20 billion gallons in 2022 versus the intended 36 billion, primarily due to failure to scale cellulosic biofuel production," [3]. Finally, emission-based regulations including California's Low Carbon Fuel Standard (LCFS) takes a different approach by setting declining carbon-intensity benchmarks rather than volumetric mandates, thus allowing fuel produces to generate tradable credits by exceeding the targets.

Together, these frameworks are the foundation to the economic and technological environment in how fuel refiners, biofuel produces, technology investors, and agricultural markets operate. The central argument of this paper is to analyze how regulatory design choices (how volumes are set, which fuel pathways qualify, and how compliance flexibility is structured, have consequences that shape supply chains, capital allocation, and the pace of decarbonization.

The Renewable Fuel Standard: Mandating the Blend

1.1 Program Structure and Mechanisms

The RFS is the dominant policy driver of biofuel demand in the US. At its core, the program requires produces and importers of gasoline and diesel to ensure that a specified percentage of their fuel supply meets a renewable standard, expressed as a renewable Volume Obligation (RVO). Compliance is tracked through Renewable Identification Numbers (RINs), a digital certificate that is generated when a qualifying renewable fuel is produced or imported. Obligated parties can either blend biofuels and generate their own RINs, or purchase RINs from other market participants [4].

Table 1: Volume Targets in billions of RINs depicting the Renewable Fuel Standards determined by the EPA. Reproduced from the EPA, Final Renewable Fuel Standards Rule for 2023, 2024, and 2025 (2023) under the CC0 Public Domain Dedication [5].

	2023	2024	2025
Cellulosic biofuel	0.84	1.09	1.38
Biomass-based diesel	2.82	3.04	3.35
Advanced biofuel	5.94	6.54	7.33
Renewable fuel	20.94	21.54	22.33
Supplemental standard	0.25	n/a	n/a

The RFS divides qualifying fuels into four nested categories: total renewable fuel, advanced biofuels, biomass-based diesel, and cellulosic biofuel, shown in Table 1. Each category has its own volume requirement, creating a compliance framework that rewards lower-carbon fuel pathways with a premium on their RIN value. Total renewable fuel is dominated by corn ethanol. Advanced biofuels must demonstrate a lifecycle greenhouse gas reduction relative to petroleum, at least a 50% lifecycle. Cellulosic biofuel must achieve a 60% reduction. Gerveni et al conducted a comprehensive economic review of the RFS program determining that total inflation-adjusted compliance costs for the program are estimated at $252.1 billion from 2011 to 2025, emphasizing the scale of market intervention that mandated blending volumes represent [3].

In June 2023, the EPA finalized the "Set 1 Rule" which established volume requirements for 2023, 2024, and 2025. The rule set total renewable fuel obligations for 2023 at 20.94 billion gallons, for 2024 at 21.54 billion gallons, and for 2025 at 22.33 billion gallons, translating to percentage standards of 11.96%, 12.50%, and 13.13% respectively as shown in Table 1. The respective fuel obligations also reflect an increase in capacity as the years advance [6]. The EPA further stated that multi-year rules set the foundation of an appropriate balance by improving the program by looking to the future through the multiple number of years. A long-term projection allows for the recognition of uncertainty and ideal goals. The EPA further finalized volume requirements for 2026 and 2027 in early 2026 representing the highest mandated volumes in program history [7].

1.2 Influence on Fuel Formation

Visible effects of the RFS on fuel formation is evident with the near-universal adoption of E10, gasoline blended with 10% ethanol, as the standard automotive fuel grade in the US. This outcome predates most current volume mandates as fuel blenders adopted E10 because of ethanol's octane boosting and oxygenate capacity that would otherwise require more expensive additives. The current 14 billion gallon ceiling on conventional corn ethanol under the RFS reflects the fact that fuel suppliers blend approximately 10% of ethanol "with or without the RFS, because doing so supplies needed levels of octane and oxygenate," [8].

