Project
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Market & Technology Watch in Energy Transition

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Headlines

QatarEnergy expects to be the world's largest LNG trader in the next 5–10 years, with its CEO saying the profitability of LNG trading is "probably 20 times what I thought it could be.

The UK government says it doesn't want to be locked into into expensive long-term LNG and energy deals that will have a "security premium"

Not one supplier responded to Pakistan LNG Ltd.'s tender to buy LNG for between four to six years starting January 2023

QatarEnergy has selected TotalEnergies as the first international partner in the North Field South (NFS) expansion project. The NFS project comprises 2 LNG trains with a combined capacity of 16 million tons per annum (MTPA).

Kazakhstan's Kashagan oilfield will resume production at a level of 400,000 barrels per day (bpd) by the end of October. Production at the oilfield was stopped in August due to gas leak.

Table of content

Market drivers

- OPEC+ has agreed to cut its targeted oil production by 2 million barrels per day from November, in response the US is planning to free some of its strategic reserve.

- EU gas storage is 92%+ full as of October 16, with France at 99% and UK at 100% full. Injection is still ongoing.

- In 9.5 months of 2022, Gazprom produced 327.4 bcm, which is 18% (72 bcm) less, than in 2021. Company exported 89.3 bcm of gas, which is 41.4% (63 bcm) less, than last year.

- For the week ending October 7, US gas storage stood at 3,231 Bcf, which is 221 Bcf (6%) lower than the five-year average and 126 Bcf (4%) lower than last year at this time.

- Attacks on Nord Stream and Nord Stream 2 infrastructure made impossible Russia's gas supplies to Europe via northern routes. The only operating pipelines from Russia to Europe include the TurkStream (less than 40 mcmd average shipped to Europe from Sep. 1) and the Ukrainian route (some standard 42 mcmd). The TurkStream's string to Turkey and the Blue Stream pipeline are working healthy.

- Turkish President Tayyip Erdogan confirmed that he had agreed with his Russian counterpart Vladimir Putin to form a natural gas hub in Turkey to sell Russian gas further to Europe. So far, two subsea pipelines connect Turkey and Russia: the Blue Stream pipeline (16 bcma, gas is supplied exclusively for Turkey) and the TurkStream pipeline (31.5 bcma; one line serves the Turkish market, the other one – European). According to Russia's vice-premier Alexander Novak, Russia can potentially sell to Europe 63 bcma of gas via Turkey.

- The US continues feeding Europe with American LNG. In September, almost 70% of the cargoes, or 4.37 mt, headed to Europe, up from the 56% and 63%, respectively, in the previous two months.

- LNG vessel charter rates reached all-time high of some $300-400k per day, according to Platts. Analysts predict the rates to reach a million per day in winter.

