Bioeconomy & Low Carbon Technology Overview for May 2024

Our summary of low carbon technology developments for May 2024 is based on data and information collated by Gifford Consulting and presented on our website: Gifford Consulting

Highlights by Topic: May 2024

More information on these articles can be found on our website dashboards.

To select a topic – Ctrl+ click on the topic below.

Topics

Ammonia	Ethanol
Biobased Chemicals	Feedstock
Biobased Plastics	Hydrogen
Biofuels	Marine Fuels
Biogas	Market Development
Biojet	Methanol
Biomaterials	Plastic Recycling
Biotechnology	Policy
CO2 Removal	Pyrolysis
e-Fuels	Recycling Plastic
E-Methanol	Textiles
Energy Transition	Torrefaction

Ammonia

1. North Ammonia AS secured a reserve for 171 MW of grid capacity for a green ammonia production plant in Eydehavn, Arendal, Norway. This reserve from Statnett and Glitre Nett ensures ample grid capacity for the facility's annual production of approximately 145,000 tonnes of green ammonia, positioning North Ammonia as a key player in the green fuel market for the maritime industry in Norway and North-West Europe.

Biobased chemicals

2. Asahi Kasei, Mitsui Chemicals, and Mitsubishi Chemical are planning a joint feasibility study on feedstock and fuel conversion at the three companies' ethylene production facilities in western Japan.

3. BASF is expanding its biomass-balanced “EcoBalanced” product range, for detergents and cleaning products. With Care 360° – Solutions for Sustainable Life, the Care Chemicals division is developing sustainability a priority.
4. CovationBio has plans to expand capacity for biobased 1,3 propanediol at Loudon, Tennessee by 33,000 metric tons, Currently, the plant has capacity to produce 77,000 metric tons. It was expanded in 2019. PDO was first commercialized in 2006. PDO has a range of uses such as a precursor for Sorona® a partially biobased polytrimethylene terephthalate fiber for carpets and fabrics. PDO also has applications in footwear, apparel, personal care, home care, pharmaceuticals, foods, and flavours.
5. Dow, Henkel Adhesive Technologies, and Kraton Corporation, have achieved a reduction in product carbon footprint for two of Henkel’s North American flagship products for end-of-line packaging: TECHNOMELT® SUPRA 100 and TECHNOMELT® SUPRA 106M.
6. Insempra is growing lipids for cosmetic and food applications. It is also developing technology that offers a bio-based alternative to everyday materials such as polymers and textiles and progressing its biological solutions to create new natural molecules for use in functional ingredients, such as antioxidants and preservatives and flavours and fragrances.
7. Merck launched Cyrene™ — as a sustainable dipolar aprotic solvent, produced in two steps from a renewable cellulose source. The bio-derived alternative was d to meet the need for solvents with strict regulation requirements for both employee safety and environmental sustainability.
8. The European Circular Bioeconomy Fund (ECBF), Qbic III and Flanders Future Tech Fund (FFTF) have partnered to provide a significant boost to a Ghent-based start-up AmphiStar. The funding round, led by ECBF, raised €6 million. This will allow AmphiStar to accelerate the industrialization of biosurfactants range. As AmphiStar gears up for full commercial deployment, the company is laying the groundwork for future expansion with plans for the construction of a 1,000 metric ton plant.

Biobased plastics

9. Suzano Ventures, the corporate venture capital arm of Suzano, the world’s largest market pulp producer, has made a strategic investment into the Canadian materials science startup, Bioform Technologies. The investment provides up to $5 million towards the company’s seed round, enabling it to accelerate its novel bio-based plastic alternatives. The products are manufactured through modified industrial processes already used in the pulp and paper sector.

Biofuels

10. Aemetis announced that the installation of a $12 million, 3 megawatts solar microgrid with battery storage and an AI energy management system has been completed at the Keyes ethanol plant. TotalEnergies was the project developer who provided the PV solar technology and built and commissioned the system. Schneider Electric provided the electrical and battery storage equipment. Aemetis is the owner and operator of the entire AI-enabled solar microgrid and battery storage system.
11. Copenhagen Malmö Port (CMP) and Green2x have established a partnership with the focus on the design, establishment, and operation of one of the world’s largest biofuel plants to date at CMP’s terminals in the port of Malmö. Green2x’s technology extracts energy from straw post harvesting. Green2x uses an advanced fermentation technology to covert the biomass into biogas which is then upgraded to biofuels.

12. Gevo, Inc. along with its wholly owned subsidiary, Verity Holdings, LLC, and ClearFlame Engine Technologies, Inc. announced a collaboration to drive decarbonization traceability from field-to-fleet for the road freight transportation market in the United States. Under this collaboration, the parties intend to use Verity's proprietary carbon accounting software to authenticate the carbon intensity (CI) of biofuels derived from crops grown on U.S. farms to their consumption in ClearFlame-equipped trucks. At the field level, data regarding the greenhouse gas (GHG) emissions required to grow a crop are tracked to calculate a CI score for crops, such as corn.
13. IFC (International Finance Corporation) and the Italian Climate Fund announced a $210 million investment in Eni S.p.A.'s Kenya subsidiary to expand the production and processing of advanced biofuels, supporting the decarbonization of the global transport industry and the livelihoods of up to 200,000 small-scale Kenyan oilseed farmers. The investment consists of $135 million from IFC and $75 million provided from the Italian Climate Fund, as part of the implementation of the Italian Government's Mattei Plan in Kenya. It will help Eni increase the production of advanced biofuel feedstock grown in Kenya. Production of oilseeds could increase from 44,000 tons to 500,000 tons per year.
14. Terragia Biofuel, a technology startup which is developing the next generation of biofuels, recently announced it has raised a $6 million seed round led by Engine Ventures and Energy Impact Partners (EIP). The company will use the capital to commercialize its novel biology-based approach to converting cellulosic biomass into ethanol and other products.
15. Trafigura acquired Greenergy's Canadian supply operations. This complements Trafigura's acquisition of Greenergy's European operations announced in March 2024. Greenergy is a significant producer and distributor of biodiesel.
16. Cemvita's optimized microorganisms are rich in oil which is then extracted Through applied research and innovation in bioprocess technology, this developed process has produced high-yield extraction of the oil from a 4,000-liter bioreactor the company has in Houston. Early tests confirm that Cemvita's Sustainable Oil is a drop-in replacement for palm oil.

