

RESEARCH NOTE

HVO/RENEWABLE DIESEL CAPACITY BUILDOUT

April 2026

EXECUTIVE SUMMARY

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Global hydrotreated vegetable oil (HVO) capacity is undergoing a structural expansion, with installed production reaching approximately 12 million metric tons annually as of 2026, up from 3 million metric tons in 2020. This buildout is driven by increasingly stringent EU and UK renewable fuel mandates, tightening carbon accounting frameworks, and the superior economics of HVO over conventional biodiesel (FAME) co-processing retrofits. However, feedstock availability—particularly used cooking oil (UCO), tallow, and palm fatty acid distillate (PFAD)—remains the binding constraint on aggregate supply, with global "waste" feedstock availability capped at 30-40 million tonnes per year against potential demand from HVO, sustainable aviation fuel (SAF), and emerging bio-intermediate applications. This supply-demand imbalance will shape producer economics, feedstock competition intensity, and co-product dynamics through 2027.

Market Context: The HVO Expansion Wave

The hydrotreated vegetable oil market has entered a phase of rapid capacity expansion unmatched in the biofuels sector outside of conventional ethanol. This buildout is not driven by technological innovation—HVO production technology has been mature since the early 2000s—but rather by a fundamental policy shift favoring HVO over conventional FAME (fatty acid methyl esters) biodiesel. The EU's Fuel Quality Directive, coupled with carbon intensity accounting under the Fuel Quality Monitoring Mechanism, has created a pricing advantage for HVO that generates a 10-15% margin premium over FAME biodiesel on a feedstock-neutral basis.

The policy foundation is dual-layered. First, EU mandates for renewable energy in transport fuel (10% by 2025, pathway to 14% by 2030) are being fulfilled predominantly through HVO rather than FAME, as HVO's lower carbon intensity (60-80 gCO₂e per megajoule, depending on feedstock and methodology) displaces FAME's weaker profile. Second, the EU's RED III directive, effective January 2025, imposes stricter sustainability criteria on feedstocks and creates a de facto preference for "waste and residual" feedstocks over virgin vegetable oils. This regulatory architecture has triggered a \$50+ billion capital deployment cycle globally, with major producers expanding existing facilities or constructing greenfield refineries.

The competitive pressure extends beyond Europe. North America's renewable diesel market, currently representing over 60% of global HVO production capacity, is driven by the U.S. Internal Revenue Code Section 45Z (Clean Fuel Production Credit), which provides a volumetric subsidy for low-carbon fuels. Early-2025 guidance disqualifying imported feedstocks from 45Z credit eligibility is reshaping global

feedstock flows and accelerating domestic feedstock cultivation, though the market remains undersupplied relative to expansion targets.

Supply-Side Capacity: Regional Mapping and Producer Positioning

The global HVO capacity landscape is dominated by integrated oil majors and specialized biofuels producers who have deployed retrofitted co-processing assets at existing hydrotreatment facilities. **Neste leads installed capacity**, with total renewable fuel production reaching 6.8 million metric tons per year by 2027, including its expanded Rotterdam facility capable of 1.2 million tonnes annually. This positions Neste as a swing producer capable of allocating feedstock between HVO and SAF depending on crack spread economics.

Europe accounts for approximately 50% of global HVO consumption but has more constrained capacity expansion potential than North America or Asia due to existing hydrotreatment infrastructure saturation. Key European producers include Preem (Sweden), Repsol (Spain, undergoing 200,000 tonne/year expansion), TotalEnergies (France and other sites), and Eni (Italy, with flexible HVO/SAF co-processing). Expansions by these players are focused on higher-margin SAF co-production or feedstock diversification rather than pure-play HVO volume growth.

North America remains the dominant HVO production base, accounting for 60% of global capacity as of 2024. This reflects the abundant availability of tallow (animal fats) in beef-producing regions and the economics of retrofitting existing U.S. refinery capacity. Phillips 66, Marathon Petroleum, and smaller independent refiners operate the majority of this capacity, with utilization rates typically ranging 85-95%, constrained principally by feedstock availability rather than reactor throughput.

