

Bioeconomy & Low Carbon Technology Overview for September 2024

Our summary of low carbon technology developments for September 2024 is based on data and information collated by Gifford Consulting and provided on the website: [Gifford Consulting](#)

Highlights by Topic: September 2024

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Ammonia production

1. **Ammonia production:** Australia. Allied Green Ammonia (AGA) has picked construction firm Nacap to build the hydrogen pipeline needed for its large-scale green hydrogen and ammonia facility in the Northern Territory of Australia which is expected to produce nearly one million tonnes of green ammonia fuel per year. The Gove facility is expected to be capable of producing 486 tonnes per day of green hydrogen for an annual output of 960,000 tonnes of green ammonia onsite. The project will utilise 4.75GW per hour of solar electricity.
2. **Ammonia production:** Australia. Allied Green Ammonia Pty Ltd has hired Affinity Capital Group as a lead manager and strategic financial adviser to help it raise about USD 6.5 billion (EUR 5.90bn) for the development and construction of a large-scale green hydrogen and ammonia facility in the Northern Territory of Australia. The site will be capable of producing 486 tonnes per day of green hydrogen for an annual output of 960,000 tonnes of green ammonia onsite. The project envisages the utilisation of 4.75GW per hour of solar electricity. Once operational, it will provide low-carbon e-fuels to key trading partners in Australia.
3. **Ammonia production:** Denmark. Skovgaard Energy ApS, Topsoe A/S and global wind turbine technology major Vestas A/S have opened REDDAP, a dynamic Power-to-Ammonia demo plant in Ramme outside Lemvig in Northwest Jutland. The Renewable Dynamic Distributed Ammonia Plant (REDDAP) in Ramme will demonstrate a dynamic approach, which entails that the Power-to-Ammonia plant will adapt to the inherent fluctuations in power output from renewable power sources which is integrated with the plant's electrolysis and ammonia synthesis loop.
4. **Ammonia production:** India. Torrent is planning to invest INR 72 billion to set up a green ammonia production facility with an annual output of 100,000 tonnes. This plant is part of the company's strategy to expand in the green hydrogen sector and create opportunities for export and domestic markets.
5. **Ammonia production:** Morocco. Australian company, Worley, will begin its initial technical design work in September 2024 for a groundbreaking green ammonia project in Tarfaya, Morocco by OCP Group. This project, the world's first Power-to-X green ammonia program, which will use wind and solar energy to produce green ammonia. Scheduled to be operational by 2027, the project will initially produce one million tons of green ammonia annually, with plans to triple this capacity by 2032. This initiative aligns with Morocco's commitment to renewable energy and is part of a \$7 billion investment by the OCP Group in green hydrogen and ammonia production.
6. **Ammonia production:** The fuel consumption of all ships was estimated to be 200 million tonnes in 2020, which corresponds to roughly 500 million tonnes of ammonia on an energy basis. Since shipping fuel demand is also expected to increase further, the current production of ammonia can only cover a moderate fraction of the demand for marine fuels. The production cost of renewable ammonia will largely depend on these major parameters: The price of renewable electricity (Solar/wind/hydro etc.); Infrastructure and capital expenditure; Electrolyzer technology for electrolysis and synthesis of Ammonia.
7. **Ammonia production:** USA. First Ammonia has secured a significant boost in its efforts to revolutionize green ammonia production, announcing progress in its Series B funding round. With investments from global players, including Mercuria Holdings and the Tokyo-based Manies Group, the company aims to advance the development of its flagship facility in Victoria, Texas.
8. **Ammonia production:** USA. Ohmium announced with Houston based Ten08 Energy the launch of a 500MW clean ammonia project in Texas to produce 1.4 million metric tons of

ammonia annually. The project will use green hydrogen from Ohmium's Proton Exchange Membrane electrolyzers and blue ammonia from Ten08's carbon-captured natural gas operations. Initially starting with 200MW of capacity, the project will scale up to 500MW over time. Located on the Texas Gulf Coast, this joint initiative is designed to meet the rising global demand for low-carbon solutions in industries such as fertilizer production, power generation, and shipping.

Biobased chemicals

9. **Biobased chemicals:** USA. Exel Composites has announced a new purchasing agreement with chemical manufacturing giant INEOS for over 100 metric tons of its ENVIREZ bio-based resin system. Exel hopes to lead the composites industry towards a more sustainable future with zero change in material performance.

Biofuels

10. **Biofuels:** Italy. Eni is involved in discussions over the potential sale of a second stake in its biofuel unit Enilive as the Italian group discusses the final details of a deal to sell a stake in the unit to KKR. The Italian energy group in July entered talks with U.S. investment firm KKR over the sale of a 20-25% stake in Enilive, based on a valuation of the company of between 11.5 billion and 12.5 billion euros (\$12.8-13.9 billion). There are signs that negotiations with KKR could end successfully. With sources indicating that KKR would likely buy 20% of Enilive.
11. **Biofuels:** Australia. Comstock Inc. on Sept. 18 announced the execution of a binding agreement between Comstock Fuels Corporation and SACL Pte. Ltd., a Singapore-based renewable fuel project developer, engaged in the delivery of several biofuel production facilities and hybrid renewable energy projects under which Comstock Fuels agreed to grant SACL an exclusive marketing agreement for Comstock Fuels' advanced lignocellulosic biomass refining processes in Australia and New Zealand. SACL and its associated stakeholders have identified three initial sites for the construction of three refineries based on Comstock's industry leading yields and decarbonizing impacts, including (1) a 250,000 metric ton per year (MTPY) refinery located in southeastern Australia, (2) a 250,000 MTPY refinery located in northwest Australia, and (3) a 750,000 MTPY refinery located on the east coast in northern Australia. Under the terms of Comstock Fuels' agreement with SACL, Comstock Fuels will contribute site specific technology rights in exchange for a 20% equity stake in each refinery, plus a royalty fee equal to 6% of each refinery's sales of licensed products, and engineering fees equal to 6% of total capital and construction costs.
12. **Biofuels:** Australia. Rio Tinto has initiated a biofuel pilot in north Queensland, Australia, to assess the viability of pongamia tree seed oil as a feedstock for renewable diesel production. Spanning 3,000 hectares of farmland and managed in partnership with Midway Limited, the project seeks to reduce the miner's dependency on fossil fuels. Pongamia is a hardy legume native to Australia, is well-suited to adverse climates and produces oil-rich seeds that can be harvested annually.
13. **Biofuels:** Brazil. General Motors will begin producing its first-ever hybrid-flex vehicles that can run on 100% ethanol or gasoline alongside their batteries in Brazil. The expected production and sale of hybrid-flex cars in Brazil is part of a \$1.42 billion investment plan in the country.
14. **Biofuels:** USA. Gevo is set to acquire Red Trail Energy's ethanol and carbon capture facilities in North Dakota for \$210 million. The deal boosts Gevo's push for sustainable aviation fuel and low-carbon products, adding a key carbon sequestration site with a million-ton capacity.

