

A decorative graphic on the left side of the slide, consisting of a series of concentric white circles of varying diameters, creating a ripple effect. It is set against a solid blue background.

# Q1 Clean Fuels Outlook

March 2026



# Contents

<b>Takeaways</b>	<b>3</b>
<b>The headline: feedstock stress in UCO</b>	<b>5</b>
<b>Deployment: SAF, ammonia, 2G ethanol</b>	<b>6</b>
<b>Companies and investment</b>	<b>16</b>
<b>Scoreboards and benchmarks</b>	<b>20</b>
<b>Policy landscape</b>	<b>23</b>
<b>Content library</b>	<b>27</b>



## What you need to know

**US policy shifts are favoring biofuels**

**CBAM exemption uncertainty has frozen the ammonia pipeline**

**Feedstock scarcity is the binding constraint for SAF**

**The OBBB reduced the SAF blender's credit from \$1.75 to \$1.00 per gallon**, putting many early-stage U.S. projects at risk. But on the other hand, California's tightened LCFS targets are creating new incentives for low-CI fuels like 2G ethanol.

**Europe's carbon border mechanism went live in January 2026**, with importers facing up to €8bn in total certificate costs across covered sectors. Ammonia's direct bill is smaller (~\$150m), but razor-thin fertilizer margins make the per ton added costs challenging, and the EU commissioner's suggestion that fertilizers could be temporarily exempted has backfired, leaving the industry frozen in wait-and-see mode.

**The EU imports 80% (900 million gallons) of its UCO today, and it needs another billion gallons by 2030**. Domestic demand can't meet this shortfall. Even if Europe matched the US collection rate (the global best at 25%), it would add only ~160Mgal. To hit its 800Mgal SAF target by 2030, the EU will need to change feedstocks, process, or import SAF directly.

## What we're watching

**2026–2027 SAF project FIDs**

**Alcohol-to-jet scale-up**

**Ammonia offtake and electrolyzer deals**

**87 SAF projects target this time window, with planned capacity peaking at 13Mt/yr in 2027**.

Whether developers secure financing and break ground on schedule will determine if supply can meet tightening EU and CORSIA mandates. FIDs should start being announced by the end of Q2 if they plan to hit their CODs.

**AtJ is emerging as the strongest challenger to HEFA, with 75–90% SAF selectivity and near-competitive costs**. LanzaJet's Freedom Pines milestone and large US ethanol-based projects like Net Zero 1 and Summit Next Gen signal the pathway is approaching commercial scale.

**121Mt/yr of low-carbon ammonia capacity is due online between 2027–2030**. Progress on securing firm offtake agreements and electrolyzer procurement over the next few years will separate real projects from paper ones. Uniper signed offtake from AM Green earlier this year, and we'll be watching for similar announcements from Chbika in Morocco and West Terre Haute in Indiana.



## What this means

### For airlines & shipping lines

**Feedstocks, functional tech, and FIDs.** Look for secured feedstock contracts, proven conversion technology (not pilot-stage), and a realistic path to FID. Projects with policy tailwinds (EU or UK mandate compliance or 45Z eligibility) carry less regulatory risk. If the developer can't show you a credible feedstock-to-gate cost stack, the project isn't ready an offtake commitment.

**Don't plan around supply that doesn't exist yet.** 60% of the SAF pipeline is still in "announced" status, and 40 projects are already cancelled or delayed. Only 1% of the low-carbon ammonia pipeline is operational. Offtakers building sustainability targets and procurement strategies around assumed future supply availability are taking on more execution risk than they may realize.

### For fuel producers and project developers

**Feedstock strategy is now the project.** UCO-based HEFA is hitting a hard ceiling. Europe already imports 80%+ of its UCO and global supply can't support announced refinery demand. Developers still building around waste fats without secured, diversified feedstock contracts are exposed. Some projects should be able to vertically integrate with suppliers, others can form long-term offtake agreements, and some made need to find multiple suppliers to fill in any gaps that come up.

**US project economics need re-underwriting.** The OBBS cut the SAF blender's credit from \$1.75 to \$1.00/gal, and many early-stage US projects were announced under the higher number. Developers should stress-test their models at the new credit level and be honest about which projects still clear hurdle rates. Some won't, and early write-downs are better than slow deaths.

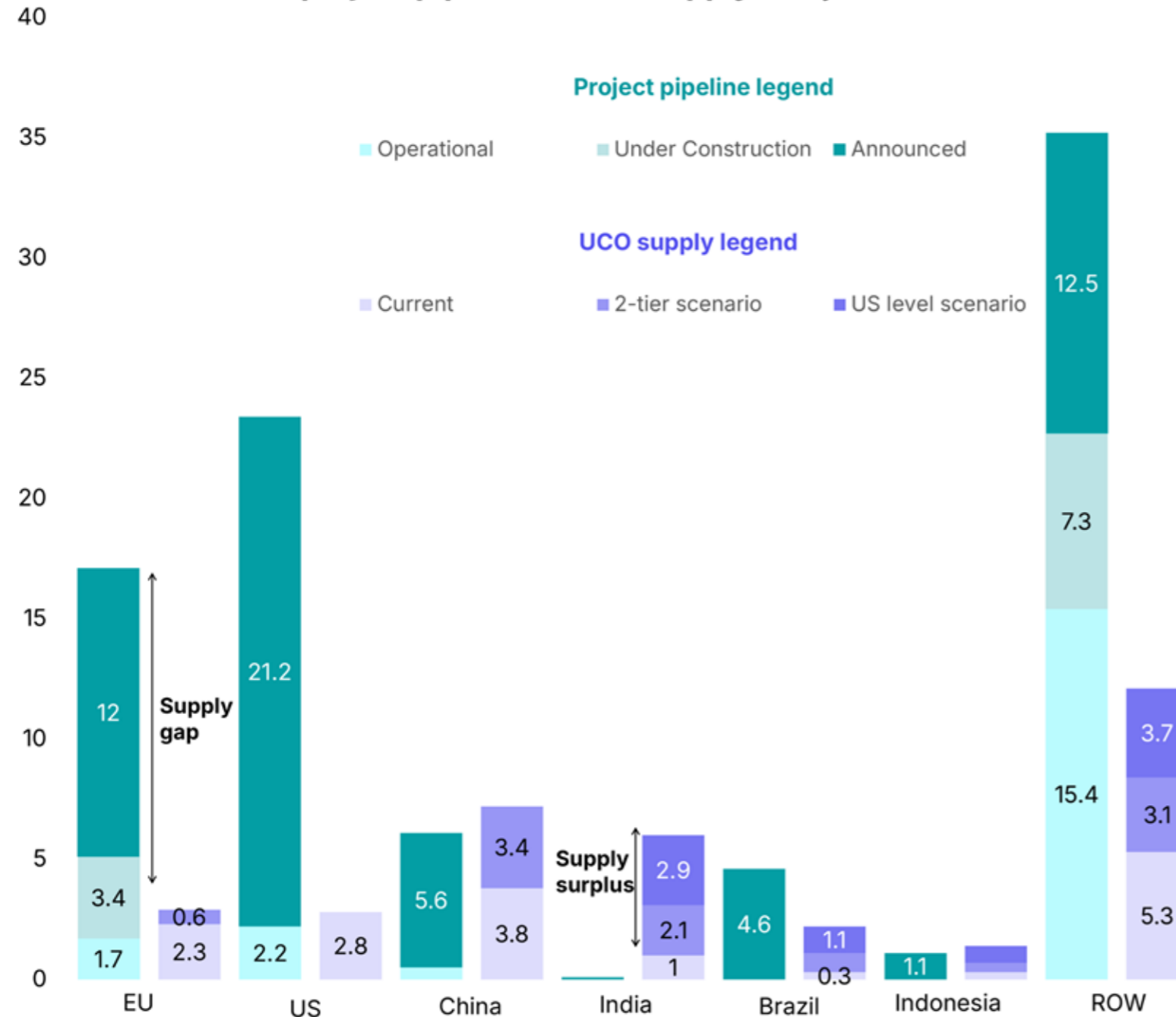
### For feedstock suppliers and traders

**You're sitting at the bottleneck — price accordingly.** The analysis is clear that feedstock scarcity is the binding constraint across SAF, 2G ethanol, and green ammonia. UCO, cellulosic biomass, and cheap clean power are all supply-limited. Suppliers with reliable volumes have pricing power that will only increase as mandates tighten and more projects compete for the same inputs.

**Traceability is becoming a market requirement, not a nice-to-have.** EU sustainability reporting, ILUC accounting, and the 45Z requirement for US/Canada/Mexico feedstock origin all point in the same direction. Suppliers that can offer verified, auditable supply chains will command a premium.

# The headline: clean fuels' broader feedstock issues are showing up first in UCO

UCO demand from project pipeline & UCO supply (Mt/yr)



**Europe cannot meet SAF targets with domestic UCO.** UCO-based HEFA produced the majority of the EU's SAF in 2024 but still covered only ~0.5% of jet fuel demand; meeting 2030 mandates would require far more UCO than Europe supplies.

**Improving collection rates won't solve the gap.** Europe would need unrealistically high UCO recovery rates, far above best-in-class global levels, since most commercial sources are already captured.