Biogas

17. AGR Biogás has started construction of the first biogas plant with biomethane injection in Andalusia, Spain. Project financing of 20 million euros was provided by ING Bank NV. The plant is in the municipality of La Calahorra, Granada and will have a total treatment capacity of approximately 100,000 tons per year, with the feedstock being mainly from livestock and olive groves.
18. Archaea Energy, a bp company announced the startup of its largest Archaea Modular Design (AMD) renewable natural gas (RNG) plant to date. Located in Shawnee, Kansas (KS), just outside of Kansas City, the facility is fully owned by Archaea and located next to a large, privately owned landfill. Using the Archaea Modular Design (AMD), the Shawnee plant captures the gas from the landfill and upgrades it to renewable natural gas (RNG).
19. Binn Group is partnering with French firm Paprec to begin work on a new Energy from Waste facility, which will provide low carbon energy to local industries. The new facility at the Binn Eco Park in Tayside, Scotland will be funded by Paprec, and will be built, owned and operated by Paprec Energies Binn, a joint venture between the French firm and Binn Group. The new plant will enable Paprec Energies Binn to provide a renewable and stable electricity and heat sources to businesses and other energy users. Half of the feedstock will come from residual waste produced from the surrounding local area as part of a 15-year contract with Binn which is an integrated and waste management company.

20. Bio Capital Group has added a fourth food waste transfer station to its portfolio in Scotland. The newly acquired Linwood food waste transfer station will significantly improve Bio Capital's ability to process feedstock for its regional Anaerobic Digestion (AD) facilities. the Linwood site has been acquired from Keenan (Recycling) Limited and has the licensed capability to process 13,200 tons of food waste per annum. The site will divert food waste from landfill and provide a feedstock for Bio Capital's Barkip and Energen AD sites in the UK.
21. Clean Energy Fuels Corp. and Maas Energy Works announced a new joint development agreement to build nine renewable natural gas (RNG) production facilities at dairy farms across seven states in the US. This project will include dairies located in Colorado, South Dakota, Georgia, Florida, Iowa, Nebraska and New Mexico, and will collect the manure from a combined herd size of approximately 35,000 cows.
22. Copenhagen Infrastructure Partners has announced it has entered into a partnership for the acquisition of the majority of the shares in Sindal Biogas. The partnership was agreed with some of the plant's current owners: a local investment company with connections to agriculture, KK Invest (owned by the Glenthøj Kirketerp family), and DBC Invest (a sister company to Danish Bio Commodities). The goal is to build a flagship plant for bioenergy in Denmark and thereby contribute positively to the green transition in Hjørring Municipality and Denmark. Sindal Biogas was established in 2017. Currently, the plant is being expanded to process 500 000 tpy of biogas with an intended production of upgraded biogas for the gas grid of up to 34 million m3. In addition, the plant will produce biogenic carbon dioxide (CO2), which will be captured, stored and/or used.
23. FuelCell Energy, Inc. and Toyota Motor North America, Inc. celebrated the grand opening of the first-of-its-kind "Tri-gen" system at the Port of Long Beach, California during May 2024. Tri-gen uses biogas to produce renewable electricity, renewable hydrogen, and usable water, and has been built to support a vehicle processing and distribution centre for Toyota Logistics Services (TLS) at Long Beach, Toyota's largest North American vehicle processing facility.
24. NORDSOL and Prodeval are planning to construct a state-of-the-art bio-LNG production plant in the southern region of Portugal. The new plant will serve an industrial facility in the olive oil production sector, utilizing their organic waste to create clean, renewable energy. This groundbreaking facility, poised to commence operations in early 2025.
25. White Summit Capital has agreed to buy a majority stake in Ferbgas Renewable, a leading independent biomethane producer in Portugal which builds and operates biomethane plants. Ferbgas holds a project pipeline requiring around €200 million of investment, with its first two projects on track to start operating by 2026. This project pipeline is expected to generate a combined output capacity of approximately 500 GWh, accounting for roughly 15% of Portugal's estimated biomethane production by 2030.
26. Yarra Valley Water is working on the construction of a second large-scale food waste-to-energy facility in Lilydale. The new facility will divert about 55,000 tons of commercial food waste from landfills every year while generating renewable electricity. The Lilydale facility will generate up to 39,000 kilowatt hours of electricity per day and is expected to be fully operational by 2026.