15. **Biofuels:** USA. Less than two weeks after Fulcrum BioEnergy Inc. and affiliated companies filed for Chapter 11 bankruptcy protection, the assets of Fulcrum Sierra Biofuels LLC and Fulcrum Bioenergy Inc. are being offered for sale at auction. Switch Ltd. has submitted a stalking horse bid of \$15 million for the assets of Fulcrum Biofuels.

Biogas

16. **Biogas:** Denmark. Electrochaea has developed a technology to produce synthetic methane. As an energy source, synthetic methane is virtually CO₂-neutral, can replace fossil natural gas and can be stored and transported in the existing gas grid. To produce it, Electrochaea uses archaea, billion-year-old microorganisms, which convert green hydrogen and recycled CO₂ into synthetic methane in bioreactors.
17. **Biogas:** EU. Toyota Motor Europe, Ford of Europe, and another major European automaker have joined its Sail for Change program to use bioLNG-fuelled vessels for transporting vehicles across Europe. The bioLNG, supplied by Titan Clean Fuels and bunkered at the Port of Zeebrugge, enables UECC (United European Car Carriers) to carry out carbon-neutral cargo operations across its network. Participating manufacturers will benefit from lower Scope 3 emissions and reduced costs related to the EU Emissions Trading System, which is set to impact maritime transport next year.
18. **Biogas:** Finland. Hycamite TCD Technologies launched Europe's largest methane-splitting plant in Kokkola, Finland, capable of producing 2,000 tonnes of low-carbon hydrogen and 6,000 tonnes of high-quality carbon annually. The facility, located in Kokkola Industrial Park, aims to decarbonize industries by preventing up to 18,000 tonnes of CO₂ emissions each year through its innovative methane-splitting process, which decomposes methane into hydrogen and carbon without releasing greenhouse gases. Hycamite's technology requires just 13% of the energy needed for hydrogen production via electrolysis, allowing for rapid scaling. The hydrogen produced can be used as an industrial raw material or clean fuel, while the carbon is captured in solid form and sold as graphite and other valuable products.
19. **Biogas:** Germany. Reverion, a German company that has developed innovative, reversible power plants that generate electricity from biogas while capturing and utilizing CO₂ emissions, has secured \$62 million in Series A funding. The round was led by Energy Impact Partners, with participation from Honda and the European Innovation Council Fund. The company's technology has been designed to overcome the limitations of conventional power generation from biogas, allowing operators to generate more revenue from the same biomass. Unlike traditional gas engines, which are inefficient and emit significant amounts of CO₂, Reverion's fuel cell-based plants achieve up to 80% efficiency in power generation, doubling the electricity output of gas engines.
20. **Biogas:** Malaysia. MRNA Scientific Sdn. Bhd., a subsidiary of BioNexus Gene Lab Corp., and Protech Builders Sdn. Bhd. have agreed to jointly develop and operate biogas plants across Malaysia. This collaboration marks a significant step in both companies' efforts to contribute to Malaysia's growing renewable energy sector, particularly in the generation of biogas from plantation wastewater.
21. **Biogas:** South Korea. Anaergia Singapore was chosen to design and construct a biogas plant on Jeju Island, South Korea, with a project valued at C\$25 million. The facility will utilize Anaergia's Omnivore™ anaerobic digestion technology to process 50,000 tons of organic waste annually, sourced from local slaughterhouses, citrus juice plants, and food production facilities.
22. **Biogas:** Spain. Nedgia, the Naturgy Group's gas distributor, has already signed 45 contracts for connection to biomethane plants for the injection of renewable gas into its gas

distribution network. The injection capacity linked to these requests amounts to 2,400 GWh/year, equivalent to the gas consumption of nearly half a million homes in Spain.

23. **Biogas:** United Kingdom. The project to be developed by a Global Sustainable Infrastructure Partners and Circular Economy Development and will convert 120,000 tonnes of food waste annually into 180 MWh of biomethane, with a portion used to generate 5 MW of green electricity. Rubicon's Infrastructure and Energy Transition Debt Fund committed £15 million to finance an anaerobic digestion plant in Wales. The facility is scheduled for commercial operations in 2026 and will reduce landfill waste and provide sustainable energy, aligning with the EU Green Standards for climate change mitigation. The total project cost exceeds £60 million and is to be funded through Rubicon's loan.
24. **Biogas:** USA. Avista, a utilities company that provides electric and natural gas services to areas in Washington, Idaho and Oregon, has issued a request for proposals seeking to secure a long-term supply of renewable natural gas (RNG). Avista anticipates proposals from both new and existing RNG sources, such as landfill RNG, biomass fast pyrolysis synthetic RNG, dairy RNG, food waste RNG, municipal wastewater treatment plant RNG, RNG community portfolios (bundled or unbundled), carbon capture with synthetic RNG byproduct, hydrogen, and other RNG offerings that meet the company's needs.
25. **Biogas:** USA. Synthica Energy commenced development on a new renewable natural gas (RNG) plant in San Antonio. The facility will be the first of its kind in San Antonio and is expected to divert nearly 250,000 tons of waste from local landfills each year. Food and beverage manufacturers and other customers will have less distance to transport their waste, lowering costs and cutting down on their emissions.
26. **Biogas:** USA. The Coalition for Renewable Natural Gas (RNG Coalition) announced a major milestone in the growth of the renewable natural gas industry, with 433 facilities now operational across North America. This achievement represents a significant leap from just a year ago, when the North American RNG industry celebrated the establishment of 300 facilities, marking a remarkable 44% growth within just one year. Dairy farm-to-RNG projects represent another key driver of recent facility growth. Agricultural waste now represents 24% of all feedstocks deployed toward RNG production, marking a new all-time high and an increase from 17% of all feedstocks just a year ago.
27. **Biogas:** USA. Unconventional Gas Solutions, a specialist in gas upgrading systems, announced the successful commissioning of two innovative biogas upgrading plants in Michigan and Wisconsin. The projects were particularly challenging due to the change in operating procedures and the high grid requirements. The first commissioning, the Three Petals RNG plant in Berlin, Wisconsin, was followed by the second: the Red Leaf RNG plant at the Maple Row Dairy Farm in Saranac, Michigan. Both plants process H₂S concentrations of more than 4,000 ppm, which are sent directly into the compressor of the gas treatment plant and then directly through the first membrane stage. Instead of focusing on protecting the membrane treatment system, Novilla and UGS opted for an unconventional approach: the system uses a multi-stage, membrane-based treatment process that tolerates very high H₂S concentrations of up to 30,000 ppm.