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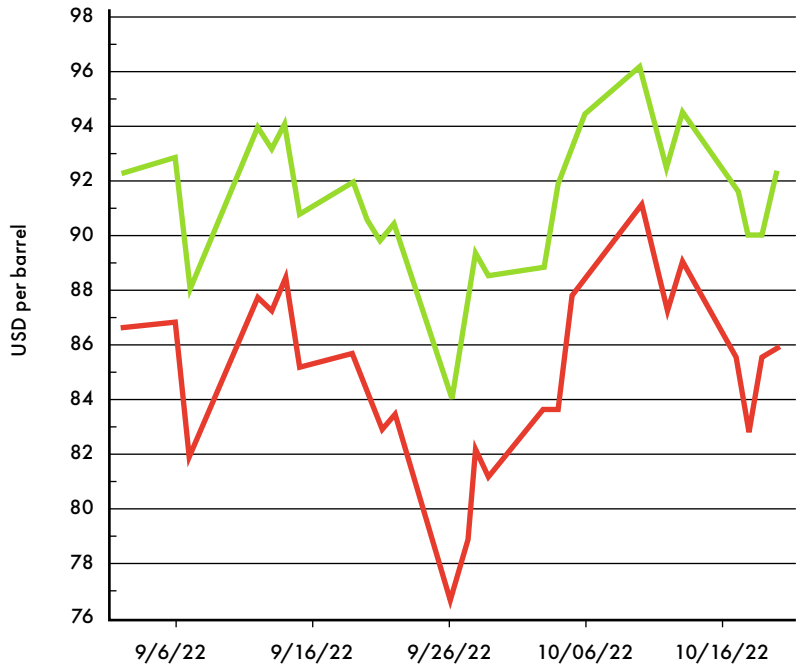
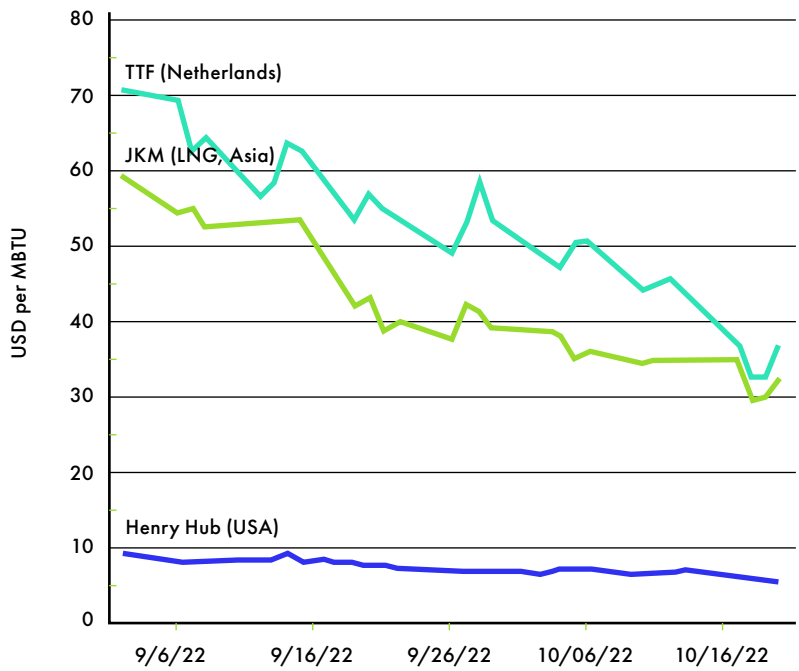
Oil price dynamics Sep–Oct ‘22



Natural gas, LNG prices Sep–Oct ‘22



Technology focus

Green Finance:

Tokyo, September 2, 2022 – Mitsubishi Heavy Industries, Ltd. (MHI) has finalized the issuance terms of the transition bond being issued today via public offering in the domestic market, as announced in the Company's press release of August 5, 2022.

Japan struggles to set standards for green financing and carbon-reducing technologies, such as carbon capture and storage, for developing nations in Asia, according to Financial Times. At the end of September, some of the world's largest financial institutions, led by Japan's Mitsubishi UFJ Bank released guidelines for investors to finance projects and technologies to help Asian countries speed up the shift away from fossil fuels.

Saudi wealth fund raises $3 billion in the first green bond sale, Bloomberg reports. PIF issued $500 million from the 100-year notes. The PIF has been mandated to develop 70% of the kingdom's renewable energy program and expects to make more than $10 billion of investment in green projects by 2026.

DOM.RF presents standards for green finance in residential buildings. This is the first of its kind green standard for real estate development in Russia.

CCUS:

1) CO_2 capture

MHIENG's First Compact CO2 Capture System Goes into Commercial Operation at Biomass Power Plant in Hiroshima.

Tokyo, June 30, 2022 – Mitsubishi Heavy Industries Engineering, Ltd. (MHIENG), a part of Mitsubishi Heavy Industries (MHI) Group, has launched full-scale operation, on schedule, of a compact CO_2 capture system ordered in November 2021 by Taihei Dengyo Kaisha, Ltd. It is the first system of its kind to go into commercial operation.
The compact CO_2 capture system was installed at a 7-megawatt (MW) class biomass power plant operated by Taihei Dengyo in Seifu Shinto, a suburb of Hiroshima City. The system has the capacity to capture 0.3 metric tons per day (tpd) and is based on a highly versatile standardized design requiring an installation space of just five meters in length and two meters wide. Its modular configuration enabled rapid transportation to the site and easy installation.
The CO_2 captured from the plant's flue gas will be used for growing vegetables in on-site greenhouses – an example of the circular economy. By fully consuming all captured CO_2 at its carbon-negative power plant, Taihei Dengyo looks to help prevent global warming and promote a decarbonized society. The biomass power plant where the system was installed was delivered by Mitsubishi Heavy Industries Power IDS, Ltd. in October 2019.