On the other hand, the more consequential and scientifically dimension of the RFS driven formulation regard concerns of lifecycle emissions and land use. In a landmark study by Lark et al. the production of corn-based ethanol in the US "has failed to meet the policy's own greenhouse gas emissions targets and negatively affected water quality, the area of land used for conservation and ecosystem processes." The study concluded that the RFS caused a persistent 30% increase in corn prices which drove substantial land conversion and generated lifecycle greenhouse gas emissions at least as high as those of petroleum fuels that the ethanol was intended to replace [9]. These findings have importance implications for how volumetric mandates should be designed by specifying that biofuel gallons are not equivalent to specifying tons of avoided carbon dioxide emissions.

Additionally, the more dynamic area of RFS-driven formulation change has been in the biomass-based diesel and renewable diesel segments. To meet growing volume obligations that cannot be entirely fulfilled by ethanol, refiners have begun analyzing hydrogenated vegetable oils and animal fats to produce renewable diesel. In the same study by Gerveni et al, economic analysis showed that the 2024 generation total for renewable diesel "represented nearly a quarter of all RIN generation for that year," and the primary driver of the renewable diesel boom over 2021-2024 was the need to use high biomass-based diesel blends to achieve California carbon intensity targets under the LCFS. Therefore, the study illustrates the interconnected nature of biomass-based diesel policy, as the paper identifies it as the "policy stack" [3]. In a separate report, the USDA identified that imported biodiesel feedstocks including used cooking oil, tallow, and canola oil all increased substantially in 2023 and 2024 as domestic feedstock costs remained elevated, with the US consuming nearly 30% of globally exported biofuel feedstocks in the 2023-2024 marketing year [10].

The RFS has also created pressure to commercialize cellulosic biofuels, fuels derived from non-food plant matter such as agricultural residues and woody biomass. However, cellulosic production has consistently fallen short of mandated volumes, requiring the EPA to exercise statutory waiver authority. The 2024 compliance year identified a partial waiver of the cellulosic volume requirement after a shortfall in 2023 production left available cellulosic RINs insufficient to cover the total compliance deficit [11]. This recurring pattern illustrates a fundamental tension in the RFS: mandating volumes for technologies that have not been fully integrated at a commercial scale can create compliance stress without necessarily accelerating the underlying innovation.

1.3 Industry Investment and Infrastructure Effects

The RFS further functions as de-facto investment signal for the biofuel sector. By guaranteeing a minimum demand for renewable fuel, the standard reduces the commercial risk of investing in production capacity and blending infrastructure [12]. The Renewable Natural Gas (RNG) Coalition noted that the US RNG industry "has grown substantially over the last decade due in part to a strong RFS" with hundreds of facilities under construction as of 2026 [13].

Table 2: 2026 and 2027 Renewable Fuel Volume Requirements, SRE Reallocation Volumes, and Total Applicable Volumes in billions RINs, Reproduced from EPA Finalizes Historic new Renewable Fuel Standards to Strengthen American Energy Security, Support Rural Economies (2026) under the CC0 Public Domain Dedication [13].

	Proposed Volume Requirement			Finalized Volume Requirement			SRE Reallocation Volume	
	2025	2026	2027	2025	2026	2027	2026	2027
Cellulosic biofuel	1.19	1.30	1.36	1.21	1.36	1.43	0	0
Biomass-based diesel	N/A	7.12	7.50	N/A	8.86	8.95	0.21	0.25
Advanced biofuel	N/A	9.02	9.46	N/A	10.82	10.98	0.24	0.34
Total renewable fuel	N/A	24.02	24.46	N/A	25.82	25.98	0.99	1.04

On the contrary, when the EPA reduces volumes standards to below to what the industry achieves or grants excessive small Refinery Exemptions (SREs), investment signal weakens. The fuel markets association SIGMA warned that retailers that consider biofuel blending investment "may not be rewarded under the new mandates" when 2023-2025 volume disappointed expectations [14]. SRE policy has been particularly contentious. In August 2025, the EPA issued decisions on 175 SRE petitions covering compliance years 2016 through 2024, exempting 11.4 billion gallons of gasoline and diesel from incurring a renewable volume obligation. These decisions were integral in requiring a September 2025 supplemental rulemaking to account for in setting 2026 and 2027 standards according to Table 2.