Biojet/SAF

28. **Biojet/SAF:** Brazil. Petrobras is exploring the production of jet fuel from corn or sugarcane-based ethanol as part of its major \$16.7 billion investment package through 2028. To make the investment work, ethanol pipelines would likely be required to supply the feedstock directly to refineries. Brazil is pushing for SAF as part of a recent bill that was approved increasing a range of biofuel mandates.

29. **Biojet/SAF:** Canada. Simply Blue Group has announced the Goldboro site in Nova Scotia, Canada formerly proposed as Goldboro Liquefied Natural Gas Project, as the location for their major sustainable aviation fuels hub. The project in Goldboro will utilize renewable electricity generated from Simply Blue Group's solar and wind farms in the Municipality of the District of St. Mary's. A dedicated transmission line will connect these facilities, ensuring a seamless flow of self-produced power. This renewable energy, along with Nova Scotia's sustainable biomass and water resources, will be utilized to produce approximately 150,000 metric tons of SAF per year.
30. **Biojet/SAF:** Fiji. Fiji Airways, Fiji Sugar Corporation Limited and Lee Enterprises Consulting have commenced an evaluation of sustainable aviation fuel production in Fiji. This initiative has the potential to support sustainable aviation and agriculture in the Pacific region, as well as to create new economic opportunities for local farmers and communities in Fiji. It's funded by the Asian Development Bank. The project is focused on establishing a comprehensive SAF production and utilization model in Fiji that uses sugar cane and its waste products as inputs to ethanol production and additional sources of energy, which can subsequently be processed into SAF. The study will evaluate molasses, sugar, bagasse, and biomass as potential feedstocks for SAF production.
31. **Biojet/SAF:** Finland. Flying Forest Limited, a UK-based biofuels company specializing in the development of SAF, has ensured the purchase of a 26.8-hectare site in Iisalmi, Finland. This land procurement marks a significant step towards establishing the first SAF production facility and biofuels research centre in the region.
32. **Biojet/SAF:** France. Haffner Energy is creating SAF Zero, a spin-off focused on the SAF market. This initiative leverages Haffner Energy's unique technology, backed by 30 years of experience and 80 international patents, positioning SAF Zero to capitalize on the growing demand for SAF and become a key player in the SAF industry. The SAF market is expected to attract over \$1 trillion in investments by 2050.
33. **Biojet/SAF:** France. TotalEnergies and Air France-KLM have signed an agreement for TotalEnergies to supply up to 1.5 million tons of more SAF to Air France-KLM Group airlines over a 10-year period, until 2035. This agreement marks one of the largest SAF purchase contracts agreed to by Air France-KLM to date. In 2022 and 2023, Air France-KLM was the world's leading SAF user, representing 17% and 16% of total global production respectively.
34. **Biojet/SAF:** Iceland. Haffner Energy, and IðunnH2, a green hydrogen developer, signed an agreement aimed at integrating Haffner Energy's unique technology in the 65,000 tonnes/year e-SAF facility under development by IðunnH2. The project is located near Keflavík International Airport in Iceland. The project combines green hydrogen from Iceland's renewable power grid with competitive biogenic carbon from Haffner Energy's patented biocarbon gasification technology to produce Sustainable Aviation Fuel (SAF). Haffner Energy's innovation consists of supplying solid biocarbon (biochar), a byproduct of its biomass thermolysis technology) and gasifying it onsite generating a fundamental change in the economics of e-SAF production.
35. **Biojet/SAF:** Indonesia. Virgin Australia has become the first international airline to use the sustainable aviation fuel produced by Indonesia's state-owned energy company Pertamina. Pertamina's SAF is a 38.43% blend of synthetic kerosene produced from Used Cooking Oil and 61.57% conventional jet fuel.
36. **Biojet/SAF:** Italy. NEXTCHEM (Sustainable Technology Solutions), through its subsidiary NextChem Tech, signed a binding Term Sheet with Sarlux S.r.l. – a company belonging to the Saras Group – including the main terms and conditions to act as engineering services and technology provider for the implementation of a pilot plant in Sarroch's facility (Sardinia,

Italy). NextChem Tech will also integrate its own NX CPO technology, which makes synthesis gas through a catalytic partial oxidation, into the process. When NX CPO technology is used for synthetic fuel production, it boosts the overall efficiency of the process by recovering and reusing the hydrogen and carbon in the off-gases, thus reducing CO2 emissions.

37. **Biojet/SAF:** South Korea. SK Energy Co., South Korea's largest oil refiner, is set to start commercial operations of a production line for sustainable aviation fuel. The refiner is planning to manufacture low-carbon fuels. SK Energy installed a five-kilometre pipeline to a bio-material storage tank to supply the renewable feedstock to a petroleum product manufacturing processes for continuous SAF production. The refiner is using co-processing technology.
38. **Biojet/SAF:** The Netherlands. Gunvor Group ("Gunvor") will join VARO Energy ("VARO") in building a large-scale SAF manufacturing facility at the Gunvor Energy Rotterdam site. The facility will process a variety of feedstocks. It will also have the capability to produce either SAF or HVO end products, allowing VARO and Gunvor to capture potential value by switching depending on market conditions and regulatory requirements.
39. **Biojet/SAF:** Uruguay. Avalon BioEnergy Uruguay S.A., a subsidiary of the U.S.-based Avalon Energy Group LLC, launched development for its first fully integrated Agriculture- SAF biorefinery in Latin America, located in Uruguay. The project has been designated as a high-impact clean energy initiative of national interest and has a projected cost of \$380 million. Production will be 100,000 MT per year utilizing the Hydrotreated Esters and Fatty Acids (HEFA) process. The project also includes the development of a 50 MW solar power plant to produce green hydrogen.
40. **Biojet/SAF:** USA. Aether Fuels signed a MoU with JetBlue. Aether has developed a breakthrough technology that utilizes a diverse array of waste feedstocks to produce sustainable liquid fuels at a lower cost and greater scale than existing technologies. The agreement creates a pathway for Aether to supply JetBlue with SAF.
41. **Biojet/SAF:** USA. Flint Hills Resources in collaboration with Delta Air Lines is in the early stages of developing a facility to blend up to 30 million gallons of neat SAF at its Pine Bend refinery in Rosemount. This work is expected to be completed in the fourth quarter of 2025. Shell will supply the neat SAF and bring its expertise in product quality, supply chains and logistics to the project.
42. **Biojet/SAF:** USA. Honeywell has agreed with USA BioEnergy (USABE) to implement its Experion PKS Distributed Control System (DCS) and safety system at USABE's new Texas Renewable Fuels Bon Wier advanced biorefinery, w. The plant is designed to convert wood waste into SAF. Honeywell Experion PKS will support the Texas Renewable Fuels plant's central control and safety operations, ensuring optimal performance, reliability, and safety. The system's real-time data acquisition, monitoring, and control capabilities will optimise the complex processes involved in converting wood waste into SAF.
43. **Biojet/SAF:** USA. Montana Renewables LLC has produced and shipped to Minneapolis-St. Paul International Airport's (MSP) the first blend of sustainable aviation fuel (SAF). The SAF shipment arrived this month and will be used to fuel Delta Air Lines commercial flights. MRL is an ISCC-approved SAF producer and the SAF being sold to MSP is produced from Minnesota camelina. This project highlights the benefits of shorter local supply chains and is pioneering camelina as a viable non-food oil that provides additional cash crop potential for farmers. Montana Renewables achieved record SAF production of approximately 7 million gallons during the second quarter of 2024.
44. **Biojet/SAF:** USA. Summit Next Gen announced it has closed on its site acquisition for the future development of its previously announced sustainable aviation fuel production

platform. Strategically located on the Houston Ship Channel, the selected 60-acre site will provide Summit Next Gen with substantial optionality to leverage existing and planned marine, pipeline, rail and other logistics infrastructure to cost competitively source ethanol feedstock for the facility and deliver SAF.

