

SAF Global Development Assessment

From project announcements to financeable supply

What 455 commercial-scale SAF projects reveal about progress toward scaling SAF supply



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Cover image: NASA



Vansam Advisory

Vansam Advisory works with sustainable aviation fuel (SAF) producers, project developers and the institutions that finance them. We assess whether a project's production advantage can translate into value for customers and investors. We start with the target market, airline requirements and the evidence needed to attract financing. Our work combines chemical engineering, technology development, producer commercialization and airline fuel procurement. We assess volume, delivery point, price and contract timing together. This report applies that approach to the global SAF project record, examining progress from announcements through construction, first production and recurring commercial supply.

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Executive summary

The assessment covers 455 commercial-scale sustainable aviation fuel (SAF) projects. By September 2026, 80 projects (17%) had secured a final investment decision (FID), were under construction, or were operating at commercial scale. Of those 80, 45 were operating. Of the 45 operating projects, 42 had public evidence of a first SAF batch; 26 of those 42 also had evidence of recurring commercial SAF supply.

Five key insights from the assessment

1. Most assessed projects remained before FID or were inactive. Of the 455 projects assessed in September 2026, 294 (65%) remained in development before FID, 80 (17%) had secured FID, were under construction or were operating, and 81 (18%) were inactive. Inactive includes canceled, paused and decommissioned projects, as well as projects without recent public updates. The assessed total was 455 in both June and September, while the number at secured FID, under construction or operating was 79 in June and 80 in September.

2. Recurring commercial SAF supply was documented for 26 operating projects. Of the 45 operating projects, 42 had public evidence of a first SAF batch. Of those 42, 26 also had evidence of recurring commercial supply; the remaining 16 had no public evidence of recurring commercial SAF supply. Producers may switch between SAF and renewable diesel, so this test does not require continuous SAF production.

3. Asia-Pacific accounted for the largest share of projects at secured FID, under construction or operating. Asia-Pacific (APAC) accounts for 37 of the global 80 projects at these stages (46%), including 20 in China. Europe accounts for 28 (35%) and North America for 9 (11%). North America also has 40 inactive projects among its 118 assessed projects (34%).

4. Hydroprocessed esters and fatty acids (HEFA) accounted for most projects at secured FID, under construction or operating. HEFA accounted for 71 of the 80 projects at these stages. Within each pathway group, 71 of 189 HEFA projects (38%) had reached these stages, compared with 3 of 132 alcohol-to-jet (ATJ) and Fischer-Tropsch (FT) projects (2%). The corresponding figures were 4 of 78 electro-SAF (eSAF) projects using power-to-liquid (PtL) technology (5%) and 2 of 56 projects using other pathways (4%). Projects with public evidence of recurring commercial SAF supply are also concentrated in HEFA.

5. Europe's SAF mandates have been accompanied by uneven progress across pathways. Of Europe's 48 HEFA projects, 26 (54%) had secured FID, were under construction, or were operating. None of its 51 eSAF/PtL projects had reached those stages. The comparison suggests that mandates alone are insufficient: projects also need viable economics, execution readiness and commercial arrangements that can attract financing.

Across the markets examined, domestic demand and resource abundance alone do not explain project progress. Projects also need viable production economics, infrastructure, customers and financing.

The 2025 supply statistics show why feedstock origin and fuel production location must be considered separately. China-origin used cooking oil accounted for 79% of certified SAF volume in the United Kingdom (UK). China-origin feedstock accounted for 61% of SAF supplied in the European Union (EU), although most SAF supplied there was refined within the EU.

Implications for decision makers

For project developers and SAF producers, financing depends on a credible plan to obtain feedstock, build the facility and supply customers. Commercial agreements need to support revenues that cover production and supply costs, while allocating risks among the parties.

For investors and lenders, project announcements and design capacity provide only part of the picture. Secured FID, financial close, construction, a first SAF batch and recurring commercial supply each provide different evidence of progress.

For airlines and other buyers, mandates create demand for SAF. Buyer agreements can help projects attract financing when they provide dependable revenue and allocate risks clearly between producers, buyers and capital providers.

For policymakers, the useful test is whether support helps projects manage price, contracted volume, construction and technology risks well enough to attract financing.

How to read this assessment

Secured FID means a final investment decision is supported by public evidence, such as a sponsor announcement, regulatory filing or direct confirmation from project leadership.

Co-processing means producing SAF within an existing conventional refinery. Nameplate capacity is a project's stated design capacity. Product slate allocation describes how a plant divides production between SAF and other fuels.

Producer netback is revenue after delivery costs. A take-or-pay agreement requires payment for a contracted quantity even if the buyer does not take that quantity of fuel.

Commercial operation date (COD) is the date commercial production begins. A non-binding letter of intent records an intention to transact; it does not establish a binding offtake commitment.

Projects remain before FID until public evidence establishes a final investment decision. This category includes initial scoping, feasibility studies, permitting, work before front-end engineering design (FEED), known as pre-FEED, front-end loading (FEL), including FEL 1, FEL 2 and FEL 3, and other engineering work. Preliminary financing and site preparation can also occur before FID.

The combined group at secured FID, under construction or operating includes projects that have reached at least one of those milestones. Operating at commercial scale describes plant status; a plant may be producing renewable diesel during a period when it is capable of making SAF.

Recurring commercial supply requires public evidence of repeated SAF supply after a first production batch. Inactive includes canceled, paused, decommissioned projects and projects without recent public updates.

FID, financial close, construction start and commercial operation are separate milestones. A financing agreement alone does not establish that FID has been secured.

Facility-level counting standard. Project counts measure distinct facilities. SAF production and supply volumes are assessed separately.

Volumetric conversions and conventions. Liquid volumes are reported in US gallons, using 3.785 liters per gallon to convert metric source figures. EU figures reported by mass use an assumed jet-fuel density of 0.80 kg/L, so the gallon equivalents are approximate. Percentages are calculated from exact counts and rounded to whole numbers, with halves rounded up. Stage-distribution shares (early stage; secured FID, under construction or operating; inactive) use whole-number rounding that preserves a 100% total in each view. Other shares may not sum to 100%.

Abbreviation reference: SAF (sustainable aviation fuel); FID (final investment decision); FEED (front-end engineering design); HEFA (hydroprocessed esters and fatty acids); HVO/RD (hydrotreated vegetable oil / renewable diesel); ATJ (alcohol-to-jet); FT (Fischer-Tropsch); PtL/eSAF (power-to-liquid / synthetic electro-SAF); UCO (used cooking oil); FOAK (first-of-a-kind commercial asset); DFI (development finance institution); DfT (UK Department for Transport); ReFuelEU (European Union aviation decarbonization mandate framework).

