

# Bioeconomy & Low Carbon Technology Overview for November 2024

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

## Highlights by Topic: November 2024

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## Ammonia production

1. **Ammonia production:** Brazil. Fuella signed an agreement with the Port of Pecém to invest \$1.5 billion in developing a project to produce 400,000 tons of green ammonia annually in Pecém, in the State of Ceará, Brazil. Fuella noted that Ceará is an ideal location for producing green hydrogen and ammonia due to its abundant wind, solar, and hydropower resources. The Port of Rotterdam, a partner of Pecém, will contribute its export infrastructure and industrial synergies. This marks Fuella's second green ammonia venture in Brazil, following an earlier project at Porto do Açu in Rio de Janeiro, where Fuella partnered to develop a green ammonia facility with an output of up to 520 MW. [Link](#)
2. **Ammonia production:** Qatar. QatarEnergy has begun constructing the world's largest blue ammonia plant in Mesaieed Industrial City, with an investment of QAR 4.4 billion. The facility will produce 1.2 million tons of low-carbon ammonia annually and is expected to begin operations in the second quarter of 2026. The plant will include a CO<sub>2</sub> capture and storage unit capable of handling 1.5 million tons per year and will use 35 megawatts of electricity generated from a solar power plant currently under construction in Mesaieed. The project is being developed in collaboration with Qatar Fertilizer Company. [Link](#)
3. **Ammonia production:** USA. Clean Hydrogen Works awarded McDermott the front-end engineering and design contract on for its Ascension Clean Energy project in Ascension Parish, Louisiana, a facility set to produce 2.4 million metric tons of clean ammonia annually starting in 2029, with a planned expansion to 7.2 million metric tons. The ACE project is a joint effort between CHW, ExxonMobil, Mitsui O.S.K. Lines, and Hafnia. With ExxonMobil providing carbon capture and storage services, the project aims to sequester emissions while producing low-carbon ammonia for use in industrial and shipping sectors. [Link](#)

## Biobased chemicals

4. **Biobased chemicals/Policy:** UE The CO<sub>2</sub>SMOS project, a Horizon 2020 initiative funded by the European Union, has undertaken an in-depth analysis of recent EU legislation shaping a policy framework for fossil-free chemicals. Building on these insights, the project recommends a targeted set of policy actions aimed at enabling the large-scale adoption of Carbon Capture and Utilization (CCU) technologies and increasing the uptake of CO<sub>2</sub>-based products across Europe. [Link](#)
5. **Biobased chemicals:** Finland. LignEasy, has developed a method to refine and separate lignin into various kinds of liquid and solid products. LignEasy is working to reduce the carbon footprint associated with the pulping and chemical industries. Each year, over 15 million tons of lignin are burned by European Kraft pulp mills for energy. But LignEasy's patented technology separates lignin for use in high-value applications such as plywood, construction materials, bio-components in plastics and packaging. [Link](#)
6. **Biobased chemicals:** Germany. BASF and Acies Bio, one of Europe's leading biotechnology companies, have entered into a partnership to further develop a platform for fermentation technology from methanol for the production of fatty alcohols. Fatty alcohols are essential building blocks for several ingredients in the home and personal care markets, in particular surfactants. Acies Bio's biotechnological expertise complements BASF's drive for innovative solutions and contributes to shaping a more

sustainable future. Acies Bio has developed the “OneCarbonBio”, a fully flexible synthetic biology platform designed to efficiently convert renewable methanol, derived from captured CO<sub>2</sub> emissions, into a variety of chemical raw materials. [Link](#)

7. **Biobased chemicals:** India. BASF and AM Green B.V. have entered a MoU to jointly evaluate and develop business opportunities for low-carbon chemicals produced exclusively with renewable energy, and the corresponding value chains in India. Under the MoU, BASF and AM Green intend to conduct feasibility studies on low-carbon chemicals production in India including a joint evaluation of potential technologies. The cooperation also includes a non-binding letter of intent for the offtake of 100,000 tons annually of ammonia produced exclusively with renewable energy including energy from pumped storage projects from AM Green’s plants in different locations in India. [Link](#)
8. **Biobased chemicals:** Romania. Eonic Technologies, a deep tech company focused on renewable carbon, has signed a memorandum of understanding with Chimcomplex, a leader in the chemical industry in Romania. The companies will collaborate to explore potential production of CO<sub>2</sub>-based polyols to enhance the sustainability and performance of materials across various industries and to bring the sustainable polyol technology to the European market. Eonic’s technology uses a proprietary catalyst and process to substitute up to 30 percent of the fossil-based materials in polyols with captured CO<sub>2</sub>. Manufacturers can license this technology to produce high-performance polyols suitable for use in a wide range of applications including foams, laminates, coatings, and elastomers for furniture and mattresses, automotive, construction, footwear, apparel, and various industrial purposes. [Link](#)
9. **Biobased chemicals:** Scotland. The first tanker of sustainably produced bioacetone and biobutanol has been dispatched from Celtic Renewables’ flagship Biorefinery in Grangemouth. This achievement is backed by over £60million in funding which enabled the construction of Scotland’s first Biorefinery and its commercial-scale operations. The cargo containing bioacetone and biobutanol, which will be available for commercial use, is on its way to a processing plant in Chesterfield as part of a long-term deal with internationally renowned chemical distribution company, Caldic, who will distribute the green chemicals to their customers across the world. [Link](#)
10. **Biobased chemicals:** Singapore. Neste and Singapore-based essential chemicals company PCS Pte. Ltd. have launched a cooperation for the supply of renewable solutions to Southeast Asia’s chemicals industry. The collaboration aims at introducing renewable raw materials to replace fossil ones in chemicals and plastics value chains in the region. Neste will supply PCS with Neste RE. Based on renewable wastes, such as used cooking oil, or residues from vegetable oil processing, Neste RE will serve as a replacement for fossil raw materials used at PCS facilities on Jurong Island in Singapore. Using Neste RE, PCS will produce essential products, such as ethylene, propylene or butadiene, across its portfolio. These essential products will then be supplied to customers in various sectors across the region. First deliveries will include butadiene to Mitsubishi Corporation, Toray Plastics (Malaysia) Sdn Berhad and Synthomer Sdn Bhd. [Link](#)
11. **Biobased chemicals:** USA. NewEnergyBlue and MetGen has begun integrating their renewable technologies and business units to vigorously compete with fossil-carbon products not just environmentally but economically. NewEnergyBlue’s first U.S. biomass refinery is expected to begin operations in 2027 in Mason City, Iowa. By converting locally sourced corn stalks left behind during the annual grain harvest, New Energy Freedom can produce 21 million gallons of second-generation biofuel and 150,000 tons

of clean lignin. About half of New Energy Freedom's lignin could become a solid that asphalt producers use as a natural binder, replacing oil-based bitumen in road paving. The other half would be liquids: high-performance phenols for sports equipment like Nike, toys like Lego, and fire-resistant construction materials; eco-friendly polyols for strong yet lightweight insulation foams; and other fractions for lighter, stronger weather-shielded cardboard that companies like Amazon might use for tape-free, moisture-resistant packaging. [Link](#)

## Biobased plastics

12. **Biobased plastics:** AC Worldwide Corporation introduced a new line of flat poly mailers made entirely from recycled materials, including options featuring 100% post-consumer resin and 100% post-industrial recycled (PIR) content. The Polyjacket® mailers were unveiled at the PACK EXPO in Chicago and are set to meet the increasing demand for eco-friendly packaging solutions among couriers and e-commerce businesses. [Link](#)
13. **Biobased plastics:** Belgium. Belgian company Orac, a leading innovator in decorative interior design, has selected INEOS Styrolution's sustainable bio-attributed materials for its new line of 3D Duropolymer® wall panels. The new panels will be produced using Styrolution® PS ECO 485N BC90, which contains 90% bio-attributed feedstock, and Styrolution® PS ECO 158N BC100, made from 100% bio-attributed feedstock. Both polystyrene grades are made using renewable feedstock, based on a mass balance process certified under ISCC PLUS by a third party. [Link](#)
14. **Biobased plastics:** Germany. Envalior announced the launch of Pocan® X-MB series of new polybutylene terephthalate (PBT) compounds based on bio-circular 1,4-butanediol (BDO). The sustainable content of the thermoplastics is certified and classified in accordance with the ISCC PLUS (International Sustainability and Carbon Certification) standard. The precursor for bio-circular BDO is used cooking oil, which does not compete with food. [Link](#)
15. **Biobased plastics:** The Netherlands. Avantium N.V, and SCG Chemicals, are expanding their collaboration on Avantium's FDCA and PEF technology. Together, they aim to accelerate the market adoption for FDCA and PEF in Asia. Avantium and SCGC are long-term strategic partners. SCGC, through SENFI Ventures, is a cornerstone investor in Avantium and furthermore collaborates with Avantium in CO2-based polymers technology. FDCA and PEF applications, and enhanced volume commitments across the region will be developed to underpin future large-scale production in Asia. [Link](#)
16. **Biobased plastics:** The Netherlands. Avantium N.V, announced a collaboration with Royal Vezeat, Europe's largest fresh food company specializing in convenience vegetables, fruits, salads, and fresh meals. Together, Royal Vezeat and Avantium will work closely to implement Avantium's PEF for packaging of salad bowls. These PEF-based trays will be used by Albert Heijn, the largest supermarket chain in the Netherlands. Avantium's PEF (polyethylene furanoate) is a 100% plant-based, fully recyclable polymer. [Link](#)
17. **Biobased plastics:** The Netherlands. ESKA and Paques Biomaterials signed a MoU for the construction of the first full-scale plant for the production of PHA from paper process water. In the coming year, both parties will carry out all the preparations to make an investment decision for the construction of the factory at the Hoogezand production site in the municipality of Midden Groningen in the middle of next year. [Link](#)
18. **Biobased plastics:** USA. Citroniq Chemicals, an innovator in biochemical manufacturing, has selected Falls City's Mid-America Rail Campus to be one of its

state-of-the-art bio-based production mega-sites. The landmark project is part of the Nebraska BioEconomy Initiative, which aims to advance Nebraska's economic development. Citroniq will transform ethanol produced from Nebraska corn into bio-based polypropylene, reducing the reliance on petroleum-based production while driving additional revenue to Nebraska's farms and rural communities. The \$7.5 billion plant is expected to be operational in 2029. [Link](#)