45. **Biojet/SAF:** USA. Twelve announced it has raised a total of \$645 million in funding. The firm noted that this raise is a mix of capital which includes \$400 million in project equity led by TPG Rise Climate, \$200 million in Series C financing, and an additional \$45 million in credit facilities from leading funders in the renewable energy sector. This funding is a strategic mix of capital which includes \$400 million in project equity led by TPG Rise Climate, \$200 million in Series C financing, and an additional \$45 million in credit facilities from leading funders in the renewable energy sector. Their projects include the completion of Air Plant One, Twelve's inaugural SAF plant located in Moses Lake, Washington, which is expected to begin production in 2025. TPG Rise Climate has committed up to \$400 million in project equity financing to support the development of future Air Plants.
46. **Biojet/SAF:** USA. DG Fuels, in cooperation with the Nebraska BioEconomy, has selected Phelps County, Nebraska, for its first Midwest production facility. The plant will produce 193 million gallons of zero or low CO₂ lifecycle emissions SAF per year and meet ASTM fuel standards. Production is expected to begin in 2030.

Biomaterials

47. **Biomaterials:** Germany. AustroCel GmbH, one of Austria's leading biorefineries, plans to commence industrial production of a new type of hydrogel granulate in the first quarter of 2025. This innovative product can be used to overcome heat-induced soil dehydration. This product is based on a patent-pending innovation from the start-up company Agrobiogel GmbH, with which Austrocel has been working for some time. It is marketed under the brand name Retentis.
48. **Biomaterials:** USA. Lygos, a sustainable specialty chemical company, announced a MoU agreement with global fermentation and biotechnology leader, CJ BIO, to produce and deliver commercial volumes of high-performing, sustainable products to the market. As part of the partnership, Lygos will develop a commercial-scale biorefinery complex in Fort Dodge, Iowa, combining CJ BIO's expertise in fermentation and biotechnology with Lygos' advanced biology, chemistry and application development technologies for high-performing, solutions.

Biotechnology

49. **Biotechnology:** Romania. International Chemical Investors Group (ICIG) has signed an agreement with Clariant to purchase the decommissioned bioethanol plant in Podari, Romania. The site will be operated by ICIG's biotechnology subsidiary Corden BioChem. As a biotechnology CDMO, Corden BioChem already operates one of Europe's largest fermentation plants at the industrial park in Frankfurt-Höchst, Germany. The acquisition of the Podari site expands Corden BioChem's aerobic fermentation capacities by approximately 1,500 m³ (gross volume).

CO₂ Removal

50. **CO₂ removal:** France. RepAir Carbon US Inc., a developer of a uniquely energy-efficient Direct Air Capture (DAC) technology, and C-Questra, an independent European carbon storage startup, announced a partnership to develop the European Union's first onshore Direct Air Capture and Storage (DACs) project in France. The technology uses a heat-free, ultra-modular electrochemical technology – provided by RepAir – which reduces energy

consumption by 70% compared to conventional DAC solutions by relying solely on electricity. Conventional DAC disadvantages are their high energy consumption, resulting in prohibitive cost at scale. Additionally, these systems rely on solvents and sorbents that require regular replacement and introduce potential health and safety risks. In contrast, RepAir's approach requires only electricity. This technology provides an efficient, cost-effective, safe, and scalable solution for atmospheric CO₂ removal.

51. **CO₂ removal:** Malaysia. Carbon Clean announced a MoU with PETRONAS CCS Solutions Sdn Bhd ("PCCSS"), a subsidiary of Petroliaam Nasional Berhad (PETRONAS) to jointly collaborate and evaluate Carbon Clean's carbon capture and storage technology.

E-Fuels

52. **E-fuels:** Brazil. HIF Global announced its first project in Brazil, after signing a land reservation contract with Port of Açú, one of Brazil's main ports, to develop a facility to produce up to 800,000 tons per year of e-Methanol.
53. **E-fuels:** USA. Infinium, the world's first producer of commercially available ultra-low carbon eFuels, and Brookfield Asset Management have entered into a strategic funding partnership aimed at accelerating the expansion of Infinium's e-Fuels platform. Infinium e-Fuels, which include e-SAF—a next-generation sustainable aviation fuel—are capable of reducing lifecycle greenhouse gas emissions by approximately 90% or more when compared to conventional fuels.

Ethanol

54. **Ethanol:** EU. EU ethanol biorefineries produced more food and animal feed than fuel in 2023, according to audited data released today by ePURE, the European renewable ethanol association. ePURE members – representing 85% of EU installed capacity – and other European producers of renewable ethanol produced 6.5 million tonnes of food and feed co-products including high-protein animal feed and 5.08 million tonnes of renewable ethanol last year. Additional co-products included 1.46 million tonnes of captured biogenic CO₂, another strategic domestic product that replaces fossil CO₂ in beverage and greenhouse applications.
55. **Ethanol:** India. Olam Agri announced a \$60 million investment to develop a multi-input bio-ethanol plant adjacent to its existing sugar factory. The facility is expected to be operational by March 2025 and will produce ethanol from sugarcane and corn, aligning with India's shift to mixed fuels like B20. With this move, Olam Agri plans to double its sugarcane crushing capacity to 8,500 tonnes per day.
56. **Ethanol:** Indonesia. Pertamina New & Renewable Energy announced a partnership to build a bioethanol plant in East Java, with a projected capacity to produce 30,000 kilolitres annually using molasses, a by-product of sugar processing. The bioethanol initiative will also support regional development, creating jobs and improving agricultural productivity by incorporating crops like corn and cassava in East Nusa Tenggara.
57. **Ethanol:** Japan. LanzaTech Global signed a Master License Agreement with Sekisui Chemical to deploy, at commercial scale, a jointly developed platform that converts syngas derived from municipal solid waste (MSW) and industrial solid waste into ethanol. Sekisui intends to build multiple facilities in municipalities across Japan which incorporate equipment packages, engineering and advisory services, consumables, and intellectual property provided by LanzaTech. Sekisui expects its first commercial-scale facility to produce 10 to 12 kilotons of ethanol annually. The ethanol output is synthetic alcohol and can be converted

into ethylene and kerosene for use as SAF as well as other material and chemical applications such as apparel, personal care, and packaging.