Asia-Pacific is emerging as the fastest-growing regional hub. China has become a net exporter of HVO, leveraging low-cost tallow and UCO sourcing and targeting Southeast Asian and Australian markets. Japan and South Korea are deploying HVO capacity for marine fuel applications and domestic transport mandates, while India's biofuels sector—focused primarily on conventional biodiesel—is gradually shifting marginal capacity toward HVO as economics favor it. Capacity growth in Asia is projected at 13.5-15% compound annual rates through 2026, substantially exceeding the 5-8% growth rates in North America and Europe.

By geographic region, estimated HVO capacity buildout through end-2026 follows this trajectory: North America adds 0.8-1.2 million tonnes net (reaching 7.2-7.6 million tonnes total), Europe adds 0.6-0.9 million tonnes (reaching 5.0-5.3 million tonnes), and Asia-Pacific adds 1.2-1.8 million tonnes (reaching 2.5-3.0 million tonnes). This totals approximately 15-16 million tonnes of global capacity by end-2026, with the gap between capacity and likely demand (driven by mandates) widening to 20-30% by 2030.

The HVO capacity buildout reflects a permanent structural shift from conventional biodiesel toward renewable diesel. Producers locking in feedstock supply contracts—particularly for UCO and tallow at contracted prices—will dominate the economics of this expansion phase; spot-dependent players face margin compression as feedstock premiums widen.

Demand-Side Drivers: Regulatory Mandates and Offtake Mechanics

HVO demand growth is almost entirely policy-driven, with regulatory mandates creating a synthetic floor under offtake. The EU's transport fuel mandate (RED III, 10% renewable energy content by 2025, rising to 14% by 2030) represents approximately 18-20 million tonnes of biofuels demand annually, of which

HVO is capturing 35-45% (or 6-9 million tonnes). UK post-Brexit targets of 12.2% renewable fuel content by 2030 add a separate 0.8-1.0 million tonnes of demand. U.S. Section 45Z eligibility, despite the imported feedstock disqualification, continues to support domestic HVO production for blend-down into conventional diesel, with volumes estimated at 2-3 million tonnes annually.

The mandates operate through a blend-down mechanism: refineries are required to achieve a specified percentage of renewable energy content in their fuel pools, which they satisfy by purchasing and blending HVO into fossil diesel. This creates a compliance-driven demand that is largely insensitive to HVO/fossil diesel price spreads in the short term, though extremely sensitive to policy reversal. The risk of mandate suspension or relaxation, particularly in the European context where cost-of-living pressures are high, represents a tail risk to demand stability.

A secondary demand driver is emerging: sustainable aviation fuel (SAF) co-processing. Producers such as Neste, TotalEnergies, and Eni are configuring their HVO units to produce both HVO and SAF flexibly, with SAF commanding a significant margin premium (currently 50-100% above HVO in most markets). The EU SAF mandate (starting at 2% of aviation fuel in January 2025, rising to 70% by 2050) is pushing SAF volumes rapidly: global SAF production climbed from 22,700 barrels per day in 2024 to 43,100 b/d in 2025 and is projected to reach 54,400 b/d in 2026. However, the SAF-HVO trade-off is asymmetric: given SAF's higher value, producers will prioritize SAF production whenever feedstock scarcity forces a choice, creating a structural headwind for HVO volume offtake in an undersupplied feedstock environment.

The Feedstock Constraint: UCO, Tallow, PFAD, and Cross-Sectoral Competition

Despite the aggressive HVO capacity buildout, global feedstock supply remains the binding constraint on volume growth. Total "waste and residual" lipid feedstock availability—comprising used cooking oil, tallow, and palm fatty acid distillate—is estimated at 30-40 million tonnes per year globally. Against this supply ceiling, demand is bifurcating across competing applications: HVO, SAF, emerging bio-intermediate synthesis (bio-epichlorohydrin, propylene glycol), and conventional biodiesel (FAME), each competing aggressively for marginal supply.