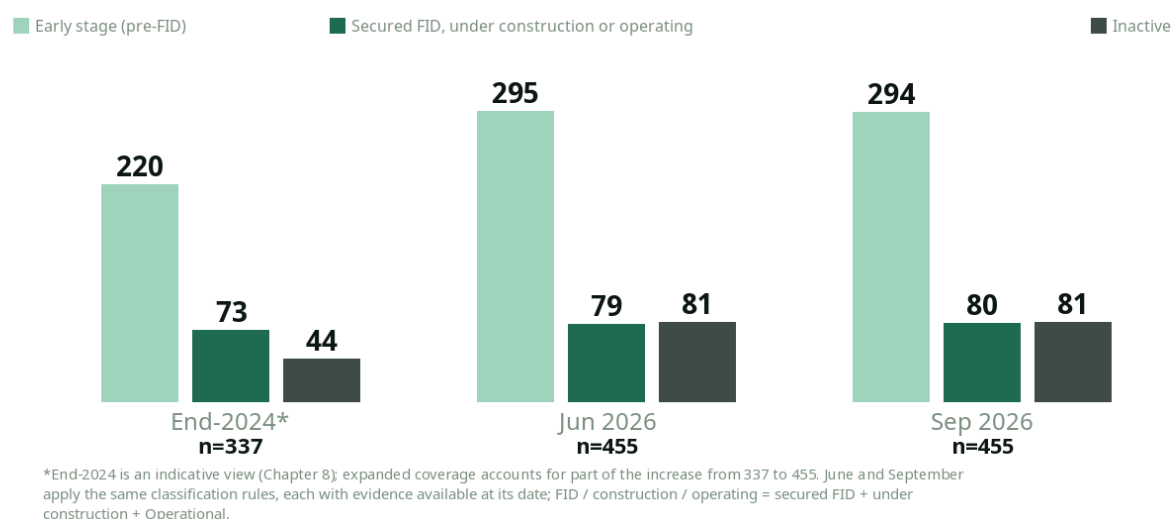
CHAPTER 1

The 2026 SAF Development Outlook

The assessment includes 337 commercial-scale SAF projects in the indicative end-2024 view and 455 in both June and September 2026. Exhibit 1.1 shows how those projects were distributed across development stages.

EXHIBIT 1.1

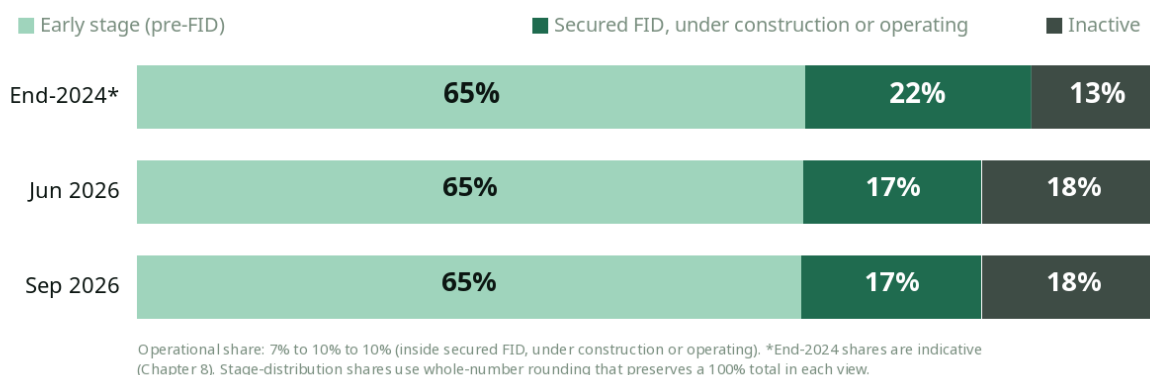
The assessed project count rose from 337 to 455; projects at FID, construction or operation numbered 79 in June 2026 and 80 in September.



Most projects remained before FID: 220 in the indicative end-2024 view, 295 in June 2026 and 294 in September. The number at secured FID, under construction or operating at commercial scale was 73, 79 and 80, respectively. The assessed total grew from 337 to 455 partly because database coverage expanded. The end-2024 comparison shows differences across the published views; it does not follow an identical set of projects. The assessed total was 455 in both June and September. With Phelan Green Group's secured FID, the combined count was 79 in June and 80 in September.

EXHIBIT 1.2

Most projects remained at early, pre-FID stages even as the assessed project count increased.



Early-stage projects represented about two-thirds of all assessed projects across the three views. The share at secured FID, under construction or operating was 22% in the indicative end-2024 view and 17% in both June and September 2026. The inactive share was 13% at end-2024 and 18% in both 2026 views. The early-stage share was 65% in both 2026 views. The stage counts provide the starting point for examining SAF supply, pathway progress and regional differences.

EXHIBIT 1.3

Project counts across three dated views.

OBSERVATION	COUNT	STATUS
31 Dec 2024	337 commercial	Indicative end-2024 view
Year-end 2025	-	No comparable project count
June 2026	455 commercial	Comparable dated view
29 Sep 2026	455 commercial	Comparable dated view

Capacity or consumption series dated in 2025 are not substitutes for a project-count observation. Interval ~21 months.

Source / Note. The series runs from end-2024 to 29 September 2026, approximately 21 months. Vansam does not have a comparable commercial-scale project count for year-end 2025, so 2025 capacity or consumption data are not used as a substitute.

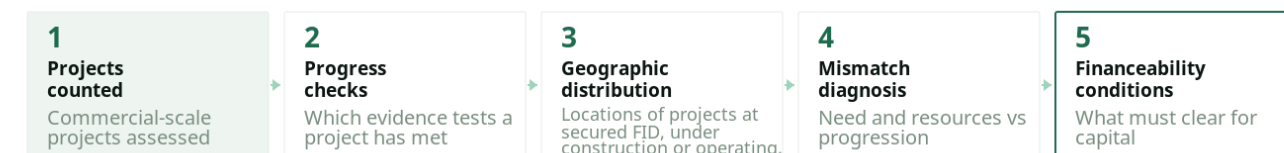
CHAPTER 2

How Vansam Assesses Project Progress

Vansam assesses project progress using public evidence of secured FID, construction, operation and SAF supply. The assessment examines what each commercial-scale project has demonstrated, how progress differs by region and pathway, and which conditions appear to help projects attract financing. The report distinguishes project observations, facts from external sources, Vansam's interpretation and questions that the evidence cannot answer. Project counts establish status and location. Explaining sponsor motives or whether a policy makes a project financeable requires additional evidence.

EXHIBIT 2.1

From the project pipeline to evidence that can support a decision.



A sharper way to read the market: start from projects counted, raise the commercial bar, locate progress, diagnose mismatches, then test financeability.

What the Evidence Shows

How is SAF project development changing?