Biojet/SAF

27. Paris-Vatry SAF is a new Sustainable Aviation Fuel production project led by Haffner Energy, the project will have an initial production capacity of 30,000 tonnes of SAF per year, with the option of doubling production to 60,000 tonnes. The proprietary SAFNOCA® technology developed by Haffner Energy has the unique characteristic of being feedstock agnostic. Biomass is an abundant raw material provided it is used in a technology process that requires no restrictive quality criteria.
28. CAPHENIA and Emerging Fuels Technology signed a MOU to integrate their technologies for the production of SAF and renewable diesel. This cooperation will optimize CAPHENIA's leading Plasma Boudouard Reactor (PBR) technology with EFT's Fischer Tropsch and upgrading "Technology Platform" to significantly improve the efficiency and scalability of SAF production. The MOU also provides for Caphenia to acquire license rights to combine its syngas technology with EFT's Technology Platform for multiple projects.
29. Chinese companies, Junheng Industry Group Biotech, Zhejiang Jiaao Enprotech and Tianzhou are planning to bring 1 million metric tons of sustainable aviation fuel production online in the next 18 as the world's second largest aviation market seeks to decarbonize. That new production would account for about 2.5% of the country's aviation fuel demand. These plants would rely on used cooking oil as feedstock, which would account for much of the UCO being imported by the US and EU.
30. Fulcrum Bioenergy's North Point project is designed to convert approximately 600,000 metric tons of pre-processed waste into 100 million Liters of Sustainable Aviation Fuel (SAF). Kent has been awarded the FEED (Front End Engineering Design) contract for this project in the United Kingdom.
31. In Washington, 40 companies and organizations that hold a stake in the development and deployment of sustainable aviation fuel united to announce the formation of the Sustainable Aviation Fuel (SAF) Coalition. The organization is made up of airlines and aircraft operators, agricultural enterprises, aircraft and aircraft equipment manufacturers, airports, technology developers, labour unions and biofuel producers.
32. LanzaJet announced a $20 million investment from Groupe ADP, the world leader in airport design and operations. The investment enables LanzaJet to continue building its capability. ADP's investment in LanzaJet comes as the company recently opened LanzaJet Freedom Pines Fuels – the world's first commercial-scale ethanol-to-SAF plant.
33. Marubeni Corporation signed a MoU regarding a feasibility study on the production and sales of sustainable aviation fuel. The project will use biomass resources.
34. Mubadala Capital is planning to invest $13 billion in sustainable aviation fuel and renewable diesel in Brazil in five $2.7 billion "modules" through its energy company Acelen. Each of the five planned facilities, the first of which is set to be online by the end of 2026, will produce 20,000 barrels of fuel per day. Key to the roll out of the modules will be the conversion of the Petrobras refinery that the company bought in Bahia in 2021.
35. Neste, Signature Aviation, which operates the world's largest network of business aviation terminals, is now providing only blended Neste MY Sustainable Aviation Fuel to all aircraft refueling at its terminal at Los Angeles International Airport (LAX).
36. Operations at the Montana Renewables facility was impacted last year by a crack found in the steam drum of the facility's hydrogen plant. A replacement drum was installed in November and the facility returned to normal operations in December. Each month has improved sequentially as the company ramped up rates, increased SAF production, reduced feedstock carbon intensity, and work through the old expensive feed. The Montana

Renewables facility commissioned renewable hydrogen, SAF and feedstock pretreatment systems in early 2023, boosting capacity to 12,000 barrels per day. Current SAF capacity in the range of 2,000 to 4,000 barrels per day, but Calumet is considering a move to what its calls MaxSAF, which would boost total capacity to 18,000 barrels per day of renewables, including 15,000 barrels per day of SAF.

37. Sustainable Aviation Fuel (SAF) refers to a C8~15 liquid hydrocarbon fuel derived from non-fossil resources, that is, green jet fuel. Aviation fuel uses C-C and C-H chemical bonds as energy storage, and its energy density is 80 times that of commercial lithium-ion batteries. The huge gap in energy density makes it difficult for the aviation field to quickly achieve electrification, so SAF has become the main route to net-zero emissions in the world's aviation industry. By the end of 2020, a total of 65 countries around the world had implemented mandatory blending policies for SAF, and by 2027, ICAO's Carbon Reduction Offset Mechanism (CORSIA) will be fully enforced.
38. The Hague Airport (RTHA) and the Port of Rotterdam Authority signed a letter of intent for the further development of supply chains for sustainable fuels, such as SAF and hydrogen for aviation fuel. Both ports are working on establishing new chains for supplying, producing and purchasing alternative fuels and will share knowledge in this area.
39. Topsoe has signed an agreement with Guangxi Hongkun Biomass to provide its HydroFlex technology to produce SAF at the Company's plant in the Qinzhou Port Area Free Trade Pilot Zone of Guangxi, China. This agreement is Topsoe's first SAF project in China. Topsoe will deliver its HydroFlex technology for the project, which is expected to process 300,000 tons of feedstock per year. Guangxi Hongkun Biomass's SAF production plant is expected to begin construction in May 2024, with SAF production to begin within the first few months of 2026.
40. Virgin Atlantic has shared headline results from Flight100, the first transatlantic flight on 100% Sustainable Aviation Fuel (SAF), proving not only that the SAF used for the flight is safe to use with existing infrastructure and delivers material reductions in CO2, but can also improve local air quality, contribute to a reduction on persistent contrail formation and reduce fuel use. A full lifecycle analysis – showed a saving of 95 metric tons of CO2, or 64% of the emissions produced from a standard flight from London Heathrow to New York JFK.

Biomaterials

41. Apple is collaborating with RISE (Research Institute of Sweden) to tackle plastic pollution with a promising new bio-based foam material. This innovative solution aligns with both companies' commitment to a sustainable future. The low-density, cellulose-based foam is derived from wood pulp. The newly developed cellulose foam has several key advantages, it demonstrates excellent properties like compression resistance and a uniform pore structure, making it aesthetically pleasing.
42. Nordic Bioproducts Group, a leader in biomaterial innovation and developer of proprietary AaltoCellTM Technology, announced the opening of its commercial-scale production facility for microcrystalline cellulose (MCC) and other cellulose derivatives in Lappeenranta, Finland.

Biotechnology

43. Fermbox Bio has launched EN3ZYME, a cutting-edge enzyme cocktail designed to enhance both the efficiency and cost-effectiveness of transforming pre-treated agri-based residues into fermentable, cellulosic sugars. These sugars can produce second-generation (2G) ethanol and serve as an alternative carbon source in precision fermentation to produce bio-ingredients and biomaterials, such as colours, dyes, flavours, fragrances, lipids, and novel food proteins, fostering a circular economy.

44. Hydrosome Labs has developed precision fermentation. This process uses customized yeast or bacteria to produce a wide range of products, from food ingredients and biofuels to pharmaceuticals and skincare solutions. Hydrosome Labs' uses ultrafine bubbles to enhance the power of water. This technology allows cells to absorb active ingredients more effectively and speeds up fermentation.