**Europe already relies heavily on imports.** Over 80% of EU UCO is imported—mostly from China—turning waste oil into a global commodity driven by US and EU biofuel policies.

**Global UCO supply still falls far short of HEFA demand.** Even with better worldwide collection, supply would remain well below announced refinery needs, leaving producers caught between locking in feedstock at risk of oversupply, pursuing costly vertical integration, or pivoting to alternative SAF pathways.

**Other low-carbon fuels face similar feedstock constraints.** Cellulosic biomass limits the scale of 2G ethanol, while green hydrogen and ammonia depend on massive supplies of cheap clean power—highlighting that feedstock availability is a broader bottleneck across emerging fuel pathways.

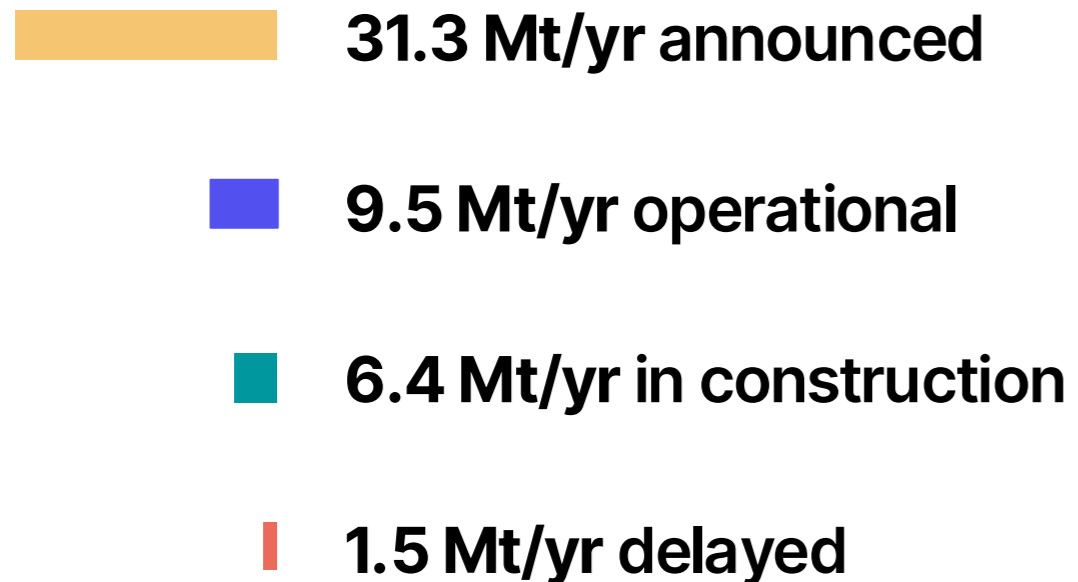


1/5

# Deployment

# SAF: What's changed

## Current capacity breakdown (to March 2026)



## Notable new project announcements from Q4/Q1

[Freedom Pines, 27kt/yr, Georgia](#). LanzaJet's plant in Georgia began producing SAF from ethanol in November 2025, marking a key milestone for alcohol-to-jet technology.

[Lianyungang Factory, 500kt, China](#). China's largest SAF plant came online in December 2025, producing 500k tons of SAF using HEFA.

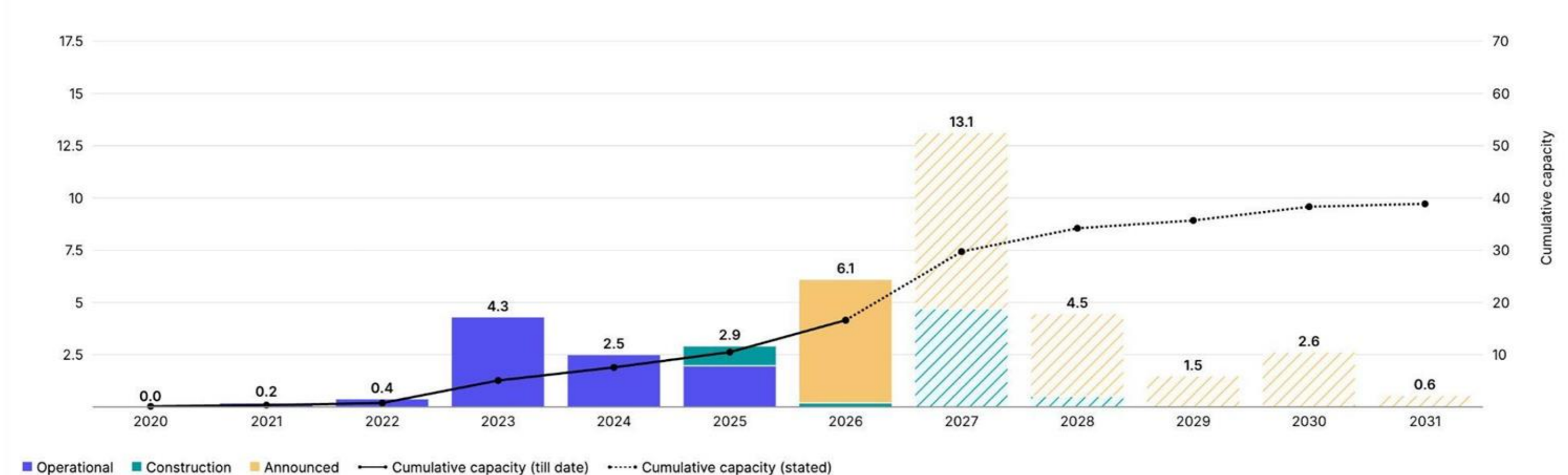
[SAF One, TBD, Middle East](#). Dubai-based project developers have raised \$208 million and finalized EPC and HEFA technology for their first project, scheduled to break ground later this year, but have not finalized a location.

[DRAGON II, 80kt/yr, United Kingdom](#). LanzaTech's partnership with LanzaJet for e-alcohol-to-jet has announced its project location in Humber, England and plans to break ground in 2027.

[Turbe, 35kt/yr, Rotterdam](#). Swiss methanol-to-jet tech startup Metafuels has awarded a contract to McDermott for front-end engineering and design (FEED) of its Turbe project in the Netherlands, with FID planned for 2027.