The assessed project count increased between the indicative end-2024 and June 2026 views, then remained unchanged in September. Asia-Pacific accounted for a larger share of projects at secured FID, under construction or operating. North America contained a large share of the projects classified as inactive. These patterns show why the total count needs to be read alongside project stage and region.

Do mandates guarantee financeable SAF supply?

Mandates create legally required demand for SAF. Projects also need viable production costs, the ability to build, commercial agreements that allocate risk and confidence that policy support will last. Europe's different outcomes for HEFA and eSAF projects illustrate this gap between required demand and project progress.

Does abundant feedstock ensure project progress?

Feedstock availability is one part of a project's economics. A project also needs affordable delivery, infrastructure, engineering capability and customers willing to buy on terms that support financing. Australia and Canada illustrate the gap between resource potential or expected demand and demonstrated project progress. Neither had an assessed commercial-scale project at secured FID, under construction or operating in either 2026 view.

How many operating facilities have evidence of recurring SAF supply?

Of the 45 projects classified as operating in September 2026, 42 had public evidence of a first SAF batch. Of those 42, 26 also had evidence of recurring commercial SAF supply. The smaller supply count reflects a separate evidence test: operating status establishes plant capability, while recurring supply requires evidence of repeated commercial supply.

CHAPTER 3

From Operating Plants to Recurring SAF Supply

Of the 45 projects classified as operating at commercial scale in September 2026, 42 had public evidence of a first SAF batch. Of those 42, 26 also had evidence of recurring commercial SAF supply. A plant can be operating and capable of producing SAF without public evidence of repeated commercial supply.

EXHIBIT 3.1

45 operating plants narrow to 42 with a first SAF batch and 26 with recurring commercial SAF supply.



Operating at commercial scale means public evidence shows that a plant is built, active and capable of producing SAF. A SAF-capable plant remains in this category when it is producing renewable diesel. A first SAF batch requires a documented, dated production event. Recurring commercial SAF supply requires public evidence of repeated commercial supply after that first batch; it does not require uninterrupted SAF production.

Of the 45 operating projects, 3 have no published SAF batch. Of the remaining 42, 26 have evidence of recurring commercial supply and 16 have evidence of a first batch only. Appendix Exhibit 3.3 lists the 26 projects with evidence of recurring supply.

EXHIBIT 3.2

Projects that have reached FID, construction or operation remain heavily concentrated in HEFA.

Projects at secured FID, under construction or operating by pathway family (n = 80)

71 of 80 at secured FID, under construction or operating are HEFA



Share at secured FID, under construction or operating within each pathway family



Of the 80 projects at secured FID, under construction or operating: 71 HEFA, 3 ATJ+FT, 4 eSAF/PtL and 2 Other. Shares within each pathway family: 38%, 2%, 5% and 4%.

Of the 455 commercial-scale projects assessed in September 2026, 189 use hydroprocessed esters and fatty acids (HEFA), 132 use alcohol-to-jet (ATJ) or Fischer-Tropsch (FT), 78 use electro-SAF (eSAF) produced through power-to-liquid (PtL), and 56 use other pathways. The assessment groups eSAF and PtL projects together. Of the 80 projects at secured FID, under construction or operating, 71 use HEFA, 3 use ATJ or FT, 4 use eSAF/PtL and 2 use other pathways.

Within each pathway group, these counts represent 38% of HEFA projects, 2% of ATJ/FT projects, 5% of eSAF/PtL projects and 4% of other projects. Projects with evidence of recurring commercial SAF supply are also concentrated in HEFA. These figures describe progress to date; the prospects of other pathways remain open.

Time from Investment or Financing to the Start of Operations

For the small group of recurring-supply projects with public dates for both investment or financing and the start of operations, the interval spans several years. The starting milestones differ between cases, and the dates do not consistently identify financial close or first SAF production. The cases illustrate project timelines; they do not establish a typical industry construction schedule or a representative median.

Four Projects at Different Milestones

Neste Singapore (Tuas)

Operating at commercial scale, with public evidence of recurring commercial SAF supply.

SkyNRG DSL-01

Reached financial close on 12 February 2026 and was under construction at the cutoff. Commercial operation and recurring SAF supply remained ahead.

LanzaJet Freedom Pines

Classified as operating at commercial scale, with public evidence of a first SAF batch. Recurring commercial supply had not been established in the public record.

XCF New Rise Reno

An operating commercial-scale renewable fuels plant without public evidence establishing recurring SAF supply.

Other projects with evidence of recurring commercial SAF supply include Diamond Green Port Arthur, Repsol Cartagena, Enilive Gela, Bangchak Bangkok, Petrobras' Duque de Caxias refinery (REDUC), Neste Porvoo, Neste Rotterdam, Cosmo Oil Sakai, ST1 Gothenburg and Montana Renewables Great Falls. The Korean co-processing facilities SK Energy Ulsan, S-Oil Ulsan and HD Hyundai Oilbank also meet the evidence test. Appendix Exhibit 3.3 provides the full list of 26 projects. EcoCeres' Johor plant has evidence of a first SAF shipment; subsequent plant-specific recurring commercial supply remains unverified in this assessment.

HEFA accounts for most projects at secured FID, under construction or operating and most projects with evidence of recurring SAF supply. The timing cases show that investment, construction, first production and recurring supply can be separated by several years. For developers, investors and buyers, each milestone answers a different question about a project's progress. Project counts show how many facilities have reached those milestones. Fuel-volume statistics show how much SAF has been supplied.

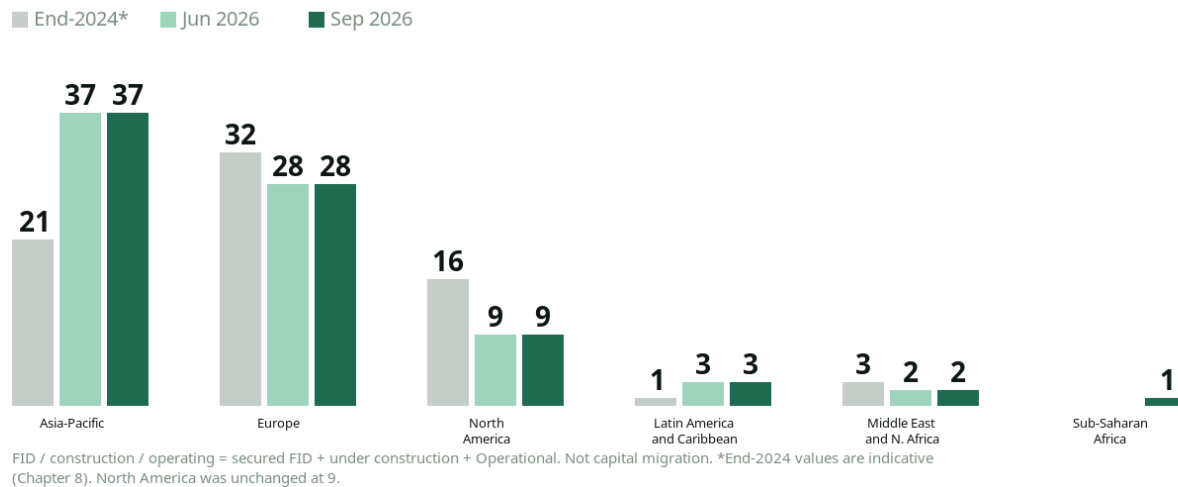
CHAPTER 4

Where SAF Projects Are Actually Advancing

Asia-Pacific accounted for more projects at secured FID, under construction or operating in the 2026 views than in the indicative end-2024 view. Its share of the global group also increased, while Europe's and North America's shares declined. North America contained nearly half of all projects classified as inactive. These figures identify project locations and stages. Assessing movement of investment capital or finished fuel between regions requires separate evidence.