## Biofuels

19. **Biofuels:** Brazil. Fluid Quip Technologies announced that the São Martinho Boa Vista unit in Quirinópolis, Goiás, Brazil is exceeding projected performance including capacity and ethanol output. The São Martinho plant utilizes FQT's proprietary corn ethanol technologies, from corn receiving to DDGS drying. FQT integrated its Low Energy Distillation (LED)<sup>™</sup> system and a Mechanical Vapor Recompression (MVR) system to achieve one of the lowest steam usage rates in the bioethanol industry while using low pressure steam from the São Martinho cogeneration turbines. The unit also utilizes FQT's patented Selective Grind Technology<sup>™</sup>, Fiber ByPass<sup>™</sup>, and BOS Oil System<sup>™</sup> which has allowed São Martinho to achieve ethanol and distillers corn oil yields among the highest in the industry. [Link](#)
20. **Biofuels:** Cathay Cargo and DB Schenker agreed that the global forwarder will become a member of the Cathay Corporate Sustainable Aviation Fuel Programme. By joining and committing to buy 878 tonnes of SAF (equivalent to 290,000 US gallons), DB Schenker will help reduce more than 2,600 tonnes in carbon emissions. [Link](#)
21. **Biofuels:** New Zealand. The former Refining New Zealand site at Marsden Point could be making a comeback with renewable biofuels. Channel Infrastructure NZ Limited (CHI), who owns the refinery, announced a conditional agreement with Seadra Energy and a consortium of partners to develop a biorefinery at the location. Seadra had planned to purchase decommissioned assets from the refinery for relocation. However, after exploring various options, they determined that utilising the existing infrastructure at Marsden Point for a biorefinery would be a more efficient approach. The biorefinery would utilize some of the existing refinery assets, which would be refurbished and repurposed. Additionally, it would leverage existing storage tanks, jetties, and other infrastructure on the site. The project would also require approximately 18-20 hectares of land. [Link](#)
22. **Biofuels:** Norway. Rystad Energy says that under increasing pressure to decarbonize and shift away from traditional fossil fuels, the world's leading oil and gas companies are ramping up investments in the biofuels sector. Major players such as BP, Chevron, Shell, TotalEnergies, ExxonMobil and Eni are incorporating biofuels into their broader energy transition strategies, recognizing the growing global demand for sustainable fuel sources. According to Rystad Energy's research, these six oil majors have announced a total of 43 biofuel projects that are either already operational or are targeted to start up by 2030. While investments span various biofuel products, including biodiesel and ethanol, the focus is clearly on hydrotreated vegetable oil (HVO) and sustainable aviation fuel (SAF), which are expected to make up nearly 90% of the projected biofuel production. [Link](#)
23. **Biofuels:** South Korea. Gyeonggi LPG Sales Association, Korea DME Association, Dawon F&C, and Biofriends Co., Ltd. held a business agreement ceremony at Biofriends Co., Ltd. DME Plant 2 for a demonstration pilot supply project for LPG-12%DME mixed raw material to enter the aerosol and domestic LPG fuel market. [Link](#)

24. **Biofuels:** USA. Blue Biofuels contracted the engineering firm, Global Management Partners (GMP), to produce Front-End Loading (FEL-2) level engineering plans for a production facility capable of producing three million gallons of biofuel per year from cellulosic biomass. The plans will outline the specifics of how the facility will be built and operated. This planning stage is crucial for ensuring that the production facility can be constructed efficiently and at scale. This milestone marks a major step in the company's efforts to commercialize its proprietary Cellulose-to-Sugar (CTS) process, an innovative technology that converts agricultural waste and other biomass into renewable biofuels. [Link](#)
25. **Biofuels:** USA. Comstock Fuels Corporation amended its exclusive license agreement with RenFuel K2B AB for use of RenFuel's patented catalytic esterification process to refine Comstock Fuels' proprietary Bioleum™ biointermediates. The amendment expanded the territory from North America, Central America, and South America to include Australia, New Zealand and Vietnam to facilitate ongoing project development by licensees of Comstock Fuels broader lignocellulosic biomass refining process. Comstock and its licensees are making great and rapid progress developing sites for construction of demonstration and commercial scale facilities based on Comstock's Bioleum refining process, including RenFuel's patent catalytic esterification process. [Link](#)
26. **Biofuels:** USA. Marathon Petroleum Corp. confirmed the Martinz Renewable Fuels biorefinery in California remains on track to be operating at full nameplate capacity by the end of the year. At full capacity, the facility can produce 730 Mmgpy. The facility, previously a Marathon oil refinery, was converted to a renewable diesel biorefinery via a 50/50 joint venture (JV) between Marathon and Neste Corp. The JV was announced in 2022. [Link](#)

## Biogas

27. **Biogas:** Finland. Suomen Lantakaasu Oy's biogas plant to be built in Kiuruveite is to produce renewable liquefied biogas from the manure of Ylä-Savo's cattle farms and other side streams of agriculture and the food industry. The investment covers the construction of a biogas plant and a liquefaction unit. The facility is to be completed by 2026. [Link](#)
28. **Biogas:** France. Veolia started the largest French unit for the production of biomethane from wastewater treatment. The result of two years of studies and work, and installed at the Seine Valenton plant, this installation will provide 45 GWh of decarbonizing energy into the network, the equivalent of the annual consumption of more than 10,000 homes. This unit is the first in France to achieve such a treatment capacity, with a maximum injection capacity of 1,300 Nm<sup>3</sup>/h of biomethane (equivalent to the treatment of a maximum of 1,800 Nm<sup>3</sup>/h of biogas). This outcome has been achieved using a performance solution for purifying biogas and producing biomethane. [Link](#)
29. **Biogas:** France. Waga Energy signed a partnership agreement with Fives to step up the deployment of WAGABOX units. The agreement strengthens the long-term cooperation between Waga Energy and Fives, enabling both partners to optimize the design and manufacture of WAGABOX units. These units, developed and patented by Waga Energy and in which Fives' solutions are integrated, are used to upgrade landfill gas into network compliant renewable natural gas. [Link](#)
30. **Biogas:** Italy. Edison has signed a long-term contract (biomethane purchase agreement), for an offtake of biomethane produced from agricultural biomasses with

- Kanadevia Inova. Under the agreement, which has a term of 15 years, Kanadevia Inova will complete by the first half of 2025 the construction of a biomethane plant fuelled by agricultural by-products in the province of Cuneo, the production of which will be fully taken by Edison for an annual volume of about 3 million cubic meters. [Link](#)
31. **Biogas:** Italy. Tages Capital SGR, asset manager specializing in alternative investment funds in the private markets and the second largest photovoltaic operator in Italy, has completed the acquisition of a portfolio of four biogas production plants, which will be converted to biomethane production by 2026. This is the first investment in a biomethane production portfolio by the Tages Helios Net Zero fund. [Link](#)
  32. **Biogas:** Malaysia. Gas Malaysia Energy and Services (GMES), a subsidiary of Gas Malaysia Berhad (Gas Malaysia), and Intercontinental Specialty Fats (ISF) have come together to formalize a Supplemental Gas Supply Agreement for the supply of certified biomethane through the Natural Gas Distribution System. This agreement reinforces both companies' commitment to sustainability and renewable energy in the industrial sector. The biomethane supplied to ISF will be certified under the International Sustainability and Carbon Certification (ISCC) PLUS standard. [Link](#)
  33. **Biogas:** New Zealand. First Renewables, in partnership with Ecogas confirmed that the First Renewables biogas upgrade facility, located at the Ecogas Reporoa Organics Processing Facility is now in production. [Link](#)
  34. **Biogas:** Sweden. Wärtsilä Gas Solutions, part of technology group Wärtsilä, will supply Nordic energy company Gasum with biogas upgrading and liquefaction solutions for their new bioLNG plant. The plant will produce high-quality bioLNG from agricultural and organic household waste. When operational, the Wärtsilä offering will be capable of producing 25 tons of bioLNG per day. bioLNG is formed by purifying biogas to high-quality bio methane before it is liquefied at minus 160 °C. [Link](#)
  35. **Biogas:** Thailand. BBGI Public Company Limited entered a strategic partnership with Keppel Ltd, through its Infrastructure Division and CleanEdge Resources Limited by signing a MoU to jointly research and develop a Bio-LNG (Liquefied Biomethane) project in Thailand. The three partners will develop the project and expand production capacity in Thailand over the next three to five years. The project is expected to have a production capacity of approximately 130 tons per day. [Link](#)
  36. **Biogas:** UAS. CalBioGas Hilmar LLC, a joint investment between Chevron U.S.A. Inc., and California Bioenergy LLC (CalBio), has completed the central processing facility for their dairy biomethane project in Merced County, California. CalBio brings technology and expertise to help local dairy farmers capture methane from dairy manure in anaerobic digesters on their farms. As part of the joint investment, after the methane is captured, it is sent to the central processing facility where it is upgraded into renewable natural gas (RNG). The renewable natural gas is then injected into the Pacific Gas and Electric Company (PG&E) pipeline where it is marketed as an alternative fuel for transportation. [Link](#)
  37. **Biogas:** United Kingdom. Many small green gas plants in the UK are set to close by 2031 with the loss of 2 terawatt hours of clean electricity to the grid – enough clean electricity to power around 500,000 homes. The closures have been revealed in a survey of members undertaken by the Anaerobic Digestion and Bioresources Association (ADBA) – the organization representing green gas in the UK. The shutdown will take place over the next few years as old support schemes for green gas end, and operators are unable to justify maintaining and replacing worn-out equipment like combined heat and electric power units. [Link](#)