2. SAF Mandates: Decarbonizing the Skies

2.1 The RefuelEU Aviation Framework

Aviation is consistently one of the hardest sectors to decarbonize, due to the energy requirements of jet fuel and the long asset lifetimes of aircraft. Khujamberdiev et al conducted a study and concluded that SAF technologies, including hydro processed esters and fatty acids (HEFAs), Fisher-Trosch fuels, and alcohol-to-jet processes, have significant reductions in greenhouse gas emissions contributing to a cleaner environment. However, these SAF technologies face significant adoption challenges in the economic supply chain perspective. If SAF production has an 57% annual increase between 2022 and 2023, the study predicts that achieving net-zero emissions could be attainable. The SAF production must be followed by a 13% growth rate in the following years. [15]

Additionally, the EU's ReFuelEU aviation regulation is part of the aviation framework and is a model as the most comprehensive SAF mandate in effect. The framework was finalized in 2023 and was placed into use in 2025. The regulation requires all aviation fuel suppliers to blend a minimum share of SAF into jet fuel at EU airports: 2% beginning in 2025 which then increases to 70% by 2050 [16]. Moreover, the mandate has a sub target that requires synthetic e-fuels to constitute at least 0.7% of aviation fuel by 2030 and 35% by 2050. According to the European commission, this measure alone could reduce aircraft carbon dioxide emissions by two-thirds in 2050 compared to if no action is taken [17].

Table 3: The theoretical and actual available feedstocks in the EU in 2030 and 2050. Reproduced from MDPI, analysis of the potential of Meeting the EU's Sustainable Aviation fuel Targets in 2030 and 2050. (2023) under the CC 4.0 Creative Commons License [18].

Feedstock Type	Theoretical Available 2030 (Mt)	Theoretical Available 2050 (Mt)	Actual Available (Mt)
Wate oils and fats	5.3	9.9	2.4
Organic fraction in MSW	44-80	33-61	21.2
Agricultural residual	45-65	65-71	87.7
Cover crops	36-108	42-127	87.7
Primary forest residual	41-68	45-75	5.1
Secondary forest residual	89-126	93-139	5.1

Furthermore, the UK has adopted a parallel framework through the Renewable Transport Fuel Obligations (SAF) Order 2024 which was effective at the start of 2025. The mandate requires SAF to make up 2% of the aviation fuel mix in 2025, increasing to 10% by 2030 and 22% by 2040 [16]. Specifically, this framework has a greater emphasis on reducing dependence on HEFA-based SAF, whose allowable share can decline from 100% in 2025 to 42% in 2040, with a dedicated sub-mandate for Power to Liquid SAF. This is depicted in Table 3 with the theoretical and actual available feedstocks predicted in the EU after the ReFuelEU imitative.

2.2 The Production Capacity Gap

The central challenge for SAF policy is a stark gap between mandated demand and available production capacity. Martulli et al. cited that despite the announced production capacity of 9.1 million tons per year globally by 2024, only 24% of the announced capacity as realized on time. Over 40% of the announced capacity intended for 2030 was also reported to face risks of delays or cancellations. In their study, they modeled SAF growth along the historically rapid scale up trajectory of solar and wind energy, the study projected that global and EU SAF capacity would fall short of respective 2030 targets by 42% and 18% [19]. This evidence suggests that mandated blending requirements cannot substitute for physical infrastructure investments that only time and capital can make.

SAF mandates are fundamentally supply-chain creation tools. By writing future demand into the law, they provide the market certainty needed to justify substantial capital investments to build commercia-scale SAF production facilities. The EU reinforced this signal through financial mechanisms. Specifically in 2024, the European commission set aside 20 million emissions allowances valued at approximately 1.5 billion Euros to support alternative fuel uptake [20].

The EU's ReFuelEU regulation also includes specific provisions which requires aircraft operators to refuel only with the necessary fuel for their flight. This practice of "tinkering" or deliberately carrying excess conventional fuel was targeted by the regulation to avoid purchasing SAF [17]. In the US, SAF policy operates primarily through tax incentives. For example, the Inflation Reduction Act's Section 45Z Clean Fuel Production Tax Credit provides up to $1.75 per gallon for SAF meeting prevailing wage requirements, with the credit generated by producers rather than blenders.