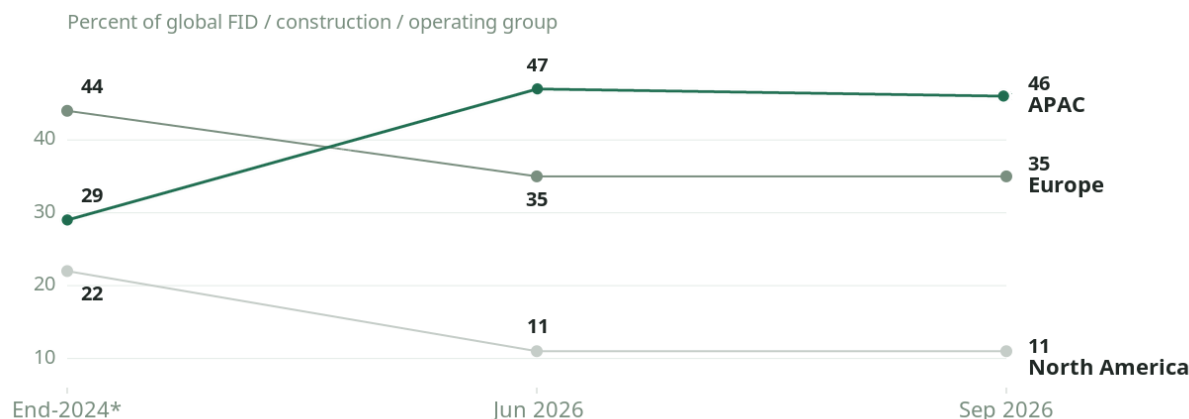
EXHIBIT 4.1

Projects at FID, construction or operation shifted by region, led by APAC's increase.



The global count at secured FID, under construction or operating was an indicative 73 at end-2024, 79 in June 2026 and 80 in September. Asia-Pacific recorded 21, 37 and 37 projects across those views; Europe recorded 32, 28 and 28; and North America recorded 16, 9 and 9. Latin America and the Caribbean recorded 1, 3 and 3, while the Middle East and North Africa recorded 3, 2 and 2. Sub-Saharan Africa had no projects at these stages in the first two views. Phelan Green Group's September FID increased its count to one.

Outside Asia-Pacific, the combined count was 52 at end-2024 and 42 in June. The end-2024 figures are indicative: these comparisons describe differences between published views, without establishing each project's movement between stages.

EXHIBIT 4.2**APAC's observed share of projects at FID, construction or operation increased by more than 10 percentage points across the dated views.**

*End-2024 shares are indicative (Chapter 8). Other regions at Sep 2026: Latin America 4% (3); Middle East and N. Africa 3% (2); Sub-Saharan Africa 1% (1).

Asia-Pacific's larger share of the global group was accompanied by smaller shares for Europe and North America. The end-2024 comparison is indicative, while June and September use the same project classification rules.

A project's location reflects several commercial requirements: production costs, feedstock access, fuel certification, delivery infrastructure, customer value and policy stability. Its production site, feedstock source, buyer, delivery point and policy market may be in different places. The regional stage counts show where projects have progressed. Explaining why they progressed requires examination of the individual projects and their commercial arrangements.

EXHIBIT 4.3**North America accounts for 40 of 81 projects classified as inactive, while 9 projects had reached FID, construction or operation.****SEPTEMBER 2026 - NORTH AMERICA****118 ASSESSED PROJECTS****9 at secured FID, construction or operating**

40 inactive (34% of 118)

North America 40**Rest of world 41****OF THE 40 INACTIVE PROJECTS****United States 35****Canada 5**

Inactive includes failed, paused, closed, canceled and no recent update.

NORTH AMERICA COMMERCIAL PROJECTS (118)**Inactive is 34% of the region**

40 inactive of 118 projects

Inactive 40**Other stages 78****AT SECURED FID, CONSTRUCTION OR OPERATING****9 projects****A split, not a simple decline.**

Inactive projects sit beside projects that are being built.

North America had 118 assessed commercial-scale projects in September 2026. Nine had secured FID, were under construction or were operating, and 40 were inactive (34%). The 40 inactive projects included 35 in the United States and 5 in Canada. They represented 49% of the 81 inactive projects globally. North America's inactive share was an indicative 23% at end-2024 and 34% in both 2026 views. Inactive includes failed, canceled, paused, decommissioned projects and projects without recent public updates; these categories distinguish projects that have stopped or paused from those whose current status is unclear.

Progress Differs Across Regions and Markets

China accounted for 20 of Asia-Pacific's 37 projects at secured FID, under construction or operating in both 2026 views. In Latin America and the Caribbean, the number of projects at secured FID, under construction or operating was an indicative one at end-2024 and three in both 2026 views, all in Brazil: two at secured FID and one operating. Sub-Saharan Africa recorded one project at secured FID following Phelan Green Group's September milestone. Australia, Canada and Mexico had no assessed commercial-scale projects at secured FID, under construction or operating in either 2026 view.

CHAPTER 5

Where Demand, Resources and Project Progress Diverge

The project comparisons suggest that domestic demand and resource abundance alone do not determine which countries advance SAF projects to secured FID, construction or commercial-scale operation. The cases also distinguish feedstock origin from fuel production location. A market can refine SAF locally using imported feedstock, or develop projects whose fuel is intended for customers elsewhere.

Domestic Demand Alone Does Not Explain Observed Project Progress

China shows the clearest gap between project progress and the domestic-demand signal visible in public data. In both the June and September 2026 views, China accounts for 20 of APAC's 37 projects that had secured a final investment decision (FID), were under construction, or were operating at commercial scale.