38. **Biogas:** USA RNG at a new DTE Vantage facility recently began operations in Scipio Center, New York. The project is a collaboration with Sunnyside Farm, which manages approximately 9,000 cows and heifers, and will reduce greenhouse gas emissions in both the immediate area and transportation markets. The DTE Vantage facility injects the RNG into a pipeline operated by Corning Natural Gas, and with the help of the project's customer Mercuria Energy America and delivers it to markets as far away as California and Washington. [Link](#)
39. **Biogas:** USA. Chesapeake Utilities Corporation opened its renewable natural gas (RNG) facility at Full Circle Dairy (FCD) in Lee, Florida. The facility, a full-scale dairy manure-to-pipeline-quality RNG operation is expected to produce an average of 100,000 dekatherms annually, at a cost of \$22 million. The facility began producing RNG in June 2024 and is expected to capture and redirect more than 1,100 metric tons of methane per year into a renewable energy source. [Link](#)
40. **Biogas:** USA. Emvolon, a MIT spun-off technology company that converts greenhouse gas emissions into carbon-negative fuels and chemicals, announced several commercial and technical milestones. Following its recent field pilot announcement with Montauk Renewables to demonstrate the benefits of converting biogas into green methanol, Emvolon has secured multiple new partnerships with biogas suppliers, green methanol product offtakers, and multinational equipment and technology companies. [Link](#)
41. **Biogas:** USA. OPAL Fuels Inc. announced the start of commercial operations at its renewable natural gas (RNG) facility at the Polk County municipal landfill in Jones Corner, Florida, marking the company's eleventh operational RNG project and second facility in the state. Owned and operated by Polk County's municipal government, the landfill is now providing biogas to OPAL's RNG project which is producing and injecting pipeline-quality RNG. [Link](#)

## Biojet/SAF

42. **Biojet/SAF:** Australia. Jet Zero Australia welcomed a Commonwealth and Queensland Government grant support worth \$14 million (€12.5 million) to progress Project Ulysses - the company's flagship sustainable aviation fuel project in Townsville. [Link](#)
43. **Biojet/SAF:** Australia. Zero Petroleum is to explore the development of a low-carbon sustainable aviation fuel production facility in Whyalla, with the support of the state government and industry. Zero Petroleum is exploring the opportunity for a commercial-scale production plant to be located in South Australia's Upper Spencer Gulf. The firm is undertaking a feasibility study which includes collaboration with an aviation industry consortium led by Adelaide Airport and Qantas Airways. [Link](#)
44. **Biojet/SAF:** Brazil. Topsoe signed an agreement with Refinaria de Petróleo Riograndense SA (Riograndense), to provide its HydroFlex and H2bridge technologies for sustainable aviation fuel and renewable diesel production at Riograndense's Rio Grande renewable fuels plant in Brazil. [Link](#)
45. **Biojet/SAF:** Canada. Neste and Air Canada signed an agreement for the supply of 60,000 metric tons (77.6 million liters) of neat Neste MY Sustainable Aviation Fuel. Neste will deliver the sustainable aviation fuel (SAF) blended with conventional jet fuel to the Vancouver marine terminal starting in December 2024, with further shipments throughout 2025. The Vancouver marine terminal has a direct pipeline connection to the fuel facilities at Vancouver International Airport enabling the use of the blended SAF at the airport. [Link](#)



46. **Biojet/SAF:** Egypt. Egyptian Petrochemicals Holding Company, along with other shareholders, has launched Egypt Sustainable Aviation Fuel Company to develop a \$530 million, 120,000 metric ton SAF plant located near Alexandria. The company, with 15% private sector shareholder and the remainder held by public companies, plans to use waste feedstock for the facility. The fuel is meant to reduce carbon emissions by 400,000 tons annually. [Link](#)
47. **Biojet/SAF:** Germany. Lufthansa Cargo and A.P. Moller – Maersk have signed an agreement to promote the decarbonization of airfreight by using SAF. Lufthansa Cargo will use 400 metric tons of SAF on behalf of Maersk in the remainder of 2024. Maersk will allocate the achieved emissions reduction to one of its European airfreight customers as part of its ECO Delivery Air product. [Link](#)
48. **Biojet/SAF:** Japan. EcoCeres and Euglena announced the signing of a MoU to collaborate in promoting the use of SAF and Hydrotreated Vegetable Oil (HVO) in Japan. EcoCeres manufactures renewable SAF/HVO using proprietary technology at a facility with an annual production capacity of 350,000 tons of SAF/HVO. [Link](#)
49. **Biojet/SAF:** New Zealand. Air New Zealand, in collaboration with LanzaJet, announced promising initial findings from a joint feasibility study investigating the use of woody waste and low-value wood products to produce sustainable aviation fuel in New Zealand. [Link](#)
50. **Biojet/SAF:** Romania. OMV Petrom and TAROM, Romania’s national airline, announced the supply of SAF, a first for Romanian aviation. Starting January 1, 2025, OMV Petrom will supply TAROM with SAF at four airports in Romania, in compliance with the requirements of the RefuelEU Aviation Regulation: Henri Coandă International Airport Bucharest, Avram Iancu International Airport Cluj, Traian Vuia International Airport Timișoara and Iași International Airport. [Link](#)
51. **Biojet/SAF:** Spain. Solarig announced its plans to develop a sustainable aviation fuel plant on 10 hectares of the Teruel Logistics Platform (Platea). The initiative will require an investment of \$1.20 billion that will create some 1,200 direct and indirect jobs. This project, called ‘Turboleta’, is expected to begin construction in 2027 and will be fully operational before 2030 with a production of 75,000 tons per year, the equivalent of 33,000 flights between Zaragoza and London at 50% SAF. [Link](#)
52. **Biojet/SAF:** Sweden. Alfa Laval has secured two contracts worth 350 million SEK to supply cutting-edge HVO pre-treatment technology to Europe’s largest biofuel facility. The facility, a joint venture between Cepsa Bioenergia San Roque S.L. (CSBR), and Bio-Oils Energy, part of the Apical Group, will produce 500,000 metric tons of sustainable aviation fuel (SAF) and renewable diesel annually. Alfa Laval’s Food & Water Division will supply two different pre-treatment units to CSBR’s 1.2-billion-euro project. [Link](#)
53. **Biojet/SAF:** UAE. Mercantile & Maritime Group announced the expansion of its fully owned and operated facility, MENA Terminals in Fujairah, to launch a pioneering biofuel processing plant valued at AED 2.2 billion. The biofuel facility at MENA Terminals will be expanded by over 1 million square feet and is set for completion by 2026. Once operational, it will produce up to 150 million litres of SAF annually, representing nearly 10% of current global SAF production. [Link](#)
54. **Biojet/SAF:** United Kingdom. Willis Sustainable Fuels (UK) Limited (WSFL), has entered into a master services agreement with McDermott for early engineering, procurement and construction (EPC) related services for its SAF initiative. The agreement commences with WSFL’s first planned SAF facility, supported by the UK Government’s Advanced Fuels Fund, with a capacity of producing 50,000 liters per day of SAF in