# SAF projects must deliver in 2026 to hit EU mandates, but nothing's in construction

## SAF pipeline by operational date (Mt/yr)



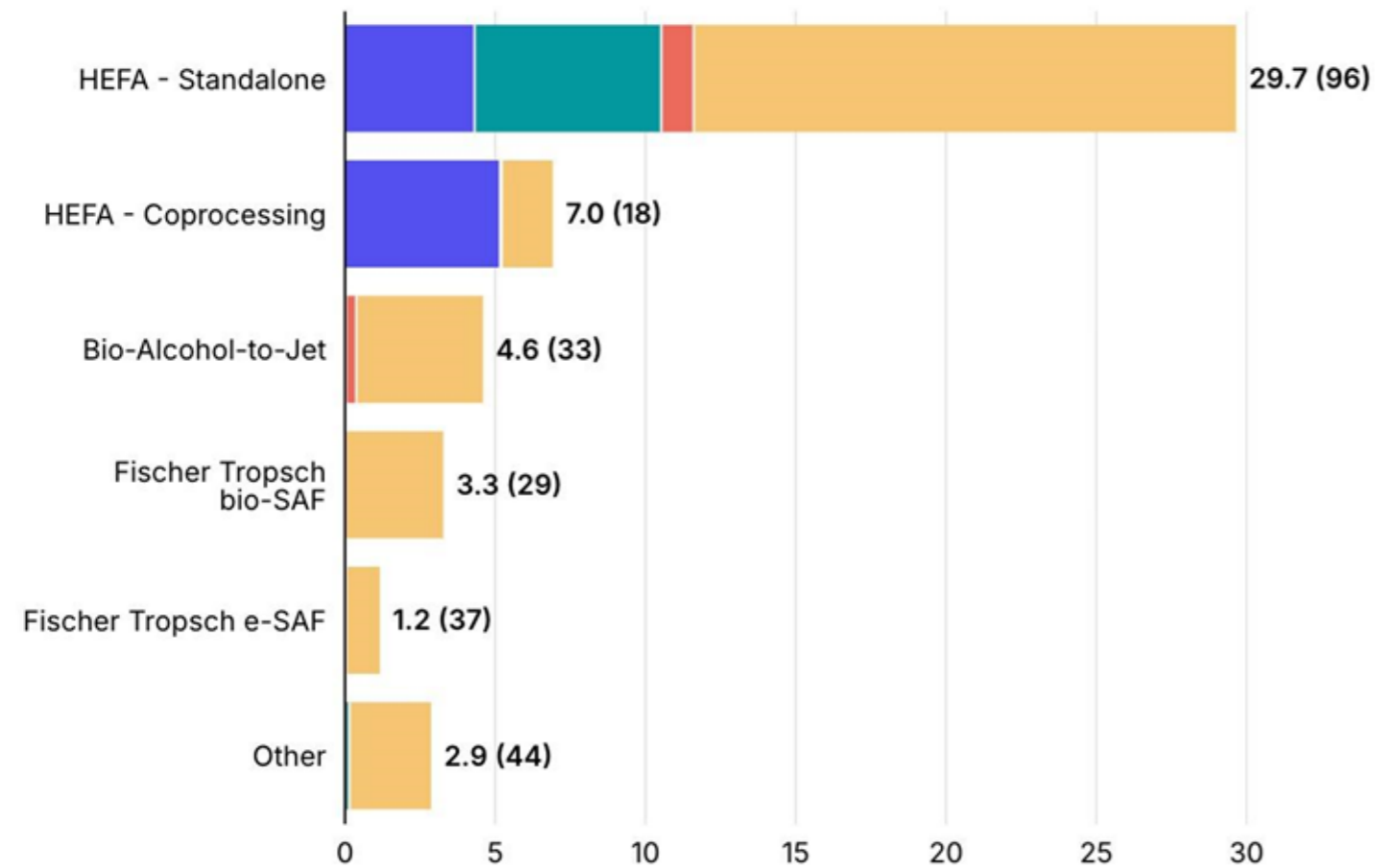
Source: Sightline Climate

**The largest wave of SAF projects ever should be coming online in 2026/2027, but demand isn't there.** Policy deadlines from ReFuelEU Aviation, the UK SAF mandate, and the US IRA tax credits triggered a wave of announcements in 2022–2023 that, given typical 3–4 year build times, cluster into this window. Of the 248 projects with announced capacity, 80 (30%) target 2026–2027. However, almost no 2026 capacity is in construction. Key names that need to deliver include SGP BioEnergy, Grön Fuels, NXTClean Fuels, Neste, ADM, and ENEOS.

**HEFA accounts for 80% of planned 2026–2027 capacity and is technically proven.** This tech is ready, demand is the harder question: only 5 of the 87 projects targeting this window have announced offtake agreements. Meanwhile, 40 projects (~9Mt/yr) have already stalled — World Energy, BP, and Shell among them, typically due to offtake or financing gaps, not technology. The projects progressing most reliably have government-backed financing, or vertically integrated feedstock.

# HEFA dominates the short and medium term as the only scaled pathway

## SAF pipeline by pathway (Mt/yr)



■ Operational ■ Construction ■ Delayed ■ Announced

Note: Data labels are total capacity and (project count).

Source: Sightline Climate

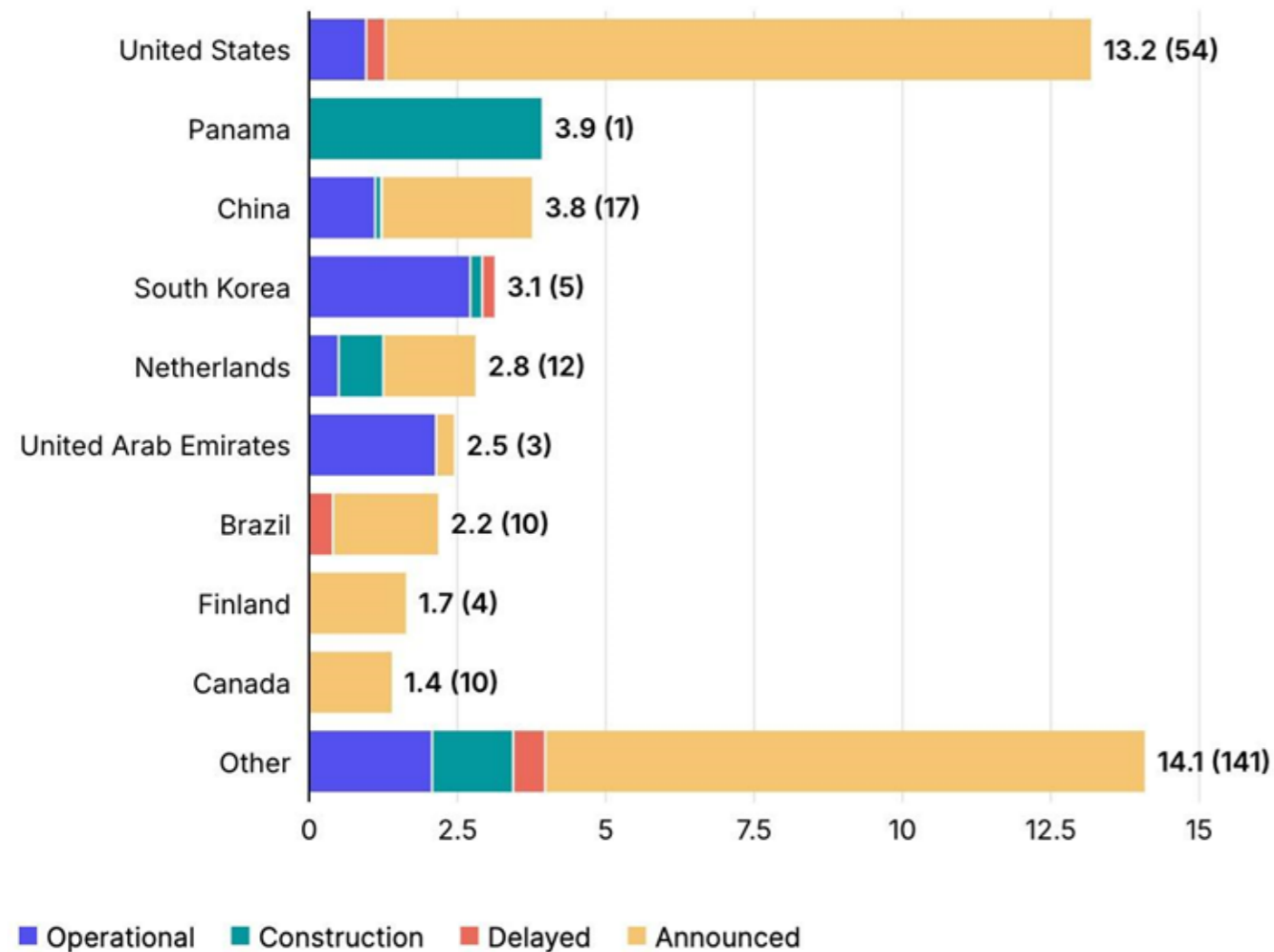
**SAF is still the HEFA story.** ~75% of announced SAF capacity uses HEFA, and for good reason: it's the only pathway with decades of refining experience, proven technology, and established waste-fat supply chains. Coprocessing accounts for more operational capacity today than standalone plants (5.2Mt/yr vs 4.3Mt/yr), as it runs in existing plants. However, this is not firm capacity — coprocessing runs SAF as a fraction of existing refinery throughput and can be switched off if demand is low. The real test for the market is whether it can support standalone HEFA. There's a lot of this in construction (6.2Mt/yr) and announced (18.1Mt/yr), but also a lot of it delayed (1.1Mt/yr).

**AtJ is the leading non-HEFA technology,** with 34 bio-AtJ projects totalling 4.8Mt/yr. Its advantage is feedstock: global ethanol production (~110 billion litres/year) dwarfs the constrained supply of waste fats that every HEFA plant competes for. LanzaJet proved the pathway commercially at Freedom Pines in November 2025 and is licensing it across 13 projects in 8 countries. Large US projects from ADM, Summit Agricultural Group, and Green Plains are positioned to exploit cheap Midwest corn ethanol.

**E-SAF is a rounding error until at least 2030.** e-SAF accounts for just 2.5Mt/yr across 68 projects, nearly all pre-operational. The core constraint is demand: the EU's e-fuel sub-mandate doesn't activate until 2030 (at 1.2%, rising to 35% by 2050), so projects will struggle to secure offtake and financing before then. The 1.3M t/yr of Fischer-Tropsch e-SAF and 0.6M t/yr of methanol-to-jet in the pipeline mostly target the post-2030 window. But without lower hydrogen and carbon capture costs, they won't be bankable.

# Tax credits gave the US the lead in announcements, but the EU is where the real demand sits

## SAF pipeline by country (Mt/yr)



Note: Data labels are total capacity and (project count).