Australia and Canada illustrate the gap between resource potential or expected demand and demonstrated project progress. Neither had an assessed commercial-scale project at secured FID, under construction or operating in either 2026 view. Japan had two projects at secured FID, under construction or operating at commercial scale. New Zealand's Seadra-led Marsden Point biorefinery remained before secured FID at the September 2026 cutoff. Its equity fundraising was still underway, and Channel Infrastructure expected FID timing to extend into 2027. LanzaJet was separately exploring an alcohol-to-jet facility at Marsden Point. Fortescue's earlier eSAF proposal had completed pre-feasibility work, but subsequent development remained conditional and its continuation was not confirmed in the reviewed 2026 disclosures. None of these proposals is included in Asia-Pacific's 37 projects at secured FID, under construction or operating.

Korea and the Netherlands also had projects at those stages. In Latin America and the Caribbean, Brazil had three projects at these stages: Acelen Renewables' Bahia project and Petrobras' Cubatão project had secured FID, while Petrobras' REDUC refinery at Duque de Caxias was operating and had evidence of recurring commercial SAF supply through co-processing. In North America, 9 projects had secured FID, were under construction, or were operating at commercial scale. Another 40 were inactive: 35 in the United States and 5 in Canada.

These examples suggest that domestic demand and resource abundance do not determine project progress on their own. Economics, infrastructure, execution, and customer value also shape whether projects advance.

EXHIBIT 5.1

China's 2025 forecast renewable diesel and SAF balance points to an export-oriented market with limited domestic demand.



Source / Note. U.S. Department of Agriculture (USDA) Foreign Agricultural Service (FAS) Global Agricultural Information Network (GAIN) CH2025-0151, Table 10, dated 27 August 2025; 2025 forecast. Renewable diesel and hydrotreated vegetable oil (HVO) are combined with SAF in that forecast. Production 185 million US gallons per year; exports 164 million US gallons per year; domestic consumption 21 million US gallons per year; nameplate capacity 793 million US gallons per year. Gallon equivalents use the conversion method described in How to read this assessment. The figures are consistent with export orientation but do not establish motive and are not a finished-SAF customs dataset.

The 2025 forecast from the U.S. Department of Agriculture (USDA) Foreign Agricultural Service (FAS), published through the Global Agricultural Information Network (GAIN), combines renewable diesel, hydrotreated vegetable oil (HVO) and SAF. It projects 185 million gallons of production, 164 million gallons of exports and 21 million gallons of domestic consumption. These combined-fuel figures indicate an export-oriented market. They do not identify finished-SAF trade volumes or explain why individual SAF projects were developed.

EXHIBIT 5.2

Feedstock origin and finished-fuel origin are different.

FEEDSTOCK ORIGIN

Feedstock origin of certified SAF

UK 2025 SAF Mandate statistics

79% of certified SAF attributed to China-origin used cooking oil

~46.5 million gal of ~59.2 million certified gallons
Total ~88 million gallons; percentage uses unrounded volumes
EU 2025 aggregate

61% of SAF by China feedstock origin
About 85% of feedstock originated outside the EU

FINISHED SAF REFINING AND IMPORTS

Where finished SAF was refined
Separate from feedstock origin

~16% of EU SAF was finished-fuel imports

Most finished SAF supplied in the EU
was refined in the EU.

Evidence supports China feedstock
dependence for certified volumes.
It does not show Europe imports most
finished SAF from China.

UK DfT, 23 July 2026. EASA ReFuelEU report 2026, 17 September 2026. Origin refers to feedstock country, not production location of finished fuel.

Source / Note. United Kingdom: fifth provisional release of the 2025 SAF Mandate statistics, Department for Transport, published 23 July 2026. EU: European Union Aviation Safety Agency (EASA) ReFuelEU Aviation annual technical report 2026, published 17 September 2026. 'Origin' in these figures refers to feedstock country, not where the finished fuel was produced. The source does not identify the exporting country for those imports.

In the fifth provisional release of the United Kingdom's 2025 SAF Mandate statistics, suppliers reported approximately 88 million US gallons of SAF, of which 59.2 million gallons were certified. Of that certified volume, approximately 46.5 million gallons were attributed to China-origin used cooking oil, representing 79%. These are SAF volumes produced from that feedstock. The percentage uses the unrounded source volumes; the gallon figures are approximate.

In the EU's 2025 aggregate, about 363 million gallons of SAF were supplied, equal to 3% of aviation fuel consumption against a 2% regulatory minimum. About 85% of feedstock originated outside the EU, and China-origin feedstock accounted for 61% of the SAF volume. Finished SAF imports accounted for about 16% of EU supply. Most SAF supplied in the EU was refined there. The approximate gallon equivalents use the conversion method in How to read this assessment.

CHAPTER 6

From Policy Demand to Financeable Supply

European mandates require SAF to make up a minimum share of aviation fuel supplied. Financing projects to meet that demand also requires viable economics, the ability to build and agreements that allocate commercial risks. The different progress of European HEFA and eSAF projects illustrates this gap between policy demand and financeable supply. The project cases show how buyer commitments, public support and financing can work together. They also identify steps still needed before construction and production. The examples illustrate commercial arrangements associated with progress; they do not establish that any one arrangement caused that progress.

EXHIBIT 6.1

In Europe, HEFA projects are much further advanced than eSAF projects: 54% have reached FID, construction or operation, versus none of the 51 eSAF projects.

EUROPE HEFA

54%

Share at FID / construction / operating

26 of 48 at these stages
16 Operational

Early stage (pre-FID) 17 · Inactive 5



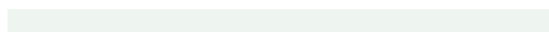
EUROPE eSAF / PtL

0%

Share at FID / construction / operating

0 of 51 at these stages
0 Operational

Early stage (pre-FID) 41 · Inactive 10



No European commercial-scale eSAF/PtL project at FID, construction or operation in either 2026 view.

Consistent with European Union Aviation Safety Agency (EASA)'s assessment that no commercial-scale EU synthetic-fuel project had reached FID. Aggregate = secured FID + under construction + Operational.

Europe had 51 assessed commercial-scale eSAF/PtL projects in September 2026: 41 before FID and 10 inactive. None had secured FID, entered construction or begun commercial-scale operation. This is consistent with the European Union Aviation Safety Agency (EASA) assessment that no commercial-scale European synthetic-fuel project had secured FID. Of Europe's 48 HEFA projects, 26 (54%) had secured FID, were under construction or were operating. Sixteen of those HEFA projects were operating at commercial scale.

Caphenia illustrates the distinction between pilot activity and commercial-scale project progress. Its operating activity centers on a pilot facility in Frankfurt-Höchst. The proposed commercial project in Steyerberg had no public evidence of secured FID or construction at the cutoff.

What policy has advanced, and what remains open

European policy has created required demand for SAF. The 2025 ReFuelEU minimum was met largely with HEFA fuel from used cooking oil (UCO). Synthetic-fuel obligations increase in later years. Revenue-support programs have also been designed, but their contribution to project financing depends on when support is awarded and on what terms.