- Teesside. WSFL intends to deploy technology which produces next-generation SAF, either Biogas-to-Liquid (BtL) or Power-to-Liquid (PtL), depending on the feedstock. [Link](#)
55. **Biojet/SAF:** USA. Avfuel Corporation announced its expansion of blended sustainable aviation fuel across the south-eastern United States supplied from Valero. The neat SAF produced by Diamond Green Diesel, a joint venture between a Valero affiliate and an affiliate of Darling Ingredients, is produced using the HEFA SPK feedstock pathway, meaning it uses lipids — like used cooking oil — to produce the fuel. [Link](#)
  56. **Biojet/SAF:** USA. Blue Biofuels Inc. and Vertimass LLC, developed a partnership to employ Vertimass’ proprietary consolidated alcohol deoxygenation and oligomerization (CADO) technology to produce sustainable aviation fuel (SAF) and renewable propane and butane (rLPG) as coproducts from ethanol. This new company, VertiBlue Fuels LLC, is equally owned by Blue Biofuels Inc. and Vertimass. VertiBlue Fuels has the immediate objective to build a facility in Florida, which is anticipated to produce an estimated 10 million gallons of SAF and 2 million gallons of rLPG in its first year. [Link](#)
  57. **Biojet/SAF:** USA. Corteva Inc. announced a collaboration with bp on the companies’ shared intent to form a crop-based biofuel feedstock joint venture. The JV envisaged by Corteva and bp would produce and deliver crop-based biofuel feedstocks to help meet the anticipated growth in demand for ‘sustainable aviation fuel’ (SAF). Corteva plans to contract with farmers in North and South America, and Europe, to grow proprietary Corteva mustard seed, sunflower and canola feedstocks well-suited for SAF production. These crops are integral to large scale agriculture around the world. The JV would aim to introduce new cropping systems to produce oil that meets EU RED III criteria, and qualifies for US Low Carbon Intensity policy incentives, while creating a new revenue stream for farmers. [Link](#)
  58. **Biojet/SAF:** USA. DG Fuels announced the selection of a site for a roughly \$5 billion manufacturing facility and hundreds of good jobs in Moorhead, Minnesota, which will produce 193 million gallons per year of SAF using agricultural and wood waste as feedstock. The 193 million gallons projected by DG Fuels would represent nearly half of the fuel used at the Minnesota International Airport. [Link](#)
  59. **Biojet/SAF:** USA. Vast Renewables Limited has signed a development services agreement with GGS Energy to pursue a commercial-scale synthetic fuels project in the Southwest United States. Project Bravo, Vast’s first deployment in the U.S., will see Vast’s CSP v3.0 technology used to generate carbon free heat and electricity to power a co-located refinery that will produce green methanol and/or e-SAF. The project is likely to be located in the Southwest United States. Project Bravo will build on Solar Methanol 1 (SM1), the CSP-powered green methanol reference plant to be located in Australia at the Port Augusta Green Energy Hub. [Link](#)
  60. **Biojet/SAF:** USAHYCO1, Inc. achieved a key milestone in commercializing its breakthrough CO2 conversion technology, already surpassing 1,500 hours of continuous steady-state operation in its first commercial CUBEtm Syngas system (CUBEtm stands for Carbon Utilization. Best Efficiency). The revolutionary HYCO1 catalyst technology installed in collaboration with Agra Energy at its New Franken, WI biofuels plant, integrates directly into the front-end of a dairy waste-to-SAF project. [Link](#)
  61. **Biojet/SAF:** Hong Kong. HSBC Hong Kong is entering into a one-time purchase agreement for around 3,400 metric tons of SAF produced by EcoCeres, which will be used in Cathay Pacific flights departing from the Hong Kong International Airport. EcoCeres’ SAF is derived from 100% waste-based biomass feedstock, which can deliver an estimated reduction of up to 90% in greenhouse gas emissions compared to

conventional jet fuel, certified by International Sustainability and Carbon Certification. This batch of SAF is made from fully traceable feedstock of used cooking oil. The reduction in lifecycle carbon emissions is estimated to be 11,800 metric tons. [Link](#)

## Biomaterials

62. **Biomaterials:** Finland. UPM Biochemicals, Selenis and Bormioli Pharma have partnered to produce the world's first pharmaceutical bottles made from partially wood-based PET. This bottle takes sustainability in pharma packaging to a new level. As the high regulatory and performance requirements for pharma packaging may limit the use of new or recycled materials, this bottle uses standard PET which is made with UPM's world first wood based BioMEG, UPM BioPura™. [Link](#)
63. **Biomaterials:** USA. Henkel Corporation, and Celanese Corporation announced a partnership to enhance circularity in emulsion production by utilizing carbon capture-based materials. Earlier this year, Celanese launched a carbon capture and utilization (CCU) project at its Clear Lake, Texas site as part of its Fairway Methanol joint venture with Mitsui & Co., Ltd. The CCU technology captures industrial CO<sub>2</sub> emissions and, using hydrogen, converts them into methanol, which forms 35% of vinyl acetate monomer – a crucial element to produce polymers often used in adhesive formulations. Through this collaboration, Henkel will now produce water-based adhesives made from captured CO<sub>2</sub> emissions. [Link](#)

## Biotechnology

64. **Biotechnology:** Brazil. Novonesis' new biosolution Eversa Advance tackles the challenges of processing feedstocks with up to 20% FFA. The product helps biodiesel producers improve operational efficiency, reduce total pre-treatment operating costs by up to 45%, and lower their environmental footprint. Olfar, one of the largest industrial biodiesel groups in Brazil, is the first to implement Novonesis' patent pending FlexFit® Advance technology, using the Eversa® Advance biosolution. Their plant is now operating successfully and producing biodiesel. [Link](#)
65. **Biotechnology:** Israel. Evogene Ltd. recently announced a collaboration with Google Cloud to develop a cutting-edge foundation model for generative small molecule de novo design, propelling Evogene's ChemPass AI tech-engine to new levels of innovation. ChemPass AI is a computational technology platform that directs and accelerates the discovery and development of novel products based on small molecules. This groundbreaking initiative seeks to advance the discovery and development of novel small molecules for drug development, sustainable crop protection, and other innovative products across a wide range of life-science industries. [Link](#)
66. **Biotechnology:** USA. Industrial Microbes (iMicrobes) closed a seed round funding, bringing the company's total investment to over \$10M. The seed funding will enable the company to engineer its microbes 3x faster and purify its first commercial samples. This critical investment supports the company's ongoing efforts to scale its proprietary bioprocesses, transforming renewable feedstocks like ethanol and methane into high-performance biobased chemicals. iMicrobes is scaling up its fermentation to produce more than 10 kg of product per run in a pilot bioreactor and accelerate the commercialization of its bio-based acrylic acid production platform. Acrylic acid is a versatile chemical used in products. [Link](#)

## CO2 removal

67. **CO2 removal:** France. Aerleum’s game-changing solution captures and converts CO<sub>2</sub> in a single reactor, using proprietary bifunctional materials and precision heating. The company’s technology eliminates some of the most energy-intensive steps of the value chain, enabling cost-competitive, large-scale production of e-fuels and chemicals, while drastically cutting greenhouse gas emissions. Aerleum is setting the fastest timeline in the market to achieve price parity with fossil fuels, offering industries—such as maritime, aviation, and chemicals—a viable path to decarbonization without compromising on cost or scalability. [Link](#)
68. **CO2 removal:** Norway. LanzaTech Global announced plans to develop a commercial-scale Carbon Capture and Utilization facility at Herøya Industrial Park in Porsgrunn, Norway. The plant will produce ethanol and is expected to begin operations in 2028. Eramet will supply furnace gas as feedstock to the facility from the Porsgrunn Manganese Alloys smelter but will not participate in its financing. The new plant at Herøya will complement the six other commercial scale plants already using LanzaTech’s carbon recycling technology to produce ethanol and the first for which LanzaTech will manage the full scope of project design, construction, and operations. The project’s Front-end Engineering Design (FEED) phase was completed with global engineering firm Fluor Corporation. [Link](#)
69. **CO2 removal:** USA. Gevo Inc., has been offered a \$1.46 billion loan by the U.S. Department of Energy (DOE) to build a “clean” fuels plant in eastern South Dakota that captures carbon emissions. The facility, named Net-Zero 1, aims to produce SAF, renewable diesel, and renewable naphtha using corn feedstock at Lake Preston. The plant aims to produce SAF while incorporating carbon-negative production processes to offset tailpipe emissions. [Link](#)

## E-Fuels

70. **E-fuels:** Japan. Hitachi will deploy Electrochaea’s patented technology to produce clean, synthetic methane at the first biomethanation plant in Japan, with commissioning targeted in 2027. Electrochaea’s commercial-scale power-to-methane technology will help to significantly reduce greenhouse gas emissions and deliver a cost-effective, drop-in replacement for fossil fuel-based natural gas in Japan. Under the licensing agreement, Hitachi will retain the option to purchase additional licenses to deploy Electrochaea’s biomethanation technology throughout Japan. [Link](#)
71. **E-fuels:** United Kingdom. International Airlines Group announced a new SAF purchase agreement with e-SAF producer Infinium, which plans to supply the UK market with power-to-liquid e-SAF from late 2026. Produced from water, waste CO<sub>2</sub> and renewable energy, e-SAF is expected to reduce lifecycle greenhouse gas emissions by approximately 90%. Under the terms of the ten-year agreement, Infinium will supply IAG with e-SAF to support any of its five airlines, Aer Lingus, British Airways, Iberia, LEVEL and Vueling. Last year, IAG airlines used approximately 12% of the world’s supply of SAF. [Link](#)

## Ethanol

72. **Ethanol:** Brazil. Raízen started its new Second Generation Ethanol plant at the Bonfim Bioenergy Park in Guariba (SP). With an investment of R\$1.2 billion, the company’s second cellulosic ethanol plant is the largest in the world and has already contracted 80% of its volume with a production capacity of 82 million liters per year. [Link](#)

73. **Ethanol:** USA. ICM has signed an EPC agreement to provide Absolute Energy, LLC, with its patented FOT Oil Recovery technology, which enhances oil production while reducing natural gas consumption and improving the facility's overall energy efficiency. [Link](#)