CO2 Removal

45. Reconciliation Energy Transition Inc. ("RETI"), and Sumitomo Corporation, through its subsidiary Ammolite Carbon Sequestration have entered into a Joint Development Agreement for the RETI East Calgary Region Carbon Transportation & Sequestration Hub project ("CTS Hub") east of Calgary, Alberta. The open-access hub will provide a CCS-as-a-service solution for both existing emitters, seeking to reduce emissions, and newly proposed energy transition facilities.
46. Bright Renewables has won a tender from Tekniska verken, a major Swedish multi-utility energy company, for the supply of CO2 liquefaction technology. The system will be installed at Tekniska verken's biogas plant Svensk Biogas in Linköping to purify and liquefy carbon dioxide (CO2) from the biogas production process to produce food-grade bioCO2. The facility will produce 20,000 tons of food-grade quality bioCO2 per year and will be commissioned before summer 2025.
47. Carbon Clean has achieved a construction milestone on Ørsted's FlagshipONE project, Europe's largest commercial-scale e-Methanol project. The first equipment has been mounted on the structural steel of the first module, marking the start of the module assembly process. Once operational, Carbon Clean's technology will be capable of capturing 70,000 tonnes of biogenic CO2 per year for Ørsted's facility in Örnsköldsvik, Sweden.
48. ENGIE New Ventures, ENGIE's Research and Innovation investment fund for innovative startups, announced that it has participated – together with GTT Strategic Ventures – in a €4m financing round to support the development of CryoCollect, a French startup that develops technologies for gas treatment, purification & liquefaction. Their technology is well suited for biogas CO2 capture.
49. Holcim Germany is building a new kiln line using pure oxygen to burn cement clinker and a CO2 processing unit at the Lägerdorf plant. With this technology, Holcim and its project partners, thyssenkrupp Polysius, and Linde Engineering are advancing CO2 capture on an industrial scale.
50. In a recent Northwestern University study, a catalyst successfully converted CO2 into carbon monoxide (CO), an important building block to produce a variety of useful chemicals. When the reaction occurs in the presence of hydrogen, for example, CO2 and hydrogen transform into synthesis gas (or syngas), a highly valuable precursor to producing fuels that can potentially replace gasoline.
51. Messer captures CO2 emissions – for example from steel, cement, glass, paper or chemical production or from fossil-fired power plants for electricity and heat generation – before they are released into the atmosphere. The recovered CO2 can be used in applications that reduce the use of fossil fuels. For example, in the production of synthetic fuels, so-called e-Fuels, or sustainable aviation fuels.

Efuels

52. HIF Global, the world´s leading e-Fuels company, announced a combined investment from existing shareholders and a Japanese energy company Idemitsu Kosan, securing US$164 million to fund its e-Fuels projects. Idemitsu joins a new group of existing HIF investors, including AME, EIG, Porsche, Baker Hughes, and Gemstone Investments.
53. Idemitsu Kosan will acquire a stake in HIF Global. HIF Global continues to actively expand its e-Fuels projects in USA, Australia, Chile, and Uruguay. HIF Global, the world´s leading e-Fuels company, announced a combined investment from existing shareholders and the Japanese energy company Idemitsu Kosan, securing US$164 million to fund its e-Fuel projects.
54. INERATEC and Sasol signed a five-year contract for the supply of Fischer-Tropsch catalysts. INERATEC will use Sasol's state-of-the-art catalysts for the production of sustainable e-fuels, for aviation. The catalysts will be used, among others, in the first large-scale industrial Power-to-Liquid plant that INERATEC is currently building in Frankfurt, Germany., The new plant is scheduled to be ready for operation in 2024. The PtL plant will produce e-fuels from CO2 and green hydrogen. INERATEC plans to produce up to 2,500 tonnes of e-fuels per year from this project.
55. Infinium has reached agreement with SMA Mineral (SMA) that will advance the development of Infinium's e-Fuels project at the Mo Industripark in Mo i Rana, Norway. The Infinium facility will utilize the CO2 that SMA will produce at its Zero Emission Quick Lime manufacturing facility as a feedstock for the production of e-Fuels.
56. Liquid Wind is developing the FlagshipTWO project which is Sweden's second large-scale production facility of for e-Methanol. The project has received its environmental permit for its planned operations in Sundsvall, Sweden. The facility, located at Sundsvall Energi's Korstaverket, has been granted approval to produce up to 130,000 tons of e-Methanol annually by applying its innovative Carbon Capture and Utilization (CCU) technology.

Emethanol

57. Johnson Matthey (JM) was selected by HIF Global as the methanol licensor for HIF Global's Paysandú e-Fuels project, Uruguay. The e-methanol will be utilised to support the rapidly growing demand from the marine market, as well as a feedstock to produce e-gasoline (via a methanol to gasoline process) which will facilitate the decarbonisation of over 150,000 vehicles.

Energy Transition

58. Green electrification is the key to the future. And in 2023, according to Ember's report, almost the entirety of new power demand was covered by growth in renewables, above all solar. Though there was growth in demand for electricity around the world, fossil fuel generation barely increased. Growth in solar and wind alone were sufficient to cover 82 percent of new electricity demand.

Ethanol

59. Nayara Energy is planning to invest $71.85 million in two new ethanol plants, based in Andrha Pradesh and Madhya Pradesh, India respectively. The facilities are expected to come online in 2026 with each be able to produce 200,000 Liters of ethanol daily from corn and rice waste. Three more ethanol plants are in earlier stages of development. It is also beginning to explore sustainable aviation fuel production. The company is backed by Russian energy giant Rosneft.

60. Verbio started construction to convert its South Bend ethanol plant into the second integrated biorefinery plant in North America. The facility will incorporate both the production of renewable natural gas (RNG) and bioethanol using an innovative production approach. The company, a subsidiary of Europe's leading biofuels and bioenergy producer Verbio SE.