3. Emission-Based Standards: Carbon Intensity as a Policy Lever

3.1 The California Low Carbon Fuel Standard

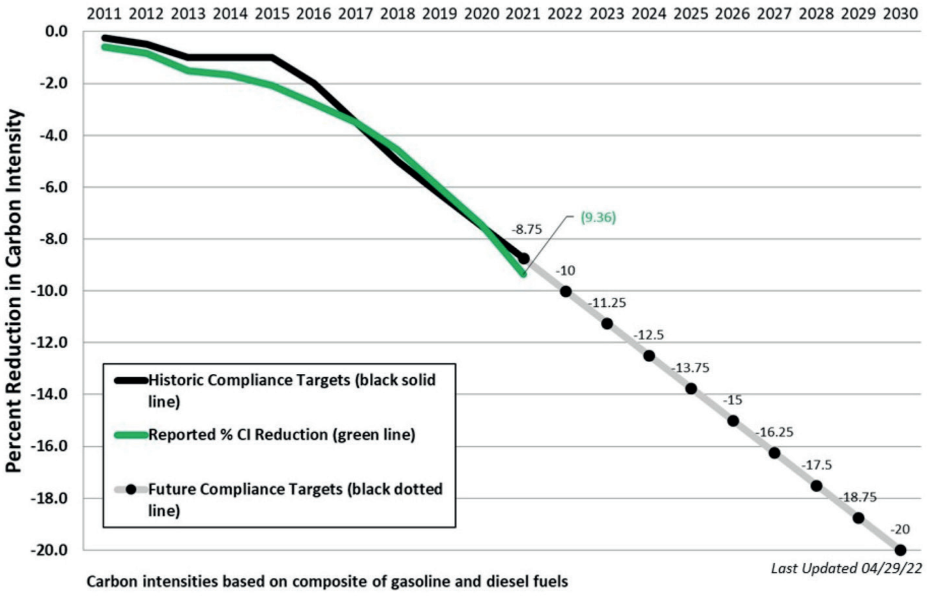

Figure 1: LCFS CI targets for 2011-2030. Reproduced from MDPI (2022), Life Cycle Assessment of Hydrogen Transportation Pathways via Pipelines and Truck Trailers: Implications as a Low Carbon Fuel under the CC 4.0 Creative Commons License [21].

While the RFS mandates specific volumes and blending shares, California's Low Carbon Fuel Standard (LCFS) has a different approach by setting declining carbon-intensity (CI) benchmarks. As shown in Figure 1, the comprehensive results of the CI reduction are reported annually with the targets showing promising results in CI reduction. This allows any fuel that beats the benchmark to generate tradable credits while fuel with higher CI generates deficit. Therefore, the performance based architecture is technology-neutral in principle, rewarding the cleanest fuels regardless of the source [22].

In a study by Axsen and Wolinetz on LCFS programs, they concluded that "low-carbon fuel standards have helped reduced GHG emissions, can effectively complement carbon pricing, and have received substantial public support in recent years," [23]. They further noted that California's LCFS was "developed as a reaction the US national biofuel blending mandate, which required usage of biofuels, but initially did not differentiate biofuels based on the carbon intensity of their different feedstocks and production methods". Therefore, this makes it a precision instrument designed to correct the blunt instrument failures of the RFS.

The most consequential change occurred in November 2024 when CARB approved amendments to establish a one-time 9% reduction in the CI benchmark from 2018 levels in 2025, reducing in a 22.75% CI reduction target, with an ultimate goal of 30% decarbonization by 2030 and 90% by 2045 [24]. Implementation was delayed to July 1, 2025, while CARB addressed procedural concerns, but the full 22.75% target took effect in Q3 2025, immediately shifting the credit surplus to deficit territory.