Source: Sightline Climate

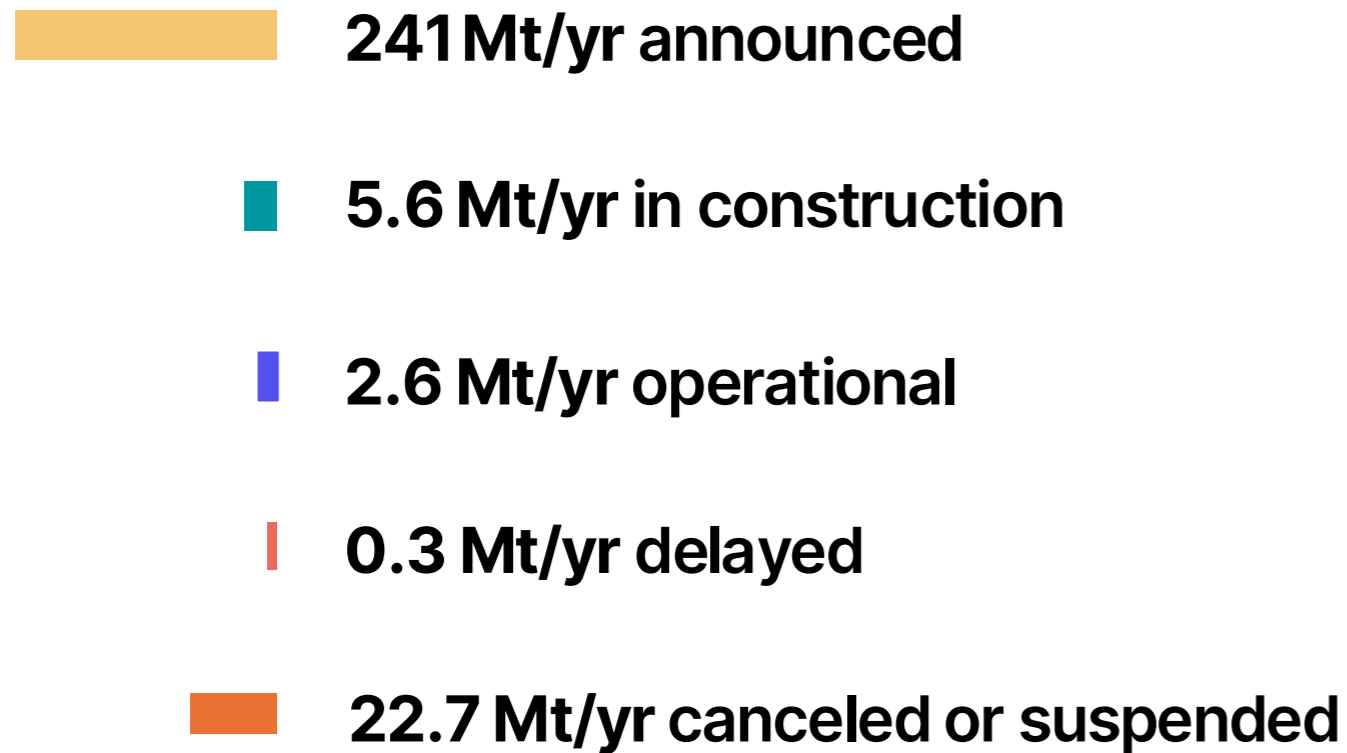
**The US' massive pipeline is policy driven and unlikely to come online.** Its 59 projects totals 18Mt/yr of planned capacity, but only ~1M t/yr is actually operational. The wave of announcements was driven by the IRA's \$1.75/gallon SAF credit, but several of the largest projects have since stalled (World Energy's Paramount Expansion, BP Cherry Point) and the credit has been reduced to \$1/gallon. The projects that are advancing (Montana Renewables, Diamond Green Diesel, Phillips 66 Rodeo) tend to be existing refinery conversions with DOE backing or captive feedstock, limiting the scale of what's working in this market.

**Europe's demand mandates give it nearly double US capacity altogether.** The region hosts 32% of all SAF projects thanks to ReFuelEU's binding demand making projects financeable. The Netherlands is the continent's hub, with Neste's operational Rotterdam plant (500k t/yr), a 700k t/yr Neste expansion underway, and Chane's Koole Tankstorage Botlek (650k t/yr) under construction.

**South Korea's blending mandate catapulted it into the top five, and producers are ready to deliver.** The country has just 4 projects but 2.7M t/yr of operational coprocessing capacity, the most of any country. Deployment is led by S-OIL's Onsan Refinery and HD Hyundai Oilbank's Daesan plant. Korea's 1% blending mandate starts in 2027, and the refiners are racing to have standalone capacity ready. China has taken a breadth approach, with 11 projects, only one at 1M t/yr, the rest smaller.

# Ammonia: What's changed

## Current capacity breakdown (up to March 2026)



## Notable new project announcements from Q4/Q1

**[Blue Point, 1.4Mt/yr, Louisiana.](#)** In October 2025, a consortium led by CF Industries and JERA reached FID on the “Blue Point” \$4bn, 1.4 Mt low-carbon ammonia plant at CF’s Blue Point complex in Ascension Parish, Louisiana

**[AM Green, 1.5Mt/yr, India.](#)** In January, AM Green announced that it has begun construction of a 1.5 Mtpa green ammonia complex at Kakinada, Andhra Pradesh.

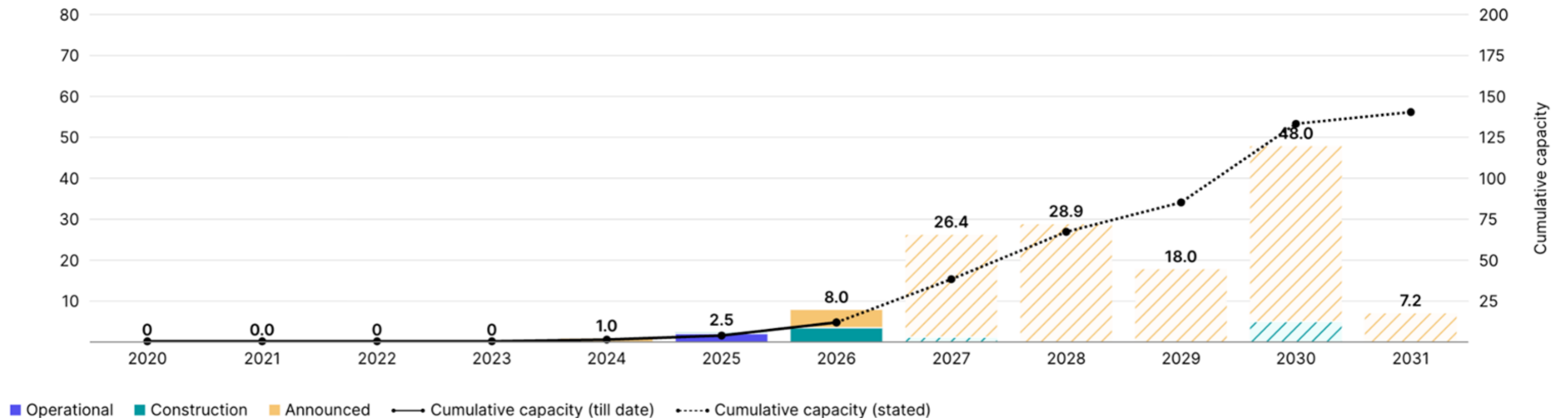
**[Laayoune, 560kt/yr, Morocco.](#)** In early February, the Moroccan government and the ORNX consortium (participants from the US, Spain and Germany) signed a 4.5 billion USD agreement for a green ammonia hub at Laayoune.

**[Namie Demonstration, 1.5kt/yr, Japan.](#)** In January, JGC reported that green ammonia production has begun at a demonstration plant in Namie, Fukushima, using hydrogen from the nearby FH2R renewable hydrogen facility

**[Beaumont New Ammonia, 1.1Mt/yr, Texas.](#)** Woodside Energy announced in December that it has produced the first ammonia from its Texas plant. It bought the plant from OCI, and is targeting first low-carbon ammonia later this year.