Feedstock

61. Established in 2006, Nuseed has 10 locations in Australia, Europe, North America and South America, including three proprietary innovation centres, more than 400 employees, and sales in more than 30 countries. Nuseed Carinata is the first commercial contract production programme in the portfolio, launched in Argentina in 2019, with global sustainable production currently being scaled in South America, North America, Europe, and Australia.
62. Farm Progress reports that soybean crushers are under competitive pressure from increased imports of used cooking oil and other renewable diesel feedstocks, which is weighing on soy oil prices and potentially risking investments into further crushing plant. In an effort to combat these lower prices, millions of bushels worth of crushing capacity went offline in April 2024 for the annual maintenance season ahead of time and are expected to remain shut for longer.
63. Louis Dreyfus Company (LDC), Global Clean Energy Holdings, Inc., and Bayer announced a strategic collaboration to promote camelina cultivation as part of Argentina Bayer's PRO Carbono Program. Camelina is used as an ultra-low carbon feedstock for advanced biofuels production. It is an "intermediate crop" planted between main crops in Argentina during winter. Camelina helps to preserve soil health, especially between summer crops of soy and corn.

Hydrogen

64. Countrywide Hydrogen, part of ReNu Energy, will become Tasmania's first major green hydrogen producer after locking in an $8 million funding deal with the Tasmanian Liberal Government. The first phase of Countrywide's plan is to construct a hydrogen production and heavy vehicle refuelling facility at the industrial hub in Brighton, which will produce up to 800 tonnes per annum of green hydrogen.
65. Once complete, HH1 will be the largest commercial renewable hydrogen production facility in Europe. It will produce around 60,000 kg of hydrogen per day, enough to keep 2,300 hydrogen trucks rolling. The 200MW electrolyzer will be powered by renewable energy from an offshore wind farm that is currently under development.
66. Actis and Fortescue was awarded the rights to develop, build, own and operate a large green hydrogen project in Oman. Hydrogen Oman SPC (Hydrom), an independent entity founded by the Omani government to develop and deliver the nation's green hydrogen strategy.
67. Asahi Kasei, is accelerating its hydrogen business with the opening of a new hydrogen plant in Kawasaki, Japan. The trial operation of four 0.8 MW modules is another step towards the realisation of a commercial multi-module 100 MW-class alkaline water electrolysis system for green hydrogen production. For the production of green hydrogen, electrolysis systems need to respond to fluctuating power supply from renewable energy sources such as wind or solar. In the pilot plant, four 0.8 MW Aqualyzer™ modules are being operated under realistic conditions, including operation during maintenance and low power supply during the nighttime.

68. bp is seeking planning approval to build a hydrogen plant at Teesside, in the UK. This process follows a consultation it led into its proposed HyGreen project in Redcar in 2023. This is based on electrolysis technology.
69. Brazilian power distributor Centrais Eletricas Brasileiras SA, or Eletrobras, has signed a MoU with the government of Maranhao state for the production of green hydrogen.
70. Copenhagen Infrastructure Partners (CIP) and Uniper SE are partnering on bringing green hydrogen to Germany from CIP's HØST Power-to-X Esbjerg project on the Danish coast. The Danish fund manager, through its Energy Transition Fund, and the German energy group have signed a MoU for a collaboration, which covers the production, transport and marketing of green hydrogen from the project to Germany. The companies are looking to supply up to 140,000 tonnes of green hydrogen a year to customers in Germany.
71. Empire Diversified Energy and Heartland Water Technology announced a new partnership with Empire Green Generation, a wholly owned subsidiary of Empire, to develop a state-of-the-art facility that will convert food waste into renewable hydrogen and carbon as part of the Department of Energy's Appalachian Regional Clean Hydrogen Hub (ARCH2).
72. Fortescue Ltd have initiated the construction of its first green hydrogen site in the US, an 80-MW electrolyser and liquefaction facility in Arizona will be able to produce up to 11,000 tonnes per year of liquid green hydrogen, starting in 2026. The plant will use wind and solar electricity, with its output used for the heavy-duty on-road transportation sector.
73. Green hydrogen startup Hysata announced that it has raised $111 million in a Series B funding round, with proceeds from the financing aimed at advancing its electrolyzer technology and expanding production. The company is developing a highly efficient electrolyzer that reduces the amount of electricity required to separate water into hydrogen and oxygen for the production of hydrogen. Key cost-saving benefits of the company's technology, according to Hysata, include high efficiency at 41.5 kwh/kg compared with approximately 52.5 kwh/kg for incumbent electrolyzers, low cost design based on abundant materials, high cell efficiency eliminating the need for expensive cooling, efficient and low-cost power electronics, and modular technology, enabling MW to GW-scale installations.
74. H-TEC SYSTEMS, a developer of PEM electrolysis technology, and Bilfinger, a leading international industrial services provider, have signed a MoU for a collaboration aimed at developing green hydrogen projects in Europe. The non-exclusive strategic partnership is centred on the development of large-scale electrolysis projects.
75. Hy Stor Energy LP has reserved more than 1 GW of Norwegian Nel ASA's electrolysers for its Mississippi Clean Hydrogen Hub. This will provide the largest zero-carbon, off-grid hydrogen production and salt cavern storage hub in the US. The capacity reservation agreement covers the supply of alkaline electrolysers from Nel's factory in Heroya, Norway.
76. Hydrom has signed agreements worth $11 billion to develop two new green hydrogen production projects with the Electricité de France (EDF Group) consortium as well as Actis and Fortescue. This follows the completion of Hydrom's second round of auctions bringing the total hydrogen production in Oman to 1.38 million tons per year by the end of the decade. Oman is strategically located between two key green hydrogen demand centres in Europe and Asia. The project with the EDF Group consortium seeks to produce approximately 178,000 tpa of green hydrogen by 2030, using around 4.5 gigawatts (GW) of wind and solar energy coupled with battery storage and an estimated 2.5 GW electrolyzer capacity.
77. Lausitz Energie Kraftwerke AG (LEAG) is developing a second Power-to-X plant to be built on the decommissioned area of the coal power site in Boxberg, Saxony, in Germany. The

hydrogen power plant (H2KW) will consist of a 110 MW electrolyzer capable of producing up to 2,100 kilograms of hydrogen per hour.