Feedstock

58. **Feedstock:** Australia. Australia's agriculture and fuel supply chain have urged the Federal Government to initiate a national low-carbon liquid fuel feedstock strategy to give effect to the ambitious agenda outlined in the Federal Government Aviation White Paper. The industry groups include GrainGrowers, the Australian Sugar Milling Council (ASMC) and Queensland CANEGROWERS Ltd. Low carbon liquid fuels have been identified as a priority industry under the Federal Government's flagship Future Made in Australia program, and a core component for the future net-zero ambitions of the Australian aviation industry.
59. **Feedstock:** USA. Gevo, Inc. has acquired Cultivate Agricultural Intelligence LLC for \$6 million, with the opportunity for the sellers to receive additional earn-out payments. Gevo will fold CultivateAI into its wholly owned Verity subsidiary to accelerate Verity's business development and growth. CultivateAI is a proven business with expected 2024 revenue of \$1.7 million and corresponding positive cash flow. CultivateAI provides agricultural data to clients through a software as a service ("SaaS") platform.
60. **Feedstock:** World production of vegetable oils is growing, as is demand. The US Department of Agriculture (USDA) expects global production of vegetable oils in the current crop year to hit a record level at 224.2 million tonnes. This would translate to a 2.7 million tonne rise year-on-year. Consumption is estimated at 221.7 million tonnes, up 5.3 million tonnes on the previous year. However, the USDA expects sunflower oil production to plummet in 2024/25, especially due to a more than 1 million tonne decline in production from Ukraine.

Hydrogen

61. **Hydrogen:** Australia. Fortescue has broken ground on its \$150 million PEM50 green hydrogen project in Gladstone, Queensland. The two-stage 50 MW project reached financial close at the start of this year and is planned to start producing hydrogen in 2025. The first stage is a 30MW electrolyser and the second will see the installation of another 20MW of capacity depending on upgrades to water supply infrastructure to the site, but it is anticipated to be commissioned by 2028.
62. **Hydrogen:** Canada. Linde announced a long-term agreement to supply clean hydrogen to Dow's Fort Saskatchewan Path2Zero Project. The company is set to invest more than \$2bn billion to develop, own, and operate an integrated clean hydrogen and atmospheric gases facility in Alberta, Canada. This new on-site complex by Linde will employ autothermal reforming, combined with the company's proprietary HISORP carbon capture technology, to produce clean hydrogen. Additionally, it will recover hydrogen from off-gases generated by Dow's ethylene cracker. Linde will provide clean hydrogen, nitrogen, and other services to support Dow's net-zero emissions integrated ethylene cracker and derivatives site. The facility will also supply clean hydrogen to both existing and new industrial clients.
63. **Hydrogen:** Chile. FCAB announced the imminent arrival of Latin America's first hydrogen-powered locomotive, developed by CRRC Qishuyan Company and set to operate on FCAB's routes in Antofagasta. The locomotive has a total power of 1000 kilowatts and is equipped with a high-capacity hydrogen storage system. FCAB has already secured hydrogen supplies for 2024 and is finalizing infrastructure and personnel training to support the locomotive's operation.
64. **Hydrogen:** France HRS, a manufacturer of hydrogen refuelling stations, announced the installation of seven new hydrogen stations in France and internationally over the past three

months. The company is aiming to expand its network and meet the increasing demand for hydrogen fuel in the transport sector. These stations include the company's first large-capacity HRS40 station at its Champagnier site near Grenoble, capable of distributing one tonne of hydrogen per day.

65. **Hydrogen:** France. Qair, a french based renewable energy company, and petroleum pipeline operator Societe des Transports Petroliers par Pipelines, known as Trapil, have teamed up to jointly develop hydrogen, e-SAF and ammonia projects. The project is building what will be France's largest renewable hydrogen production facility.
66. **Hydrogen:** France. TotalEnergies announced its investment in the Japan Hydrogen Fund, joining forces with major Japanese corporations, including Toyota and Iwatani, in a \$400 million initiative aimed at developing low-carbon hydrogen technologies to drive global decarbonization efforts.
67. **Hydrogen:** Germany. E.ON Hydrogen, part of German energy company E.ON SE, plans to install an electrolyser with a capacity of around 20 MW to help meet the hydrogen needs of mobility and the industry in the Rhine-Ruhr region, Germany. The planned electrolyser is expected to produce up to 2,300 tonnes of hydrogen annually, using renewable energy. The hydrogen will be filled into containers via filling stations and transported to end customers in the Rhine-Ruhr region by truck. Production is expected to begin in 2027.
68. **Hydrogen:** Germany. Hypermotive unveiled the X-M1, a platform for hydrogen fuel cell-based power generation for marine applications. Developed in collaboration with Honda, and underpinned by Hypermotive's SYSTEM-X technology, X-M1 is a scalable, modular, hydrogen fuel cell power system that makes clean energy transition more accessible and achievable for maritime operators. The company said that X-M1 is designed to bring sustainable energy and reliable performance to a variety of newbuild and existing vessels, including cruise ships, ferries, workboats, motor yachts.
69. **Hydrogen:** Germany. German electrolyser manufacturer Enapter AG has secured orders worth EUR 23.4 million (USD 25.8m) in the first half of 2024 compared with just EUR 4.6 million in the same period of 2023. The company has received new orders for megawatt-class devices from Germany, Europe, Asia, the US and, above all, Italy. Enapter mainly sees as a growth driver a government-funded initiative in Italy, which aims at the establishment of hydrogen centres in 52 regions.
70. **Hydrogen:** Germany. German LNG terminal operator Deutsche ReGas has completed the front-end engineering and design phase for its planned hydrogen hub in Lubmin. The project, known as H2-Hub Lubmin, started in September 2023. Deutsche ReGas has signed an agreement in principle with Norwegian company Høegh LNG to realize a floating hydrogen import terminal in Lubmin, creating a large-scale electrolysis plant. The first phase of the project will focus on constructing a 200-MW electrolyzer plant by the end of 2026, intending to produce up to 30,000 tons of green hydrogen annually. The second phase involves expanding the production to 500 MW by 2028.
71. **Hydrogen:** Germany. German nationalised energy company Securing Energy for Europe GmbH (SEFE) said it has completed a deal to take full control of gas network operator Wiga in a move that would bolster Germany's hydrogen strategy. Through the transaction, the nationalised company is gaining control of Wiga's subsidiaries GASCADE and NEL, which together operate gas pipelines with a total length of 4,150 km.
72. **Hydrogen:** Germany. Shell plc is proposing to upgrade an existing site in Germany and preparing it for green hydrogen production with the installation of a 100-MW electrolyser. Worley will first help Shell to convert its Energy and Chemicals Park Rheinland near Cologne, Western Germany, into a base oil production unit that will be able to cover 9% of the EU and

40% of Germany's base oil demand. This project includes repurposing the on-site hydrocracker and electrifying the plant, which alone will cut Shell's scope 1 and 2 emissions by 620,000 tonnes annually.