3.2 Fuel Formulation Consequences

The LCFS has produced measurable changes to California's fuel mix. By assigning each fuel pathway a lifecycle CI score that accounts for feedstock production, manufacturing, transportation,

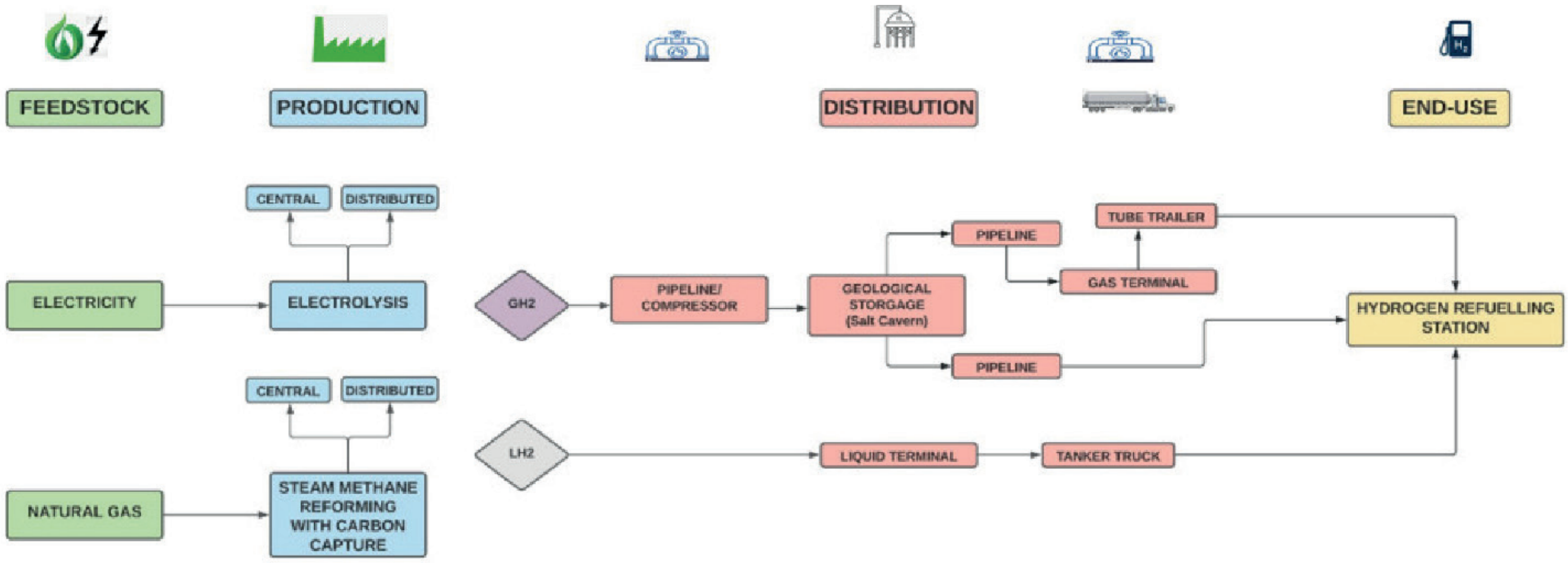

Figure 2: Supply chain network for analyzing cost of dispensed hydrogen at the station based on the pathway. Reproduced from MDPI (2021), Low Carbon Scenario Analysis of a Hydrogen-Based Energy Transition for On-Road Transportation in California under the CC 4.0 Creative Commons License [26].

and combustion, the program creates granular incentives for fuel producers to reduce emissions at every stage of the supply chain. Electricity and hydrogen for vehicles, renewable diesel, biomethane, ethanol, biodiesel, and alternative jet fuel all participate in the LCFS as low-CI alternatives [22].

The 2024 LCFS amendments introduced important structural changes affecting which fuels and feedstocks can generate credits. For instance, credits for hydrogen produced by fossil natural gas will be eliminated by January 1, 2035. The amendments also limit credits for biodiesel using virgin soybean and canola oil to 20% of annual production, pushing the industry toward waste-based feedstocks. Beginning with 2024 reports, all existing fuel pathways must transition to CARB's updated GREET 4.0 lifecycle accounting model [25].