78. McPhy Energy SA is set to supply its 1-MW electrolyser and a hydrogen filling station to French green energy firm Valorem for the Rouen green hydrogen valley project in France.
79. NEOM Green Hydrogen Co. has announced progress on building what it claims to be the world's largest hydrogen plant in Saudi Arabia. Wesam Al-Ghamdi revealed that the construction of the plant in NEOM's city of "Oxagon" is advancing significantly. The plant is to be fully operational by 2026. Once operational, the plant is expected to produce 600 tons of carbon-free hydrogen daily by 2026, enough to power around 20,000 hydrogen buses.
80. Nexergy Holdings PLCs, has announced a strategic collaboration with Lorentz, which produces green hydrogen. Production of green hydrogen is expected to commence in 2024, with the potential to reshape the future of energy and transportation. The LORENTZ process requires less than 5 kWh / kg hydrogen gas produced and generates 0 kg CO2.
81. Ohmium International unveiled a partnership with Dutch green hydrogen firm Hygro that will start with a 5.4-MW pilot project. The project will combine Ohmium's Proton Exchange Membrane (PEM) electrolysers with Hygro wind turbines at the EWEF Wind Park in Wieringerwerf, in the Dutch province of North Holland.
82. Plug Power Inc announced the supply of up to 3 GW of its PEM electrolysers for a commercial-scale hydrogen-to-ammonia project in the Northern Territory of Australia developed by Allied Green Ammonia Pty Ltd (AGA).an energy infrastructure projects developer. The facility will be capable of producing 2,500 metric tonnes of green ammonia per day. The site will be located in the Gove Peninsula.
83. Plug Power Inc indicated that it obtained a "critical" certification that enables the commercial sale of its electrolysers in South Korea. The company has achieved certification of the EX425D device to the Korean Gas Safety (KGS) Corporation Standard AH271 for Facility/Technical/Inspection Code for Manufacture of Water Electrolysis Hydrogen Generator. As part of the process, KGS has approved Plug's Rochester Gigafactory for electrolyser stack production and partner company Alpha ECC's facility in Vietnam for system production and assembly.
84. Plug Power Inc is participating with a group of air transport sector players to study the feasibility of establishing a hydrogen-based hub at the Hartsfield-Jackson Atlanta International Airport (ATL) in Atlanta, Georgia. The company, which is actively working on creating an end-to-end green hydrogen ecosystem, has teamed up with European aircraft manufacturer Airbus SE and US carrier Delta Air Lines Inc to "help map the industry's hydrogen blueprint.
85. Renewable energy franchise Green Energy Park has obtained USD 30 million (EUR 27.9m) in equity financing to back its ambitious project for a 10.8-GW electrolyser to produce green hydrogen in the Brazilian state of Piaui.
86. Swiss Steel Group has commissioned Lhyfe to install a 30-MW green hydrogen production plant to decarbonise the manufacturing of stainless-steel products at its site in France's Savoie department. The Nantes, France-based green hydrogen developer indicated that it would set up the facility for its client's Ugitech subsidiary, in line with the group's ambitions to decarbonise part of its industrial operations. The initiative will be carried out under a MoU between Lhyfe and Ugitech.
87. The European Commission is awarding nearly €720 million to seven renewable hydrogen projects in Europe, selected through the first competitive bidding process under the European Hydrogen Bank. The funds for this auction come from the revenues of the EU Emissions Trading System. The winning bidders will produce renewable hydrogen in Europe

and will receive a subsidy to bridge the price difference between their production costs and the market price for hydrogen, which is currently driven by non-renewable producers. The renewable hydrogen they produce will be used in sectors such as steel, chemicals, maritime transport and fertilisers.

88. The U.S. Department of Energy's Loan Programs Office has announced a conditional commitment to Plug Power's subsidiary, Plug Power Energy Loan Borrower, LLC, for an up to $1.66 billion loan guarantee. The capital will help finance the construction of up to six facilities across several states to produce clean hydrogen utilizing the company's own electrolyzer technology.
89. Yosemite Clean Energy announced its strategic partnership with Celly, which focuses on low-carbon and sustainable fuel distribution. Yosemite Clean Energy specializes in converting forest and agricultural waste into carbon-negative hydrogen. Their state-of-the-art biofuel plants utilize waste biomass. Celly is committed to providing efficient, low-carbon hydrogen and renewable fuels through their integrated supply chain to end-use customers, fulfilling its mission of providing hydrogen from "stump to pump." Celly's innovative modular hydrogen refueling stations play a crucial role, facilitating the efficient delivery of gaseous hydrogen to customers across a range of sectors.

Marine Fuels

90. Bergen Engines has been selected to provide four C25:33L8A generating sets to support the world's largest hydrogen ferries, operating on Norway's longest ferry connection from Bodø to Lofoten. The generating sets will be fueled by low carbon Hydrotreated Vegetable Oil (HVO) and will serve as reliable support power to the hydrogen fuel cells onboard, which act as the vessel's main propulsion power. These new ferries will be powered with a hybrid mix of 85% hydrogen fuel cells and 15% biofuel.
91. Bunker Holding A/S and SyntexNRG Inc. have entered into an agreement for the development and production of renewable methanol to supply the fuel at the ports where Bunker Holding has physical operations located around the world. Bunker Holding recognizes methanol as one of the most ready-to-transition future fuels for the industry. This need to secure access to green methanol, considered a top choice for decarbonizing the marine industry, forms the basis and essence of the partnership between SyntexNRG and Bunker Holding.
92. Fortescue, with support from the Maritime and Port Authority of Singapore, government agencies, research institutes, and industry partners, has successfully completed propulsion and manoeuvrability trials of its Singapore-registered Fortescue Green Pioneer in the Port of Singapore. The trials were conducted using 6.4 m3 (4.4 metric tons) of liquid ammonia, in combination with diesel and Hydrogenated Vegetable Oil (HVO) as marine fuel.
93. Hapag-Lloyd and IKEA are collaborating to advance cleaner shipping, with both companies having agreed to use Hapag-Lloyd's highest product option for biofuels "Ship Green 100", which relies on waste- and residue-based biofuel instead of conventional marine fuel oil. Hapag-Lloyd has launched the Ship Green product to offer its customers emission-reduced ocean transport. Hapag-Lloyd's customers can choose between 100%, 50% or 25% CO_2e emission avoidance. Ship Green is available for all shipments, including standard, reefer, hardtop, or tankers.
94. Holland America Line announced the start of a long-term biofuel test on its flagship, Rotterdam, leveraging 100% low carbon intensity biofuel while sailing within the Norwegian World Heritage Fjords. The ship bunkered the biofuel before leaving the Port of Rotterdam, the Netherlands, and will operate one of its four engines using low carbon intensity oil