73. **Hydrogen:** Germany. Siemens Energy AG has been contracted to supply and install the electrolyzers needed for the 100-MW Hamburg Green Hydrogen Hub (HGHH) to be built at the site of a decommissioned coal-fired power station in the Moorburg district.
74. **Hydrogen:** Germany. Sunfire GmbH has received an order to build a 100-MW electrolyser for energy group RWE AG, representing the final stage of a major 300-MW green hydrogen project. The electrolyser will be installed at RWE's site in Lingen, western Germany. The 100-MW project has a value of around -million-euro range.
75. **Hydrogen:** Germany. The Lingen green hydrogen facility, located 25 km (15.5 mi) from the Dutch border, will be capable of producing up to 11,000 tonnes of green hydrogen per year to replace the consumption of grey hydrogen currently produced by carbon reforming. It will be initially powered by offshore wind energy under a power purchase agreement.
76. **Hydrogen:** Hungary. MOL Group started production at its 10-megawatt green hydrogen plant in Százhalombatta, Hungary, capable of producing 1,600 tonnes of green hydrogen per year. The plant will cut the Danube Refinery's carbon dioxide emissions by 25,000 tonnes annually.
77. **Hydrogen:** India. Gensol Engineering Limited, in partnership with Matrix Gas & Renewables, was awarded the EPC contract for India's first biomass-to-green hydrogen project. This project, set to be completed within 18 months, will convert 25 tons of bio-waste into 1 ton of hydrogen per day. The project will utilize advanced gasification technology developed in collaboration with Westinghouse, USA.
78. **Hydrogen:** India. Thermax, a major energy and environmental solutions provider in India, has partnered with UK-based Ceres Power to manufacture and commercialise solid oxide electrolysis technology in India. The partnership grants Thermax a global license to produce, sell, and service stack array modules based on Ceres' SOEC technology. By leveraging its expertise in heat integration, Thermax plans to develop multi-megawatt SOEC electrolyser modules, which are up to 25% more efficient than traditional low-temperature electrolysis.
79. **Hydrogen:** Japan. Toyota Motor and BMW will expand their collaboration related to operations of fuel cell vehicles in a bid to increase the competitiveness of their hydrogen-powered cars. Under the extended partnership, Toyota will provide key components such as hydrogen tanks to BMW, which in turn will build and sell mass-produced FCVs in the next few years.
80. **Hydrogen:** Germany. Lhyfe announced a binding agreement with refuelling station developer H2 MOBILITY Deutschland to provide hydrogen for some of its fuel stations in Germany. The hydrogen will be supplied from Lhyfe's future production site in Schwäbisch Gmünd. Lhyfe and H2 MOBILITY Deutschland have signed a five-year agreement for the delivery of renewable hydrogen produced from renewable power sources for the transport sector.
81. **Hydrogen:** Mexico. Mexico's Federal Electricity Commission, CFE, is exploring a partnership with Pemex to produce green hydrogen at the Salina Cruz refinery, aiming to decarbonize energy production by replacing traditional hydrogen made from natural gas with a renewable alternative. Pemex, Mexico's largest consumer of hydrogen, currently uses 220,000 tons annually for refining, most of which is produced from fossil fuels. The green hydrogen would be created by electrolysis using renewable energy.
82. **Hydrogen:** New Zealand. Toyota New Zealand has announced it has leased its first Toyota Mirai fuel cell electric vehicle (FCEV) to Coregas NZ. In April, Coregas NZ launched a hydrogen express refueller with Halcyon at Wiri in South Auckland.

83. **Hydrogen:** Norway. Equinor ASA has decided not to participate in an early-stage project to build a hydrogen export pipeline from Norway to Germany as planned with partner RWE AG due to high costs and lack of demand.
84. **Hydrogen:** Portugal. Plug Power has signed a contract to provide 25 MW of PEM electrolyzers for the H2DRIVEN project in Portugal, set to produce 80,000 tons of green methanol annually. The collaboration with Dourogás and CapWatt focuses on using biomass gasification and solar-powered electrolysis to generate methanol. Plug Power's involvement provides technical support and equipment.
85. **Hydrogen:** Spain. Acciona and Plug Power announced a €49 million investment for a green hydrogen production plant in Arteixo, Galicia. The project, named "Arteixo H2V", is a strategic industrial initiative by the Galician Government, which has accelerated its approval process. The plant will utilize renewable energy to produce approximately 3,000 tons of green hydrogen annually, using four 5-megawatt electrolyzer modules.
86. **Hydrogen:** Spain. Cepsa is proposing to present its €2 billion green hydrogen and ammonia projects at the San Roque Energy Park in Spain to Industry Minister Jordi Hereu. The energy park, one of the largest industrial sites in Andalusia, plays a pivotal role in Cepsa's ambitious Andalusian Valley of Green Hydrogen initiative, which aims to decarbonize heavy transport and industry. Cepsa's partnerships with companies like Fertiberia and Enagás, and its collaboration with the Port of Rotterdam, aim to create a green hydrogen corridor linking northern and southern Europe, further positioning Andalusia as a leader in the global energy transition. To support this corridor, Cepsa has formed alliances with European companies like Yara Clean Ammonia, Gasunie, ACE Terminal, and GETEC, enabling the delivery of green hydrogen and ammonia to customers in northern Europe.
87. **Hydrogen:** Spain. Hygreen Energy, a global electrolyzer manufacturer, and Coxabengoa, a vertically integrated global water and energy utility, have signed an agreement to collaborate on hydrogen technology advancement, market expansion for electrolyzer solutions in Europe, and production capacity expansion that will accelerate European hydrogen project developments.
88. **Hydrogen:** Spain. Redexis SA has injected green hydrogen into the gas grid on the island of Mallorca, marking this the first instance of green hydrogen blending in Spain. The system that allows for the introduction of green hydrogen produced at the Lloseta plant into the extensive gas network on the Balearic Island. The project included constructing a hydrogen reception station, a dedicated 3.2-kilometre (1.99 miles) long hydrogen pipeline and a blending facility that allows hydrogen to be injected into the gas grid.
89. **Hydrogen:** United Kingdom. UK utility SSE plc and EET Hydrogen, part of Essar Energy Transition (EET), have teamed up to develop a green hydrogen production facility with a capacity of 40 MWe in the Northwest of England. The project is located at the Stanlow Manufacturing Complex in Ellesmere Port in Cheshire. Development work is underway, with feasibility studies completed and design and site investigation work continuing.
90. **Hydrogen:** USA. Abu Dhabi National Oil Company (ADNOC) will acquire a 35% equity stake in Exxon Mobil Corporation's proposed low-carbon hydrogen and ammonia production facility in Baytown, Texas. The facility is expected to be the world's largest of its kind upon startup, capable of producing up to 1 billion cubic feet (bcf) daily of low-carbon hydrogen, which is virtually carbon-free with approximately 98% of carbon dioxide removed and more than 1 million tons of low-carbon ammonia per year. A final investment decision is expected in 2025 with an anticipated startup in 2029.
91. **Hydrogen:** USA. Hgen, a hydrogen startup focused on decarbonizing heavy industries, has raised \$5 million in seed funding to commercialize its high-efficiency alkaline electrolyzers.