Used cooking oil (UCO) remains the preferred feedstock for low-carbon-intensity HVO production. However, UCO supply is structurally constrained by global food consumption patterns and collection infrastructure. Major sourcing regions include the European Union (estimated collection of 0.8-1.0 million tonnes annually), Southeast Asia (Malaysia, Indonesia, Thailand: 1.0-1.2 million tonnes), and North America (0.6-0.8 million tonnes). China has become the dominant supplier of UCO to U.S. markets, with 2.8 billion pounds imported in 2024 (approximately 1.3 million tonnes), but U.S. policy shifts disqualifying imported feedstocks from 45Z credits are reshaping these flows. The January 2025 implementation of Section 45Z credit eligibility rules triggered a sharp reduction in U.S. UCO imports, with volumes plummeting in April 2025 as importers re-evaluated supply strategies.

Tallow (beef and sheep fat) provides a more elastic feedstock base, as it is a byproduct of meat processing and supply scales with livestock production. Global tallow availability is approximately 8-10 million tonnes annually, though only 4-6 million tonnes is typically directed toward biofuels due to competing uses in feed, chemicals, and cosmetics. Tallow's carbon intensity is superior to UCO under EU carbon accounting frameworks (60-65 gCO_{2e} per megajoule versus 70-80 for UCO, depending on feedstock provenance), creating competitive advantages for tallow-based HVO in regulated markets. However, tallow supply is geographically distributed (Australia, Brazil, U.S. Great Plains, European rendering centers) with logistical costs that limit arbitrage opportunities.

Palm fatty acid distillate (PFAD), derived from palm oil refining, provides a residual feedstock opportunity that regulators have begun recognizing under RED III eligibility criteria. Global PFAD availability is estimated at 3-5 million tonnes annually, with the bulk produced in Indonesia and Malaysia. However, regulatory uncertainty surrounding palm-based feedstocks (due to deforestation concerns and EU policy sensitivities) has constrained PFAD deployment in European HVO production. Conversely, PFAD is gaining traction in Asian and North American HVO units as a cost-effective, high-availability feedstock.

Cross-sectoral competition is intensifying. The SAF mandate's rapid growth is capturing the highest-quality UCO volumes (particularly "advanced" UCO with verified low-carbon-intensity provenance), leaving lower-quality, higher-cost feedstock streams for conventional HVO production. Emerging bio-intermediate applications—if they commercialize at scale—would further fragment feedstock availability. Conventional biodiesel (FAME) production, though declining as a policy priority in Europe, continues in North America and Southeast Asia, competing for the same tallow and vegetable oil pools. The convergence of these demands is tightening feedstock spreads and pushing HVO producers into lower-value, less-efficient feedstock substitutes (vegetable oil versus waste oils) or geographic arbitrage strategies that increase logistical costs.

Feedstock	Est. Global Supply (MT/yr)	Key Regions	Carbon Intensity (gCO _{2e} /MJ)
Used Cooking Oil (UCO)	4.5-5.5 MT	EU, Southeast Asia, North America	70-80
Tallow	4.0-6.0 MT	Australia, Brazil, North America, Europe	60-65
PFAD	3.0-5.0 MT	Indonesia, Malaysia	75-90
Vegetable Oil (virgin, if used)	~2.0 MT	Southeast Asia, South America	80-100
Total Available ("Waste")	~12.0-18.0 MT	Global	Blended

Glycerin Dynamics: HVO's Absence and Implications for Biodiesel Markets

A critical distinction separates HVO production from conventional biodiesel (FAME). Biodiesel is produced through transesterification of vegetable oils or fats with methanol, yielding both fatty acid methyl esters (FAME) and glycerin as co-products in a roughly 10:1 ratio (10 tonnes biodiesel yields 1 tonne crude glycerin). HVO, by contrast, employs hydrotreating—a heterogeneous catalytic process that converts triglycerides directly to paraffinic hydrocarbons without producing glycerin. This structural difference has profound implications for global glycerin supply and market structure.

As HVO displaces FAME in regulatory compliance hierarchies, the global glycerin supply pool contracts. The glycerin market, valued at approximately 5.0 million tonnes in 2026 and growing at 4-5% compound annually, derives roughly 60-70% of its supply from biodiesel co-production. The remaining 30-40% comes from chemical synthesis, glycerol esterification, and recycled/recovered streams. India's biodiesel sector exemplifies the dynamic: biodiesel output jumped 60% between 2024 and 2025, yet overall feedstock utilization rose only to 59.8%, indicating that feedstock availability—not reactor capacity—

constrains incremental glycerin volumes. This suggests that as HVO mandates absorb marginal feedstock availability, biodiesel production will plateau or decline, directly suppressing global glycerin supply.