At the cutoff, the reviewed public record did not establish awarded revenue support sufficient to finance commercial-scale European eSAF projects. First-of-a-kind projects may need long-term revenue support, while buyers often commit for shorter periods. Projects also need to complete permitting and engineering before construction and commercial operation. Europe has examples of HEFA project finance, but the assessment did not identify comparable non-recourse eSAF financing, in which lenders rely primarily on the project's revenues for repayment. **For policymakers**, the useful test is whether support helps a project manage and allocate price, volume, construction and technology risks well enough to attract investment.

EXHIBIT 6.2

Commercial structures seen in projects that have advanced, and mechanisms still at the design stage.

Architectural examples from public cases with confirmed commercial structures; not a conversion rate for Europe's 41 eSAF projects still pre-FID.

ARCHITECTURE	EXEMPLAR	WHAT IT DOES	WHAT REMAINS TO BE RESOLVED
Airline-anchor	SkyNRG DSL-01; Infinium Project Roadrunner	Pairs a motivated aviation buyer with project revenue and, in some cases, equity alignment.	Full coverage of first-of-a-kind (FOAK) eSAF price-gap risk in Europe.
Trader / aggregator	Syzygy-Trafigura	Intermediary takes placement risk and connects a project to multiple end markets.	Financial close for construction remains open in the cited case.
Integrated major	Green Sky Egypt-Shell	Wraps feedstock role with long-term take-or-pay offtake and emerging-market debt.	SAF-only slate share and COD risk.
Public revenue bridge	Germany, Austria and Luxembourg auction; UK	Designed to address the producer-buyer price gap.	Conversion of designed or announced mechanisms into awarded, project-level revenue contracts.
Development finance institutions / emerging-market finance	Green Sky; Acelen	Broadens the capital stack where projects need capital beyond commercial debt.	Product allocation and realized SAF/hydrotreated vegetable oil (HVO) netbacks across eligible markets.
Hybrid, still pre-FID	Arcadia eFuels Project ENDOR	Combines binding offtake, public support, FEED and project-management preparation.	FID and the remaining financing case beyond a strong binding offtake.

Trader row is Syzygy-Trafigura only. Acelen reached secured FID in May 2026.

Announced support or engineering progress does not establish financial close or secured FID.

The projects reviewed use several approaches to secure buyers, revenue and financing.

Airline buyers. Some projects are built around an airline that commits to buy fuel and, in some cases, invests in the project. SkyNRG DSL-01 and Infinium Project Roadrunner illustrate this approach.

Traders and aggregators. An intermediary can buy fuel from a project and sell it into multiple markets, taking responsibility for finding buyers. Syzygy's binding offtake agreement with Trafigura illustrates this structure. Syzygy had not reached financial close for construction at the cutoff.

Integrated energy companies. A company can support a project in several roles. In Green Sky Egypt, Shell combines a feedstock role with a long-term take-or-pay agreement. Under this agreement, the buyer pays for the contracted quantity even if it does not take that quantity of fuel.

Public revenue support. Public programs aim to help close the gap between SAF production costs and what buyers will pay. A program's design or announcement does not establish that a project has received a revenue-support contract. At the cutoff, the Germany-Austria-Luxembourg auction, UK revenue mechanisms and EU support initiatives remained in the design or announcement stage for this assessment.

Development finance institutions. These institutions can provide capital when commercial lenders alone may not finance a project. Green Sky and Acelen illustrate this approach. Green Sky signed its financing in May 2026 and remained before FID at the cutoff. Acelen Renewables secured FID in May 2026 for its Bahia biorefinery, with financing from a lender group led by HSBC and the International Finance Corporation (IFC). The facility is designed to produce both SAF and renewable diesel.

Combined approaches. Projects can bring together buyer commitments, public support and engineering work. Arcadia eFuels' Project ENDOR has a binding Uniper offtake agreement, public grant support, completed FEED studies and project-management preparation. These measures can strengthen its financing case. The project remained before FID at the cutoff.

Financing milestones in two project cases

SkyNRG DSL-01 reached financial close on 12 February 2026 and was under construction at the cutoff. Its financing combines non-recourse project debt with an airline buyer commitment. Infinium Project Roadrunner reached FID and debt financial close in May 2025 and entered construction in North America. Its commercial structure combines buyer commitments with sponsor equity.

ZAFFRA's proposed Brandenburg project remained unresolved following the dissolution of its joint venture.

CHAPTER 7

What Further Progress Requires

Further project progress depends on demand that can support production, competitive costs, the ability to build, commercial agreements and financing. Vansam examines five questions: Is there a durable market for the fuel? Can the project produce and supply it at a competitive cost? Can the sponsors complete permitting, engineering and construction? Do customer agreements support the revenue the producer needs? Can the allocation of risks attract debt and equity investment?

Asia-Pacific

The number of projects at secured FID, under construction or operating was 21 in the indicative end-2024 view and 37 in both June and September 2026. APAC accounted for 47% of all projects globally at these stages in June 2026 and 46% in September. China accounted for 20 of the region's 37 projects. Additional SAF supply will depend on projects under construction beginning production. Progress outside China would broaden the region's production base.

Europe

Europe had the largest total number of assessed commercial-scale projects. The number at secured FID, under construction or operating was 28 in both 2026 views, compared with an indicative 32 at end-2024. Its share of the global group at these stages also declined. Further progress would include revenue-support contracts awarded to individual projects, HEFA plants under construction beginning commercial operation, and financing for commercial-scale PtL projects.

North America

Nine projects had secured FID, were under construction or were operating in both 2026 views, compared with an indicative 16 at end-2024. Another 40 were inactive. The inactive category includes paused or canceled projects, as well as projects without recent public updates. Further progress will depend on viable production economics, durable policy and buyer agreements that can attract investment.

Latin America and the Caribbean

Three projects had secured FID or were operating in both 2026 views, compared with one in the indicative end-2024 view. All three are in Brazil: two at secured FID and one operating. Further progress would include construction of the two Brazilian projects at secured FID and projects elsewhere in the region reaching FID.

Middle East and North Africa; Sub-Saharan Africa

The Middle East and North Africa had two projects at secured FID, under construction or operating in both 2026 views. Sub-Saharan Africa had one project at secured FID in September: Phelan Green Group's Phelan eFuels Hopefield project near Saldanha Bay in South Africa's Western Cape. The project secured FID on 15 September 2026 and was targeting financial close and the start of construction in the first quarter of 2027.

EXHIBIT 7.1

Five connected questions for assessing progress toward financeability.

Europe eSAF: 41 projects still before FID.

1

Durable reason to build

A durable reason to build or produce must persist through the asset or contract horizon.

Mandate text is one input to a durable reason to build.