The company's proprietary alkaline electrolyzers achieve 20 times the volume output density of traditional models, enabling systems that are 1/20th the size to produce the same amount of hydrogen. Additionally, Hgen's technology is 9% more efficient than standard alkaline cells, reducing both size and cost. This will make clean hydrogen production more scalable.

92. **Hydrogen:** USA. The development of US hydrogen hubs is underway, but their full realization will take time. While the Department of Energy has allocated \$7 billion for the H2Hubs, the deployment of these funds will be spread over the next decade, with the majority not being disbursed for several years. Critical to understanding the H2Hubs is the phased approach outlined by the DOE, which allows for careful planning and implementation. This approach includes stages for concept development, detailed planning, and final construction and operation. However, potential risks exist, such as technological challenges, market uncertainties, and the need for significant private investment to complement federal funding.
93. **Hydrogen:** USA. Woodland Biofuels has announced a \$1.35 billion investment to establish a large-scale renewable natural gas and green hydrogen production facility in St. John the Baptist Parish, Louisiana. The plant, which will be located at the Globalplex facility at the Port of South Louisiana will use waste biomass to produce sustainable biofuels for transportation, heating, and electricity generation. Once operational, it will be one of the largest renewable biofuel production plants globally.

Logistics

94. **Logistics:** Sweden. Orkla Suomi (food business), the transport company Scandic Trans and Viking Line have launched scheduled freight service with transport that runs on biofuel in Sweden. Transport emissions along the green freight corridor that stretches from Fågelmara, Sweden to Turku, Finland are 90 per cent lower.

Marine fuels

95. **Marine fuels:** Europe. A.P. Moller Maersk and Hapag-Lloyd announced the details of an operational partnership, the Gemini Cooperation, which will be launched in February 2025. This cooperation will deploy between 300 and 340 vessels, with Maersk providing 60% and Hapag-Lloyd 40% of the fleet. Many of these ships will be equipped to adopt cleaner fuels such as green methanol. The Gemini Cooperation will introduce two distinct ocean networks, including a Cape of Good Hope route due to disruptions in the Red Sea and a Trans-Suez network. The Cape of Good Hope fleet will consist of up to 340 vessels, offering a capacity of 3.7 million TEUs, while the Trans-Suez network will field approximately 300 vessels with a 3.4 million TEU capacity. In October, Gemini will decide which network will begin February operations, based on Red Sea transit risks.
96. **Marine fuels:** Japan. A.P. Moller – Maersk has undertaken a simulation to support the development of methanol bunkering in Japan by co-hosting Japan's first "methanol bunkering simulation" at the Port of Yokohama. The Alette Maersk, Maersk's fifth dual-fuel methanol vessel, participated in the methanol bunkering simulation conducted by Kokuka Sangyo's methanol tanker, Eikamaru.
97. **Marine fuels:** Oman Asyad Group, in collaboration with OQ Alternative Energy and Sumitomo Corporation Middle East FZE, announced a joint study agreement to explore the potential of establishing Oman as a global leader in low-carbon fuels for bunkering. The group has issued a RFI to the world's leading shipping companies to drive the adoption of global green logistic solutions in Oman.

98. **Marine fuels:** Spain. Cepsa has undertaken its first direct supply of second-generation biofuels for the cruise industry at the Port of Barcelona. Further supplies have been confirmed for the coming months, with biofuels available on a regular basis from the Ports of Barcelona and Algeciras. The supplied fuel contains a 24% sustainable component.
99. **Marine fuels:** USA. Amogy announced a new partnership to advance ammonia-powered solutions in the maritime sector. This collaboration will focus on integrating HD KSOE EcoPhin's eco-friendly propulsion systems with Amogy's ammonia-to-electrical power technology, aiming to provide a turn-key solution for the electrification of vessels. By combining HD KSOE EcoPhin's propulsion expertise with Amogy's ammonia "cracking" system—which splits ammonia into hydrogen and nitrogen for carbon-free power generation—the partnership aims to optimize the performance and sustainability of maritime energy systems.

Methanol

100. **Methanol:** South Korea. Plagen and eight other companies established an agreement to develop the country's first commercial-scale green methanol plant, set to begin construction in late 2025, using locally sourced forest residues as feedstock. The plant, which will produce 10,000 tons of green methanol annually by 2027. This is part of a broader initiative to transform the former coal mining town into a carbon-neutral clean energy hub. The green methanol will be synthesized from hydrogen and carbon monoxide, derived from the catalytic processing of the forest residues. The project also supports the local forestry industry and aims to supply fuel for ships in the US-Korea Green Shipping Corridor.
101. **Methanol:** Sweden. Uniper has selected Liquid Wind for developing the NorthStarH2 project in the municipality of Östersund, Sweden. Uniper's is planning to produce over 100,000 tonnes of e-methanol for the shipping and chemical industries to replace fossil fuels and feedstock. Once operational, NorthStarH2 will convert biogenic carbon dioxide and renewable electricity into e-Methanol.

Plastic recycling

102. **Plastic recycling:** Schneider Electric, the world's most sustainable company and leader in the digital transformation of energy management and automation, has partnered with GR3N, Polyethylene Terephthalate (PET) chemical recycler, to create the first open automation system for the advanced plastic recycling industry. This new process breaks down PET into its chemical building blocks that can be recombined to create new PET pellets with virgin-like quality for packaging and textiles. The technology is based on alkaline hydrolysis, which can manage a higher amount of impurities compared to the existing technologies.
103. **Plastic recycling:** United Kingdom. CARBIOS and FCC Environment UK, one of the UK's leading recycling and waste management companies, signed a Lol to jointly study the implementation of a UK-based plant using CARBIOS' PET biorecycling licensed technology. Carbios is a biotech company developing and industrializing biological solutions to reinvent the life cycle of plastic and textiles. Carbios develops enzyme-based processes to break down plastic. Its two disruptive technologies for the biorecycling of PET and the biodegradation of PLA are now reaching commercial scale.