The refined glycerin market is already beginning to reflect this supply tightness. Pharmaceutical and personal care applications—which require USP or FCC grade glycerin (99%+ purity)—are experiencing tighter supply and rising premiums (40-50% above crude glycerin pricing currently, likely to widen to 50-70% by end-2026). Crude glycerin, the biodiesel co-product, faces downward pressure from oversupply in commodity chemical applications, compressing the margin structure for marginal biodiesel producers. This bifurcation—refined glycerin scarcity paired with crude glycerin commodity weakness—creates an arbitrage opportunity for refined glycerin producers and an economic headwind for marginal biodiesel players, accelerating FAME-to-HVO substitution.

For Tornavia Trading's glycerin desk, the HVO expansion represents a strategic inflection point. The supply tightness in refined glycerin (driven by HVO displacement of FAME) is creating a durably higher-margin environment for specialty-grade material, particularly if emerging applications (bio-epichlorohydrin, propylene glycol synthesis) gain traction. Conversely, crude glycerin pricing is vulnerable to oversupply shocks if biodiesel mandates are relaxed or suspended, a tail risk that warrants monitoring.

SAF Co-Processing and Feedstock Allocation Dynamics

The rapid scaling of sustainable aviation fuel production is creating a secondary demand vector that is reshaping feedstock allocation within HVO producers. Unlike captive HVO facilities (designed for diesel output exclusively), leading producers including Neste, TotalEnergies, Eni, and MOL Group have invested in flexible co-processing units capable of producing both HVO and SAF from the same feedstock input stream, with output proportions determined by market crack spreads and regulatory incentives.

SAF currently commands a price premium of 50-100% above HVO on a volumetric basis, reflecting the nascent stage of the SAF market and the higher specifications required for aviation fuel. This premium creates a powerful incentive for producers to allocate feedstock toward SAF whenever constraints bind. In a feedstock-undersupplied environment (which the market already exhibits), producers facing a binary choice between HVO and SAF offtake will systematically prioritize SAF, creating a structural headwind for HVO volume growth and upward pressure on HVO pricing to compensate for constrained input supplies.

The dynamic is already visible in producer guidance. TotalEnergies has announced significant SAF capacity expansion (230,000 tonnes per year by 2026) and has begun reducing HVO-specific guidance in favor of flexible renewable fuel capacity. Neste, with the largest renewable fuel production base, has explicitly stated that SAF will absorb a greater share of marginal feedstock in a tight market environment. This signals that HVO volume growth expectations embedded in current industry consensus may prove optimistic, particularly if SAF demand accelerates faster than expected under EU and UK mandates.

The MOL Group's recent successful co-processing trial at its Slovnaft refinery (producing HVO from cashew nut shell oil and UCO in parallel with SAF production) exemplifies the technical flexibility that major producers are now deploying. This flexibility will likely become the norm rather than the exception among large integrated producers, creating a more dynamic—and potentially more volatile—demand pattern for HVO as producers shift output allocation in response to margin signals.

Forward Outlook: 3-6 Month and 12-Month Scenarios

Near-Term (Q2-Q3 2026): HVO capacity continues to ramp into service, with an estimated 0.4-0.6 million tonnes of new capacity reaching nameplate by mid-2026. This supply growth will likely outpace

demand growth (driven by seasonal normalization after winter heating demands and marginal mandate fulfillment). HVO crack spreads (the margin between HVO output value and feedstock input cost) will likely compress modestly, in the range of 5-10%, as marginal capacity comes online and feedstock competition intensifies. Feedstock prices—particularly UCO and tallow—will remain elevated relative to virgin vegetable oil, reflecting scarcity value. The SAF market will continue pulling the highest-quality UCO feedstock, leaving lower-specification waste oils for HVO producers.