2

Produce competitivelySite-specific power, hydrogen, CO₂, infrastructure and delivered economics must be credible.*Resource abundance is more likely to translate into progress when paired with competitive delivered economics.*

3

Execute

Projects must progress through permitting and engineering to construction and commercial operation.

Evidenced permitting and engineering progress indicate execution readiness.

4

Reconcile economics

A creditworthy structure must carry volume, tenor and price-gap risk through the financing horizon.

Binding, creditworthy offtake terms carry more weight than announcements.

5

Attract capital

The resulting risk allocation must allow debt and equity committees to commit.

HEFA project finance already shows regional capital can clear when the structure is mature.

Connected conditions ending in capital formation. Revenue support can strengthen the chain as one input among several. No FID probability.

Europe's project record suggests that mandates alone are insufficient to finance commercial-scale eSAF supply. Projects also need to raise the debt and equity required to build. Over the next 12 months, watch whether any of the 16 projects with evidence of a first SAF batch, but no evidence of recurring supply, establish recurring commercial SAF supply.

CHAPTER 8

Technical Methodology, Data & Limitations

This chapter explains how projects are counted and classified, how the three dated views can be compared and what the available evidence can establish. This edition was published in October 2026, with project data updated through 29 September 2026. The two 2026 views record project status at 30 June and 29 September. Later disclosures were used only to verify status at those dates. Developments after a cutoff were not used to advance a project's stage in that view.

Scope and counting criteria

The assessment covers commercial-scale facilities that convert feedstock into SAF. Commercial scale is assessed project by project, without a fixed annual-volume threshold. Each plant or distinct project expansion is counted as one project; alternate names and repeated announcements do not create additional entries. A facility counts as commercial scale when its developer presents it as a production facility intended to sell fuel, supported by evidence such as offtake, commercial or project financing and permitting. Facilities presented as demonstrators, or built mainly to validate technology, are treated as pilot or demonstration projects. Commercial co-processing at an existing refinery is assessed under the same test. Bench-scale and pilot projects, handling services without SAF conversion, duplicate entries and unverified stage changes are excluded. Canceled projects remain in the assessed total as inactive.

How project stages were classified

Each project is assigned one stage: operating at commercial scale, under construction, secured FID, early stage or inactive. Early stage includes concepts, feasibility studies, permitting, engineering and other progress before verified FID. Inactive includes paused, canceled, decommissioned projects and projects without recent public updates. These statuses describe different circumstances.

Evidence for project stages

FID, financial close, construction start and commercial operation are separate milestones. Secured FID requires public evidence of a final investment decision. Early engineering and site preparation alone do not establish that a project is under construction. Construction status requires public evidence that the commercial-scale production facility is being built. A project can be classified as under construction or operating without a separate FID announcement when evidence establishes that stage. Financial close is recorded when public evidence confirms a dated financing transaction. The same rules apply at the June and September cutoffs. Phelan Green Group's September FID is included only in the September view.

Phelan Green Group's Hopefield eSAF project, developed through Phelan eFuels near Saldanha Bay in South Africa's Western Cape, secured FID on 15 September 2026. The classification draws on the South African Presidency's address at the Africa Green Hydrogen Summit, which confirmed investment approval, committed equity and secured offtake terms. Engineering News reported board approval for Phase 1 and construction equity commitments on 16 September. Financial close and construction were targeted for the first quarter of 2027. The project therefore counts at secured FID, with those subsequent milestones still ahead. One project at FID does not establish a broader regional financing pattern.

Canada had no assessed commercial-scale projects at secured FID, under construction or operating in either 2026 view. Parkland's proposed standalone renewable diesel and HEFA complex at Burnaby was canceled in March 2023 and is classified as inactive. Co-processing at the existing Burnaby refinery is not recorded as a separate project. Its demonstrated SAF activity is a first low-carbon jet fuel batch purchased by Air Canada in December 2024.

Recurring commercial SAF supply requires a dated first production event and public evidence of subsequent repeated commercial supply. A first batch alone does not meet this test. An operating renewable fuels plant is counted as providing recurring SAF supply only when that evidence is available. Chapter 3 explains the project cases, and Appendix Exhibit 3.3 lists the 26 projects that meet the test.

Projects are grouped into HEFA, including co-processing; ATJ and FT; eSAF/PtL; and other pathways. The combined count at secured FID, under construction or operating includes projects with public evidence of at least one of those milestones. Individual exhibits identify any more specific stage distinctions.

Comparing the Three Dated Views

The headline charts compare an indicative end-2024 view of 337 projects with June and September 2026 views of 455 projects each. The two 2026 views use the same counting, classification and evidence rules. The end-2024 figures come from an earlier publication and are not directly comparable project by project. Comparisons with end-2024 therefore show differences between published views. Annual estimates based on dated project events provide supporting analysis only. Individual milestone announcements illustrate specific changes without providing a complete record of every project transition. Expanded database coverage contributed to the increase from 337 to 455 assessed projects. That increase does not mean 118 new plants were built. The total was 455 in both June and September 2026.

Operating status requires public evidence that a plant is active and capable of producing SAF, supported by certification, a stated production capability or a test batch. Renewable fuel plants without demonstrated SAF capability are excluded. Three operating plants have no published SAF batch: Orlen Płock, Pengyao Panjin and Par Pacific Kapolei.

Disclosed SAF design capacity was available for 74 of 337 projects in the end-2024 view and 104 of 455 in each 2026 view. Project counts describe facilities; production volumes are assessed separately.

By September, 80 of the 455 projects had secured FID, were under construction or were operating, representing 17% of the total. Asia-Pacific had 37 projects at those stages in both 2026 views. The assessment does not include 2016 and 2021 comparisons because the available data are insufficient.

Data limits and analytical boundaries

Where public records do not disclose target dates, offtake prices, contracted volumes or contractual terms, those fields are left blank. Undisclosed investment amounts are not treated as zero. Regional project counts do not establish whether capital moved between regions, and operating status does not establish the volume of SAF produced.

The assessment reports project counts, regional and pathway distributions, and documented project cases. It does not estimate the likelihood of individual projects reaching FID or production, rank national readiness, forecast 2030 supply or create a combined readiness score. Questions that the available evidence cannot answer remain unresolved.

Method summary

Exhibit	Focus
EX-8.1 Data sources	Headline charts use three dated project counts: 337 (indicative), 455 in both 2026 views. The June and September 2026 views build on the UHasselt Global SAF Production Capacity Database by Martulli and Malina, published on Zenodo on July 10, 2026. Year-end estimates built from dated project events are supporting analysis only.
EX-8.2 Coverage control	Growth in assessed projects reflects coverage as well as new projects. End-2024 to June includes the largest coverage expansion; June to September reflects Phelan Green Group secured FID, raising the combined group by one project. June and September use the same rules; end-2024 is indicative. On the same 455 projects, the share at secured FID, under construction or operating was 17% in both June (79) and September (80).
EX-8.3 Stage and pathway definitions	Defines commercial scale, project stages, FID versus financial close, facility versus phase, pathway groups and the recurring-supply evidence test.
EX-8.4 Known limitations	No comparable year-end 2025 project count; end-2024 view indicative; operating status is not production volume; missing information and unresolved questions are reported as limits.