Additionally, the LCFS has supported infrastructure development beyond liquid fuels. Since October 2024, 71 hydrogen refueling stations and 749 fast EV charger sites have been approved under LCFS infrastructure provisions [27]. This cycle is driven by the flow chart shown in Figure 2 where hydrogen refueling stations are the ultimate result of the policy's improvement. CARB projected that as consumers shift to lower CI-fuels and more efficient vehicles, fuel costs per mile will decrease by 42% in 2045, translating to more than $20 billion in annual fuel expenditure savings.

Moreover, in the study by Axsen and Wolinetz, they noted that while existing evidence shows that LCFS programs can reduce GHG emissions and can complement carbon pricing, there is "relatively little research on the contribution that an LCFS can make to a climate policy mix", including how it interacts with vehicle purchase subsidies, emissions, trading schemes, and fuel economy standards [23]. To add on, the LCF credit market, which hit a low in June 2025, rebounded sharply after OAL approved the amended regulations, reflecting confidence in future credit demand.

4. Policy Comparison and Interaction Effects

4.1 Volumetric vs Carbon-Intensity Approaches

The RFS and LCFS represent distinct policies of regulatory design. The RFS is a quantity mandate by requiring a specified number of renewable fuel gallons in the market, predictable volume demand standards, but they also have blunt incentives for carbon reduction in each compliance category. As the study by Lark et al. showed that, this bluntness can produce unreasonable outcomes where mandated volumes drive land conversion that erases putative climate benefits of biofuels produced [9]. On the other hand, the LCFS is a price-on carbon mechanism which rewards marginal reduction in carbon intensity which creates continuing incentives for fuel producers to seek lower CI feedstocks, production processes, and supply chain optimizations.

One practical illustration involves corn ethanol. Under the RFS, corn ethanol is a qualifying conventional biofuel with a compliance pathway. However, under the LCFS, the CI of corn ethanol varies significantly with the production facility depending on the energy source powering the distillery, whether the plant captures biogas, and the agricultural practices used to grow corn. Therefore, the LCFS creates incentives for ethanol producers to invest in carbon reduction within the corn ethanol category, while the RFS creates no marginal incentive when volume compliance is achieved. Gerveni et al study also shows that policy interaction confirms that both RFS and LCFS are functionally complementary where RFS drives volumes and LCFS drives quality within those volumes [3].

4.2 Interaction Effects and the Policy Stack

Although multiple overlapping policies apply to the same fuel or producer, interaction effects can produce unexpected outcomes. In Gerveni et al study, they identified the interconnected nature of biomass-based diesel as a "policy stack" dynamic that "cannot be fully understood one policy at a time". They noted that renewable diesel boom of 2021-2024 was not only driven by RFS in isolation but also through the interaction of RFS compliance needs, LCFS carbon-intensity targets, and the economics of renewable diesel as a drop-in replacement [3]. RFS volume obligations, 45Z tax credits, LCFS credits, and state-level incentives are all ways that can make the economic case for certain fuel pathways compelling at relatively high production costs but can also distort feedstock markets in ways that undermine sustainability goals.