# Low-carbon ammonia has been waiting for regulation - and now CBAM is here

## Ammonia pipeline by operational date (Mt/yr)



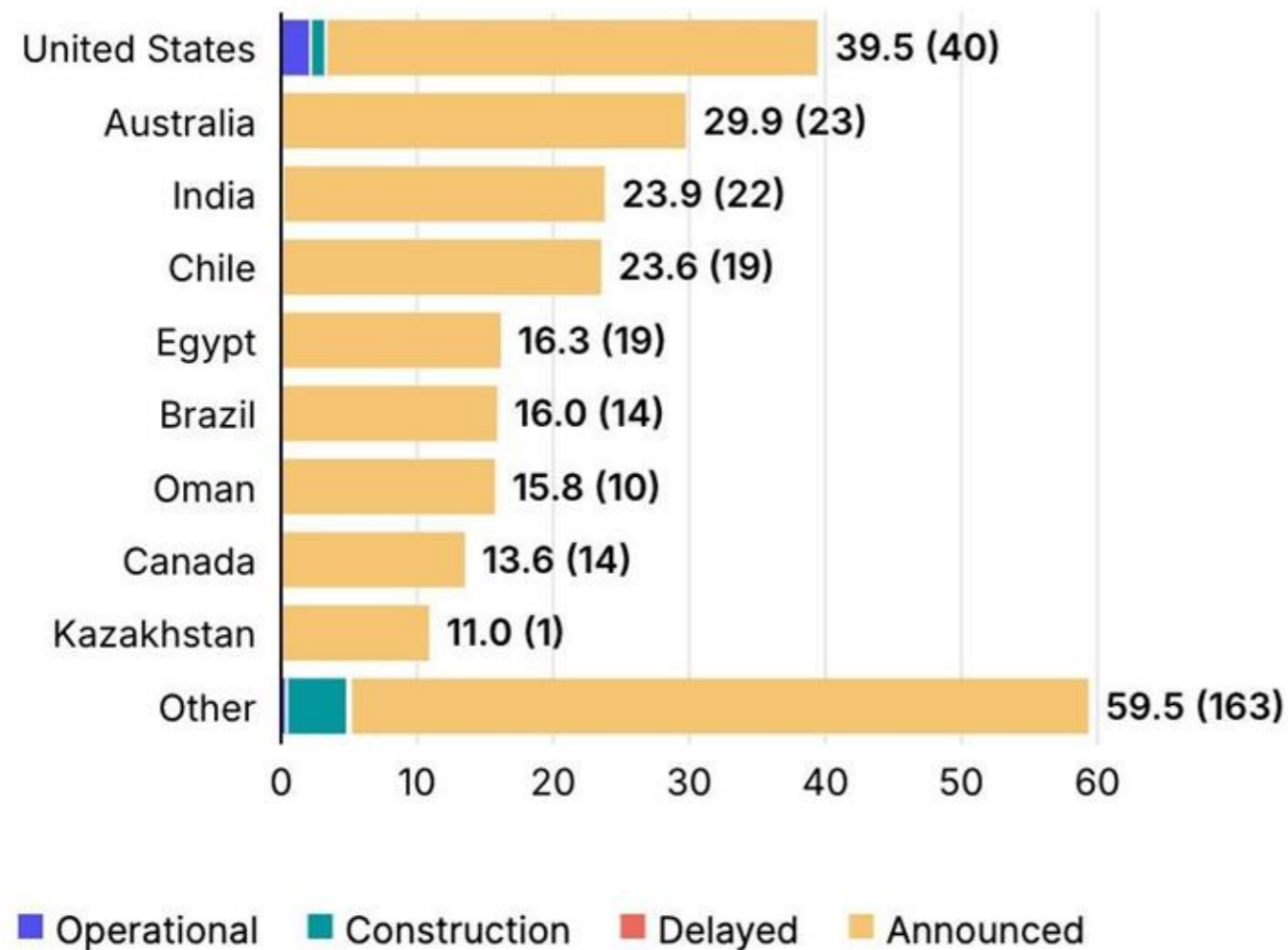
Source: Sightline Climate

**Blue vs green isn't a race, it's a transition.** Blue ammonia is quietly leading the near-term buildout: projects like Woodside Beaumont (1.1Mt/yr, 2025), CF Industries Donaldsonville (1.7Mt/yr, operational), and the Qatar Ammonia-7 project (1.2Mt/yr, 2026) are already in construction or production, leveraging existing gas infrastructure and US 45Q tax credits. By contrast, only one large-scale green project is under construction (NEOM). The vast green pipeline doesn't begin to dominate until 2028–2030, when over 80Mt/yr of green capacity is targeted, almost entirely at the "Announced" stage with no FID. This aligns with a large increase in CBAM tariffs, making green ammonia's higher premium competitive.

**2030 looms as the sector's credibility test:** 48Mt/yr is targeted for that year alone, and none of it has broken ground despite a 2-3 year average construction time. The largest 2030 projects, Mundra (5.6Mt), Kakinada (5Mt), Suez (2.3Mt), are all green ammonia mega-projects in India and Egypt that would each require gigawatt-scale renewable buildouts and electrolyzer procurement that hasn't yet been contracted. The more encouraging signal is on the demand side: offtake contracts have risen steadily from 3 in 2020 to 18 in 2024, with buyers like JERA, Yara, and E.ON making increasingly large commitments. Japan's 15-year price-gap subsidies for ammonia imports awarded in late 2025 should unlock more firm commitments.

# Countries are driven by their natural resources - either cheap gas or cheap power

## Ammonia pipeline by country (Mt/yr)



**Note:** Data labels are total capacity and (project count).

Source: Sightline Climate

**The technology choice in each country is dictated by its resources.**

The US dominates blue ammonia (28 Mt/yr) because it combines the world's cheapest natural gas, proven CCS geology along the Gulf Coast, and \$85/t tax credits under 45Q. India, Chile, Egypt, Morocco, and Brazil are pursuing almost exclusively green ammonia, leveraging solar and wind resources with levelised power costs below \$20/MWh in many cases, giving them structurally low opex once electrolyser capital is absorbed. Australia and Canada are hedging across both pathways, with a combination of cheap gas and power. The differentiator will be which projects can leverage existing port and logistics infrastructure.

**Green projects are predominantly export-oriented**, targeting regions willing to pay a decarbonisation premium. The EU is the strongest demand pull, driven by CBAM: Yara, E.ON, Uniper, and S.E.T. Select Energy have all signed offtake contracts, and projects across Norway, Morocco, Chile, Brazil, and Egypt explicitly reference European market access. Japan remains the other major anchor through its price-gap subsidies and JERA's co-firing programme. South Korea, once expected to be the third pillar of Asian demand, effectively withdrew in October 2025 when it cancelled the Clean Hydrogen Power Generation (CHPS) bidding intended to subsidize ammonia co-firing, as the new administration's 2040 coal phase-out rendered it uneconomic.



## 2G Ethanol: What's changed

### Current capacity breakdown (up to March 2026)

 **423 kt/yr announced**

 **178 kt/yr in construction**

 **611 kt/yr operational**

 **334 kt/yr delayed**

 **342 kt/yr canceled**

### Notable new project announcements from 2025

**2G Ethanol had a slow end to 2025.** There have been no major project announcements since Q4 of 2025, indicative of the slow pace of progress in this sector. There were some notable exceptions earlier in the year:

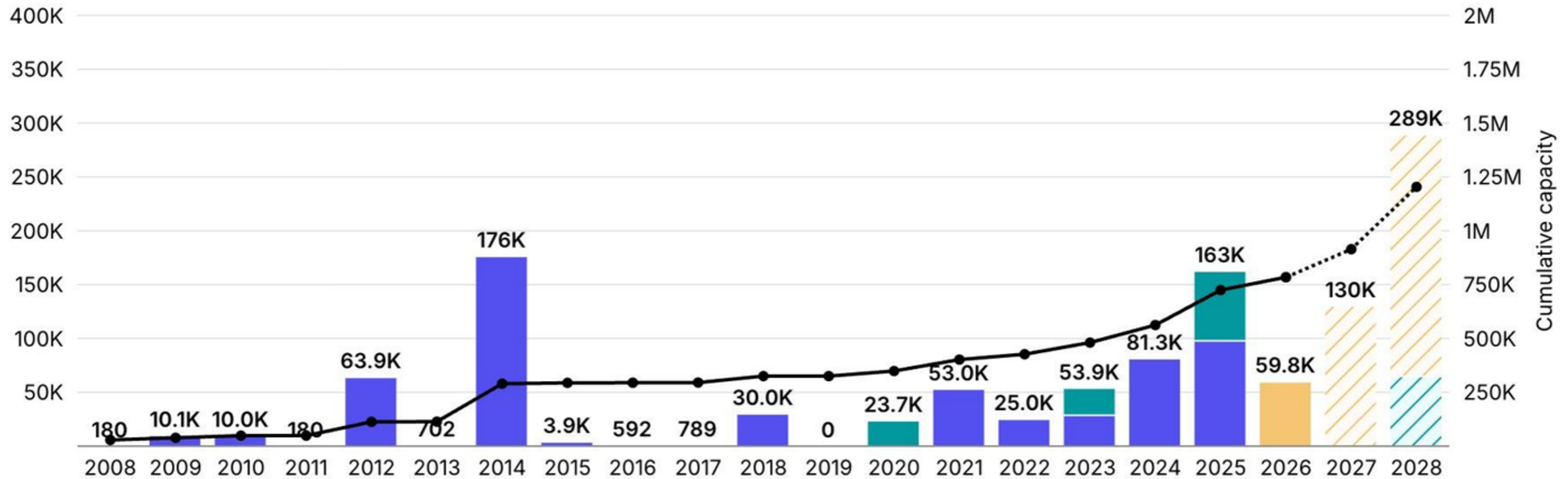
**Exygen I, 143kt/yr, Brazil.** GranBio and a consortium of Brazilian sugarcane ethanol companies announced a new 143kt/yr, \$250m plant in January 2025.

**Raízen Costa Pinto discontinuation.** As part of their 7-plant buildout of new 2G ethanol, they shut down commercial operations of Costa Pinto to use it as an R&D and research facility in January 2025.

**Saffire Renewables Acquisition.** Conestoga Energy acquired the 2G-ethanol-to-SAF technology and project developer in August 2025.

# A slow resurgence, but if Raízen fails, the rest of the industry goes with it

## 2G Ethanol pipeline by operational date (Mt/yr)



■ Operational ■ Construction ■ Announced — Cumulative capacity (till date) - - - Cumulative capacity (stated) Source: Sightline Climate

**Policy support that never fully materialized left scars on the industry.** The 2011–2015 wave saw a surge of ambitious projects, particularly in the US, backed by expectations of strong renewable fuel mandates and government incentives. When that support fell short, many of these projects were canceled or suspended, contributing to the sector's ~37% attrition rate and over 1 million tonnes per annum of lost capacity. Large-scale US facilities from DuPont (90kt), POET-DSM (75kt), and INEOS Bio (24kt) were among the highest-profile casualties.

**The next wave of capacity is building momentum.** The 2025–2028 pipeline is substantial, led overwhelmingly by Raízen (~614kt/yr across 10 projects out of 800kt total), which benefits from Brazil's deep sugarcane supply chain integration and long-term Shell offtake contracts. But Raízen is now in acute financial distress, with Shell committing ~\$668m to a rescue recapitalisation in March 2026, putting the majority of the global pipeline at risk. Beyond Raízen, the cohort faces its own challenges: securing feedstock at scale, competing with cheaper first-generation ethanol, and proving unit economics without the subsidies early pioneers assumed would arrive.