Appendix

Supporting exhibits

The appendix provides definitions, commercial comparisons, market-readiness views and questions that remain unresolved. It applies the same evidence standards as the main chapters.

EXHIBIT 2.2

Observed facts, external sources, Vansam analysis and unresolved questions are kept separate.

Four sentence types stay distinct, keeping counts separate from motive claims.

Observed

Dated project counts and stage facts at a stated date.

External

Published outside facts used as cited, without rewriting.

Analytical

Interpretation that stays separate from the count fact.

Unresolved

Claims the evidence cannot settle; left open.

Methods legend. Dated fact and analytical interpretation are kept separate.

EXHIBIT 3.3

The 26 projects with public evidence of recurring commercial SAF supply.

#	Facility	Country	Region	Pathway
1	EcoCeres / Zhangjiagang	China	Asia-Pacific	HEFA
2	Junheng Industry Group Biotechnology / Puyang	China	Asia-Pacific	HEFA
3	Shandong Haike Chemical / Dongying	China	Asia-Pacific	HEFA
4	Shandong Sanju / Rizhao	China	Asia-Pacific	HEFA
5	Sinopec / Zhenhai	China	Asia-Pacific	Co-processing
6	Zhejiang Jiaao Enprotech / Lianyungang	China	Asia-Pacific	HEFA
7	Cosmo Oil / Sakai	Japan	Asia-Pacific	HEFA
8	HD Hyundai Oilbank	Republic of Korea	Asia-Pacific	Co-processing
9	S-Oil / Ulsan	Republic of Korea	Asia-Pacific	Co-processing
10	SK Energy / Ulsan	Republic of Korea	Asia-Pacific	Co-processing
11	Neste Singapore (Tuas)	Singapore	Asia-Pacific	HEFA
12	Formosa / Yunlin	Taiwan	Asia-Pacific	Co-processing
13	Bangchak / Bangkok	Thailand	Asia-Pacific	HEFA
14	TotalEnergies / Antwerp	Belgium	Europe	Co-processing
15	Neste / Porvoo	Finland	Europe	HEFA
16	TotalEnergies / Gonfreville-l'Orcher	France	Europe	Co-processing
17	TotalEnergies / La Mède	France	Europe	HEFA
18	Enilive / Gela	Italy	Europe	HEFA

#	Facility	Country	Region	Pathway
19	Neste / Rotterdam	Netherlands	Europe	HEFA
20	Moeve / Palos de la Frontera	Spain	Europe	Co-processing
21	Repsol / Cartagena	Spain	Europe	HEFA
22	ST1 / Gothenburg	Sweden	Europe	HEFA
23	Phillips 66 / Humber	United Kingdom	Europe	Co-processing
24	Diamond Green / Port Arthur	United States	North America	HEFA
25	Montana Renewables / Great Falls	United States	North America	HEFA
26	Petrobras / Duque de Caxias	Brazil	Latin America and the Caribbean	Co-processing

EXHIBIT 5.3

September 2026 project-stage counts in selected markets.

September 2026 project-stage counts in selected markets.

Markets discussed

China, Malaysia-Singapore, Australia, Canada, Japan, and Brazil (Latin America and the Caribbean).

September 2026 counts

September 2026 project-stage counts (secured FID, under construction or operating): China 20; Australia 0; Canada 0; Japan 2; Brazil 3.

Export orientation vs domestic use

Exports

U.S. Department of Agriculture (USDA) forecast: 164 million gal/yr exports versus 21 million gal/yr consumption

See Exhibits 5.1 and 5.2; renewable diesel, hydrotreated vegetable oil (HVO) and SAF combined

Domestic use

UK/EU feedstock reliance

Source / Note. Vansam project review, 29 September 2026.

EXHIBIT 6.3

Selected markets differ in domestic production, supply access and pathway readiness.

Readiness indicators, not 2030 gallon balances.

MARKET	DOMESTIC PLANTS	SUPPLY ACCESS	PATHWAY	READINESS
EU	Partial, HEFA-skewed	High for 2025 HEFA via external feedstock refined in-EU	HEFA ready enough for early years; eSAF still pre-production	HEFA production-ready with China-weighted feedstock access; eSAF still pre-production
UK	Weak domestic HEFA at secured FID, under construction or operating; eSAF	High via certified HEFA feedstock channel	HEFA compliance via import/feedstock functioning; domestic PTL still pre-FID	Mandate-ready via China-heavy certified HEFA feedstock, with a thin domestic HEFA secured-FID/construction/operation
Japan	Thin	Likely necessary	Two projects in the combined secured-FID, under construction or operating group; no eSAF at secured FID or construction	Policy-forming with thin domestic secured FID, under construction or operating counts
Korea	Relatively stronger co-process HEFA	Domestic co-process plus regional trade	HEFA/co-process path for early obligation; eSAF at FID / construction: 0	Co-process HEFA-ready for the early mandate if slate share scales; eSAF readiness still to be established
Singapore	Single platform at FID / construction / operating	Hub-ready levy/procurement	HEFA incumbent ready; next-gen still pre-FID	Hub/procurement-ready on one HEFA platform

UK: 79% of certified SAF volume was from China-origin used cooking oil. EU: 61%.

EXHIBIT 7.2

Important questions that remain unresolved.

These items mark the current limits of the evidence.

ITEM	STATUS	WHY IT BLOCKS A STRONGER CLAIM
Public offtake evidence	Unresolved	Cannot state share of projects at FID, construction or operation with take-or-pay investment-grade offtake.
SAF production volumes	Unresolved	Operating status does not show how much SAF a project produces.
Capital movement between regions	Cannot yet be tested	Public project-cost and financing data are too limited to show whether capital is moving between regions.
Probability early-stage project reaches secured FID, under construction or operating	Unresolved	The dated views do not track an identical set of facilities.
Why projects were built	Unresolved	The available evidence does not establish whether domestic demand or energy-security pressure caused China's project growth.
Asia-Pacific inactive share	Unresolved	A low inactive share may reflect projects missing from the record. Low Inactive may reflect incomplete coverage as well as bankability.

Public offtake evidence, SAF production volumes and whether capital is moving between regions stay outside the public information available for this assessment.

Source / Note. Open questions include the quality and bankability of offtake across the full project set, utilized SAF production volumes, whether capital is moving between regions, the probability that an early-stage project progresses to FID, construction or operation, and other causal claims that the available evidence does not resolve. These are areas for future work.



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