Compact carbon capture solutions are provided by few firms (e.g. Baker Hughes). Compact carbon capture systems can boast lower CAPEX vs. conventional equipment, are installed faster and easier, and may work more efficiently. According to Baker Hughes, compact carbon capture technology can reduce carbon footprint by up to 75%, being at the same time less expensive than conventional technologies. The BH CCC technology is solvent agnostic and can be employed with highly viscous solvents.
The pioneer of compact CO2 capture technology was Compact Carbon Capture AS (3C), which was founded through the collaboration between Fjell Technology Group AS, Equinor ASA, Prototech AS and SINTEF. The company was established in Norway. The first patent for the technology was granted in 1999 after which it was tested and developed together with several partners including Fjell Technology Group AS and Equinor AS. The company also received support from the government of Norway. In November 2020, the company was acquired by Baker Hughes).

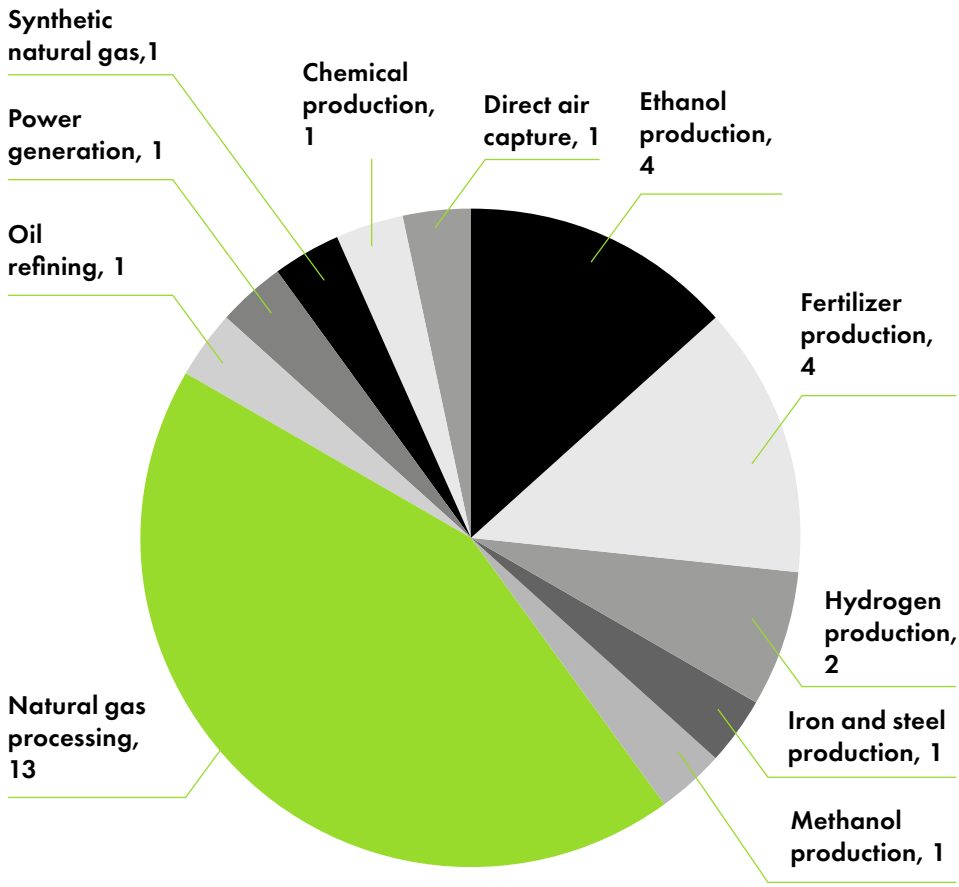
MHI and MHIENG Awarded FEED Contract Relating to a GTCC Power Plant and CO_2 Capture Plant for a Power Station in Scotland