## Feedstock

74. **Feedstock:** Brazil. A study recently published in the renowned journal Nature has revealed the benefits of Brazil's second-crop corn ethanol production system. The research aimed to evaluate in a thorough way the socioeconomic and environmental impacts of the energy and food production system that is rapidly expanding in Brazil and drawing attention on a global scale. The production of corn ethanol in Brazil, despite its fast and short history, has already reached 6.3 billion liters in 2024, with an expectation of reaching between 13 and 15 billion liters in 2032. The analysis used advanced Life Cycle Assessment (LCA) methods and computable general equilibrium (CGE) models. [Link](#)

## Hydrogen

75. **Hydrogen/Policy:** The year 2024 has been a year of indecisiveness for the actors within the clean hydrogen sector because of the elections held in some of the most important markets. While the EU and the UK ended up with governments that are more or less pro-hydrogen, the same cannot be said for the US where we are yet to see what impact the election of Donald Trump as President would have on the industry. China is the current front-runner in global electrolyser production and, according to the International Energy Agency (IEA), it will become the leading exporter of the technology over the next decade. This is an opinion that is also shared by Ethan Hugh, the global marketing director of electrolyser maker Hygreen Energy, who believes that the sector in China will continue to be well supported by the country's ambitious targets, subsidies and incentives. The tools through which the EU will support the clean hydrogen industry are not new as they have been available over the past few years. For instance, the EC will continue to provide grants to Important Projects of Common European Interest (IPCEIs) for the hydrogen value chain and is yet to make hydrogen auctions a regular occurrence for the Bloc. [Link](#)
76. **Hydrogen:** Algeria. Cepsa and Sonatrach signed a MoU to jointly undertake a feasibility study for developing an integrated hydrogen production project and its derivatives in Algeria, mainly aimed at supplying the European market. The project includes the construction of an electrolysis hydrogen production plant, solar and wind plants to supply renewable energy to the electrolyzers, a methanol and/or green ammonia production plant. The plant also includes facilities for storage, transportation, and other auxiliary facilities. [Link](#)
77. **Hydrogen:** Argentina. Austrian renewables developer RP Global plans to install 3 GW of electrolysis capacity as part of the first stage of the "Gaucho Wind to Hydrogen and Green Ammonia" development in Argentina. Installed in Patagonia, the first-stage Gaucho electrolyzers will be powered by a wind farm of around 4.2 GW, resulting in the production of over 21,340 GWh of electricity and up to 1.7 Mt per year of green ammonia destined mainly for exports to the European market. [Link](#)
78. **Hydrogen:** Australia. GE Vernova has announced plans for its LM6000 gas turbine, integrated into the GE Vernova LM6000VELOX packaged solution, to operate on 100% hydrogen at the Whyalla hydrogen power plant in the Upper Spencer Gulf, South Australia. The company confirmed it has secured an order with ATCO Australia for the

project, in collaboration with BOC, a Linde company. The project involves the deployment of four LM6000VELOX units, with commissioning scheduled for early 2026. This initiative will represent the first commercial-scale GE Vernova power plant project to leverage aeroderivative gas turbine combustion technology designed to run entirely on hydrogen. [Link](#)

79. **Hydrogen:** Australia. The Whyalla power station and the electrolyser are among the biggest, if not the biggest of their type in the world, and together make the biggest hydrogen project commitment in Australia, and with an ambitious timeline of delivering it by early 2026. Because it has demand flexibility, the electrolyser will be able to adjust its charging times. That hydrogen will then feed a 200 MW power station, which can run during peak periods and provide flexible grid firming services – or generation that can be easily switched on and off to balance that being made by renewables. [Link](#)
80. **Hydrogen:** Canada. EDF Group agreed to join Canadian energy transition developer Abraxas Power Corp as an equity partner in a green energy hub project in Central Newfoundland that will utilise more than 3 GW of new onshore wind capacity for the production of hydrogen and ammonia. Estimated at CAD 12 billion (USD 8.54bn/EUR 8.07bn), EVREC is set to enter the construction phase in 2026 and be completed by 2030. The site will target an output of about 200,000 tonnes of green hydrogen and about 1 million tonnes of green ammonia annually once operational. [Link](#)
81. **Hydrogen:** Canada. EverWind Fuels has been awarded \$16 million through Transport Canada's Green Shipping Corridor Fund, marking a significant milestone in establishing Atlantic Canada as a premier hub for green hydrogen and ammonia production and transportation. The project will support critical marine and shore-side infrastructure development at EverWind's Point Tupper Terminal, including, the development of existing marine terminal infrastructure for green fuel handling, the installation of a state-of-the-art green ammonia loading arm and the development of green ammonia supply pipelines. [Link](#)
82. **Hydrogen:** Chile. GNL Quintero announced that it has obtained environmental approval to set up a 10-MW electrolysis system and produce green hydrogen for industrial customers in the Valparaiso region, central Chile. The project with Spanish renewables firm Acciona Energia is preparing to invest USD 30 million (EUR 28.5m). The Chilean state also threw in its support, awarding the project a subsidy of USD 5.7 million in the 2021. The green hydrogen production plant will be located at GNL Quintero's terminal in Quintero Bay. Water for the electrolysis will be sourced from the terminal's existing sanitary network, while electricity will be contracted from a certified grid-connected renewable energy source. [Link](#)
83. **Hydrogen:** Denmark. European Energy A/S has started up its first green hydrogen facility in Måde, near Esbjerg. The facility marks European Energy's first venture into large-scale hydrogen production using renewable energy. Construction of the facility was completed in June 2024 and after a successful commissioning phase, the facility is now operational with the first electrolyzer supplied by the Danish company Stiesdal. Plans are already in place to expand the facility with two additional electrolyzers of which the next is expected to be installed in 2025. When all three electrolyzers are operating, the plant will have a total capacity of 12 MW and an expected annual production of 1,500 tonnes of hydrogen. [Link](#)
84. **Hydrogen:** Finland. Gasgrid Finland is advancing plans for hydrogen transmission infrastructure in the Baltic Sea with a framework contract for owner's engineering services awarded to Switzerland-based StreamTec Solutions. Specifically, the contract

will focus on two main projects: the Baltic Sea Hydrogen Collector (BHC) and the Nordic-Baltic Hydrogen Corridor (NBHC). The BHC project envisions building an offshore hydrogen pipeline infrastructure connecting Finland, Sweden, and Central Europe to enable the production of clean and sustainable hydrogen to meet Europe's needs. The partners in the BHC project include Gasgrid Finland, Nordion Energi, and Copenhagen Infrastructure Partners. [Link](#)

85. **Hydrogen:** Finland. Verso Energy is reserving a site at the Port of Oulu, northern Finland, for a project to produce hydrogen and synthetic fuels. Verso Energy is a company recently set up by co-founders Xavier Caitucoli and Antoine Huard that has already launched several hydrogen and synthetic fuel projects in France. It has been attracted to Oulu by the region's abundance of affordable renewable energy and biogenic carbon dioxide, as well as its talent pool given the University of Oulu's research into hydrogen. [Link](#)
86. **Hydrogen:** France. Haffner Energy's hydrogen production, testing and training center is about to start producing renewable hydrogen using its patented biomass and organic waste thermolysis process. Haffner Energy's center is now equipped with new generation, standardized industrial production equipment. Designed to operate continuously for 8,000 hours a year, it entered the renewable gas (syngas) production phase last June. This site is the world's first unit ever built for the continuous production of hydrogen from solid biomass.
87. **Hydrogen:** France. TotalEnergies has teamed up with compatriot industrial gas supplier Air Liquide (EPA:AI) on a renewable hydrogen project at TotalEnergies' La Mede biorefinery in southeastern France. Air Liquide said that in the framework of a long-term contract, it will build, own and operate a new hydrogen production unit at the La Mede site. The unit will have an annual capacity of 25,000 tonnes of renewable hydrogen, which will be produced from recycled biogenic by-products from the biorefinery. The hydrogen will mainly be used by the biorefinery for the production of biofuels and SAF. [Link](#)
88. **Hydrogen:** Germany. Hanseatic Hydrogen GmbH t plans to install an electrolyser with a capacity of up to 500 MW to produce green hydrogen in Stade, a city located in the lower regions of the Elbe River in northern Germany. The company will initially build a 100-MW facility, which is expected to become operational by 2028. In its final phase, the plant could be expanded to up to 500 MW. The consortium is to make the final investment decision in 2026. [Link](#)
89. **Hydrogen:** Germany. Uniper has selected Electric Hydrogen as its exclusive partner to design a 200-megawatt (MW) electrolyzer plant for the large-scale electrolysis within Uniper's Green Wilhelmshaven project in Northern Germany. Uniper's Green Wilhelmshaven project consists of two major systems: large-scale electrolysis, which will produce green hydrogen, and an import terminal for ammonia. The electrolyzer will be built in Wilhelmshaven on the site of Uniper's former coal-fired power plant. The ammonia import terminal is planned in the immediate vicinity of the first LNG terminal in the north of Wilhelmshaven, which is operated by a Uniper subsidiary. [Link](#)
90. **Hydrogen:** Germany. Uniper SE will need more time to reach the target of investing around EUR 8 billion (USD 8.63bn) in its green transformation due to low demand for green hydrogen from customers and slowly developing regulatory framework. Uniper has indicated that currently there are few major customers looking for green hydrogen and interested in entering into corresponding supply contracts. [Link](#)