derived from organic waste or residues and certified according to the EU Renewable Energy Directive while in the Fjords.

95. Maris Fiducia Norway is pioneering the next generation of maritime transport via development of hydrogen-powered dry-bulk vessels across Europe. Teaming up with maritime innovator HAV Hydrogen, a hydrogen producer and distributor, Norwegian Hydrogen, and Dutch ship designer Ankerbeer. This coalition is set to revolutionize dry-bulk shipping vessels in Europe.
96. Marta Cosulich an IMO Type II chemical bunker tanker fully equipped to carry methanol and biofuels up to B100 was added to the Fratelli Cosulich fleet.
97. NYK Line, NYK Bulk & Projects Carriers, TSUNEISHI SHIPBUILDING Co., Ltd. and British energy business Drax Group have signed a MoU to develop both the world's first biomass-fuelled ship (bioship) and the technology that could power it. The biomass fuel plant would use a gasifier to combust biomass at high temperatures and create and contain gases including carbon monoxide, hydrogen, and methane. These gases would then be used to power a generator which could propel the bioship, and also provide a proportion of its internal power.
98. Scan Global Logistics (SGL), a global provider of transport and logistics solutions, and shipping company Hapag-Lloyd announced a partnership with a multimillion-dollar ocean biofuel initiative. Under the terms of the deal, SGL and Hapag-Lloyd have embarked on an initiative to integrate biofuels into their shipping operations. By utilizing biofuel derived from renewable sources, both partners aim to support customers in substantially reducing carbon emissions.

Market Development

99. Spain's Official Credit Institute is supporting the MAPFRE fund by Energías Renovables II, FCR. The insurance group, together with its partner, IAM Carbonzero, launched an innovative vehicle last year, as the first fund in Europe dedicated to investment in biomethane, a 100% green biofuel derived from agriculture sector waste. ICO will be investing €15 million in the fund through Axis, its venture capital subsidiary. Specifically, Axis will make the investment through its own fund named Fond-ICO Sostenibilidad e Infraestructuras, which promotes investment in infrastructure projects for sustainable mobility, renewable energies, and circular economy.
100. KKR and HASI have committed up to $1 billion to a new venture investing in clean energy assets, with HASI responsible for sourcing investments and managing CCH1. Investments will be consistent with HASI's existing investment strategy, which includes a focus on behind-the-meter, grid-connected, renewable natural gas and transport projects. Behind-the-meter projects include building or facility-specific distributed energy projects which reduce energy usage or cost, such as community solar, electric storage and energy efficiency projects, while grid-connected projects include renewables such as solar, solar-plus-storage, and onshore wind. Other projects to be supported are renewable natural gas and transport projects typically encompassing RNG plants, and transportation fleet enhancement and decarbonization.

Methanol

101. C2X, which is owned by A. P. Moller Holding and Maersk, have acquired a stake in Sungas Renewables. The parties will develop more projects producing green methanol. SunGas and C2X aim to develop, own, and operate multiple green methanol production facilities in North America.

102. Carbon Clean has achieved a fabrication milestone on Ørsted's FlagshipONE project, Europe's largest commercial-scale e-Methanol facility which is currently being constructed. FlagshipONE will be Ørsted's largest commercial-scale Power-to-X facility and Europe's largest e-Methanol plant and is expected to be operational in 2025. It will supply up to 55,000 tons of e-Methanol per year to the shipping industry, which today accounts for around 3% of global carbon emissions.
103. The HIF Paysandú e Fuels facility, with an expected production capacity of 700,000 metric tons per year of e-methanol will be the largest e-methanol plant in South America and will use electrolytic (green) hydrogen and waste CO2 from an ethanol plant to produce the e-methanol

Plastic Recycling

104. BlueAlp, a leading advanced recycling technology company, has signed an agreement with Recupero Etico Sostenibile S.p.A (RES), a waste management company in Italy. BlueAlp will supply a technology license and will engineer, procure, and fabricate the unit in its workshop in Eindhoven, The Netherlands. RES will own and operate the plant to process and convert 20kt of mixed plastic waste a year. This plant will be set up in Pettoranello del Molise in Italy and will be commissioned mid-2026.
105. CARBIOS, and Hündgen Entsorgungs GmbH & Co. KG (Hündgen), a waste management company focused on logistics, sorting services and the recycling of recyclable materials from waste mixtures, announced the signing of a non-binding MoU related to the sourcing, preparation and recycling of 15kt/year of post-consumer PET waste using CARBIOS' biorecycling technology at its first commercial plant in Longlaville, from the end 2026. The partnership will leverage Hündgen's expertise and network in the sourcing and preparation of light packaging waste collected from German households. This PET waste will be prepared into flakes ready for biorecycling using CARBIOS' enzymatic depolymerization technology.
106. Chemical and physical recycling are going to play essential roles in realising the objectives of advancing the circular economy. These technologies are indispensable for the green transition. A wider range of different chemical and physical recycling processes are needed to keep as much of the carbon embedded in plastics as possible in the cycle. Through this, the required volumes and scalability of the circular economy can be achieved. Chemical and physical recycling enable the utilisation of waste streams that cannot be mechanically recycled and are currently sent to incineration or landfill.
107. LyondellBasell has secured a location for an integrated plastic waste recycling hub south of an existing industrial park in Knapsack, Germany, signing a land lease agreement with YNCORIS GmbH & Co. KG. The hub is planned to combine various advanced sorting and recycling operations, helping to address the plastic waste challenge and grow the circular economy. The project will be developed in phases; the initial phase will see the construction of an advanced sorting facility that will process mixed plastic waste to produce feedstock for mechanical and advanced recycling. This mixed plastic waste is not recycled today and mostly sent to incineration for energy recovery.
108. OMV and Borealis have entered into long-term feedstock supply agreements for their recycling facilities with TOMRA Feedstock, a subsidiary of leading sorting technology producer TOMRA. These agreements ensure a consistent supply of sustainable and high-quality raw materials for OMV Group's recycling operations.
109. A program initiated by GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), Covestro and partners will establish closed-loop pathways for high-value plastics from end-