2/5

# Companies and investment

# HEFA is dominated by big players, with innovators developing the new pathways

Leading SAF developers and tech providers across pathways

					
<b>Headquarters</b>	Espoo, Finland	Charlotte, North Carolina	Great Falls, Montana	Deerfield, Illinois	Karlsruhe, Germany
<b>Stage, market cap</b>	Public • \$22bn	Public • \$152bn	Private • Unknown	Private • \$700m	Series B • Unknown
<b>Technology</b>	HEFA	HEFA	HEFA	Alcohol-to-jet	e-SAF
<b>Deployment stage</b>	Commercial	Commercial	Commercial	Demonstration	Pilot
<b>Business model</b>	Project development, oil refining	Tech development and licensing	Project development	Tech development, project development	Tech development, project development
<b>Key partnerships</b>	<ul style="list-style-type: none"> <li>• <a href="#">United Airlines</a></li> <li>• <a href="#">Cathay Pacific</a></li> <li>• <a href="#">World Fuel Services</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">bp</a></li> <li>• <a href="#">Cosmo Oil</a></li> <li>• <a href="#">Johnson Matthey</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">DoE LPO</a></li> <li>• <a href="#">Shell</a></li> <li>• <a href="#">Topsoe</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">British Airways</a></li> <li>• <a href="#">IAG</a></li> <li>• <a href="#">Shell</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Sasol</a></li> <li>• <a href="#">GIZ / H2Uppp Chile</a></li> <li>• <a href="#">Rolls Royce</a></li> </ul>
<b>Differentiators</b>	Largest SAF producer, major <a href="#">Singapore</a> and <a href="#">Rotterdam</a> projects online	Largest tech supplier for both HEFA and F-T, building methanol-to-jet tech	Strong feedstock integration, LPO funding, and <a href="#">largest operational project</a> in the US	Only commercial-scale ETJ plant in operation ( <a href="#">Freedom Pines, GA</a> ); patented ATJ technology;	Modular Power-to-Liquid approach for distributed deployment; operates world's largest e-SAF plant ( <a href="#">Frankfurt</a> )

Source: Sightline Climate

# Production, tech, and demand are dominated by the traditional ammonia players

Largest project and technology developers in low-carbon ammonia



**TOPSOE**



Headquarters

Oslo, Norway

Deerfield, Illinois

Gurugram, India

Lyngby, Denmark

Houston, Texas

Stage, market cap

Public • \$125bn

Public • \$17bn

Public • \$1.5bn

Private • \$1.5bn

Public • \$4.8bn

Technology

Blue and green ammonia

Blue ammonia

Green ammonia

Blue and green ammonia

Blue and green ammonia

Deployment stage

Commercial

Commercial

Commercial

Commercial

Commercial

Business model

Integrated producer, trader, and distributor

Project development and production

Project development

Tech development and licensing

Tech development and licensing

Key partnerships

- Air Products
- ACME
- NYK Line

- JERA & Mitsui
- Occidental
- ExxonMobil

- IHI Corp
- Scatec
- Yara

- First Ammonia
- ACWA Power
- Mintal Hydrogen

- OCI
- INPEX
- Indorama

Differentiators

Only company that spans the full value chain — production, shipping, trading, and demand (fertilizer production)

Ammonia incumbent developing Blue Point, which will be the world's largest low-carbon ammonia plant

Renewable developer operating existing world-first solar green ammonia pilot. Building large Indian ammonia project.

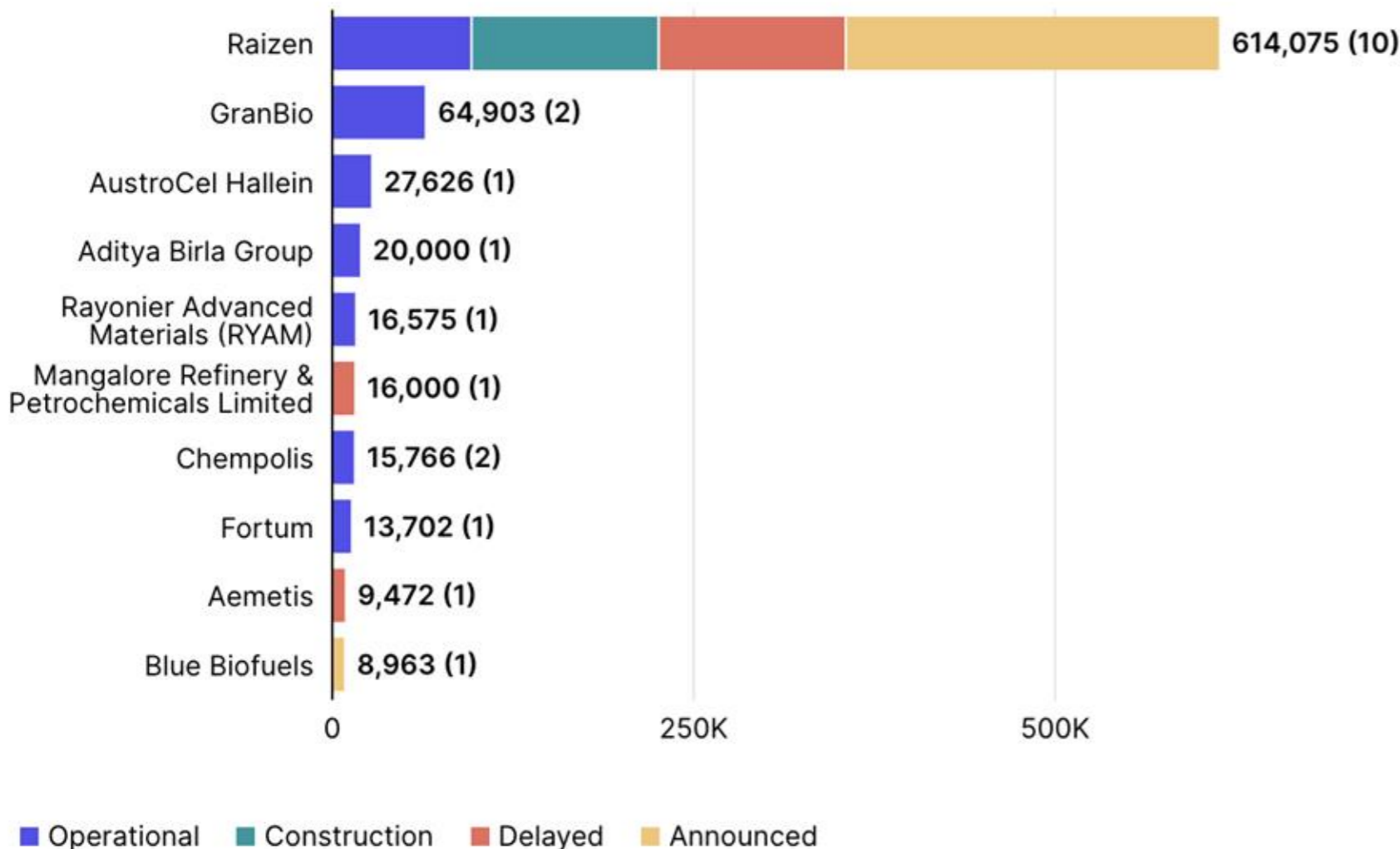
Second largest ammonia tech provider globally. Tech includes both hydrogen electrolysis and ammonia synthesis

Largest ammonia tech provider – almost 50% of global capacity. Tech portfolio with green, blue, cracking, and conventional ammonia

Source: Sightline Climate

# The 2G ethanol industry depends on Raízen, which is facing financial difficulties

## 2G Ethanol pipeline by owner (t/yr)



Note: Data labels are total capacity and (project count).

**Raízen’s all-or-nothing strategy made it the 2G ethanol leader.** By committing to multiple projects simultaneously and integrating them into existing sugarcane operations, the company has pushed the technology beyond demonstration plants toward an industrial rollout.

**Brazil’s sugarcane system provides a unique platform for scaling cellulosic ethanol.** Residues such as bagasse and straw can be processed alongside conventional ethanol production, allowing developers to expand fuel output using existing logistics, feedstock supply chains, and mill infrastructure.

**Financial pressures that could affect the pace of its expansion.** Rising debt levels required to pursue new projects, credit downgrades, and weaker operating performance due to drought and wildfires have forced the company to reassess capital spending. It is exploring restructuring options, raising uncertainty around the timeline for bringing new projects online.