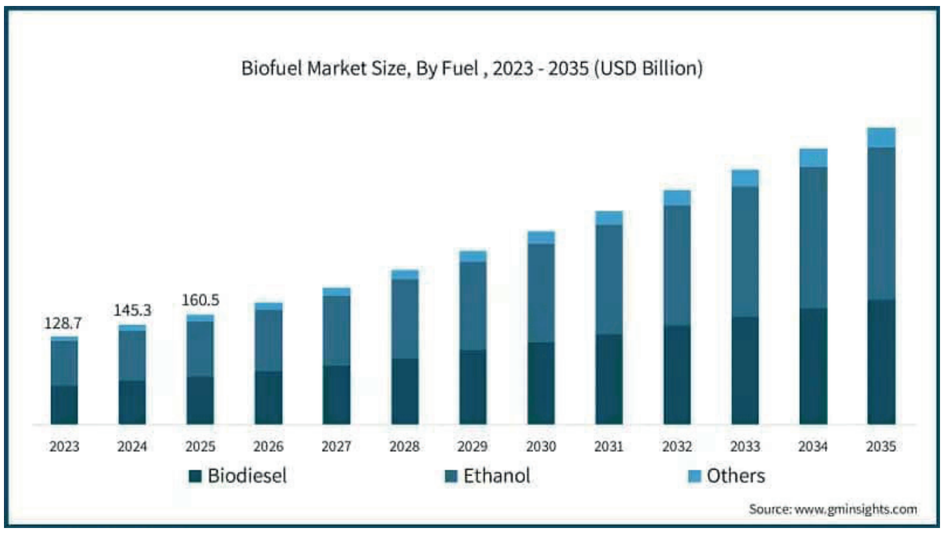

Figure 3: Biofuel Market Revenue Share, By Application 2025. Reproduced from Global Market Insights (2026), Biofuel Market Size under the CC 4.0 Creative Commons License [21].

As shown in Figure 3, the global biofuel market was estimated in 2025 at $160.5 billion and is expected to grow at a of CAGR of 10.3% through 2035, driven in part by "continuous and exponential mandates for decarbonization in transport," [28].While environmentally motivated, the growth requires careful monitoring to ensure that feedback sourcing does not undermine the lifecycle emission reductions that justify the mandates in the first place. This concern is directly supported by the PNAS findings on corn ethanol land use change.

Additionally, vehicle emissions standards also interact with fuel policy in ways that can either amplify or undermine renewable fuel demand. Growth energy has argued that the EPA's proposed tailpipe emission standards risk limiting the use of liquid biofuels and undermining growth in the bioeconomy by failing to credit fuel composition improvements in emission calculations [29]. Axsen and Wolinetz's study also proves that policy mixes cautions against siloed regulatory design, taking into account that overlapping climate policies for vehicle and fuels can produce conflicting incentives and redundances [23].

5. Critical Assessment: Achievements, Limitations, and Emerging Directions

5.1 What Policy has Achieved

The regulatory frameworks in this paper have all produced measurable results. For the RFS, a multi-billion-gallon renewable fuel market was created. In Iowa alone, the biofuels industry consumed nearly 60% of the 2024 corn crop and produced 4.61 billion gallons of fuel ethanol [10]. The SAF mandates have catalyzed investment commitments and technology development that was commercially reliable just a decade ago. The LCFS has successfully reduced the carbon intensity of California's transportation fuel pool, with the dramatic shift to net deficit territory in Q3 2025 confirming that the 2024 amendments are already reshaping the market [24].

5.2 Limitations and Unresolved Tensions

Despite these achievements, limitations remain. Lark et al. highlight that the most significant empirical challenge is the RFS' environmental rationale where lifecycle GHG emissions of corn ethanol produced to meet RFS mandates "are no less than those of gasoline, and are likely even greater when land use emissions are included" [9]. These findings suggest that profound advances in both technology and policy design that are needed to achieve the intended environmental benefits of biofuel production and use, that the volumetric mandates without robust lifecycle accounting are insufficient.