of-life vehicles (ELVs). The goal is to create an efficient and sustainable automotive plastic recycling system.

Policy

110. In Australia, the government released its A$22.7 billion Future Made in Australia budget package aimed at making the country a renewable energy superpower and an indispensable part of the global economy.
111. Leaders of the U.S. ethanol industry are seeking to intervene in a legal challenge of the ReFuelEU Aviation Regulation, which effectively bans the use of renewable, crop-based biofuels like corn ethanol as a feedstock for decarbonizing the aviation sector. Collaborating in the intervention are the Renewable Fuels Association, U.S. Grains Council, Growth Energy and LanzaJet. Earlier this year, LanzaJet opened the world's first ethanol-to-jet biorefinery, in Georgia.
112. National Markets and Competition Commission (CNMC) has approved a resolution (RDC/DE/004/22) that will simplify the procedures for biomethane producers to connect their facilities to the gas network in an effective manner. During 2023, the 9 plants connected to the system produced 243 GWh, 40% more than in 2022. Currently, there are numerous projects in development that require interaction between producers and gas operators.
113. The Indian Government wants all passenger vehicles to run on E100 in the next few years in preparation for the country's transition later to hydrogen. A key platform for the NDA government is to shift farmers away from being food producers and instead become energy producers. The prime minister is aiming to push India into becoming a $5 trillion economy which will have to rely on a wide range of sectors from energy to infrastructure to achieve those goals.
114. The Indonesian government plans to dedicate 2 million hectares of sugarcane in Papau to produce ethanol as part of its efforts to gain energy independence and improving air quality. It is also exploring the use of corn and seaweed as feedstock. The president signed a decree in mid-April calling for the creation of a task force to accelerate sugarcane for ethanol production.
115. Utrecht University researchers Eelco Vogt and Bert Weckhuysen have developed a concept refinery that is completely carbon neutral. The concept would be in Europe, and considers energy, materials, and resources, as well as financial and political constraints. Some key aspects of the refinery of the future involve the conversion of CO2, plastics and biomass waste into useful raw materials, the production of sustainable hydrogen, and air capture systems to extract CO2. Other important details of the future concept refinery are the need for large quantities of renewable energy, and greater mineral resources for hardware than is the case at present. This, in turn, demands substantially larger land or offshore areas for solar panels and/or wind turbines.

Pyrolysis

116. Neste successfully concluded its first processing run with pyrolysis oil from waste tires. The pyrolysis oil derived from the tires was processed into high-quality raw material for chemicals and plastics at Neste's refinery in Porvoo, Finland. The pyrolysis oil was supplied by Swedish supplier Scandinavian Enviro Systems. The goal of Neste's pilot run was to evaluate the potential of chemical recycling beyond plastic waste to potentially broaden the pool of waste streams that could be processed into high-quality products.

Recycling Plastic

117. ALPLA is launching a recyclable wine bottle made of PET. The bottle weighs only an eighth of a glass bottle, reduces the carbon footprint by up to 50 per cent and provides savings of up to 30 per cent. It can be made entirely of recycled PET (rPET).

Textiles

118. The Aachen-based start-up SA-Dynamics has developed a bio-based recyclable insulation textile which consists of 100 percent bio-based aerogel-fibres. The fibres contain up to 90 percent air, trapped in the nano-pore system of the aerogel-fibres. The bio-based raw material is sustainably sourced and certified. The insulation textiles made from bio-based aerogel fibres are said to insulate the same or even better than synthetic insulating materials of fossil origin like PET, PE or PP and mineral or stone wool.

Torrefaction

119. Vega Biofuels, Inc. has filed a provisional patent application for its generation four (G4) torrefaction machine. Vega recently announced that its G4 torrefaction machine increases the manufacturing capacity by approximately twenty five percent.

Wind

120. Chris Bowen MP, Minister for Climate Change and Energy - Australia, has announced a preliminary intention to award Iberdrola Australia an offshore feasibility licence for the Aurora Green site off the coast of Gippsland, Victoria. The licence is subject to consultation with Native Title holders in accordance with the Native Title Act. Iberdrola Australia welcomes the opportunity to work collaboratively with First Nation's people to ensure the benefits of Australia's energy transition are shared with all stakeholders.

Company Summary – May 2024

Frequency of mention.

Company	Frequency
Plug Power	4
Neste	3
Fortescue	2
Infinium	2
Carbon Clean	2
Asahi Kasei	2
Ohmium	2
Bright Renewables	2
Hydrom	2
Idemitsu	2

Topics & Themes Summary– May 2024

Topics and themes- Top 10 (frequency of mention).

Topic	Frequency
Hydrogen	27
Biojet/SAF	15
Biogas	11
Biobased chemicals	9
Marine fuels	9
e-fuels	7
Biofuels	7
Policy	6
Plastic recycling	6
CO2 Removal	6

Prepared with the assistance of ChatGPT.