Tokyo, August 30, 2022 – Mitsubishi Heavy Industries, Ltd. (MHI), with support from its power solutions brand, Mitsubishi Power, and Mitsubishi Heavy Industries Engineering, Ltd. (MHIENG), part of MHI Group, have jointly been awarded a Front End Engineering Design (FEED) contract relating to a gas turbine combined cycle (GTCC) power plant and CO_2 capture plant planned for construction at the Peterhead Power Station in Aberdeenshire, Scotland.
For the execution of the FEED, MHI and MHIENG partnered with two international engineering firms: Worley and Técnicas Reunidas. S.A. to deliver the engineering design of MHI's most advanced, next-generation and high-efficiency M701JAC (J-series air-cooled) gas turbine, and MHIENG's "Advanced KM CDR Process™" developed together with The Kansai Electric Power Co., Inc.
The project at Aberdeenshire is being developed jointly by SSE Thermal, part of SSE plc, one of the major power providers in the UK, and Norway-based Equinor Energy AS, one of the largest energy companies in Northern Europe.
The plant is expected to capture up to 1.5 million tonnes per annual of CO_2.

The captured CO_2 would be transported and sequestered underground in the North Sea. The project could be the first of its kind in Scotland and is looking to achieve commercial-scale CO_2 capture and storage (CCS) from the GTCC plant's flue-gas emissions.

Only one commercial power-sector carbon capture and storage facility operates in the world today: the Boundary Dam 3 project in Saskatchewan, Canada, which was launched in 2014. Unit 3 at the Boundary Dam coal-fired power station has a capture capacity of approximately 1 Mtpa of CO_2. The majority of the captured CO_2 is transported via pipeline and used for enhanced oil recovery at the Weyburn Oil Field also in Saskatchewan. A portion of the captured CO_2 is transported via pipeline to the nearby Aquistore Project for dedicated geological storage.
At the same time, more than 30 power-sector CCS projects are in preliminary or advanced stages of development at commercial power plants worldwide, according to the Global CCS Institute. One-third of the projects would involve existing or new natural gas plants.
The U.S. accounts for at least eight of the proposed natural gas plant projects. The U.S. Energy Department in October 2021 announced $45 million in research and development funds to jumpstart CCS at natural gas plants and industrial operations. In the US CCS projects at power plants can get a tax credit of $85 per metric ton for CCUS projects that store CO_2 and $60 per metric ton for CCUS projects that use CO_2 through the 45Q federal tax legislation. However, according to Global CCS Institute, costs of CO_2 avoided for a natural gas power plant in the USA vary from $74 to $114.

Number of operational commercial scale CCS projects by sector



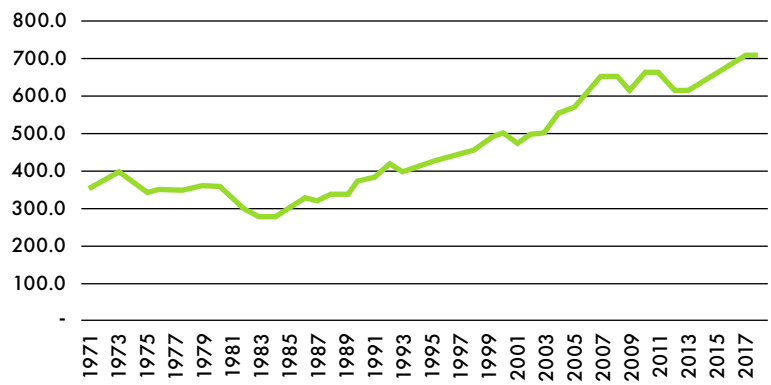
Source: Global CCS Institute, CO2RE database https://co2re.co/

Stena Bulk launches a project to demonstrate CO_2 emissions reduction potential in shipping

Leading tanker shipping company Stena Bulk has announced that it is launching a two-year, three phase project aimed at demonstrating shipboard carbon capture, together with the Global Centre for Maritime Decarbonisation (GCMD) and the Oil and Gas Climate Initiative (OGCI). Targeting at least a 30% absolute capture rate for carbon dioxide (CO_2) during normal vessel operations and on deep-sea voyages, and by working with organizations to offload and sequester or reuse the CO_2, the project is the world's first initiative demonstrating end-to-end shipboard carbon capture at such a large scale and across the full value chain. The project aims to establish a pathway to reduce the cost of onboard CO_2 capture to €150 per tonne of CO_2 or lower, to allow the technology to be commercially deployed in the near future. The project will use non-proprietary equipment and processes, so results can be shared broadly and publicly to maximize learning and encourage further development.