Policy

104. **Policy:** Australia. Australia and Germany have signed a joint declaration of intent to negotiate an AUD-660-million (USD 443.4m/EUR 400m) arrangement that will facilitate Australian producers' to export of green hydrogen to Europe utilising the German government's H2Global auction mechanism. The purpose of Germany's H2Global mechanism is to facilitate the import and export of clean fuels such as renewable hydrogen derivatives, including ammonia and methanol, from regions with cost-effective production to high-demand markets. The pilot H2Global auction was initiated at the end of 2022 with three lots dedicated to green ammonia, methanol and e-sustainable aviation fuel.
105. **Policy:** EU. The European Commission is tightening regulations to ensure EU hydrogen subsidies prioritize European companies, responding to concerns about competition from cheaper Chinese imports. This move coincides with the upcoming launch of the next round of funding for green hydrogen projects, aiming to bolster Europe's domestic industry.
106. **Policy:** United Kingdom. The UK government's export credit agency (UKEF) announced that it has signed a partnership agreement with Chilean economic development agency Corfo to pool resources and jointly finance eligible green hydrogen projects in Chile. UKEF said that it has over GBP 5 billion (USD 6.57bn/EUR 5.92bn) in financing available for businesses in Chile that want to use UK goods and services in hydrogen projects.

Pyrolysis

107. **Pyrolysis:** USA. BluSky Carbon Inc. announced that it has entered into a sales agreement with a U.S. based purchaser pursuant to which the company has agreed to supply, and the purchaser has agreed to purchase, up to 382,213 metric tons of biochar over a period of 10 years. The company has indicated that its ability to meet scheduled delivery of biochar beyond year 1 is conditional upon its commissioning and receiving an additional two (2) Vulcan Heavy biomass pyrolysis systems (Vulcan Heavy). The company anticipates that each Vulcan Heavy will cost approximately US\$3 million and take up to nine months to be manufactured and delivered to the job site. At present, the company believes that it will have the ability to produce 15,000 tons.

Recycling plastic

108. **Recycling plastic:** Germany. LyondellBasell (LYB) is investing in a new closed-loop preparation centre in Lich, Germany. This sophisticated recycling centre will transform plastic waste into high-quality feedstock for high-performance materials.
109. **Recycling plastic:** Samsara Eco, the enviro-tech innovator and NILIT, the world's leader in the production of nylon 6,6 for apparel, have announced plans to explore investment and construction of a nylon 6,6 textile-to-textile recycled polymer production site in South East Asia to help close the loop on nylon 6,6. Aiming to be operational by late 2026, the anticipated facility will be uniquely capable of recycling textile waste, producing high-quality recycled nylon 6,6 polymers, for textile brands and manufacturers to seamlessly use in their existing supply chains to create new textile fabrics, infinitely.

Renewable Diesel

110. **Renewable Diesel:** Spain. Honeywell and Repsol announced a collaboration for a new production pathway for biofuels and circular materials. The two will also explore the possible integration of these methods into Repsol's existing facilities. The companies plan to scale and commercialize Honeywell's technologies, which use various wastes like fats, oils, greases, biomass and solids for chemical production and renewable fuels at Repsol's

refineries. Their goal is to produce different biofuels, including sustainable aviation fuel (SAF) and renewable diesel, while making use of existing refinery assets.

111. **Renewable diesel:** USA. Vertex Energy has filed for bankruptcy in a Texas court, just months after it paused renewable diesel output at an Alabama refinery. In May, Vertex paused renewable diesel production at its refinery in Mobile, Alabama, citing macroeconomic issues.

Technology Development

112. **Technology development:** Sweden. The Hydrogen Breakthrough Ironmaking Technology (HYBRIT) initiative has presented the results of six years of research in a final report to the Swedish Energy Agency. The report shows that direct reduced iron produced with the HYBRIT process has superior characteristics compared to iron produced with fossil fuels. So far, more than 5,000 tonnes of hydrogen-reduced sponge iron have been produced at HYBRIT's pilot plant in Luleå.

Sector Status Report: September 2024

As the low carbon and energy transition develops the nature and mix of projects and developments will change. Below is an overview of the mix of projects and activities during September 2024 characterised by Technology Development, Infrastructure, Policy and Commercial deployment.

Category	Number of Entries	Examples
Technology Development	41	1. HYBRIT Initiative (Sweden) 2. Reverion biogas power plant (Germany) 3. Flying Forest SAF production facility (Finland) 4. Siemens Energy hydrogen electrolyzers (Germany) 5. Amogy's ammonia-to-electricity system for maritime applications (USA).
Infrastructure	38	1. Nacap's hydrogen pipeline construction (Australia) 2. H2Hub Lubmin hydrogen terminal (Germany) 3. Methanol plant using forest residues (South Korea) 4. Redexis green hydrogen grid (Spain) 5. Biomethane facility in Wales (UK).
Policy	26	1. EU hydrogen subsidies for European companies (Europe) 2. H2Global auction mechanism (Australia & Germany) 3. UK-Chile green hydrogen financing (UK & Chile) 4. EU Aviation biofuel mandates (Europe) 5. Australia's hydrogen trade agreement with Germany.
Commercial Deployment	22	1. Toyota-BMW hydrogen vehicle collaboration (Japan) 2. TotalEnergies supplying SAF to Air France-KLM (France) 3. ExxonMobil's hydrogen facility (USA) 4. Summit Next Gen SAF production (USA) 5. UECC biomethane vessel operations (Europe).

Company Summary – September 2024

Frequency of mention.

Company	Frequency
Toyota	3
Allied Green Ammonia	2
Amogy	2
Cespa	2
Excel Composites	2
Gensol Engineering	2
Gevo	2
Haffner Energy	2
LanzaTech	2
Lygos	2
Maersk	2
SK Energy	2
TotalEnergies	2
Woodland Biofuels	2
Acciona	1
ADNOC	1
Aether Fuels	1
Air Company	1
Anaegia	1
Asyad Group	1
Australian Government	1
AustroCel	1
Avalon Bioenergy	1
Avista	1
BlueSky Carbon	1
BP	1
Carbios	1
Carbon Clean	1
Total	119

Topics & Themes Summary– September 2024

Frequency of mention

Category	Frequency
Hydrogen	36
Biojet	21
Biogas	13
Ammonia production	7
Biofuels	7
Marine fuels	6
Ethanol	5
Biobased chemicals	3
Biomaterials	3
Feedstock	3
Policy	3
Recycling plastic	3
CO2 Removal	2
e-fuels	2
Plastic recycling	2
Renewable diesel	2
Biotechnology	1
Investment for new green ammonia production	1
Logistics	1
Methanol	1
Pyrolysis	1
Technology development	1
Total	124