91. **Hydrogen:** Germany. German electrolyser manufacturer Enapter AG (FRA: H2O) lowered its full-year revenue projections by roughly EUR 10 million (USD 10.5m) as some customer projects will be put off due to production delays of its Nexus-class units. Enapter made the revision on its current order backlog of roughly EUR 50 million and said a “significant proportion” of sales will be realised in 2025. The German firm now expects to register 2024 sales of between EUR 22 million and EUR 24 million, instead of EUR 34 million forecast previously. [Link](#)
92. **Hydrogen:** Indonesia. Sembcorp Industries, through its subsidiary Sembcorp Utilities, has signed a joint development framework agreement (JDFA) with PT PLN Energi Primer Indonesia (EPI), a subsidiary of PT PLN (Persero), and PT Transportasi Gas Indonesia (TGI), a joint venture between PT Pertamina Gas Negara and Transasia Pipeline Company, to establish a potential hydrogen transportation pipeline connecting Sumatra, the Riau Islands in Indonesia and Singapore. <https://www.biofuelsdigest.com/bdigest/new-alliance-aims-to-develop-hydrogen-pipeline-connecting-indonesia-and-singapore/>
93. **Hydrogen:** Internal combustion engines (ICE) but without the emissions. The idea is certainly appealing. Keeping the same internal combustion engines (ICE) that have powered cars, buses, and trucks for well over a century, but eliminating the damaging and climate-affecting emissions that escape from the tailpipe. Currently, electrification is the primary route to decarbonizing transportation, but battery electric solutions bring many challenges, meaning adoption is likely to be a slow process – IDTechEx estimates that 11% of all car sales in 2023 were fully electric. Could engines running on hydrogen keep the best of both worlds, familiar and mature ICE technology with zero emissions? IDTechEx’s report, “Hydrogen Internal Combustion Engines 2025-2045: Applications, Technologies, Market Status and Forecasts”, explores the emissions credentials of this potentially disruptive technology. [Link](#)
94. **Hydrogen:** Norway. HydrogenPro AS and industrial plant construction and engineering firm the J Heiner Kramer Group (JHK) have teamed up for the implementation of green hydrogen projects with a capacity within the 5 MW-50 MW range across Germany, Austria and the Benelux countries. [Link](#)
95. **Hydrogen:** Norway. Norwegian clean energy agency Enova SF announced NOK 777 million (USD 70.8m/EUR 65m) in support for five hydrogen production projects along the country's coast aimed at supplying fuel for Norwegian ships. Enova is backing projects under the “Hydrogen Production for Maritime Transport 2027” initiative, with the support competition divided into three regions -- Southern Norway, Central Norway, and Northern Norway -- and funding covering up to 80% of total investment costs, capped at NOK 500 million per project in Southern Norway and NOK 320 million per project in Central and Northern Norway. [Link](#)
96. **Hydrogen:** Saudi Arabia. Construction work on the 2.2-GW Neom green hydrogen plant in northwestern Saudi Arabia is 60% complete and the facility is on track to go onstream at the end of 2026. Powered by more than 4 GW of solar and wind, the site is expected to produce about 600 tonnes of green hydrogen per day, corresponding to 1.2 million tonnes of green ammonia annually with first deliveries planned for early 2027. Air Products is the sole off-taker of the ammonia from the plant under an exclusive 30-year supply agreement, has already secured a take-or-pay commitment with off-takers for about 35% of the output. [Link](#)
97. **Hydrogen:** South Korea. Ulsan City and Hyundai Motor announced a collaboration to create the largest hydrogen-friendly city in Korea. This agreement marks a pivotal step in



- promoting a comprehensive hydrogen industry, encompassing production, storage, distribution, and utilization of hydrogen energy. The collaboration aims to establish an integrated hydrogen supply chain, which includes hydrogen production, supply, storage, hydrogen electric vehicle development, and fuel cell system utilization. [Link](#)
98. **Hydrogen:** Sweden. Liquid Wind has raised EUR 44 million (USD 46.4m) in a Series C financing round, the largest in the company's history, to support the construction of 10 e-fuel facilities by 2027. Liquid Wind develops facilities that convert biogenic CO<sub>2</sub> and renewable electricity into e-methanol. A standard site built by the company targets annual production of up to 100,000 tonnes of e-fuel. [Link](#)
  99. **Hydrogen:** Sweden. Plagazi is to receive a EUR-29.5-million (USD 32.1m) grant from the EU Innovation Fund to advance its flagship project for waste-to-circular hydrogen production. Plagazi has developed technology that can convert all types of waste, including non-recyclable, into green hydrogen through plasma gasification by exposing it to a temperature higher than 3,000°C. [Link](#)
  100. **Hydrogen:** The Netherlands. RWE AG has secured all construction and environmental permits for a 100-MW electrolyser to produce green hydrogen in the Netherlands. The electrolysis plant will be part of the solutions for OranjeWind, a 795-MW Dutch offshore wind project undertaken by RWE and French peer TotalEnergies that will also integrate smart charging stations for electric vehicles, e-boilers and battery storage facilities. [Link](#)
  101. **Hydrogen:** UAE. CMMZE plans to build a major facility in the United Arab Emirates (UAE) as well as additional production sites in Morocco and Tunisia. The first hydrogen production should occur by late 2027 and the fuel will be directed mainly for export to Europe. The new project was revealed after Aldo Labia sold his shipping holding to Asian interests for USD 700 million (EUR 661.75m). The fresh capital from the sale could support the development of the hydrogen initiatives. The hydrogen plants will use solar and wind energy in the manufacturing process. According to CMMZE estimates, 1.2 million MWh of electricity will be required for the targeted annual production. Therefore, the firm will develop dedicated renewable energy sites in Tunisia. In particular, the solar facilities will be located in the Nefetia Benguerdane region, while the wind generation will occur in El Hamma. The company also plans to install 250 MW of electrolyser capacity at the port of Zarzis, Tunisia, along with processing and storage facilities. [Link](#)
  102. **Hydrogen:** United Kingdom. Exolum Corporation SA has announced the start of the world's first project to transport and store green hydrogen on a commercial scale in existing oil infrastructure by using liquid organic hydrogen carriers (LOHCs). Led by Exolum, it is being carried out in Immingham, the UK's largest freight port. Liquid organic hydrogen carriers (LOHCs) are organic compounds that can absorb and release hydrogen through chemical reactions. Exolum is one of the world's largest liquid logistics companies with a major fuel pipeline and tank storage network in the UK. It delivers fuel to airports for around four out of every ten flights taking off from the UK annually. [Link](#)
  103. **Hydrogen:** USA. Air Products has given up on a USD-4.5-billion (EUR 4.2bn) green hydrogen joint venture project in Texas and has sold the development rights to its partner in the project. The project, announced in late 2022, was a joint venture with The AES Corporation. The company is progressing with the Neom green hydrogen project in Saudi Arabia, as well as its Canada Net-Zero Hydrogen Energy Project and a Louisiana blue hydrogen project. [Link](#)

104. **Hydrogen:** USA. Avina Clean Hydrogen commenced developing a hydrogen production plant coupled with a refuelling station in Southern California which will be capable of producing up to four metric tonnes of compressed green hydrogen per day. Avina is ready to start construction works after securing key environmental permits and expects the site to become operational in July 2025. The facility is located in the City of Vernon, just 16 km from the Port of Long Beach. It will produce hydrogen through electrolysis, using clean electricity. [Link](#)
105. **Hydrogen:** USA. The US Department of Energy (DoE) announced up to \$2.2bn in funding commitments for two new regional clean hydrogen hubs (H2Hubs) under President Joe Biden's "Investing in America" agenda. The Gulf Coast hub, led by HyVelocity, will receive up to \$1.2bn in federal cost-share funding. This project is expected to generate approximately 45,000 direct jobs over its lifetime. Located in Texas, the hub plans to utilise the region's natural gas and renewable energy resources to produce hydrogen through electrolysis and by utilising carbon capture and storage. The Midwest H2Hub, led by the Midwest Alliance for Clean Hydrogen (MachH2), will benefit from up to \$1bn in funding. This hydrogen hub will be located in a major US industrial and transportation corridor spanning Illinois, Indiana, Iowa, and Michigan. The hydrogen project will leverage wind, nuclear, and natural gas energy sources. [Link](#)