The transportation sector contributes 24% of global energy-related greenhouse gas emissions. Around 10% of that total comes from international deep-sea shipping.
According to the OGCI – Stena Bulk joint study, onboard carbon capture is feasible, with total costs for a Suezmax vessel varying from $20 million to some $30 million, depending on the efficiency of the equipment. Capture and liquefaction expenditures make up almost 50% of the total costs. Operating expenses may reach $0.9 – 1.8 million per year.
In April 2022, the EU announced funding of the EverLoNG multilateral shipboard carbon capture project. In October 2022, South Korean shipbuilder Daewoo Shipbuilding & Marine Engineering completed a verification test of its carbon capture and storage technology on board an LNG carrier.

CO_2 emissions from international marine bunkers (million tonnes)



Source: International Energy Agency

2) CO_2 transportation

Mitsubishi Shipbuilding and MOL Acquire AiP for LCO_2 Carrier from DNV under Joint Development.

Mitsubishi Shipbuilding Co., Ltd. and Mitsui O.S.K. Lines, Ltd. announced the acquisition of Approval in Principle for their jointly developed liquefied CO_2 (LCO2) carrier from the Norwegian classification society Det Norske Veritas AS. The presentation ceremony took place on September 5 at Fiera Milano, the venue of Gastech 2022, a major international conference on global energy and environmental issues, including natural gas, LNG, and hydrogen, held in Milan, Italy.
The LCO_2 carrier that underwent a Hazard Identification Study (HAZID)(Note2) and received an AiP is a 50,000m3-class vessel for which the two companies completed a joint concept study in November 2021. The vessel design incorporates tank pressure specifications for larger vessels in the future. Mitsubishi Shipbuilding and MOL are also integrating the knowledge of an MOL-invested company, Norway-based Larvik Shipping AS, which has managed LCO_2 vessels in Europe for more than 30 years. The HAZID was implemented in line with actual operations.

Mitsubishi Shipbuilding and MOL will leverage their respective and complementary strengths and knowledge to advance this joint development project, and through the newly acquired AiP will continually work to develop various technologies, including LCO_2 vessels, which will be essential in building a carbon capture, utilization and storage (CCUS) value chain, thereby contributing to the realization of a carbon-neutral society.

CO_2 has been shipped by sea since the late 1980s, initially on converted dry cargo vessels. So far, there are only four LCO_2 vessels in operation. The first ship built in 1999 by Frisian Shipyard Welgelegen with the purpose of transporting CO_2 is the "Coral Carbonic" (now "Helle") with a 1,250 m^3 capacity. $LC0_2$ use relatively modest temperatures in their cryotanks (from -35˚ to -55˚ degrees celcius), but very high pressures (from 5.5 MPa to 19 MPa) compared with LNG and LPG vessels. In theory, small-scale LNG or LPG ships can be converted to carrying liquid CO_2, but many challenges have to be met, with the resistance of a cryotank to high pressures being of utmost importance. "Helle", "Gerda", "Embla" and "Froya" are four LCO2 ships sailing under Norwegian flag and owned by Nippon Gases corporation. Northern Lights CCS project offshore Norway has ordered two CO_2 transport vessels, each with a cargo capacity of 7,500 m3 and a length of 130 m, from Dalian Shipbuilding Industry Co. (DSIC).