Medium-Term (Q4 2026-Q2 2027): The structural supply-demand imbalance for feedstocks will become increasingly apparent. HVO capacity utilization will begin declining below current 85-95% levels as available feedstock cannot support full-nameplate operation across the global fleet. Spot HVO pricing will likely increase in absolute terms as the blend-down premium (the price uplift from regulatory compliance value) gains prominence over commodity crack spread dynamics. Producers will increasingly shift to contract-based feedstock procurement, reducing spot market liquidity and pushing price discovery further into illiquid forward markets. The SAF market's rapid growth will accelerate feedstock allocation away from HVO, particularly among flexible co-processors. This creates a bifurcated market: producers with long-term feedstock supply contracts will maintain margins and volumes, while spot-dependent players will face margin compression and sub-optimal capacity utilization.

Over a 12-month horizon through Q2 2027, the most likely outcome is a modest HVO supply growth (reaching 14.5-15.5 million tonnes aggregate capacity) paired with slower-than-expected volume growth due to feedstock constraints. Global HVO production volumes are likely to reach 11-12 million tonnes in 2026, implying utilization of 75-80% of installed capacity. The feedstock constraint will persist, keeping UCO and tallow pricing elevated relative to historical averages and maintaining the crude-to-refined glycerin spread at elevated levels. Regulatory policy remains the dominant uncertainty: any material rollback of EU RED III or UK SAF mandates would collapse demand and trigger significant HVO producer margin compression; conversely, acceleration of regulatory mandates (particularly in Asia, where China and India are discussing broader renewable fuel adoption) would intensify feedstock competition and support elevated HVO pricing.

Key Risks and Watch Items

The primary exogenous risk to the HVO capacity expansion thesis is policy reversal. The EU's renewable fuel mandates, while politically durable due to climate commitments, remain vulnerable to cost-of-living pressures that could trigger mandate suspension or relaxation, particularly if crude oil prices spike and renewable fuel blends increase consumer fuel costs. Monitoring EU political discourse around fuel affordability and agricultural lobbying (which prefers conventional biodiesel to HVO due to higher feedstock demand) is essential. A material mandate reduction would collapse HVO demand pricing, likely triggering forced margin compression and potential idling of marginal production capacity.

Second, feedstock geopolitical risks warrant close attention. Indonesian and Malaysian PFAD exports face potential disruption from regulatory tightening on palm-based feedstocks or physical supply shocks from El Niño weather patterns. Chinese tallow and UCO sourcing could be disrupted by tariffs or trade tensions. South American soy and beef tallow supplies are vulnerable to drought or political instability. Any region-specific feedstock supply shock would trigger arbitrage dynamics and potentially force producers into less-efficient feedstock substitution, compressing margins and potentially triggering HVO production deferrals.

Third, the SAF market's trajectory is a key variable. If SAF demand growth decelerates due to slower-than-expected air travel demand recovery, high SAF pricing relative to fossil fuels, or regulatory relief for aviation, flexible co-processors will revert to HVO-dominant production, potentially easing feedstock competition and supporting HVO volumes. Conversely, if SAF demand accelerates beyond current

expectations (driven by airline decarbonization commitments or aggressive policy mandates), SAF will absorb marginal feedstock at the expense of HVO, compressing HVO volume growth and supporting HVO pricing.

Fourth, Chinese HVO export growth represents a structural competitive threat. China's abundant low-cost tallow sourcing and high capacity utilization are enabling competitive pricing that could displace European and North American HVO in regional markets, compressing producer margins in mature markets. This would incentivize consolidation and capacity rationalization, particularly among smaller independent HVO producers in Europe and North America.

The HVO capacity buildout appears architecturally sound—feedstock availability and regulatory mandates justify the investment cycle. However, the speed of capacity realization is decoupling from the pace of demand growth, creating a 20-30% structural oversupply by 2030. Producers optimizing for margin rather than volume, securing long-term feedstock contracts, and positioning for flexible SAF co-production will outperform commodity-oriented peers.

Finally, emerging glycerin supply disruptions merit monitoring. If biodiesel production declines faster than expected due to HVO displacement, refined glycerin supply could tighten more rapidly than currently priced, creating margin expansion opportunities for specialty-grade players. Conversely, if bio-intermediate applications (particularly bio-epichlorohydrin and propylene glycol) fail to commercialize at scale, refined glycerin demand will remain constrained, and pricing will default to commodity crude glycerin dynamics.

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