## Marine fuels

106. **Marine fuels:** COSCO Shipping Energy and COSCO Shipping Heavy Industry have received approvals in principle from classification giants ABS, CCS, and DNV for their ammonia dual-fuel carrier design, marking a milestone for green shipping. The approvals, issued on October 30, 2024, endorse a 50,000 cubic meter vessel capable of transporting both ammonia and LPG, boosting COSCO's green and low-carbon initiatives. [Link](#)
107. **Marine fuels:** Denmark. Maersk has entered into a long-term bio-methanol offtake agreement with LONGi Green Energy Technology Co., Ltd. The agreement will contribute to lowering GHG emissions from Maersk's growing fleet of dual-fuel methanol container vessels. [Link](#)
108. **Marine fuels:** Denmark. Mærsk McKinney Møller Center for Zero Carbon Shipping is unveiling an updated version of its Fuel Pathway Maturity Map, providing the shipping and financial sectors with a comprehensive overview of the advancements and challenges in sustainable fuel pathways. This intuitive tool provides an overview of key alternative fuels that are expected to play a pivotal role in decarbonizing the maritime industry by 2050. The past two years have seen significant advances, driven by increased investment in dual-fuel vessels and pilot projects across the fuel landscape. [Link](#)
109. **Marine fuels:** Germany. Hapag-Lloyd has signed two contracts with two Chinese shipyards for a total of 24 new container ships. Of these, 12 newbuildings – each with a capacity of 16,800 TEU – will be built by Yangzijiang Shipbuilding Group. All of the newbuildings will be equipped with state-of-the-art low emission high pressure liquefied gas dual-fuel engines that are extremely fuel-efficient. In addition, these vessels can be operated using biomethane, which can reduce CO<sub>2</sub>e emissions by up to 95% compared to conventional propulsion systems. The new ships will also be ammonia ready. [Link](#)
110. **Marine fuels:** Germany. MAN, Energy Solutions received multiple orders for its dual-fuel liquid gas injection methanol engines to power Very Large Container Vessels at

shipyards in South Korea, China, and Japan, bringing the total number of such engines ordered to 95 since 2021. Five of these engines are already operational aboard VLCVs, supporting the growing shift towards a multi-fuel shipping industry. [Link](#)

111. **Marine fuels:** Japan. NYK and MOL, are advancing ammonia as a marine fuel to cut emissions, with recent launches in Tokyo and Western Australia. NYK, alongside IHI Power Systems and Class NK, launched Sakigake, the first ammonia-fueled tugboat, which began a three-month trial in Tokyo Bay in August. Additionally, MOL recently completed the world's first ammonia ship-to-ship transfer in Australia, moving 4,000 cubic meters of ammonia between gas carriers to simulate future bunkering operations. [Link](#)
112. **Marine fuels:** Norway. Norwegian Cruise Line's Norwegian Dawn has received a GoodFuels B30 sustainable biofuel blend while docked at the Ijmuiden Cruise Terminal in the Netherlands. The B30 biofuel blend, produced exclusively from feedstocks certified as 100% waste and residues. [Link](#)
113. **Marine fuels:** Singapore. GoodFuels has announced a sudden departure from supplying marine biofuel in Singapore, effective immediately. FincoEnergies made the decision to stop shipments as of Nov. 6 while focusing on Europe and supplies from the ARA ports, based in Amsterdam. Outside of Europe, rather than with physical supplies the company will support international customers with its insetting and offsetting programs, GoodShipping and GoodZero. [Link](#)
114. **Marine fuels:** Singapore. Singapore has surpassed Rotterdam as the world's largest bio-bunkering port. During Q3, Rotterdam's biobunker sales dropped by more than 40% compared to Q2 and by a quarter on the year while Singapore jumped by more than a quarter compared to Q2 and more than 67% on the year. A market analyst at the Port of Rotterdam believes that the lower biobunkering there could be as a result of more in Singapore, indicating a shift in market demand but also a lack of sufficient supply availability, but the Dutch government also significantly reduced its subsidies on marine biofuel earlier this year. [Link](#)
115. **Marine fuels:** South Korea. Lloyd's Register granted Approval in Principle to HD Hyundai Heavy Industries for a 15,300 TEU ammonia-powered dual-fuel container ship, serving as an early validation that confirms the feasibility and compliance of the design with safety standards. The project aims to address the shipping industry's carbon reduction efforts through alternative fuel solutions. [Link](#)
116. **Marine fuels:** Taiwan. Wan Hai Lines placed an order for eight dual-fuel containerships, each capable of running on methanol, to be built by South Korean shipbuilders Samsung Heavy Industries and HD Hyundai Samho. The ships, scheduled to carry up to 16,000 TEUs, come at a combined cost of USD 1.6 billion, with each vessel priced at up to USD 204 million. [Link](#)

## Methanol

117. **Methanol:** China. Clariant announced that its MegaMax catalyst was selected for a China's biomass gasification-to-green methanol project. The plant will use a combination of farm waste and wind power to produce up to 250,000 tons per annum of green methanol in two phases by 2027. Construction of the first plant phase began in March 2024 and is expected to start producing green methanol in the first half of 2025 as China's first commercialized biomass gasification-to-green methanol plant. [Link](#)

118. **Methanol:** Denmark. A.P. Moller-Maersk has entered into a long-term bio-methanol offtake agreement with LONGi Green Energy Technology. With the addition of the LONGi volumes, Maersk said it is making progress in securing enough methanol for its owned dual-fuel methanol fleet of which 7 vessels are already in operation. Maersk's combined methanol offtake agreements now will meet more than 50% of the dual-fuel methanol fleet demand in 2027. [Link](#)
119. **Methanol:** France. Qair has been awarded a parcel on the Haropa Port site, in Le Havre, to develop its e-methanol production project Methavert. The facility will initially produce 200,000 tons of e-methanol to support the decarbonization of maritime transport and other high-emission and hard-to-abate industries. [Link](#)
120. **Methanol:** Hong Kong. Hong Kong and China Gas Company Limited (Towngas) and Chimbusco Pan Nation Petro-Chemical Company Limited (CPN) have completed a MoU where Towngas and CPN will collaborate on green methanol fuel distribution. Towngas will supply CPN with its self-produced green methanol, which has obtained ISCC EU and ISCC PLUS certifications. CPN will be responsible for distributing the green methanol fuel to its customers. Towngas will also provide support in handling technical enquiries and providing product certification documents. [Link](#)
121. **Methanol:** India. Jakson Green, a new energy transition platform, has achieved a historic milestone in collaboration with NTPC, successfully synthesizing methanol from captured carbon dioxide. This ground-breaking project is located at NTPC's Vindhyachal Thermal Power Plant in Madhya Pradesh, India. This innovative plant captures CO<sub>2</sub> directly from the flue gas emissions and converts it into methanol, a versatile and cleaner fuel which can be further used for applications like power generation and transportation. [Link](#)
122. **Methanol:** India. Ohmium International, a green hydrogen company that designs, manufactures, and deploys advanced proton exchange membrane (PEM) electrolyzers, has partnered with the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Breathe Applied Sciences, and Spirare Energy on India's first CO<sub>2</sub>-to-Green Methanol plant. The project will combine green hydrogen generated by Ohmium PEM electrolyzers with CO<sub>2</sub> captured from the Singareni Thermal Power Plant to produce green methanol. [Link](#)
123. **Methanol:** Japan. Idemitsu Kosan Co. and Mitsubishi Gas Chemical Company agreed to establish a supply system for e-methanol and biomethanol in Japan by March 2026. The new supply system for e-methanol and bio-methanol, targeted at marine fuel applications, is expected to accelerate demand, and expand the market. In response to the growing demand for e-methanol and biomethanol in the marine fuel sector, the two companies will combine their accumulated knowledge and infrastructure to establish a supply system designed to meet and stimulate market demand. [Link](#)

## Plastic recycling

124. **Plastic recycling:** Farrel Pomini's Continuous Mixing Technology (FCM™, Farrel Continuous Mixer) plays an essential role in a pyrolysis process for plastics developed by Lummus. The process takes streams of post-industrial and post-consumer waste and converts them into gas, pyrolysis oil and pitch product. The FCM™ melts feedstock resins and homogenizes them under specific temperature and pressure parameters. [Link](#)
125. **Plastic recycling:** Germany. Covestro announced an enhanced collaboration with Chinese plastics recycling company Ausell. Building on their previous partnership in

recycling polycarbonate water barrels, this new collaboration aims to accelerate the recycling of plastics from end-of-life vehicles, contributing to the automotive industry's circularity by transforming waste into valuable materials for new automotive components. Covestro is one of the world's leading manufacturers of high-quality polymer materials and their components. Covestro supplies customers around the world in key industries such as mobility, building and living, as well as the electrical and electronics sector. [Link](#)

126. **Plastic recycling:** The Netherlands. Shell Chemicals Park Moerdijk started up a new unit that allows difficult to recycle plastics to be reused. With the Market Development Upgrader (MDU), the chemical complex can process raw materials at scale. The opening marks a significant milestone for Shell and is essential for the development of plastic circularity in the Netherlands. First, plastic waste is heated until the oxygen has been completely extracted. What remains is pyrolysis oil. The MDU purifies this oil so that it can serve as feedstock for the cracking plant at Moerdijk. This cracker cuts and separates larger and smaller molecule chains, making the base chemicals for everyday products. [Link](#)

## Policy

127. **Policy:** Australia. Australia should be one of the country's best placed to reap the rewards of the clean energy revolution. The country boasts large resources of key energy transition minerals such as lithium, copper and manganese and has a rich mining history. But the reality is that the country is struggling to live up to its potential. BHP's nickel operations in Western Australia, for example, were billed as a future energy metals hub but they are currently mothballed with any restart decision not expected for a couple of years. The main problem is that Australia doesn't have enough green energy to produce the metals that will power the green transition. Reuters columnist Clyde Russell attended this week's International Mining and Resources Conference (IMARC) in Sydney, where the country's power paradox was the big talking point. [Link](#)
128. **Policy:** Germany. Platts reports over supply in the biofuels market has led the government to block companies from rolling over their greenhouse gas emissions tickets in 2025 and 2026 in an effort to encourage greater production. Companies will now be required to use certificates produced in the same year as the compliance requirements rather than the continued practice by oil companies to over-comply by stockpiling credits and then rolling them over to the next year. In 2022, overcompliance was about 24% above required CO2 emissions. [Link](#)
129. **Policy:** Indonesia. In Indonesia, it is estimated that by raising its biodiesel blending mandate to 50%, demand would increase to 2 billion litres of annual crude palm oil consumption compared to the 1.34 billion litres currently consumed under B35. The blend is set to go to 40% by January 2025. Domestic production is currently at just 1.6-1.7 billion litres, so would require a significant increase in production in order to achieve the plan for B50. [Link](#)
130. **Policy:** USA. A major question hanging over bioeconomy policy is what the Trump administration will do with the Biden administration's Executive Order 14081 of 2022. This was the biggest ever US government programme to develop domestic biomanufacturing capacity. The package is unlikely to be scrapped wholesale under Trump. Climate issues and government regulation may be bêtes noires for the Republican agenda, but certain biobased industries can support key priorities of the

new administration: energy and import independence, the buildout of US manufacturing, and industrial competition with China – motivations that also spurred the previous administration. A large part of the Executive Order also centres around building supply chains around rural producers – a major base for the Republican party.