Froya LNG vessel, photo by Larvik Shipping

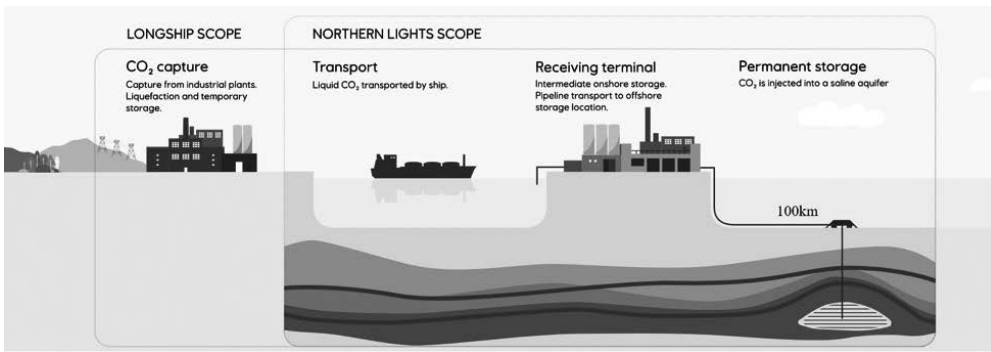
3) CO_2 sequestration & storage

Norway: Northern Lights Project Signs World's First Commercial Agreement on Cross-Border CO2 Transport and Storage.

Stavanger, August 29, 2022 – TotalEnergies announced the signature of a commercial agreement between Northern Lights and Yara to transport and store CO_2 captured from Yara Sluiskil, an ammonia and fertilizer plant in the Netherlands. From early 2025, 800,000 tons of CO_2 per year will be captured, compressed, and liquefied in the Netherlands and then transported to the Northern Lights site to be permanently stored in geological layers some 2,600 meters under the seabed off the coast of Øygarden, in Norway. This agreement, the first of its kind worldwide, is a major milestone in the decarbonization of heavy industry in Europe, paving the way for international CO_2 transport and storage as a service. It sets a new standard for European industrial companies looking to use Northern Lights solutions as part of their decarbonization strategies. "Developing CO_2 transportation and storage services is crucial for decarbonizing European industry: we are pleased to welcome Yara as first commercial partner for Northern Lights, which will help support its decarbonization strategy," said Patrick Pouyanné, Chairman and Chief Executive Officer of TotalEnergies. " TotalEnergies aims to develop a CO_2 storage capacity of more than 10 million tons per year by 2030, both for its own facilities and for its customers, in line with its ambition to get to net zero by 2050, together with society."

More detail:

There are few existing examples of transborder CO_2 operations. One is the cross-border CO_2 pipeline from Beulah (North Dakota, USA) to the Weyburn field near Goodwater (Saskatchewan, Canada). The construction cost was $100 million, and the pipeline received various tax credits and grants from the United States government. The project offered a cross border model for collaboration on the capture, transport and injection of CO_2.
In August 2022, Malaysian Petronas signed an MoU with six Korean firms to explore opportunities of cross-border CO_2 transportation.



Northern Lights CCS hub concept, Equinor

4) Hydrogen

The first ever test of a hydrogen burning instead of natural gas on a US working natural gas power plant has been successfully completed. There are turbines already capable of burning hydrogen, but the New York project is notable because officials say it is the first time an existing U.S. gas facility has been retrofitted to use the fuel. The New York Power Authority announced it successfully mixed green hydrogen with natural gas and used the fuel to generate electricity with reduced emissions from a retrofitted General Electric combustion turbine in Brentwood, New York. The experiment was held with fuel blends from 5% to 44% hydrogen. With the Brentwood facility generating 47 MW, EPRI's report shows carbon dioxide emission rates were reduced about 14% with a fuel blend containing 35% hydrogen.

More detail:

General Electric has more than 100 turbines running on hydrogen-methane mixtures.
Researchers at the University of Stavinger in Norway announced 100 percent hydrogen-burning gas turbine successful test in summer 2022.
Demand for hydrogen in the US could reach more than 40 mt/year by 2050, according to the National Renewable Energy Laboratory (NREL). Currently some 10 mt/year of hydrogen are produced in the US.
According to the IEA, global demand for hydrogen reached 94 mt, and by 2030 hydrogen demand may reach around 180 mt.

Dates and events to follow in November

The 2022 United Nations Climate Change Conference (COP27) will be hosted by Egypt in in Sharm El-Sheikh between November 7–18, 2022;

Damaged by fire in early June, Freeport LNG terminal on the US Gulf Coast is expected to restart in November;

ADIPEC (Abu Dhabi International Petroleum Exhibition & Conference) is to be held in Abu Dhabi, UAE between October 31 – November 3, 2022;

OPEC's World Oil Outlook 2022 to be presented at ADIPEC;

SPE Annual Caspian Technical Conference is to be held on November 15–17 in Astana, Kazakhstan.