**Advantages**

- Tech readiness:** First company to commercialize large-scale sugarcane cellulosic ethanol
- Massive scale pipeline:** ~614 kt/yr across 10 projects (25% of global pipeline)
- Established supply chain:** Draws feedstock from existing sugarcane mills and bagasse feedstock

**Challenges**

- Financial stress:** High leverage and credit downgrades threaten expansion plans
- Pipeline concentration risk:** Global deployment dependent on Raízen
- Capital intensity:** Cellulosic biomass is expensive to process, economies of scale might not be enough



3/5

# Scoreboards and benchmarks

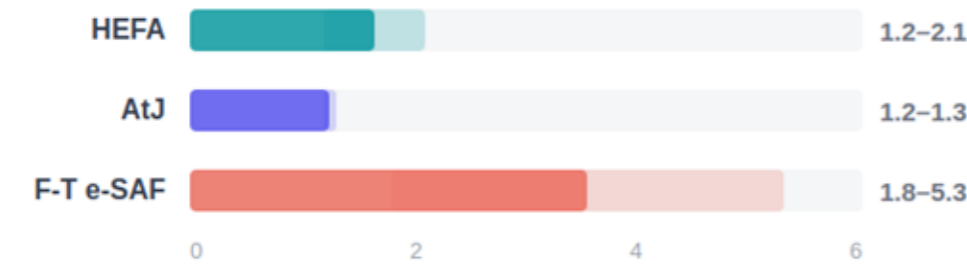
# HEFA dominates on cost and readiness, but feedstock constraints cap its ceiling

## SAF benchmarks across the three main pathways

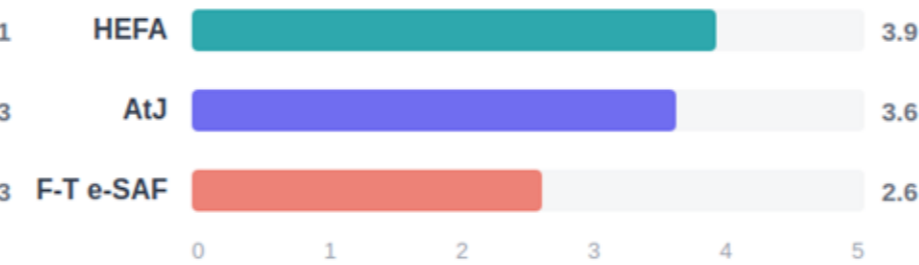
HEFA holds a dominant lead, but AtJ is close behind

HEFA Alcohol-to-Jet F-T e-SAF

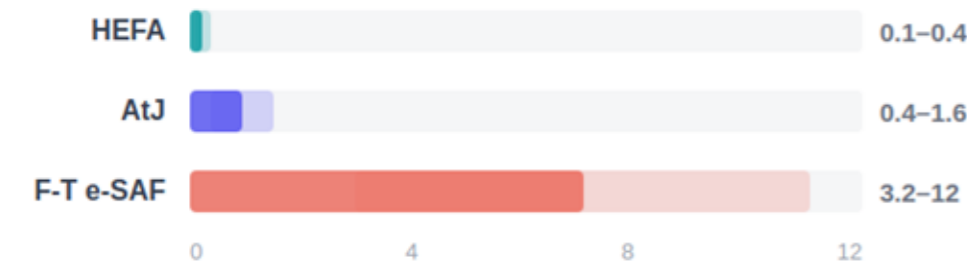
CURRENT PRICE (\$/L)



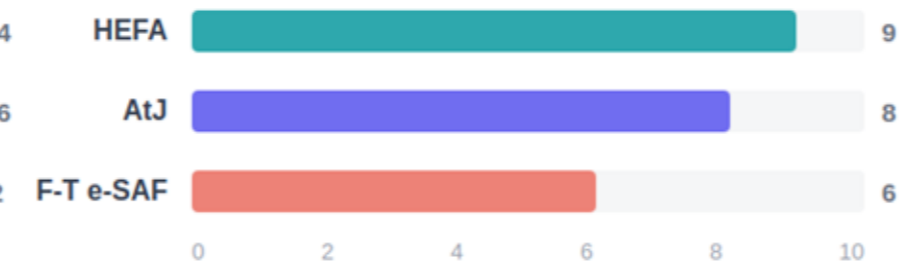
MARKET READINESS (OUT OF 5)



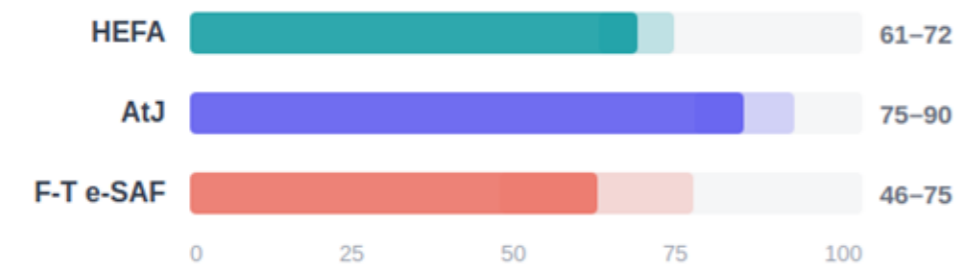
CAPEX (\$/L CAPACITY)



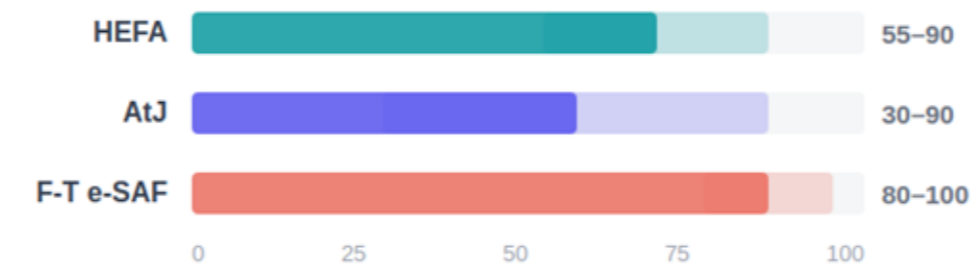
TECH READINESS LEVEL



MAX SAF YIELD (%)



EMISSIONS REDUCTION (% VS JET A)



**HEFA is the only fully commercial SAF pathway today**, with the lowest capex and a tech readiness level of 9. Refinery infrastructure can be retrofitted quickly, but yield tops out at 72%, with lower-value naphtha output narrowing margins.

**Alcohol-to-Jet is the strongest challenger**, nearly matching HEFA on price and outperforming it on selectivity at 75–90%. A TRL of 8 and readiness score of 3.6 put it on the cusp of commercial deployment — it just needs more runtime from existing projects to build investor confidence.

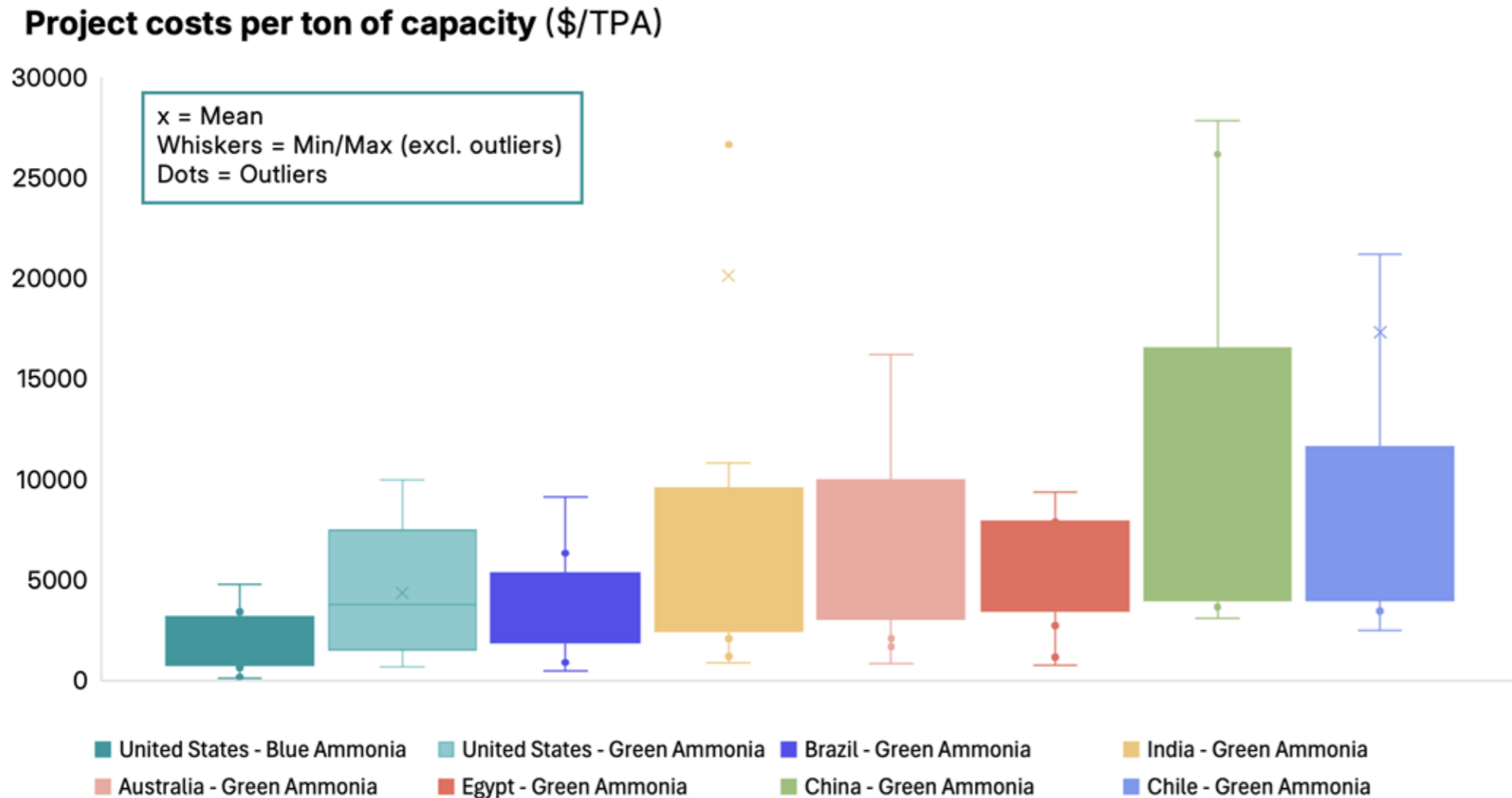
**F-T e-SAF offers the deepest emissions reductions (80–100%)** but remains far behind on cost and readiness. Its theoretically unlimited (but expensive) feedstocks and guaranteed demand through RefuelEU make the case for deployment.