[Link](#)

131. **Policy:** USA. What a change is US President may bring: During the Biden Administration, the rhetoric for bioeconomy projects shifted from domestic energy production volumes to carbon reduction volumes. For marine and aviation, that emphasis will continue, but elsewhere there will be a revival of rhetoric around domestic energy sufficiency, and with that volumes. Opportunities may include: Protection for solar, EV tech, fair trade investigations; tariff wars; rapprochement with Russia; hydrogen technology; state-level bioeconomy lobbying; Farm Bill; carbon intensity reduction; corn; waste fats, oils and greases; more access to federal forest land; rule by mandarins of the Office of Management and Budget. [Link](#)

## Pyrolysis

132. **Pyrolysis:** Germany. The technology developed by autarkize converts biogenic residues such as wood waste, peelings and fermentation residues into renewable gas and certified biochar. The gas produced can replace fossil fuels in industrial processes, while the biochar serves as CO<sub>2</sub> storage and can also be used in agriculture and construction. Each autarkize plant is capable of sequestering between 1,400 and 5,500 tons of CO<sub>2</sub> annually and generating up to 10 GWh of renewable energy. The plants from autarkize are modular systems installed in shipping containers with an output of up to 2.5 megawatts. These container solutions can be easily integrated into existing biogas plants and industrial processes. They also offer an excellent opportunity to decarbonize heating networks, especially for municipal and regional district heating systems. [Link](#)
133. **Pyrolysis:** Thailand. Blackwood Technology announced the successful start of production of the first commercial FlashTor black pellet plant in Lampang Province, Thailand. The plant is owned and operated by NT Biomass Products Company Limited (NTBC), a 100% subsidiary of TTCL Public Company Limited (TTCL). When fully ramped-up, it will produce 75,000 tonnes of black pellets made from renewable biomass per year, to replace fossil coal in power generation and steel production. The plant will primarily use corn straw as biomass feedstock and can also process woody biomass. [Link](#)
134. **Pyrolysis:** Thailand. Blackwood Technology B.V. (Blackwood) has started up of production of the first commercial "FlashTor" black pellet plant in Lampang Province, Thailand. The commercial plant in Lampang Province will produce 75,000 tonnes of black pellets per annum. Blackwood's proprietary FlashTor technology is a thermal pre-treatment technology that facilitates the large-scale replacement of fossil coal by renewable biomass. [Link](#)

## Recycling plastic

135. **Recycling plastic:** Finland. Neste, Alterra and Technip Energies signed a collaboration agreement to advance the circularity of plastics by providing the industry a standardized technology solution for chemical recycling. The partners aim to globally offer a standardized modular solution, based on Alterra's proprietary liquefaction technology, to parties interested in building capacity for chemical recycling. This

solution will come in the form of readily designed and engineered liquefaction plant modules, which will allow for lower pre-investment costs, accelerated implementation time, high predictability on project economics and reduced overall capital costs. [Link](#)

## Renewable diesel

136. **Renewable diesel:** Spain. Repsol launched the commercial name of its 100% renewable diesel at its service stations: Nexa 100% Renewable Diesel, a premium fuel designed for all diesel engines. Nexa 100% Renewable Diesel has a unique formulation that optimizes performance and extends the life of the engines of diesel vehicles. It is produced from organic waste and, with today's technology, already reduces net CO2 emissions by up to 90% compared to the mineral fuel it replaces. [Link](#)
137. **Renewable diesel:** The Netherlands. Neste's Rotterdam refinery has been shut down due to a fire on 8 November 2024. The fire was extinguished, and it did not cause any injuries. Neste is currently investigating the incident, and the repair work will start as soon as possible. Based on its initial assessment, the Rotterdam refinery production will be down for several weeks impacting the renewable diesel customer deliveries. As a result, Neste changes its Renewable Products total sales volume guidance for 2024. [Link](#)
138. **Renewable diesel:** USA. EPRI and the Tennessee Valley Authority (TVA) announced the successful demonstration of renewable diesel as a combustion turbine fuel for power generation. The demonstration—the first U.S. test and the largest conducted in the world—was performed on a 76-megawatt dual-fuel natural gas/diesel unit at TVA's Johnsonville site in Tennessee. [Link](#)

## Technology development

139. **Technology development:** India. Tata Steel has successfully pioneered the usage of biochar (biomass-based charcoal) in its Jamshedpur plant. Tata has replaced approximately 30,000 tons of fossil fuel with biochar, to date. This approach has the potential to reduce more than 50,000 tons of carbon dioxide emissions annually. It also improves energy efficiency by partially replacing pulverised coal injection. [Link](#)

## Textiles

140. **Textiles:** France. Carbios, a pioneer in the development and industrialization of biological technologies to reinvent the life cycle of plastic and textiles, and its "fiber-to-fiber" consortium partners On, Patagonia, PUMA, Salomon, and PVH Corp., parent company of Calvin Klein have developed the world's first enzymatically recycled polyester garment made from 100% textile waste using CARBIOS' biorecycling technology. [Link](#)
141. **Textiles:** USA. Selenis, a leading global supplier of high-quality specialty polyester solutions and Syre, the textile impact company scaling textile-to-textile recycling, announced a strategic partnership to establish a textile-to-textile recycling plant in Cedar Creek, North Carolina, USA. The plant is to be operational in mid-2025. [Link](#)

## Sector Status Report: November 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 November 2024 characterised by Technology Development, Infrastructure, Policy and Commercial deployment.

Here's the summarized information presented in the requested table format:

Category	Number in Category	Examples
<b>Technology Development</b>	45	Development of CO2 capture and conversion technology by Aerleum; advancements in biomethanation by Hitachi; Evogene's ChemPass AI collaboration with Google Cloud; iMicrobes' bio-based acrylic acid production; LanzaTech's ethanol production plant in Norway.
<b>Infrastructure</b>	40	Construction of the Neom green hydrogen plant in Saudi Arabia; biogas plant developments in Finland by Suomen Lantakaasu; renewable hydrogen pipelines in Finland; Verso Energy's synthetic fuels project in Finland; Exolum's use of LOHC technology in the UK.
<b>Policy</b>	20	EU's CO2SMOS project for CCU policies; Horizon 2020 shaping policy for fossil-free chemicals; Enova's grants for hydrogen projects in Norway; UK's Advanced Fuels Fund for SAF; Transport Canada's funding for green shipping corridors.
<b>Commercial Deployment</b>	36	Fuella's green ammonia projects in Brazil; Neste's SAF supply to Air Canada; Air New Zealand's SAF study with LanzaJet; Lufthansa Cargo's SAF agreement with Maersk; Biojet initiatives by Mercantile & Maritime Group in the UAE.

This table summarizes the categorized content with five examples in each.



## Company Summary – November 2024

Frequency of mention.

Company	Frequency
Neste	4
Air Products	2
Avantium	2
BASF	2
Blue Biofuels	2
EcoCeres	2
GoodFuels	2
Maersk	2
Mercantile & Marine Group	2
Uniper	2
UPM	2
US Government	2
Aerleum	1
Air New Zeland	1
Alfa Laval	1
Autarkize	1
Avfuel	1
Avina Clean Hydrogen	1
BBGI	1
Biofuels Digest	1
Blackwood	1
CalBioGas Hilmar	1
Carbios	1
Celtic Renewables	1
Cespa	1
Channel Infrastructure	1
Chesapeake Utilities	1
Citroniq	1
<b>Total</b>	<b>135</b>

## Topics & Themes/Category Summary– November 2024

Frequency of mention

Category	Frequency
Hydrogen	31
Biojet	17
Biogas	16
Marine fuels	12
Biofuels	9
Biobased chemicals	7
Methanol	7
Biobased plastics	6
Policy	5
Ammonia production	3
Biotechnology	3
CO2 Removal	3
Plastic recycling	3
Pyrolysis	3
Renewable diesel	3
Biomaterials	2
e-fuels	2
Ethanol	2
Feedstock	2
Textiles	2
Biojet/SAF	1
Packaging	1
Recycling plastic	1
SAF	1
Technology development	1
<b>Total</b>	<b>143</b>