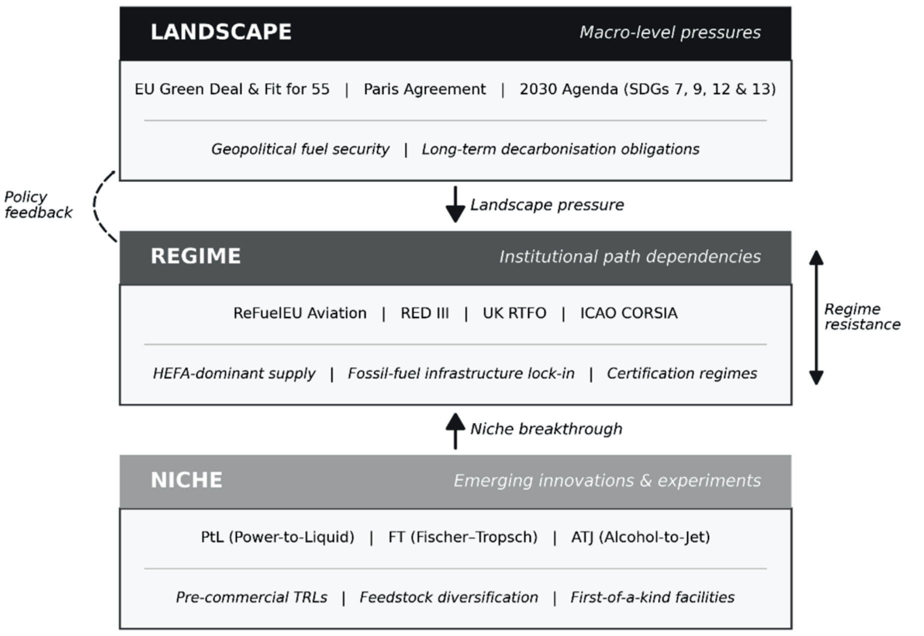

Figure 4: Multi-Level Perspective Framework for the SAF industry in Europe to 2050. Reproduced from MDPI (2026), Policy Misalignment and Systemic Barriers to Sustainable Aviation Fuel Deployment in Europe: An MLP-Informed Stakeholder Analysis under the CC 4.0 Creative Commons License [30].

Moreover, the SAF policy landscape has a stark gap between ambition and current trajectory. In Figure 4, the projected framework for the SAF industry in Europe is displayed. However, the gap between the current trajectory has been remarked on by Lark et al. The study quantified this gap where a scale-up scenario analysis showed that global SAF capacity would fall short of 2030 policy target by 42% [19]. This evidence underscores that the mandate can only drive production scale-up if regulatory certainty persists long enough to justify the capital investment cycles involved, and if complementary support mechanisms de-risk production facilities.

5.3 The Role of Political Continuity

Regulatory effectiveness depends critically on the continuity of the policy implementation. The RFS has been subject to significant volatility through the SRE granting process [11]. In the SAF domain, Climate Catalyst noted that while Refuel EU Aviation entered in force in 2025, the political environment has grown challenging with more right-leaning parties gaining seats in European Parliament, shifting policy priorities away from Green Deal implementation [31].

Additionally, the biofuels sectors have repeatedly demonstrated extreme sensitivity to policy decisions. CoBank's analysis at the end of 2024 identified resolution of the 45Z Clean Fuel Production Tax Credit parameters as "a major driver of expanded biofuel production with lower emissions" [29]. With the study by Axsen and Wolinetz, they concluded that a well-designed LCFS would be an efficient complement to carbon pricing, but only if its trajectory is credible and stable enough to warrant capital investments of refuel pathway development.

Conclusion and Future Outlook

The Renewable Fuel Standard, Sustainable Aviation fuel mandates, and carbon-intensity based standards are complementary approaches using regulatory authority to reshape the fuel in vehicles, aircrafts, and ships. Each one demonstrates capacity to alter fuel formulation and redirect investment capital which changes the supply chain developments at both the small and large scale. Each also has revealed limitations of its own design logics: volumetric mandates that drive land conversion undermine their own climate rationale. Blending requirements race ahead or production capacity, and carbon-intensity benchmarks can create credit surpluses when stringency falls below market reality.

The gap between policy ambition and physical reality is an ongoing issue that remains central to fuel policy. Bridging this gap requires complementary technology investment, infrastructure development, and stable mandates that can ensure the lifecycle of emission reductions.

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Biographies

Dr Raj Shah is director at Koehler Instrument Company in New York, where he has worked for over 25 years. He is an elected Fellow or Chartered professional with numerous organisations, including ASTM, IChemE, STLE, NLGI, the Energy Institute, the Royal Society of Chemistry, and the Chartered Management Institute, among others, and is an ASTM Eagle Award recipient. He coedited the bestseller Fuels and Lubricants Handbook and holds a PhD in Chemical Engineering from Penn State. Dr Shah is an adjunct professor in materials science and chemical engineering at Stony Brook University, serves on multiple academic advisory boards, and has authored over 725 publications during more than three decades in the energy industry.

Natalie Ma

Ms Natalie Ma is an undergraduate student studying chemical engineering and economics at Barnard College of Columbia University. She is also a research intern at Koehler Instrument Company in Holtzville, NY where she researches petroleum and fuel related topics.

Author Contact Details

Dr. Raj Shah, Koehler Instrument Company

- Holtsville, NY11742 USA
- **Email: rshah@koehlerinstrument.com**
- **Web: www.koehlerinstrument.com**