**Feedstock is the most decisive differentiator**, and the one least likely to converge with scale. HEFA will remain structurally capped by finite waste oil supply, while AtJ can draw on a US ethanol market 25 times larger. E-SAF's long-term competitiveness hinges on whether hydrogen and CO<sub>2</sub> costs fall fast enough to close the gap.

Source: Sightline Climate technology profiles, April 2025. Ranges reflect variation by feedstock, scale, and configuration.



# The US is a surprisingly cheap place to build low-carbon ammonia



Source: Sightline Climate // Projects above \$30k/TPA not shown but are included in the analysis.

**US cost advantage comes from existing oil and gas infrastructure.** US blue ammonia comes in at \$2,000–5,000/TPA (roughly half the cheapest green projects anywhere) driven by existing gas infrastructure, Gulf Coast logistics, and lower financing costs from creditworthy incumbents.

**Chinese costs are inflated by bundled power generation.** Projects like Green Port Hydrogen City and Tongliao exceed \$20,000/TPA because they include dedicated renewables in their capex. This is partly a necessity under China's green hydrogen certification rules, but also an advantage that locks in long-term energy costs and avoids PPA renegotiation risk. Strip out the power component and they'd likely fall closer to the \$6,000–8,000/TPA range seen elsewhere.



4/5

Policy

# SAF: Mandates in Europe are better than credits in the US

## ReFuel EU Aviation

**Location:** European Union

**Sectors:** SAF

**Status:** In force since 1 Jan 2025

**The numbers:**

2% SAF mandate from 2025

6% by 2030 (incl. 1.2% e-fuels)

70% target by 2050

**Implementation:**

Applies to all departing EU flights. SAF is currently ~3x cost of fossil jet fuel. Airlines will decarbonize certain airports/routes first, then will need to have SAF at all airports from 2035

**Implications:** Guaranteed market for SAF across the EU

**Key companies affected:**

Air bp, TotalEnergies, Neste, SkyNRG, all EU airlines

## 45Z Tax Credit

**Location:** United States

**Sectors:** SAF, RD

**Status:** Active 2025–2029

**The numbers:**

**\$1.75/gal** max SAF credit in 2025

**\$1.00/gal** max SAF credit from 2026

**\$1.00/gal** max non-SAF fuel credit

**Implementation:**

Credit tied to lifecycle GHG via GREET model. From 2026, feedstocks must be from US/Canada/Mexico. ILUC excluded from CI calculations

**Implications:** Extra revenue stream for SAF producers in the US

**Key companies affected:**

Montana Renewables, World Energy, Gevo, LanzaJet, Valero

## UK SAF Revenue Certainty Mechanism

**Location:** United Kingdom

**Sectors:** SAF

**Status:** TBD SAF Bill introduced May 2025

**The numbers:**

2% SAF mandate from 2025

10% by 2030, 22% by 2040

**Strike price** via CfD contracts

**Implementation:**

Govt pays the difference if prices fall below strike; producer repays if above. HEFA excluded

**Implications:** Non-HEFA SAF producers get a leg up in the UK

**Key companies affected:**

Velocys, Alfanar, Arcadia eFuels, IAG, British Airways

# Ammonia: Europe gets a big stick with CBAM, while Japan offers a carrot

## EU CBAM

**Location:** European Union

**Sectors:** Cement, steel, aluminium, fertilisers, hydrogen, electricity

**Status:** Active since 2026

### **The numbers:**

**2.5%** 2026 free allowances phase out

**100%** full cost applied by 2034

**50t** de minimis threshold exempts  
~90% of importers

### **Implementation:**

Ammonia importers must purchase CBAM certificates priced at EU ETS rates

**Implication:** Both foreign and domestic ammonia suppliers to the EU are incentivized to go blue or green

### **Key companies affected:**

OCI, Yara, CF Industries, SABIC, Trammo, all EU fertiliser importers

## 45Q Tax Credit

**Location:** United States

**Sectors:** CCS at industrial facilities, power plants, DAC

**Status:** Active since 2021

### **The numbers:**

**\$85/t** CO<sub>2</sub> stored or utilised (with wage req.)

**\$180/t** for direct air capture (with wage req.)

**12 yr** credit period; construction by 1 Jan 2033

### **Implementation:**

OBBB equalised credit for all end-uses (storage, EOR, utilisation)

**Implication:** Blue ammonia has extra revenue available in the US

### **Key companies affected:**

CF Industries, ExxonMobil, Wabash Valley, Denbury, Summit Carbon

## Japan Price-Gap Support

**Location:** Japan

**Sectors:** Low-carbon H<sub>2</sub>/ammonia

**Status:** Active since 2024

### **The numbers:**

**¥3T** (~\$19B) budget over 15 years

**70%** min GHG reduction vs. fossil comparator

**12Mt** hydrogen target by 2040 (incl. ammonia)

### **Implementation:**

CfD-style subsidy via JOGMEC. Bridges gap between low-carbon fuel cost and fossil reference price

**Implication:** Projects that can win funding under the program have a competitive advantage

### **Key companies affected:**

JERA, Mitsui, CF Industries, Tosoh, IHI, Hokkaido Electric

## 2G Ethanol: Stacking credits in the US or Brazil goes a long way

### California LCFS

**Location:** California (+ OR, WA, BC)  
**Sectors:** Low-carbon fuels  
**Status:** Amended rules effective 1 Jul 2025

**The numbers:**

**30%** CI reduction target by 2030 (up from 20%)  
**90%** CI reduction target by 2045  
**9%** one-time CI benchmark step-down in 2025

**Implementation:**

2G ethanol earns high credits due to very low CI. Credits tradeable; stackable with RINs and 45Z

**Implication:** CA clean fuels projects have even more incentives

**Key companies affected:**

POET-DSM, Raizen, Clariant, Verbio, all CA fuel blenders

### RINs (D3 Cellulosic)

**Location:** United States (federal)  
**Sectors:** Low-carbon fuels  
**Status:** 2026-27 RVOs proposed Jun 2025

**The numbers:**

**60%** min GHG reduction  
**~\$2.45** avg D3 RIN price (Q1 2025)  
**1.19B** gal cellulosic biofuel mandate

**Implementation:**

2G ethanol qualifies for D3 RINs, the highest-value category. EPA proposing to cut RINs for imported fuels/foreign feedstocks

**Implication:** Domestically produced 2G ethanol have plenty of credits claim

**Key companies affected:**

POET-DSM, Raizen, Valero, Marathon, all obligated refiners

### Brazil Fuel of the Future

**Location:** Brazil  
**Sectors:** Ethanol, biodiesel, SAF, biomethane  
**Status:** Active since 2024; E30 from Aug 2025

**The numbers:**

**E30** mandatory ethanol blend  
**B20** biodiesel blend target by 2030

**Implementation:**

Ethanol blend range expanded to 22-35%. SAF mandate: 1% by 2027, 10% by 2037. CCS regulation under ANP. 2G ethanol benefits from higher blend ceiling.

**Implication:** Brazil wants projects that use every part of the sugarcane

**Key companies affected:**

Raizen, Petrobras, FS Bioenergia, BP, Bunge, Copersucar



5/5

# Content library



# Content Library

## [Sector compasses](#)

[Maritime](#)

[Sustainable Aviation Fuel \(SAF\)](#)

[Methanol](#)

[Low Carbon Transportation Fuels](#)

[Ammonia](#)

[Hydrogen Production](#)

[Hydrogen Transport & Storage](#)

[Renewable Natural Gas \(RNG\)](#)

## [Research](#)

[Clean fuels and the Strait of Hormuz](#)

[AtJ ethanol analysis](#)

[UCO supply analysis](#)

[IMO Delays Net-Zero Framework](#)

[Nuclear Ships](#)

[Gevo's push into SAF](#)

## [Project databases](#)

[All projects dashboard](#)

[2G Ethanol](#)

[Sustainable Aviation Fuel \(SAF\)](#)

[Ammonia](#)

## [Key policies](#)

[CBAM is an €8bn problem](#)

[Germany cuts H2 funding](#)

[EPA new RFS](#)

[ReFuelEU Aviation](#)

[45V Credit](#)

[CA LCFS](#)

## [Tech profiles](#)

[HEFA](#)

[F-T e-SAF](#)

[Alcohol-to-Jet](#)

[F-T bio-SAF](#)

[Methanol-to-Jet](#)

[Alkaline Water Electrolyzer](#)

[Proton Exchange Membrane](#)

[Solid Oxide Electrolyzer](#)

[Anion Exchange Membrane](#)

[Methane Pyrolysis](#)

[Geologic Hydrogen](#)



# Let's build together



**CONTACT**

[sales@sightlineclimate.com](mailto:sales@sightlineclimate.com)

[www.sightlineclimate.com](http://www.sightlineclimate.com)